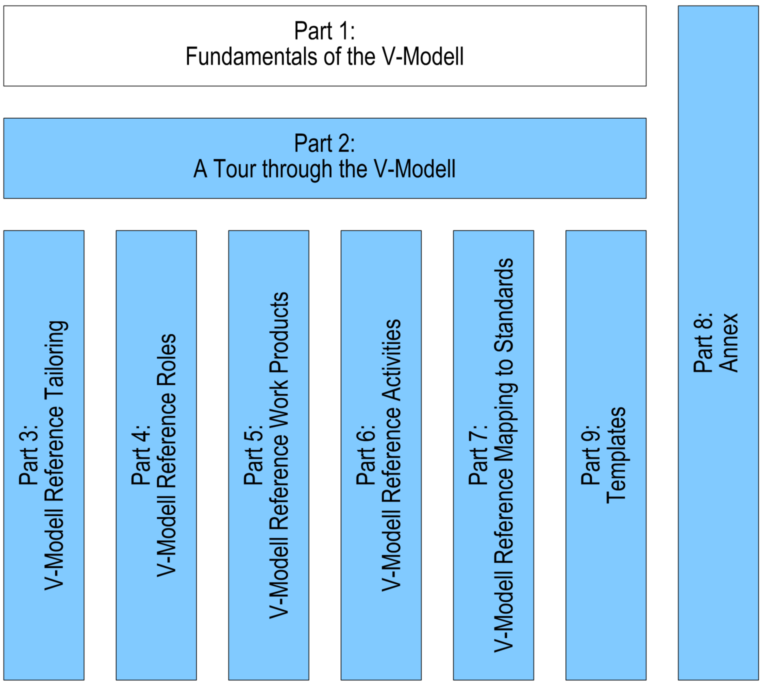
Part 1: Fundamentals of the V-Modell

V-Modell® XT



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1 Introduction

The V-Modell is a process model for planning and executing »Projects. The V-Modell improves project transparency, project management and the probability of success by defining concrete practices with associated results and responsible »Roles. The V-Modell XT is a further development of the V-Modell 97. In the following the "V-Modell XT" will be designated as "V-Modell".

1.1 Objectives

This document is intended to briefly and precisely describe the fundamentals for the application of the V-Modell. It defines all terms important for the understanding of the V-Modell. Before starting a »V-Modell Project, all participants shall have a uniform understanding of the practice based on the V-Modell fundamentals described in this manual.

1.2 Audience

This document is intended for all who want to realize their own projects using the V-Modell. For all stakeholders having management tasks and decision competences in a V-Modell project, the reading of this document is indispensable. In addition, it is a brief introduction for all who want to inform themselves about the V-Modell.

1.3 Contents and Structure

This document comprises the following chapters:

»Objectives and Structure of the V-Modell

This chapter describes the objectives for the development of the V-Modell, the advantages of its use as well as the limits and the target groups of the V-Modell. Contents and structure of the V-Modell and its elements will be explained.

»Basic Concepts of the V-Modell

This chapter presents the basic core concepts of the V-Modell, particularly the concepts of »Process Modules , »Project Types, »Project Type Variant, »Project Execution Strategy and »Decision Gate. In addition, the interaction between various »V-Modell Project and the target-oriented and result-oriented project execution approach will be described.

»Management Mechanisms of the V-Modell

Successful projects require a target-oriented direction, execution and control. This in turn requires interaction between various management mechanisms, like »Project Management, »Quality Assurance, »Configuration Management, and »Problem and Change Management. This chapter provides application guidance for the management mechanisms specified in the V-Modell.

»Project Execution

This chapter provides the application guidelines for the actual processing of the project task. This application guidance covers system development projects of suppliers and the »Further Development of the V-Modell . This chapter describes the procedures for the maintenance and further development of the V-Modell.

2 Objectives and Structure of the V-Modell

The »V-Modell is designed as guidance for planning and executing development projects, taking into account the entire system life cycle. It defines the results to be achieved in a project and describes the actual approaches for developing these results. In addition the V-Modell specifies the responsibilities of each participant. Thus, the V-Modell describes in detail, "who" has to do "what" and "when" within a project. Other guidelines, e.g. ISO standards, are presently in use, but they are less concrete than the V-Modell because they, e.g., do not specify product templates.

These standardized, methodical guidelines permit a systematic execution even of complex and extensive projects. Thus, projects get more planable, traceable and lead to high-quality results with greater reliability, which is advantageous for acquirer and supplier.

The cooperation between acquirer and supplier is an essential factor of success. Thus, it is regulated by the V-Modell. The responsibilities of both sides are specified. Thus, the V-Modell standards are an important basis for contracts between acquirer and supplier. In addition, the V-Modell improves the comparability of »Offers.

Also small business enterprises profit from the V-Modell. The V-Modell provides them with standardized and well-tried templates for development and management processes. Thus, small business enterprises can systematize their processes with reasonable effort and thereby reliably achieve high-quality development results, as well.

Thus, the V-Modell can be used as basis for contracting, as process guidance and as basis of communication.

2.1 V-Modell 97 as Origin

With the publication of the »Development Standards for IT Systems of the Federal Republic of Germany in 1997, the V-Modell 97 entered into force as standard for all civil and military federal agencies. In detail, the Federal Ministry of Defense (BMVg), the Federal Office of the Bundeswehr for Information Management and Information Technology (IT-AmtBw), and the Federal Ministry of the Interior, Central Office for Information Technology Coordination in the Federal Administration (BMI-KBSt), provided the following documents as General Directives (Allgemeiner Umdruck - AU) No. 250 to 252 and as KBSt Series, Volume 27/1 and 27/2:

- Software Lifecycle Process Model (AU 250)
  - Part 1: Regulations (AU 250-1, KBSt Volume 27/1)
  - Part 2: Supplements with Regard to Authorities (AU 250-2, KBSt Volume 27/2)
  - Part 3: Collection of Manuals (AU 250-3, KBSt Volume 27/2)
- Methods Standard (AU 251)
- Functional Tool Requirements (AU 252)

2.2 The V-Modell XT as the successor of the V-Modell 97

In 1997, the V-Modell 97 was completed; since then it has not been updated. Therefore, it did not reflect the state-of-the-art of information technology in 2004. New methods and technologies - as for example the component-based development or the test-first approach - are considered only to a limited degree in the V-Modell 97. As a consequence, in 2004, the V-Modell was no longer used as much as it would be desirable.

In addition, comprehensive experiences with the V-Modell 97 were collected, and proposals for improvements were developed. The implementation of these proposals will improve the effective use and acceptance of the new V-Modell.

Against this background, division A5 of the Federal Office of the Bundeswehr for Information Management and Information Technology and the Federal Ministry of the Interior, Central Office for Information Technology Coordination in the Federal Administration (BMI-KBSt) have advanced the »Development Standards for IT Systems of the Federal Republic of Germany on the basis of the V-Modell 97. Proceeding from contents and scope of the V-Modell 97, the following requirements were implemented:

- Improvement of the following quality characteristics: project-specific and organization-specific adaptability, applicability within the scope of the project, scalability to different project sizes, and changeability and growth potential of the V-Modell itself
- Consideration of the state-of-the-art of technology and adaptation to current regulations and standards
- Extension of the application to the entire system life cycle already during the development
- Introduction of an organization-specific process for improving process models

2.3 Objectives of the V-Modell

The »V-Modell provides guidance for the planning and realization of »Projects. The following objectives are intended to be achieved by a project execution »Project Compliant to the V-Modell:

Minimization of Project Risks

The V-Modell improves project transparency and project control by specifying standardized approaches and describing the corresponding results and responsible »Roles. It permits an early recognition of planning deviations and risks and improves process management, thus reducing the project risk.

Improvement and Guarantee of Quality

As a standardized process model, the V-Modell ensures that the results to be provided are complete and have the desired quality. Defined interim results can be checked at an early stage. Uniform product contents will improve readability, understandability and verifiability.

Reduction of Total Cost over the Entire Project and System Life Cycle

The effort for the development, production, operation and maintenance of a system can be calculated, estimated and controlled in a transparent manner by applying a standardized process model. The results obtained are uniform and easily retraced. This reduces the acquirers dependency on the supplier and the effort for subsequent activities and projects.

Improvement of Communication between all Stakeholders

The standardized and uniform description of all relevant elements and terms is the basis for the mutual understanding between all stakeholders. Thus, the frictional loss between user, acquirer, supplier and developer is reduced.

2.4 Limits of the V-Modell

The following aspects are not covered by the »V-Modell. In a »V-Modell Project, these aspects must be regulated in addition, or the »V-Modell must be adapted accordingly:

- The placing of contracts for services is not regulated. The »V-Modell only considers the placing of contracts for subsections.
- During the »Introduction and Maintenance of an Organization-Specific Process Model, the model does not differentiate between acquirer and supplier.
- The organization and execution of operation, maintenance, repair and »Disposal of the system are not covered by the V-Modell. However, planning and preparation of a concept for these tasks are regulated in the V-Modell.

2.5 Audience of the V-Modell

The »V-Modell is intended for all persons participating as acquirer or supplier in development projects. As process model for project management, it is particularly designed for »Project Leaders and executives who monitor, execute and accompany the project. For the project staff, the V-Modell in many ways offers support for a successful cooperation in and contribution to the projects. The V-Modell supports the handling of projects in enterprises, public and military agencies, and authorities and agencies of the Bundeswehr.

2.6 Contents and Structure of the V-Modell

As shown in Figure 1, the documentation of the »V-Modell comprises the following sections, each of which is intended for a specific »V-Modell User group:

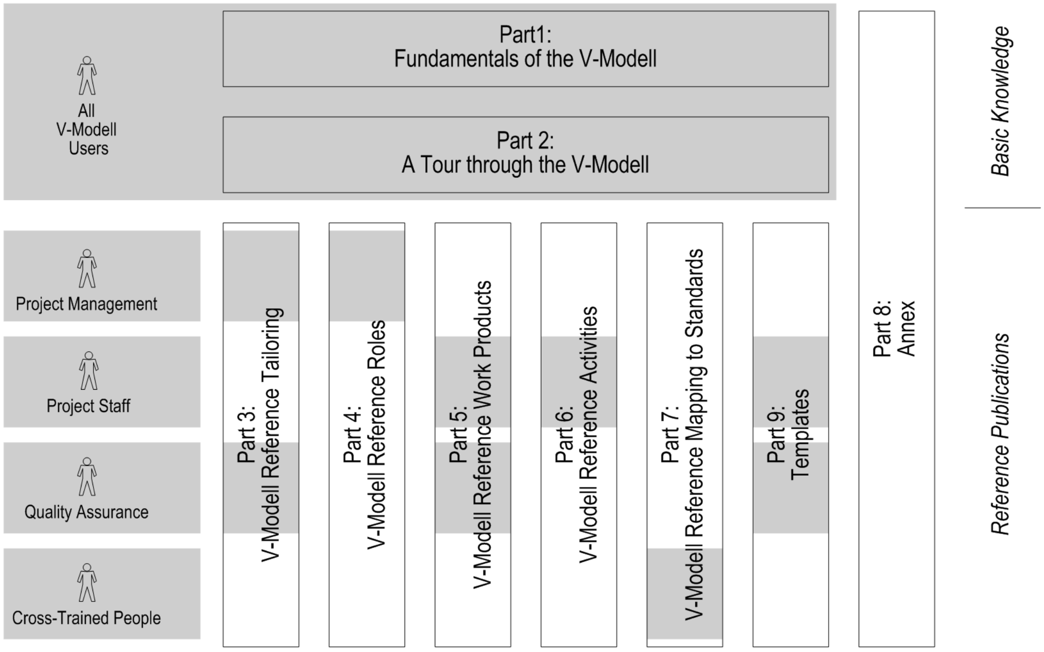


Figure 1: Target Groups of the V-Modell Sections

A fundamental knowledge of the first two parts is the prerequisite for the successful application of the V-Modell in a project. The following parts 3 to 7 are »V-Modell References. A V-Modell reference is a specific view of the contents of the V-Modell. It is not necessary to read these V-Modell References before starting a project. Instead, the V-Modell References and the parts 8 and 9 can be used as reference work to be at hand when necessary during project execution.

Section 1: »Fundamentals of the V-Modell

This section describes the basic core concepts of the V-Modell and the interaction between various V-Modell projects. In addition, it introduces application guidelines regulating the implementation of the V-Modell in concrete projects. Some of these application guidelines concentrate on basic management mechanisms, while others cover the proper processing of the project task.

Section 2: »A Tour through the V-Modell

The Tour through the V-Modell shows by means of selected examples how the V-Modell is applied within the scope of a concrete project. This section gives a first impression of the use of the V-Modell in practical projects.

Section 3: »V-Modell Reference Tailoring

The V-Modell Reference Tailoring describes the project types, project type variants and project characteristics which are used for preparing a specific application profile for the project. In addition, it presents the significant contents of the project execution strategies and process modules feasible with the V-Modell. Moreover, the decision gates available in the V-Modell will be described. Thus, this V-Modell reference includes the information required for »Tailoring.

Section 4: »V-Modell Reference Roles

The V-Modell Reference Roles provides a survey of all roles included in the V-Modell. In addition to a detailed description of the roles, this reference describes the products and activities for which each individual role is responsible and the processes in which the role is included. Thus, this V-Modell Reference provides a guideline for the assignment of roles and a first orientation for the future tasks and competences of the project members.

Section 5: »V-Modell Reference Work Products

The V-Modell Reference Products includes all disciplines, products and subjects of the V-Modell in accordance with the hierarchical product model. It describes the connections between the individual products by means of so-called product dependencies. Thus, this V-Modell reference is particularly relevant for editors and inspectors of V-Modell products.

Section 6: »V-Modell Reference Activities

The V-Modell Reference Activities includes all activities and work steps of the V-Modell in accordance with the hierarchical activity model. In particular, it describes the processing of the specific work steps within the scope of an activity. An activity determines the way and the work steps which will be employed in order to develop an actual product. Accordingly, this V-Modell Reference is particularly relevant for the project staff.

Section 7: »V-Modell Reference Mapping to Standards

Being used as base of organization-wide development processes, the V-Modell must be compatible with current (quasi) standards and regulations, e.g., »ISO 9001:2000, »ISO/IEC 15288 and »CMMI®. For each standard, the V-Modell Reference Mapping to Standards includes a presentation of the terms of the respective standard mapped to the V-Modell concept. Thus, this V-Modell Reference supports cross-trained persons who are already familiar with certain standards. In addition, the V-Modell Reference Mapping to Standards shows the coverage of standards like ISO, IEC, and CMMI by the V-Modell.

Section 8: »Annex

The Appendix includes several indices and reference works, e.g., method references, tool references, a glossary, a list of abbreviations and reference documents. The other V-Modell sections refer to the entries in the appendix as required.

Section 9: »Templates

This section includes templates for the individual products in the form of RTF documents. These templates can be employed directly within the scope of a project or adapted as required before use.

3 Basic Concepts of the V-Modell

Within the framework of further development, the content of the V-Modell was extended. In addition, the quality characteristics of the V-Modell were improved, particularly with regard to the project-specific and organization-specific adaptability, the applicability to the project, the scalability to various project sizes and the changeability and extendability of the V-Modell itself. In order to achieve this, the structure of the V-Modell was revised completely, and the formerly monolithic model was subdivided into individual components. Predefined process templates describe which components will be used in an actual project constellation and in which sequence the required »Work Products and intermediate results have to be developed.

The following section provides a brief survey of the overall structure of the updated V-Modell. Afterwards, the individual basic concepts of the V-Modell will be described in detail, followed by a summary of the target-oriented and result-oriented approach of the V-Modell.

3.1 Overall Structure of the V-Modell

The V-Modell regulates "who" has to do "what" and "when" during a project. Figure 2 provides a survey of the overall structure of the V-Modell. The V-Modell can be applied to a great variety of project constellations; however, not all »V-Modell Project follow the same pattern. Depending on some characteristics, the projects can be classified and subdivided into »Project Type.

In order to ensure that the V-Modell can be employed simply and without significant effort, various »Project Type Variants are predefined, which determine the so-called »Project Execution Strategy. The process modules which must be used and the process modules which can be selected in addition are specified for every project type.

A »Process Module covers an actual task which may have to be accomplished during a V-Modell project. The »Work Product which have to be developed within the scope of the task, the »Activity required for developing the individual products and the »Roles included in the creation of the products are specified within a process module. The individual process modules are self-contained.

The project type does not only define the process modules to be used but also the possible project type variants, which in turn determine additional process modules to be used and the general conditions for the project execution strategy of a project. A »Project Execution Strategy corresponds to a sequence of decision gates. A »Decision Gate indicates a »Project Progress Stage in the »Project Setting where the current state of the project is evaluated. Depending on the evaluation, the Executives decide on the further project processing and can take corrective action as required.

Some process modules and decision gates must be applied to every project compliant with the V-Modell in order to ensure a minimum project execution quality. These mandatory process modules form the »V-Modell Core.

The document »Fundamentals of the V-Modell describes how the standards of the V-Modell should be implemented within the scope of a project. It covers the supporting organizational aspects and the fulfillment of the actual project task.

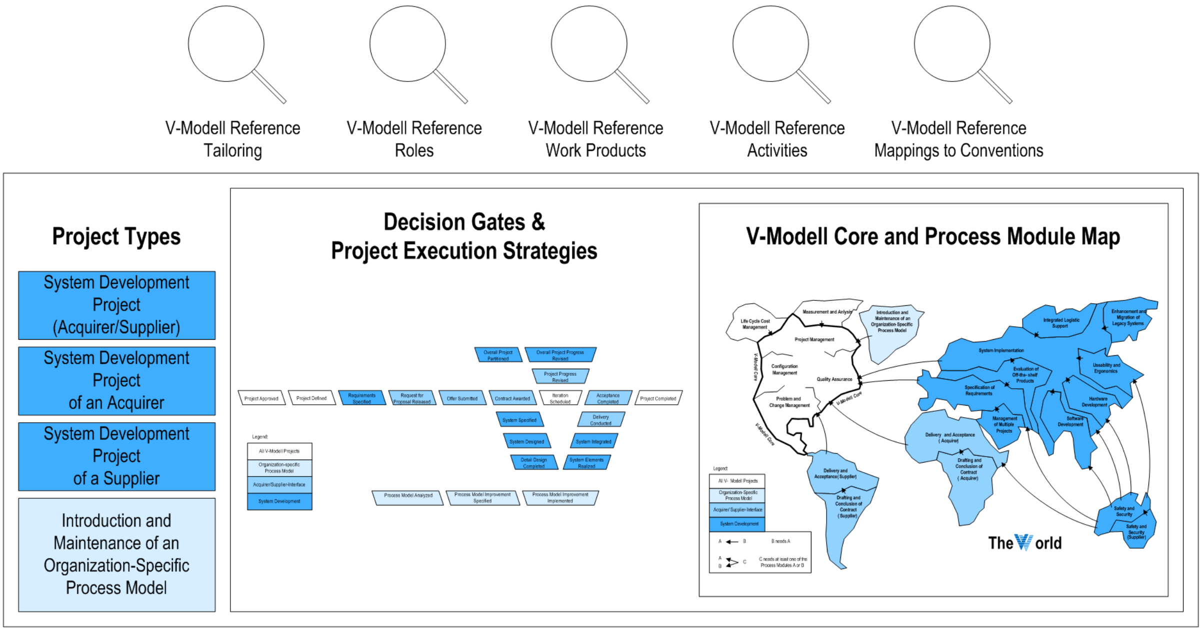


Figure 2: Overall Structure of the V-Modell and Presentation Based on the Point of View

The elements described up to now are the actual contents of the V-Modell, which are complemented by so-called »Mapping to Standards. A mapping to standards establishes a relation between the terms of a (quasi) standard or a regulation and the contents of the V-Modell. Mapping to Standards include, among others, the »Mapping to CMMI® and the »Mapping to ISO 15288. For users, who have processed their projects up to now in accordance with other regulations, procedures or standards, the mappings to standards facilitate the change to the V-Modell.

During a project, different persons and groups of persons deal with the particular contents of the V-Modell. At the beginning of a project, e.g., the project-specific adaptation of the V-Modell is of prime importance for the »Project Leader. At a later stage of the project, the project leader and the project team focus on the actual process and the respective individual tasks. For quality assurance, on the other hand, the requirements posed by the V-Modell on the products to be tested are essential.

Thus, every V-Modell user group sees the contents of the V-Modell from a different point of view. In order to fulfill the specific requirements of the individual user groups, the documentation of the V-Modell is subdivided into »V-Modell Reference, which correspond exactly to these points of view. Thus, the »V-Modell Reference Tailoring especially describes the creation of a project-specific V-Modell. The contents of the individual V-Modell References have already been described briefly in »Objectives and Structure of the V-Modell.

3.2 Project Types

The V-Modell can profitably be used in a variety of project constellations as guideline for the systematic managing and processing of a project. Not every V-Modell project follows the same stereotype pattern. Depending on characteristic features, projects can be subdivided into »Project Types. This classification will be described briefly in the following paragraphs.

A project is classified by its project type. The V-Modell supports projects for awarding a contract to a supplier and projects for developing a »System as supplier or as acquirer/supplier. These three projects types are distinguished based on the project role which the project assumes with respect to other stakeholders. The project roles are subdivided into »Acquirer, »Supplier or Projects where specification of requirements, project management and development are executed within an. organization (Acquirer/Supplier). Each project role implies a specific view with regard to the project and includes several specific project tasks. The V-Modell uses the so-called Subject of the Project for concretizing the framework of the approach. The V-Modell supports the development of software (SW), hardware (HW), complex or embedded hardware and software systems (HW and SW) and the system integration. The »Tailoring process must provide a suitable »Project Characteristic . In addition to contract awarding and development project types, the V-Model also supports projects for the introduction and maintenance of process models. For the »Introduction and Maintenance of an Organization-Specific Process Model , the V-Modell offers an individual project type.

The different project roles can be subdivided into three classes. In the project role Acquirer/Supplier, exactly one V-Modell project is executed in order to autonomously develop a system or an organization-specific process model. In the project role Acquirer, a system development contract is awarded to one or more suppliers based on specified requirements. In the project role Supplier, a system development project is executed based on the requirements specified by the Acquirer. It is important to note, that a distinction between Acquirer and Supplier is impossible during the development of an organization-specific process model.

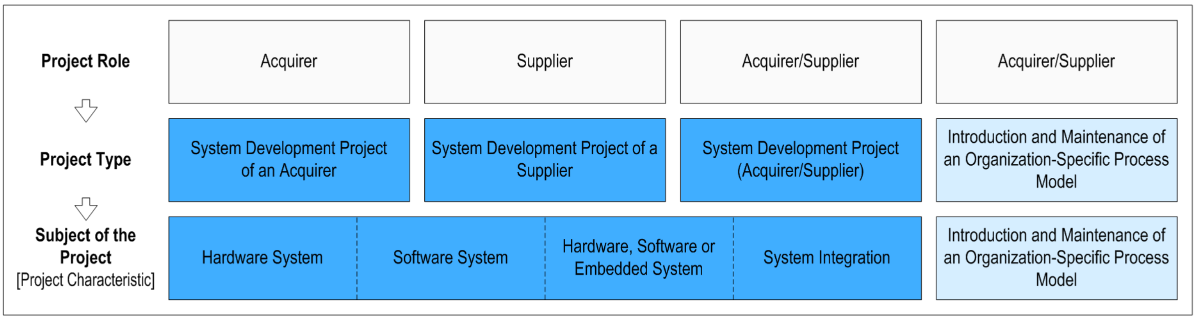


Figure 3: Classification of Projects and Subdivision into Project Types

As shown in Figure 3, the following project types are specified based on the Subject of the Project and the Project Role:

- »System Development Project (Acquirer)
- »System Development Project (Supplier)
- »System Development Project (Acquirer/Supplier)
- »Introduction and Maintenance of an Organization-Specific Process Model

The selection of a project type is the first step for determining "what" has to be done in a project. The decision for a »Project Type integrates the process modules into the project and determines the project characteristics to be considered.

3.3 Project Type Variant

For each »Project Type, the V-Modell offers at least one »Project Type Variant, which characterizes the Project in more detail. A Project Type Variant in a Project determines particularly the general conditions for possible project flows, which are used as selection criteria in the »Tailoring process. A Project Type Variant determines the design of the »Project Execution Strategy and thus the possible workflow in the coarse plan of a Project.

The selection of a Project Variant can also integrate »Process Module and »Project Characteristics , complementing those of the project type specifications, into the Project.

Abbildung 4 indicates different Project Type Variants provided by the V-Modell and the characteristics used for selecting the suitable Project Type Variant:

- For the Project Type »Introduction and Maintenance of an Organization-Specific Process Model, there is only one suitable Project Type Variant, which has the same name.
- For the Project Type »System Development Project (Acquirer) , the distinction is based on the structure of the order: The Project Type Variant is selected depending on the fact as to whether the Acquirer cooperates with one or several Suppliers simultatneously.
- The Selection of a suitable Project Type Variant within the framework of the Project Types »System Development Project (Supplier) and »System Development Project (Acquirer/Supplier) generally depends on the system life cycle section covered by the Project. Enhancement and migration require another Project Type Variant than system maintenance.

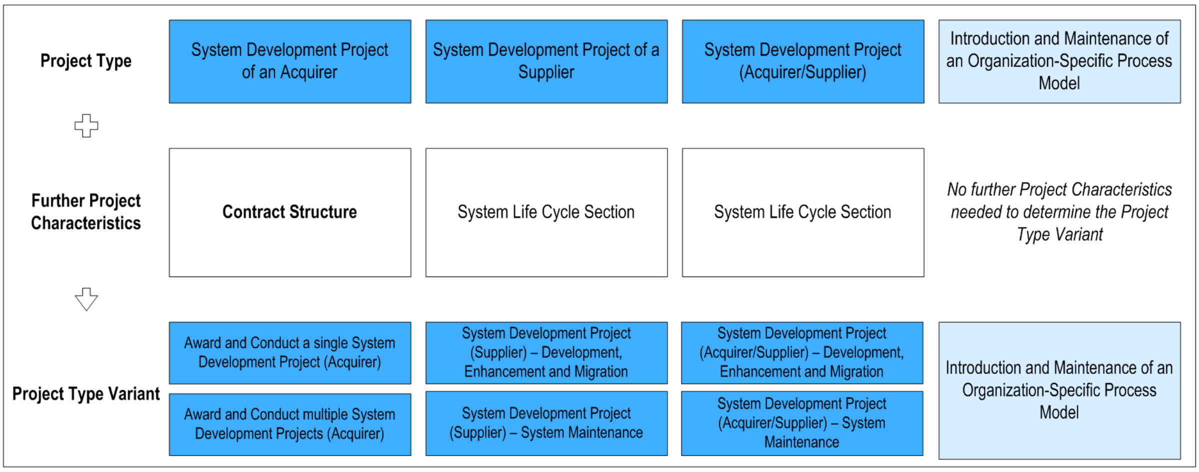


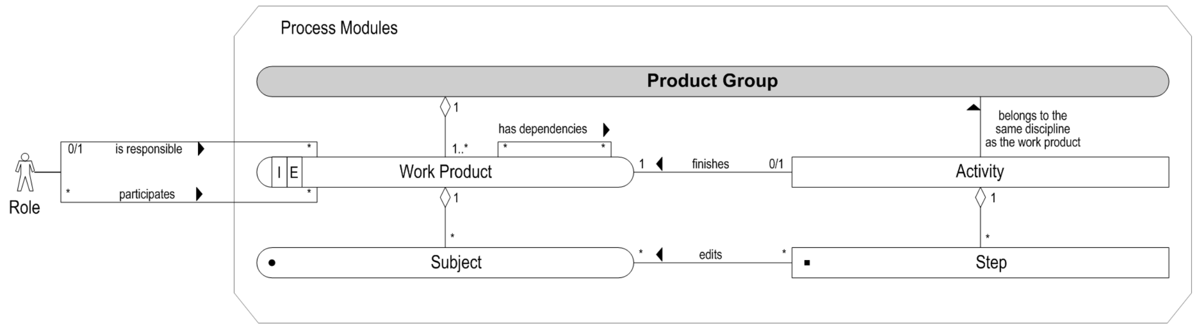
Abbildung 4: Assignment of Project Type Variants to Project Types

3.4 Process Modules

The significant contents of the V-Modell are included in process modules which are based on one another. Every process module is a self-contained unit and can be changed or extended individually. A »Process Module covers all parts concerning a particular task which may occur within the scope of a V-Modell project. As shown schematically in Figure 5, a process module encapsulates the »Work Product and »Activity, which are relevant for the fulfillment of this task and thus belong together with regard to a specific topic, e.g., the contents of »Project Management or software development.

»Work Products in the V-Modell are depicted with rounded corners, »Activity in rectangular form.

Figure 5: Process Modules and their Components/Work Products. The results and interim results to be developed are designated as »Work Product. The entirety of all products is structured in a hierarchical manner, by integrating products which belong together into a »Discipline. Additionally, a complex product may be subdivided into several » Topics.



The specific products may depend on one another. A »Product Dependency of this type describes a consistency condition between two or more products. In this connection, there may be a product dependency within a process module or between products of different process modules.

A product can be specified explicitly as »Initial Product or as »External Product . There is no dependency between the designation as initial or external: designating a product as initial does not imply it being external. An initial product is a product which shall always be developed once - and only once - during a V-Modell project, e.g. the »Project Manual or the »Project Plan. Products which are not developed within the scope of the respective V-Modell project but entered as input into the project are designated as external products. However, the structure and the requirements regarding the contents of these external products are specified in the V-Modell.

Activities. Every product developed within the scope of the respective V-Modell project will be completed by exactly one »Activity. The ways for processing the individual products are specified in the »Activity. The activities of a process module are also structured in a hierarchical manner. Activities which are related with regard to their contents and procedural approach and the products prepared are integrated into »Discipline. In addition, activities may be subdivided into work steps. A »Work Step may be compared to a work instruction which has to be executed separately and covers one or several »Topics .

Integration of Roles. In addition to products and activities, a process module also includes the cooperation and responsibilities of roles. A »Role encapsulates a set of tasks and responsibilities. By that role concept, the V-Modell remains independent of organizational circumstances. At the beginning of a V-Modell project, those roles are assigned concrete persons and organizational units. After Tailoring, exactly one responsible role is assigned to each product (»Responsible Person). In addition, several roles may support in the creation of a product (»Contributor).

Thus, a process module specifies "what" shall be done in an actual project, i.e., which products shall be developed and which activities shall be executed. In addition, the process module specifies, "who" or which role will be responsible for a product.

3.5 V-Modell Core and Process Module Map

The »Process Module used are specified for every »Project Type and every Project Type Variant. Thus, the »Process Module is the central unit of »Tailoring, i.e., of the project-specific adaptation of the V-Modell to a concrete »V-Modell Project. Thereby, the »Process Modules required for a »V-Modell Project are selected and specified in accordance with the specifications of the »Project Type. The Process Modules are divided into four areas depending on the project type. The color identification of these project types are used in Figure 6 for allocating process modules.

V-Modell Core. The first area contains those Process Modules, that may be used in every V-Modell Project. It contains the »V-Modell Core , which ensures a minimum level of project execution quality: in every project »Project Compliant to the V-Modell, the basic management mechanisms as defined in the »Process Module of the »V-Modell Core shall be used. As shown in Figure 6, the »Process Module of the »V-Modell Core include »Project Management, »Quality Assurance, »Configuration Management and »Problem and Change Management.

In addition, but independent of the V-Modell Core, the »Process Modules »Life Cycle Cost Management and »Measurement and Analysis may be used in every »Project Type . »Life Cycle Cost Management defines procedures and tools for integrating the project management into the superior financial management. »Measurement and Analysis provides procedures for the organization-wide acquisition and evaluation of several independent parameters.

Introduction and Maintenance of an Organization-Specific Process Model. Another area contains the process modules for the development of an organization-specific process model. The only process module in this area is »Introduction and Maintenance of an Organization-Specific Process Model. It respects the procedures and directives for the introduction of an organization-specific process module and the following establishment of a continuous improvement process.

System Development. The third area covers all process modules that are necessary or optional for system development. These are »Specification of Requirements, »System Development, »Hardware Development, »Software Development, »Integrated Logistic Support , »Enhancement and Migration of Legacy Systems, »Evaluation of Off-the-Shelf Products, »Usability and Ergonomics, »Safety and Security (Supplier), and »Safety and Security. In addition, the process module »Management of Multiple Projects belongs to this area. It supports the functional segmentation of an overall project into several sub-projects before the final specification of the requirements.

Acquirer/Supplier Interface. The fourth area contains those process modules that serve the communication between Acquirer and Supplier. It covers »Delivery and Acceptance (Acquirer), » Delivery and Acceptance (Supplier), »Drafting and Conclusion of Contract (Acquirer), and » Drafting and Conclusion of Contract (Supplier). These process modules define the relationship between Acquirer and Supplier and how it is fixed contractually. Moreover, it describes how the developed item has to be delivered by the Supplier to the Acquirer and how the acceptance procedure has to be organized.

The individual process modules of the V-Modell will be described in detail in the »V-Modell Reference Tailoring.

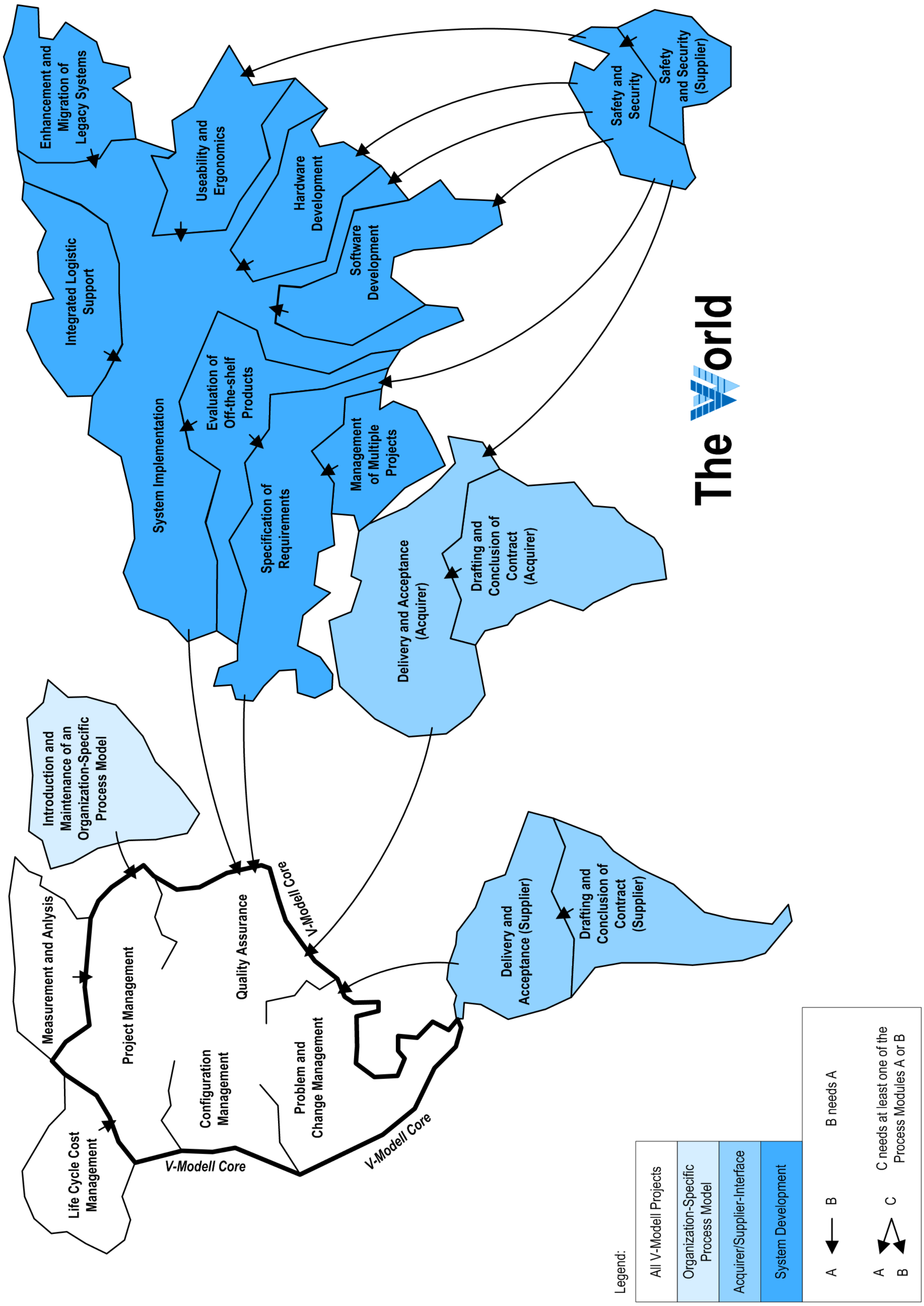


Figure 6: »Process Module Map

3.6 Project Execution Strategy

The V-Modell 97 specifies the input products required for the execution of an activity explicitly by the product flow. A comparable restriction does not exist in the present V-Modell. Process Modules and the products and activities included therein explicitly do not contain any specifications or restrictions regarding a possible sequence for executing activities or developing products.

Normally, the sequence of a project with regard to contents and time is complex. In order to permit a reliable planning and control of a project, an ordered project life cycle must be developed. For this purpose, the V-Modell provides the user with a Project Execution Strategy, the design of which depends on the Project Type and the Project Type Variant. A »Project Execution Strategy defines a basic framework for the ordered and replicable execution of a project.

The project execution strategy specifies "when", i.e. in which sequence, products will be developed and activities will be executed.

3.7 Decision Gates

The »Project Execution Strategy defines a fundamental framework for the ordered and replicable execution of a project. The project execution strategy specifies the sequence of the »Project Progress Stage to be achieved during the project. As shown in Figure 7, the achievement of a project progress stage is marked by a decision gate. A »Decision Gate indicates a milestone in the project sequence, where the current state of the project has to be evaluated. For every decision gate, the V-Modell defines a quantity of products which must be submitted in state »Finished at the end of the project progress stage. Based on all submitted products, the higher management decides whether the »Project Progress Stage was completed successfully and whether the next »Project Section may be entered.

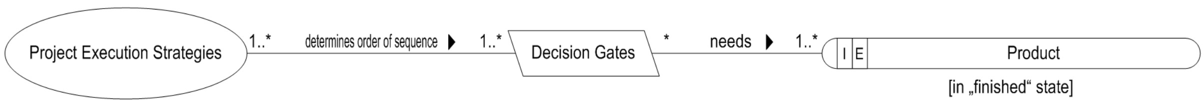


Figure 7: Project Execution Strategy, Decision Gates and Products

Figure 8 shows all »Decision Gate available in the V-Modell. The decision gates are differently coloured to show the belonging to the project types.

The decision gates »Project Approved, »Project Defined, »Iteration Scheduled and »Project Completed are used in all project types and, thus, also in each project execution strategy.

The system development is represented by the decision gates »Requirements Specified, »System Specified, »System Designed, »Detailed Design Completed, »System Elements Realized, and »System Integrated . The decision gates »Overall Project Partitioned and »Overall Project Progress Revised are used when the project is subdivided into several sub-projects before the specification of the requirements.

The decision gates that deal with the relationship between aquirer and supplier are »Request for Proposal Released , »Offer Submitted, »Contract Awarded, »Delivery Conducted, »Acceptance Completed and »Project Progress Revised.

Finally, the project type »Introduction and Maintenance of an Organization-Specific Process Model also includes the decision gates »Process Model Analyzed, »Process Model Improvement Specified and »Process Model Improvement Implemented.

The decision gates allocated to the project types and depicted in Figure 8 provide a specific, fundamental framework for the project execution in the V-Modell. The »V-Modell Reference Tailoring describes the sequence of decision gates for every project execution strategy possible in detail.

Together with the project execution strategy, the decision gates specify "what" shall be done "when", i.e., when shall the products be finished.

The case that a decision gate cannot successfully be passed is not planned in advance in the V-Modell. If the »Steering Committee has reasons not to declare a decision gate as passed, the following possibilities exist:

1. The products that have to be submitted at the decision gate are revised until they have an appropriate quality.
2. The Steering Committee decides to go back in the plan some project progress stages to enforce the repeated processing of several products and new project progress decisions.
3. The project is cancelled.

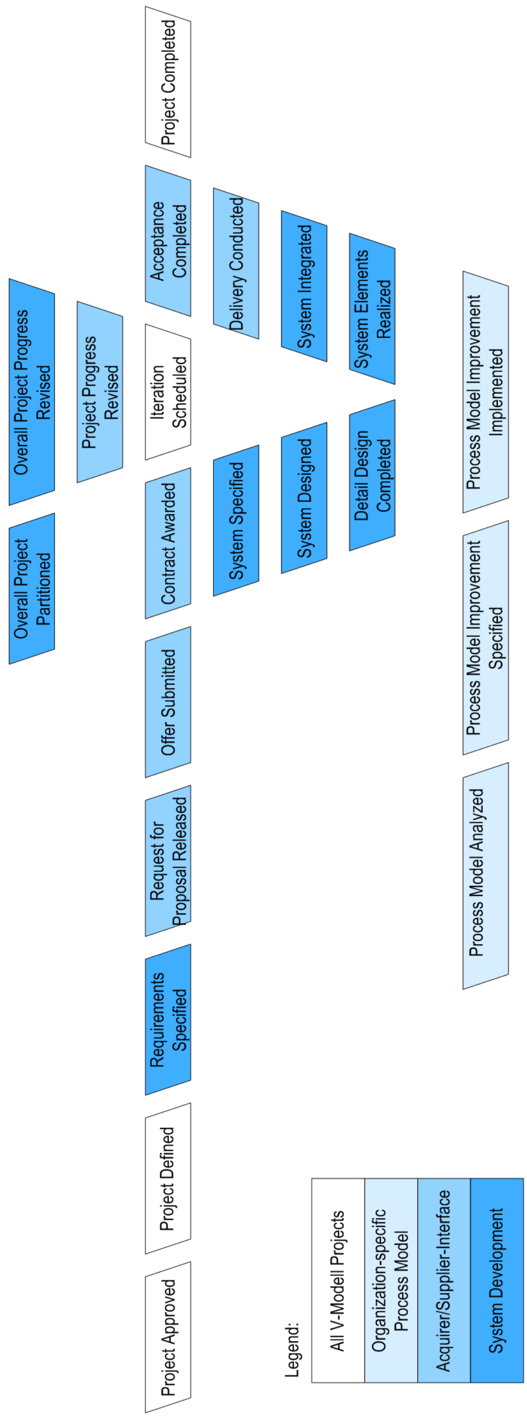


Figure 8: Decision Gates of the Project Execution Strategies

3.8 Overview of Basic Concepts

An important principle of the V-Modell is its target-oriented and result-oriented practicing. This basic philosophy is visible in numerous aspects of the V-Modell:

- Products are in the focus of the V-Modell. They are the central project results.

- The Project Execution Strategy and »Decision Gate specify the completion schedule of the products and, thus, the fundamental structure of the project progression.
- The detailed project planning and control is based on the processing and completion of products.
- One definite »Role is responsible for each product, and within the scope of an actual project a person or organizational unit is assigned to this role.
- The product quality can be verified by defined product requirements and explicit descriptions of dependencies with other products.

Thus, the products defined in the V-Modell are the central interim and final results of the project. Based on the objectives of the project, these results are defined during the project concept and planning phase. During the project progression, they are processed and completed using professionally practices.

The target and result orientation of the V-Modell avoids unnecessary activities which are not oriented towards a result. Activities and work steps which do not contribute to the achievement of a result are not described in the V-Modell. This focussing of the V-Modell is a significant prerequisite for an efficient project execution.

4 Management Mechanisms of the V-Modell

The V-Modell describes a process model for planning and executing development projects, considering the entire system life cycle. Successful projects require the cooperation of various basic management mechanisms, particularly of »Project Management, »Quality Assurance, »Configuration Management and »Problem and Change Management. The »V-Modell Core includes exactly those »Process Modules which provide these management mechanisms.

The following paragraphs introduce the application guidelines for the basic management mechanisms of the V-Modell.

4.1 Tailoring

The V-Modell is a generic process standard for projects, which is intended to be applicable to a maximum variety of project constellations. Therefore, the V-Modell must be adaptable to the actual project conditions. This adaptation, the so-called »Tailoring, is one of the first and most critical activities to be executed by the V-Modell user. In the V-Modell, »Tailoring is defined as the definition of the »Project Type and the selection of a possible »Project Type Variant and the applicable process modules. The detailed adaptation of the V-Modell to the level of the product models to be developed and activity models to be executed is conducted within the scope of project planning in accordance with the specifications of the generative product dependencies (compare paragraph »Project Planning).

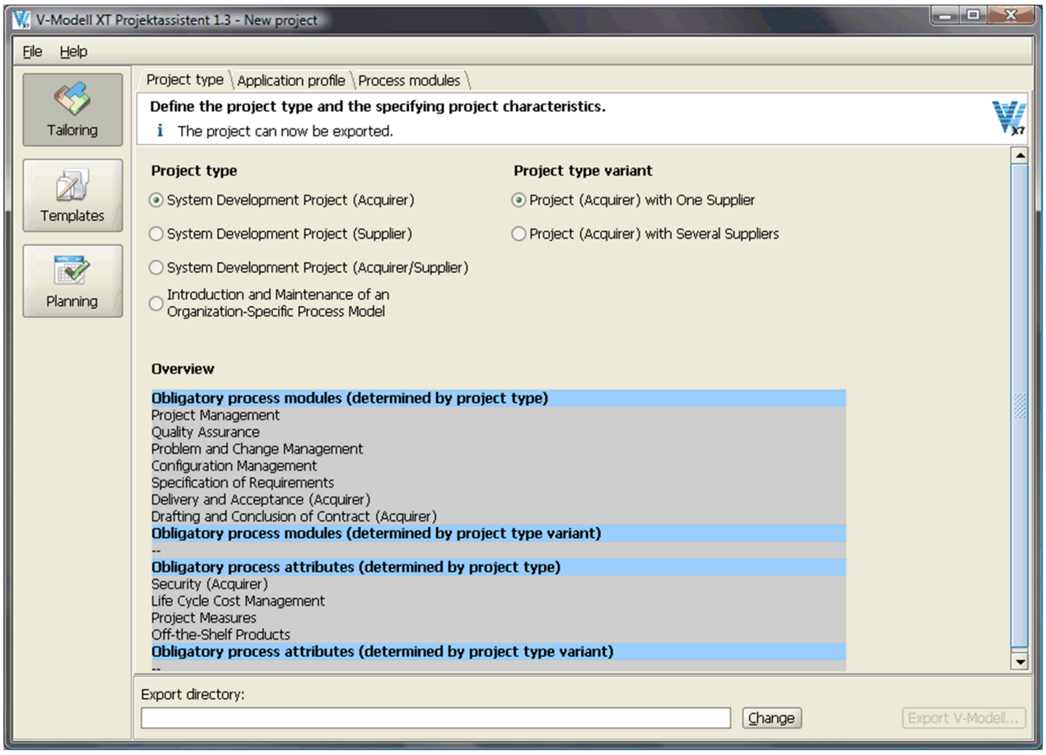


Figure 9: Tailoring of a V-Modell

Static Tailoring. As shown in Figure 9, the project is first characterized by the project type and the project type variant. The result of this characterization is the framework for the »Application Profile, which determines the »Project Characteristics which characterize the project in more detail. During the Tailoring Process, the »V-Modell User determines a value describing the project more accurately for each project characteristic. The complete Application Profile determines the selection of the »Process Modules to be used and the »Project Execution Strategy.

Figure 9 shows an example for the tailoring result of a possible »V-Modell Project on the part of the acquirer using the V-Modell project assistant. The V-Modell project assistant is a software tool used for tool-supported tailoring. Based on the project characterization, the project type »System Development Project (Acquirer) and afterwards the project type variant »Project (Acquirer) with Several Suppliers were selected. This selection is the basis for specifying the process modules to be used and the project characteristics, to be decided on during the tailoring process.

The final determination of the project type and the corresponding selection of process modules and project execution strategy has to be documented in the »Project Manual. The reasons for the selection of a particular application profile, project type and project type variant and the use of additional process modules have to be stated clearly.

This simple, but effective tailoring mechanism hides all sections of the V-Modell which are not required for a project. Thus, the V-Modell User has only to deal with the process modules and the specified project execution strategy relevant for his project.

Dynamic Tailoring. During the project life cycle, additional process modules may be selected or removed, with the exception of the mandatory process modules of the »V-Modell Core. The rules for this »Dynamic Tailoring are already defined in the V-Modell by specifically indicated product dependencies, which are designated as »Tailoring-Related Product Dependency (see »V-Modell Reference Tailoring).

For example, one of these tailoring-related product dependencies defines the following rule:

If at least one »Hardware Unit was identified in the product »System Architecture , the process module »Hardware Development has to *be selected in the »Project Manual .*

Let's assume that the process module »Hardware Development was not selected in a project, but the planned »System Architecture identifies »Hardware Units . In this case, the above tailoring-related product dependency requires the process module »Hardware Development to be selected as well. Of course, the tailoring documentation in the »Project Manual has to be adapted accordingly.

This type of dynamic tailoring during the project life offers a high degree of flexibility. The V-Modell core guarantees a basic degree of quality which is ensured in every project compliant with the V-Modell.

Parts of the »Project Manual may be agreed as subject of a contract. In case of public contracts, this agreement is already included in the »Request for Proposal . If the tailoring result of a project has been agreed as contract-relevant part of the »Project Manual, the tailoring - and particularly the dynamic tailoring - is transparent for all stakeholders of the project.

4.2 Project Organization

The project organization superimposes the existing organization of the project's environment, e.g. the line organization of a company or government agency. Nevertheless, the project organization must be clearly and firmly established in the surrounding organization. This requires an unambiguous regulation of competences as well as the definition and organization of project communication and reporting.

Based on the tasks and responsibilities, competences have to be determined, funds allocated and framework conditions defined. This has to be documented in the »Project Progress Decision and worked out in the »Project Manual and the »QA Manual.

In addition, the »Roles must be staffed. This manning of roles is the most important factor for the success of a project. The individual key roles, e.g. »Project Leader and »System Architect, have to be manned with experienced, competent and accepted persons. The same applies to project control panels, e.g. the »Steering Committee or the »Change Control Board.

4.3 Project Planning

After the project-specific adaptation of the V-Modell (»Tailoring) has been completed, the project execution strategy, which specifies the sequence of the project progress stages to be achieved during the project, has been determined. A project progress stage is represented by a decision gate.

The actual number of decision gates and the corresponding project progress stages depend on the needs of the project to be executed. The project execution strategy only provides a general frame, which has to be filled by the project as required.

Within the scope of a system development, for example, a prototype of the system should first be developed in order to validate the prepared »Overall System Specification; afterwards, the contracts for the proper system development should be awarded based on the gained experience. As shown in Figure 10, the »V-Modell Project will then include the »Decision Gate »Requirements Specified, »Request for Proposal Released, »Contract Awarded and »Acceptance Completed twice - once for the prototype and once for the proper system.

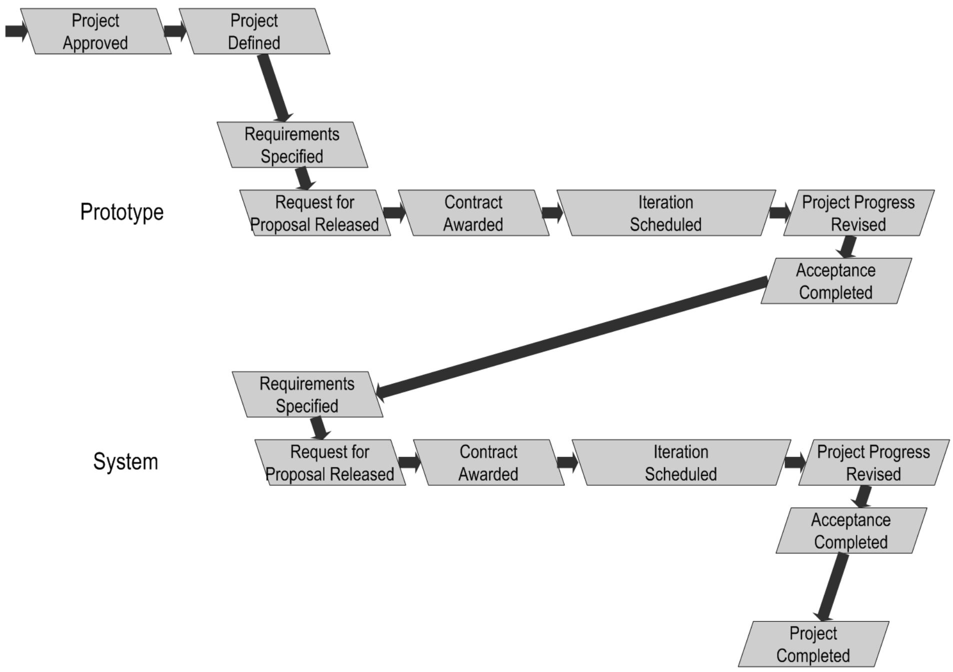


Figure 10: Project-Specific Development of the Project Execution Strategy

This project-specific development of the »Project Execution Strategy has to be prepared by the »Project Leader during project planning and has to be included in the »Project Manual and the »Project Plan.

Thus, a basic frame for a detailed project planning and organization is defined. The decision gates of the project execution strategy give the order of the products to be created. A product which will be created once and only once during a project is designated as »Initial Product in the V-Modell. The initial products and the products defined by the decision gates - together with the corresponding activities - can be integrated immediately into the project plan.

A so called »Generative Product Dependency defines additional products and activities which have to be planned. A generative product dependency defines what particular contents of a product imperatively imply the creation of additional products. However, it is not regulated, when these products have to be finished. For example, the V-Modell contains a generative product dependency defining that for each »Hardware Unit that has been identified in the »System Architecture, a »Hardware Specification has to be created. In detail, the generative product dependencies are described in the »V-Modell Reference Work Products.

The project plan must be complemented by additional products and activities as required by these generative product dependencies. In addition, further products - and thus also activities - can of course be integrated into the plan, always considering the defined generative product dependencies.

4.4 Risk-Minimizing Project Control

During the project, project progress and project risks have to be reviewed continually and systematically, and difficulties have to be circumvented appropriately. The process module »Project Management specifies the procedures required for this purpose. At higher level, the decision gates are used for monitoring the project progress and reducing the overall risk for project success.

The decision gates indicate quality gates a decision on the project progress and the following project execution based on the products to be submitted at the respective decision gate. This decision lies in the area of responsibility of the »Executive and has to be made in the »Steering Committee, which includes all key persons of the project, as shown in Figure 11.

The decision has to be documented in the product »Project Progress Decision, where the funds and resources for the following »Project Section will be released. It is also possible to impose conditions for the following project section. If the decision on the project progress is in the negative, it is possible to specify, in individual cases, whether the submitted products have to be improved and submitted again, the project shall undergo a fundamentally new development or the project shall be cancelled.

The steering committee does not have to meet physically to make a project progress decision. Instead, the project progress decision can be made by circulation of an appropriate document or by e-mail. Additionally, it is possible to cover several project progress decisions in a single meeting. This procedure is advised especially in case of several parallel development threads.

The consequent application of the »Project Execution Strategy and the »Decision Gates leads to a risk-minimizing project control. Undesirable developments will be recognized early in the »Project Stages, which permits an early initiation of appropriate countermeasures.

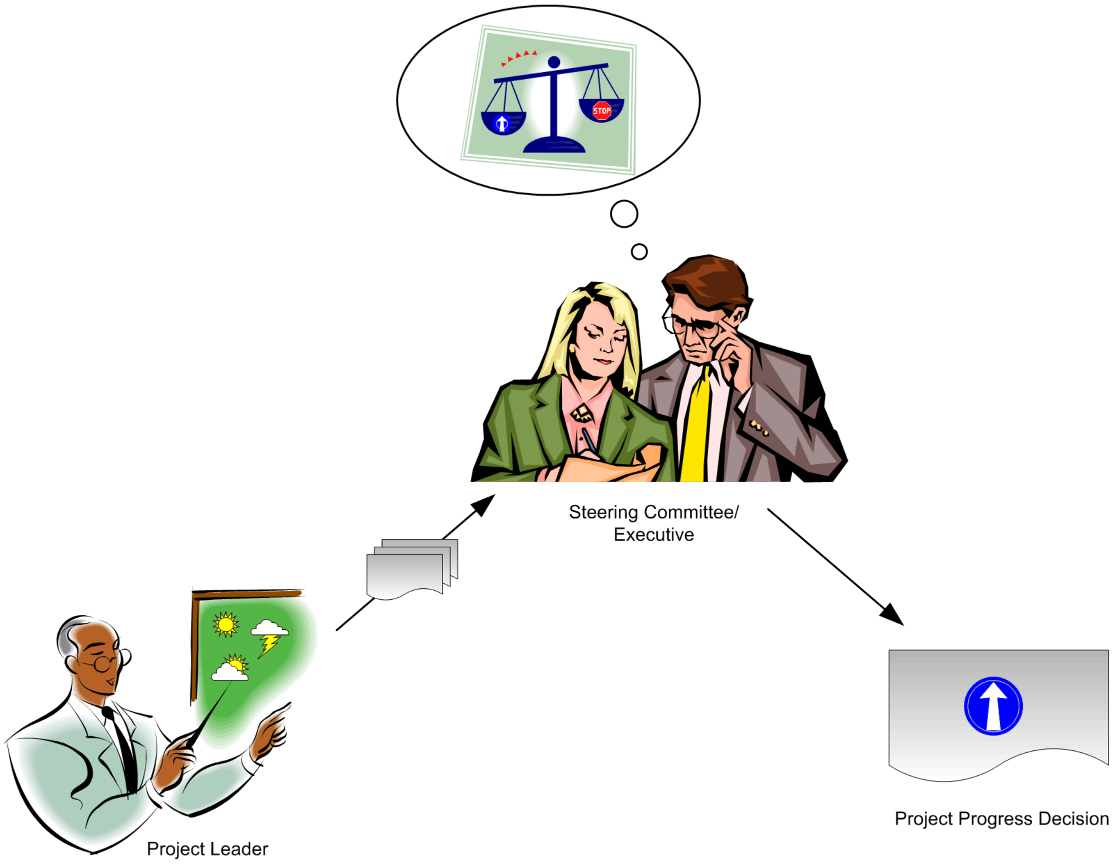


Figure 11: »Decision Gate and Project Progress Decision

The following products have to be submitted at all decision gates except for »Project Approved and »Project Completed: »Project Progress Decision, »Project Plan, »Project Status Report, and »Quality Status Report.

4.5 Quality Assurance and Product State Model

The quality of the project result has to be ensured by constructive and analytical quality assurance procedures. It is essential to execute the analytical quality assurance in parallel to and independent of the constructive development process. The quality assurance within the project requires a uniform and coordinated approach, which is understood, supported and applied by all participants.

The V-Modell defines standards for the form and contents of the products, which will be developed in the course of a V-Modell project. The »V-Modell Reference Work Products describes these standards for every product. In addition, the so-called product dependencies specify additional rules for the overall consistency regarding the contents of several products. The V-Modell differentiates between 4 types of product dependencies: »Content-Related Product Dependencies, »Generative Product Dependency, »Structural Product Dependency and »Tailoring-Related Product Dependency (see »V-Modell Reference Tailoring and »V-Modell Reference Work Products).

Each »Work Product has a »Product State. Potential product states include »In Processing, »Submitted and »Finished, as shown in Figure 12. The state of a »Work Product will be redetermined, at the latest, if the processing »Activity has been completed successfully.

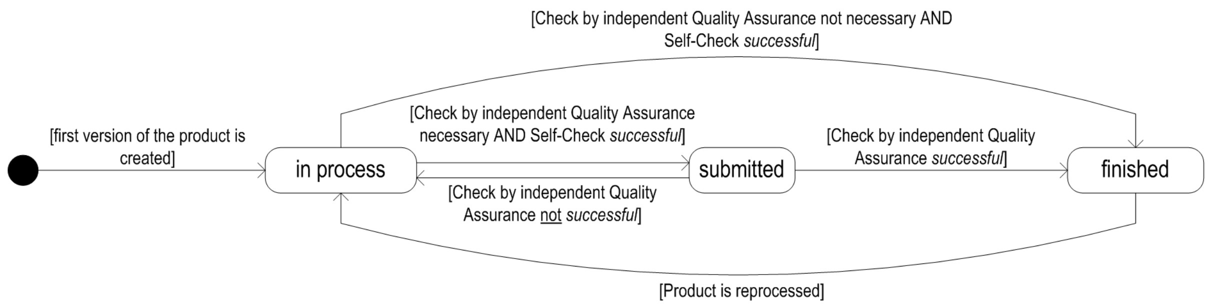


Figure 12: Product State Model

In order to complete an activity successfully, the generated product must be checked accordingly. The evaluation sequence is shown in Figure 13. Each evaluation, conducted by an independent quality assurance or as self-check, checks contents and form of the »Work Product in accordance with the V-Modell definitions. In addition, the consistency with the contents of other products has to be checked. This includes a check of every »Relevant Product Dependency. In this connection, relevant product dependencies are all product dependencies between the »Work Product to be checked and the products which have already reached the state »Finished.

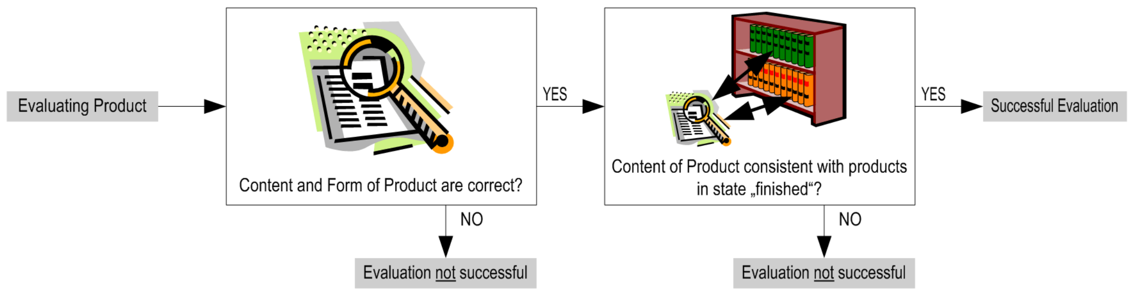


Figure 13: Evaluation Sequence

At first, a self-check has always to be executed as shown in Figure 12. As already described, this self-check checks the »Work Product itself and its consistency with the contents of work products in state »Finished. However, it is not mandatory to document contents and scope of the evaluation in accordance with the V-Modell.

In addition, the »QA Manual and the corresponding »System Implementation, Integration and Evaluation Concept define in advance whether the evaluation must be executed by an additional independent quality assurance. As already described, this independent quality assurance checks the »Work Product itself and its consistency with the contents of finished products. Contrary to the self-check procedure, however, an appropriate »Evaluation Specification System Element and »Evaluation Report System Element will be prepared for preparing and documenting the conducted evaluations.

If an independent quality assurance is required, the product first changes to the state »Submitted and - after a successful evaluation - to the state »Finished. If an independent evaluation is not required, the products changes to the state »Finished immediately after the self-check has been completed successfully.

If an evaluation is not successful, the »Work Product must undergo appropriate reprocessing and a new quality assurance. If a »Relevant Product Dependency has been violated, the persons responsible for these »Work Product are responsible for remedying the inconsistency.

In this connection, it may be possible that the responsible roles (»Responsible Person) decide that a »Finished »Work Product is returned to the state »In Processing in order to execute the required corrections.

As shown in Figure 12, a product which has already reached the state »Finished may be returned to the state »In Processing also by events not connected with the quality assurance process. For example, a »Work Product may be modified - and thus returned to the state »In Processing - by modifications determined and executed within the scope of change management or by a reprocessing of the »Work Product in the following processing stages.

This procedure ensures that all products in the state »Finished are not only correct as seen alone, but also consistent with the contents of other products and thus correct in their entirety. This is independent of the sequence in which the individual »Work Product were »Finished.

4.6 Configuration Management

The »Configuration Management manages all products and »Product Configurations in accordance with the »Project Plan. A »Product Configuration identifies a quantity of matched products that belong together from the »Product Library in a specific version and in their respective product state - the so-called »Product Version.

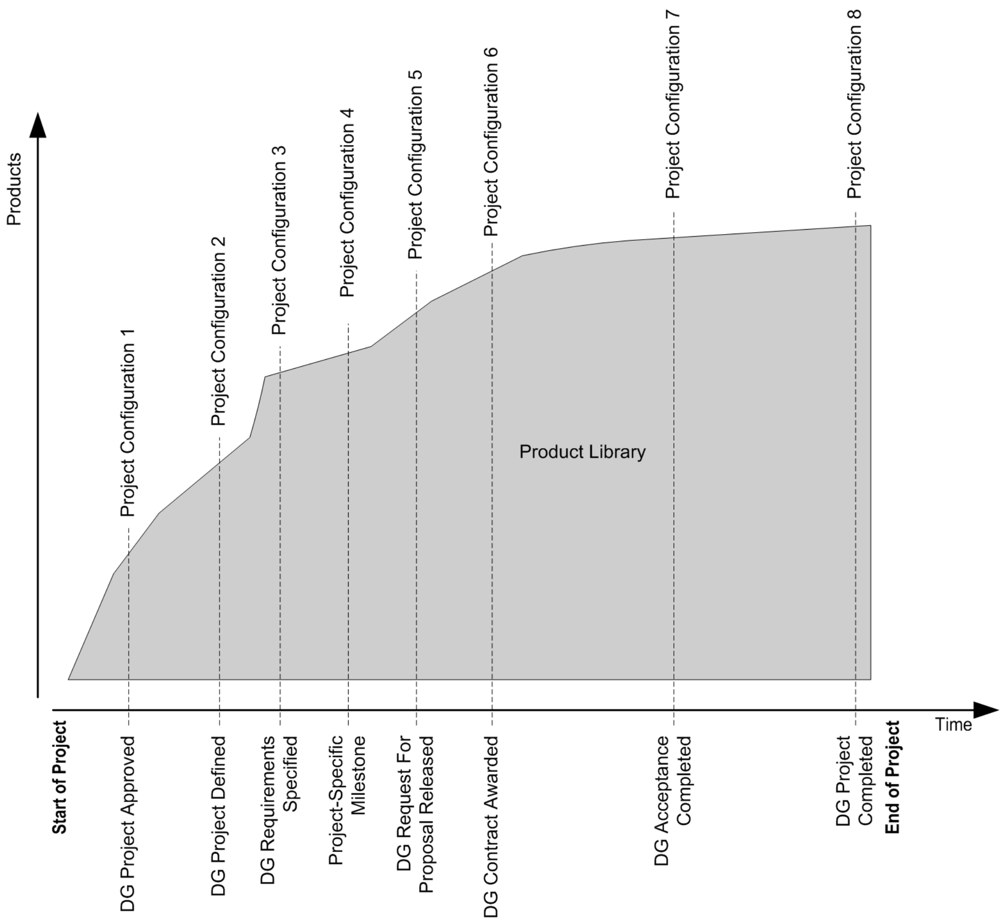


Figure 14: Decision Gates and Product Configurations

Thus, the »Configuration Management is intended to document the current and previous »Product Configuration of a system and the degree of fulfillment of the physical and functional requirements and to ensure complete transparency in this respect during the entire system life cycle.

Every planned »Decision Gate generates a »Product Configuration – as shown exemplarily in Figure 14 – thus documenting the project progress and ensuring a replicable quality assurance.

4.7 Problem and Change Management

During the entire project life cycle, products will be modified and changed. If a certain degree of completeness has been reached, it is necessary to follow product changes also formally. This formal problem and change management is defined in the »Process Module »Problem and Change Management. This procedure is shaped specifically for each project in the »Project Manual. In particular, it has to be documented which which types of changes are meant to be traced by the formal problem and change management. In this connection, it should be noted, that only products in the state »Finished can be subject to a formal problem and change management.

Within the scope of the formal problem and change management, all faults, problems and change proposals have to be documented and evaluated and the further procedure in the project has to be decided. Problem reports and change requests (see »Problem Report / Change Request) may occur during the entire project and system life cycle and can be prepared by all persons concerned, e.g., »Software Developer, »User or »Ergonomics Manager.

There may be a great variety of reasons for problem reports and change requests, e.g. system malfunctions, deferred corrective actions, lacking or additional system functionalities, changes of the environment on the side of the acquirer or supplier, problems regarding external subcontractors, misunderstandings in the requirements stated in the contract and newly recognized dependencies. These problem reports and change requests have to be documented and followed by a »Change Status List. This list informs on type and state of a change, state of the decisions and planned schedule.

The change procedure itself, i.e. the recording, evaluation and decision, is a self-contained replicable process. This process is controlled by the »Role »Change Request Manager. Mandatory decisions will be made by the »Change Control Board, the composition and decision competence of which will be determined in the »Project Manual and should depend on the effects of changes.

5 Project Execution

As already described in the paragraph »Project Types, the V-Modell is a generic process model standard for development projects. It supports the following four project types:

- »System Development Project (Acquirer)
- »System Development Project (Supplier)
- »System Development Project (Acquirer/Supplier)
- »Introduction and Maintenance of an Organization-Specific Process Model

The »Management Mechanisms of the V-Modell presented in the previous chapter have to be applied to each project type. During the creation of the actual project result, specific procedures for project execution regarding its contents will be required. These procedures will be described in the following paragraphs.

5.1 Acquirer/Supplier Interface

According to the V-Modell, is is possible to execute two V-Modell projects within the scope of system development: »System Development Project (Acquirer) and »System Development Project (Supplier). The V-Modell provides a specially adapted project execution strategy for these different project types (see paragraph »Project Execution Strategy). Figure 15 shows an example for two different project execution strategies and the sequence of the corresponding »Decision Gate.

The V-Modell explicitly describes the »Interface between V-Modell Projects of the »Acquirer and of the »Supplier. An »Interface Product, which is developed outside the particular »V-Modell Project, is designated as »External Product in the V-Modell. Figure 15 shows the interface products which are exchanged between the V-Modell project of the acquirer and the supplier.

The V-Modell project of the acquirer develops a » Request for Proposal. This request for proposal includes the previously prepared »Requirements Specification and definitions regarding the content of the »Project Manual of the supplier. Based on the request for proposal, the V-Modell project of the potential supplier makes an » Offer. This offer includes the offer-relevant and contract-relevant parts of the »Project Manual and the »QA Manual of the potential supplier. If the acquirer accepts the offer, a » Contract will be concluded. This contract can be complemented by » Contract Addendum.

The »Project Status Reports inform the acquirer about project progress, project planning, project control measures, quality assurance and problem and change lists. The acquirer should be represented in the »Steering Committee and the »Change Control Board in order to ensure a direct coordination between acquirer and supplier.

The V-Modell project of the supplier sends interim products and end products as »Delivery to the acquirer. The V-Modell project of the acquirer provides a feedback to these interim and final deliveries by means of a »Statement of Acceptance. It is important that a statement of acceptance is only to be made for the decision gate »Acceptance Completed. The consequence is that the sole formal acceptance of development documents is not admissible. In general, the »User, who is represented by the acquirer, can only decide whether the supplier realized what has been required when the supplier delivers Software and Hardware respectively.

A supplier may act as acquirer with respect to a sub-supplier. The projects of the »Sub-Acquirer and the »Sub-Supplier will be processed in accordance with the V-Modell and connected via the already described »Acquirer/Supplier Interface.

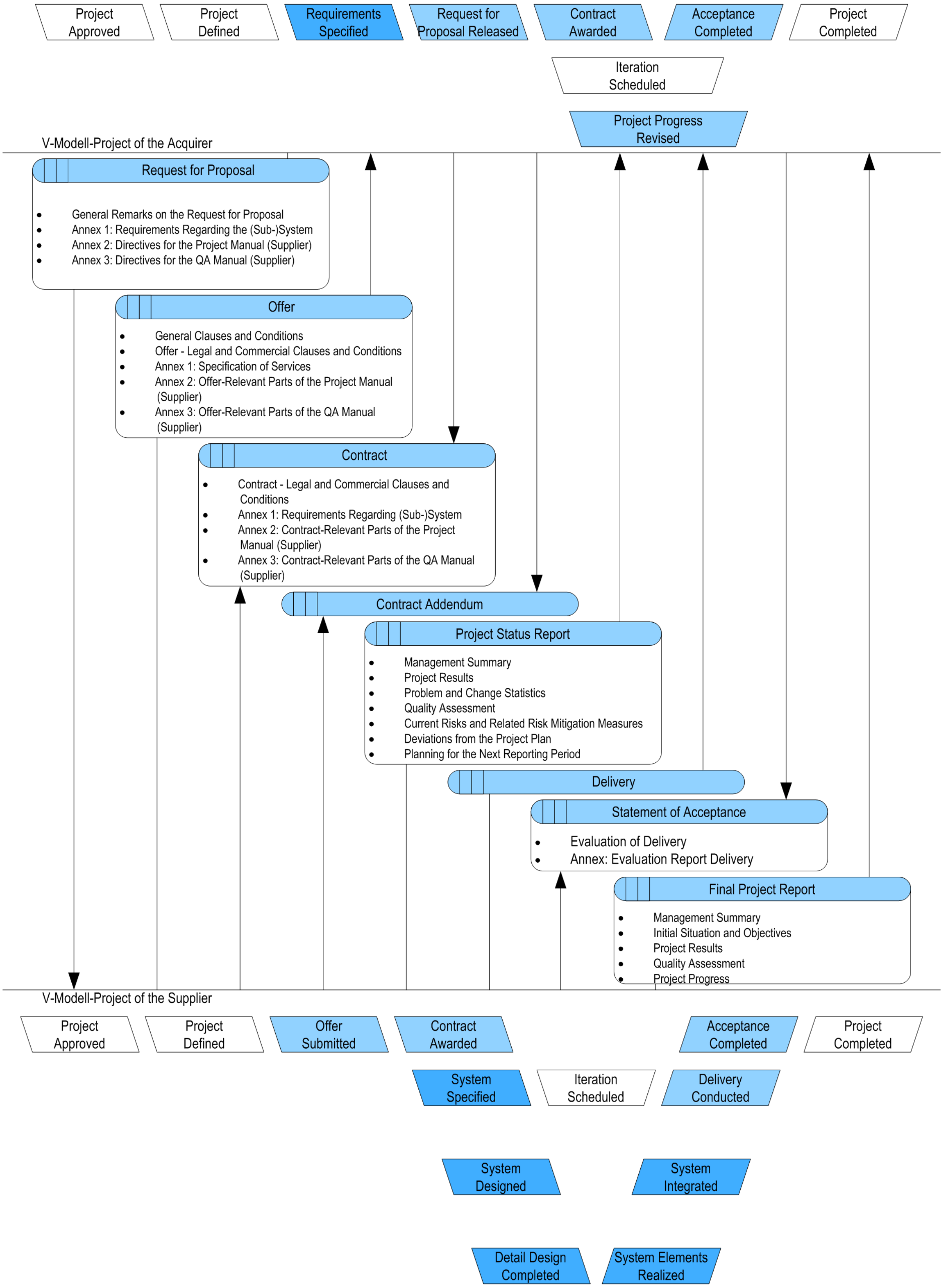


Figure 15: Acquirer/Supplier Interface

If the system development project of the acquirer exceeds a certain magnitude, it should be subdivided into appropriate sub-projects. Even if these projects are executed within one company, this subdivision should also be conducted in accordance with the described acquirer/supplier interface. This is the only way to control the coordination between the projects adequately and to make corrections if required.

5.2 System Development

The system development includes the development of the »System to be prepared and the development of the »Enabling System required in various system life cycles. For the development, the system is subdivided hierarchically into smaller units until finally a realization is possible. It is subdivided hierarchically into »Segments, »Hardware Units, »Software Unit, »External Units, »Hardware Component, »Software Components, »Hardware Module, »Software Modules, »External Hardware Modules, and »External Software Modules (see »V-Modell Reference Work Products, see Chapter »Structural Product Dependencies).

In accordance with this hierarchical system structure, the system is specified and subdivided into smaller units during the system development. The »Decision Gates depicted in Figure 16 are the basic steps for the refinement of the specification and the subdivision into smaller units.

There is an accurate procedure for every subdivision step, which is based on a uniform pattern and permits a complete tracing of the requirements. During every step, the requirements of the higher »System Elements are taken into account, the subdivision is designed, the realization of the »System Elements is specified, and finally, the requirements are assigned to the next level of »System Elements.

The realization and integration of the system is conducted in reverse order as compared to the specification and subdivision. Based on the realized »Hardware Modules and »Software Module, the more complex »System Elements, and finally the system are integrated. As shown in Figure 16, verification and validation are ensured at every design level.

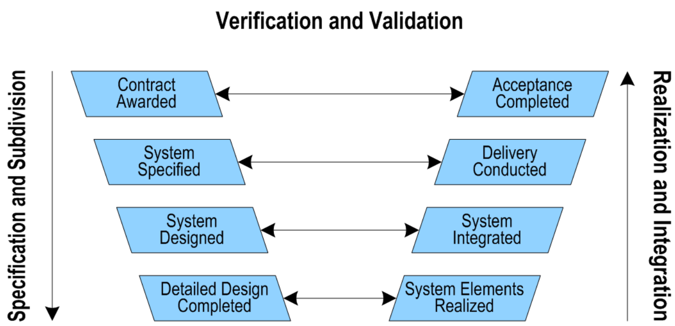


Figure 16: System Development Structure

5.3 Introduction and Maintenance of an Organization-Specific V-Modell

The »Process Module »Introduction and Maintenance of an Organization-Specific Process Model describes a procedure for introducing and continually improving an »Organization-Specific Process Model. The procedures and guidelines of this process module have to be applied during the organization-specific adaptation of the V-Modell. The »V-Modell is adapted to the organization, specified in detail and complemented by specific organization processes (see »Further Development of the V-Modell).

5.4 Multi-Projektmanagement

Within the framework of the V-Modell, an Acquirer may cooperate during a project with several Suppliers in parallel. The individual »Decision Gate of these sub-projects can be achieved independently of each other.

There are a variety of reasons for subdividing a project in this way, e.g., if it is impossible to find a general contractor as sole supplier, or if the project definition based on the first architectural considerations already shows that the system comprises several relatively independent components, which may be developed independently by several suppliers.

In order to subdivide a project into several sub-projects, the Acquirer needs the contents of the process module »Management of Multiple Projects. The selection of the project type variant »Project (Acquirer) with Several Suppliers adds this process module to the project-specific application profile.

6 Further Development of the V-Modell

A two-stage procedure is defined for the maintenance and further development of the V-Modell. The procedure is also recommended for modifications of a V-Modell adapted to a specific organization if the adoption of the updated V-Modell is planned or the organization-specific V-Modell is intended to be updated for other reasons.

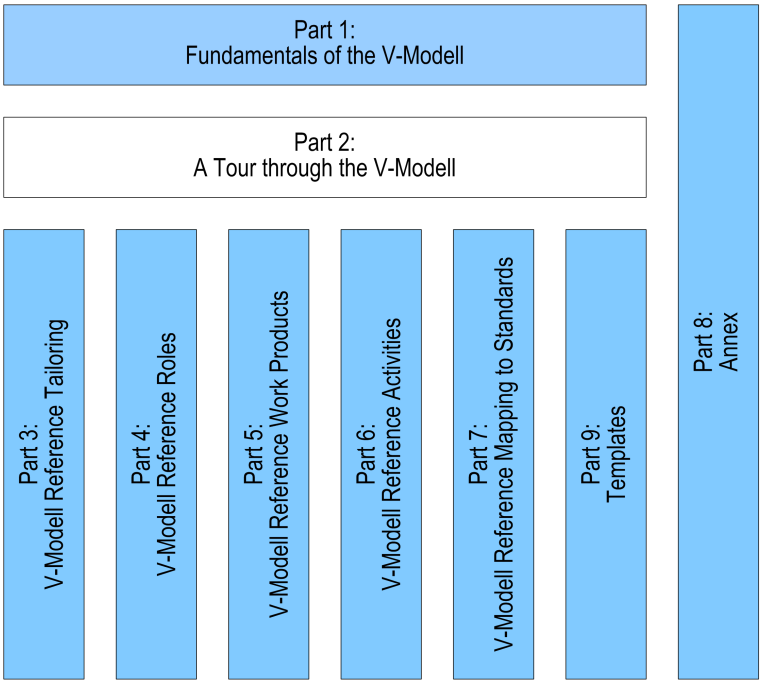
At relatively short intervals, which correspond to the innovation cycles of information technology, the V-Modell may be changed and upgraded. For this purpose, an »Advanced V-Modell, or parts of an advanced V-Modell, will be developed in accordance with the development of an organization-specific V-Modell. These change and development proposals are submitted to the Weit association (»Weit e.V.). The Weit e.V. decides whether the changes will be integrated into the »V-Modell. Changes and upgradings can only affect »Process Module, »Project Execution Strategy, »Decision Gate, »Project Characteristic and »Mapping to Standards.

Changes beyond this scope, e.g., changes of the existing »Fundamentals of the V-Modell, belong to the second stage of the procedure. Changes of this type have to be executed by a special review and coordination process with the »V-Modell Users within the scope of an updating project.

7 List of Figures

Part 2: A Tour through the V-Modell

V-Modell® XT



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Export templates	Version 1.3 English
Export environment	Version 2.1.3
V-Modell XT	V-Modell® XT Version 1.3

Table of Contents

1 Introduction

1.1 Objectives

The V-Modell Tour demonstrates the use of the V-Modell by leading the reader through an imaginary showcase. It gives a first impression of the application of the V-Modell, demonstrating how some of the main »Products are created.

1.2 Audience

This document is intended for all persons employing the V-Modell. For the »Project Leader of a V-Modell project, this document is required reading. Furthermore, this document provides a hands-on introduction for those who want to inform themselves about the V-Modell.

1.3 Contents and Structure

This document consists of the following chapters:

»Introduction into the Sample Project

This chapter delineates the exemplary project. It gives an outline of the course of the project and of parts of the exemplary documents.

»Initializing a Project

This chapter explains the work products »Project Proposal and »Project Progress Decision in excerpts. These work products must be produced during the initialization of the project and submitted at the »Decision Gate »Project Approved, the approach for producing them will be exemplified.

»Definition of a Project

The products »Project Manual, »Project Plan and »Project Progress Decision, which need to be delivered at the »Decision Gate »Project Defined are explained in this chapter.

»Specification of Requirements

This chapter explains the products »Work Order and »Requirements Specification, which need to be delivered at the »Decision Gate »Requirements Specified.

2 Introduction into the Sample Project

This chapter introduces the sample project on which the V-Modell Tour is based. This sample project deals with the development of an information system. The V-Modell project is conducted from the point of view of the acquirer. The information system is intended to support the members of a university in filing applications for trademarks and patents. It will be realized by a supplier determined by a »Request for Proposal.

2.1 Project Setting

The V-Modell can be applied by both, acquirer and supplier. The sample project will deal solely with the project of the acquirer, the role of which is adopted by the Technische Universität München (TUM). It is an imaginary project.

The acquirer project is subdivided into two areas of responsibility, i.e., execution and management. Executive authority is a chair of the Technische Universität München - hereinafter referred to as **Project Team of the TUM**. The Management is vested in the Trademark and Patent Administration of the Technische Universität München - hereinafter referred to as **Trademark and Patent Administration**. The information system to be realized will be referred to as **Trademark and Patent Information System.**

When applying the V-Modell, the project type variants defined in the model provide a rough project sequence. The project type variant relevant for our pilot project - »Project (Acquirer) with One Supplier (see Figure 1) - defines a basis which will be adapted specifically to the Trademark and Patent Information System. This project-specific planning is part of the »Project Manual and will be described in our exemplary project in the Chapter »Project Manual.

During the development of the Trademark and Patent Information System, only a part of the system - i.e. the subsystem for the application for trademarks - will be developed in the first expansion stage. Only if this system meets with adequate acceptance on part of the user, the following two expansion stages - the application for patents and the management of trademarks and patents - will be commissioned. As shown in Figure 1, the Trademark and Patent Information System will be subdivided into three »Project Stages. A project stage describes the interval between two (partial) shipments of a supplier. For each project stage the »Decision Gates beginning with »Requirements Specified up to »Acceptance Completed are planned correspondingly.

In each project stage the affected »Product Instance will be revised by the acquirer, i.e., particularly the Technische Universität München. This applies amongst others to the »Requirements Specification. For each of the project stages I to III, a supplier,who will be responsible for the realization of the respective subsystem, is determined by a request for proposal. The Technische Universität München supports the suppliers during their projects and is responsible for the final acceptances. After the final acceptances the decision, whether the delivered system needs to be modified in the next project stage or whether the following project stage may be initiated, can be made.

For a more detailed discussion of the sample project, we will concentrate on the start of the project and the first project stage. We will extract the first few decision gates from the overall sequence. Figure 2 shows the products to be submitted to the management at every decision gate. The products written in gray will be submitted multiple times. The sequence of the depicted decision gates will be described in the following paragraphs.

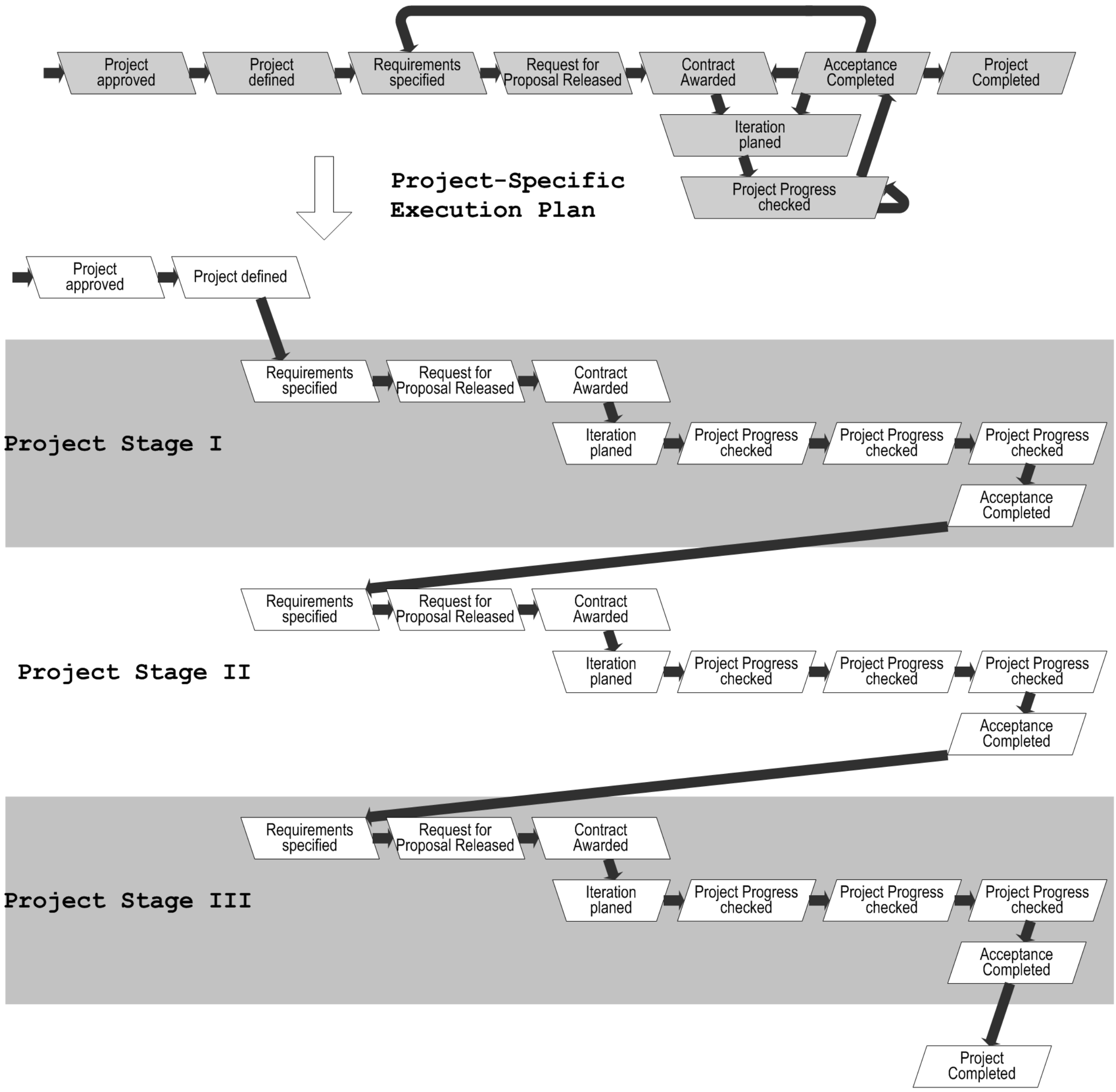


Figure 1: »Project Execution Strategy for the Trademark and Patent Information System Project

At the beginning stands the idea for the Trademark and Patent Information System project, which is elaborated into a »Project Proposal. The acquirer of the Trademark and Patent Information System - i.e. the Project Team of the TUM - submits this project proposal to the responsible management, i.e., the Trademark and Patent Administration. Since all circumstances are satisfactory - good idea, implementation in three sequential steps sensible and funds available - it is reasonable to assume that the »Project Progress Decision will be positive and the decision gate »Project Approved will be passed.

In the following »Project Section, which will lead to the decision gate »Project Defined, the planning and organization of the project is defined in detail. Requirements for various areas - e.g. configuration management, are specified. The products »Project Plan, »Project Manual, »QA Manual, »Product Library, »Project Status Report and »Quality Status Report will be submitted before the final »Project Progress Decision can be taken. The »Project Progress Decision includes - among other things - an evaluation of the previous deliverables and a detailed planning for the following project section.

At the decision gate »Requirements Specified, the Project Team of the TUM submits the product »Requirements Specification. The requirements are the basis for the system to be developed. During this project section, the Project Team of the TUM repeatedly prepares the product »Requirements Evaluation, the results of which will be included into the requirements document. Furthermore the Product »RFP Concept must also be defined during this project section.

Finally, the requirements will be reviewed and submitted to the Trademark and Patent Administration on a meeting, during which the »Project Progress Decision will be made. Moreover the actual Product Instances of the »Project Status Report, »Quality Status Report and »Project Plan need to be submitted.

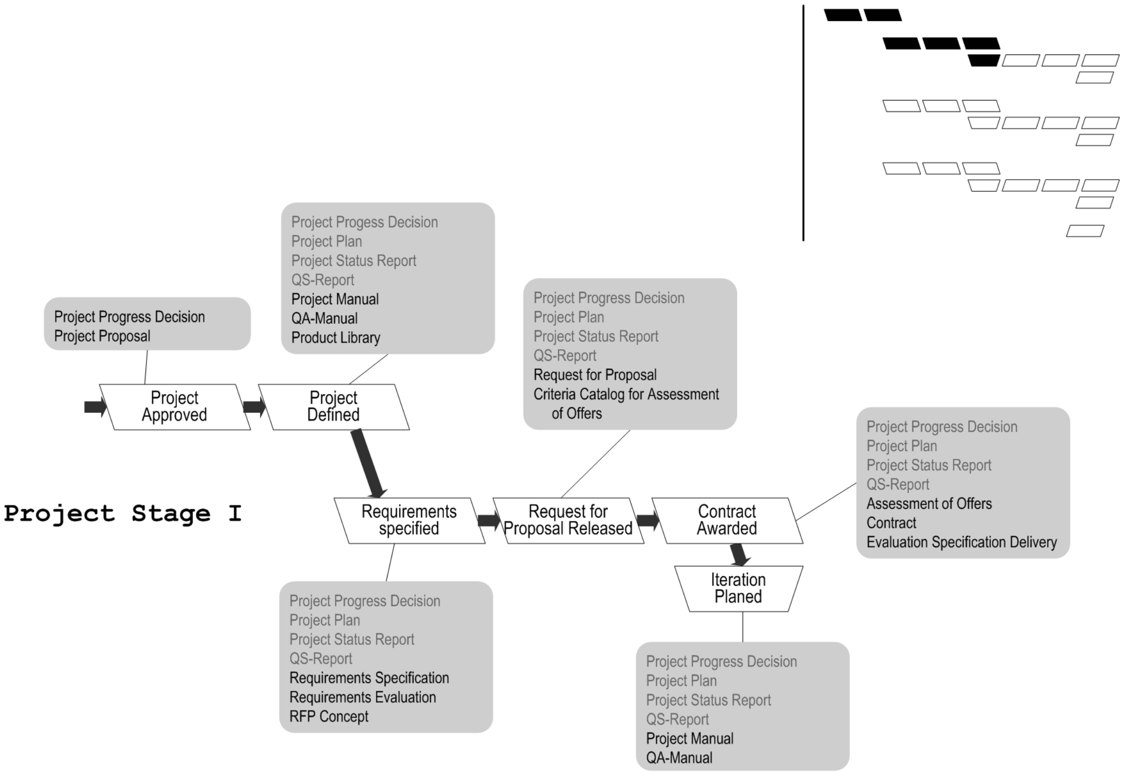


Figure 2: Decision Gates and Products to be Submitted

The »Requirements Specification will be included in the »Request for Proposal, which can be completed in the next project section. In addition the Project Team of the TUM develops guidelines for evaluating and comparing offers received from potential suppliers. The request for proposal will be published, and the decision gate »Request for Proposal Released may be passed.

Within a legally specified period, offers can be submitted. The Project Team of the TUM records the results of the assay of the submitted offers in the product »Offer Assessment. The decision on the the award of a contract will be based on these results. Hereupon the Project Team of the TUM elaborates a contract in close contact with the Trademark and Patent Administration and the supplier.

Finally the »Evaluation Specification Delivery must be worked out, in order to be able to conduct the acceptance later on. When all these product have been developed the decision gate »Contract Awarded may be passed.

Now it is up to the supplier to fulfill the obligations specified in the contract and realize the Trademark and Patent Information Subsystem I. For this purpose a consolidated plan of the upcoming iteration is necessary. The plan will be delivered at the »Decision Gate »Iteration Scheduled of the acquirer. At this decision gate revised product instances of the »Project Manual and »QA Manual may have to be submitted in addition to the usual product instances of the »Project Status Report, »Quality Status Report and »Project Plan. These products will be referred to the Trademark and Patent Administration in the scope of the Steering Committee meeting.

Finally the acquirer accompanies and supervises the project progress up to the acceptance. Synchronized with important milestones of the supplier (e.g. completion of the »Overall System Specification, or the completion of the detailed design or of the first prototype) the acquirer passes the milestone »Project Progress Revised. Within this milestone the »Project Status Report of the supplier are presented and help the acquirer to keep track of the progress of the suppliers work, which is in turn documented within the acquirers own »Project Status Report. Change requests concerning the actual expansion stage of the system and new feature requests will be collected and documented before entering the request for proposal of the second project stage.

2.2 Overview of the Products of the Sample Project

Figure 3 shows the products which are used as examples in the following chapters. The elaborated subjects of the sample products are marked in black.

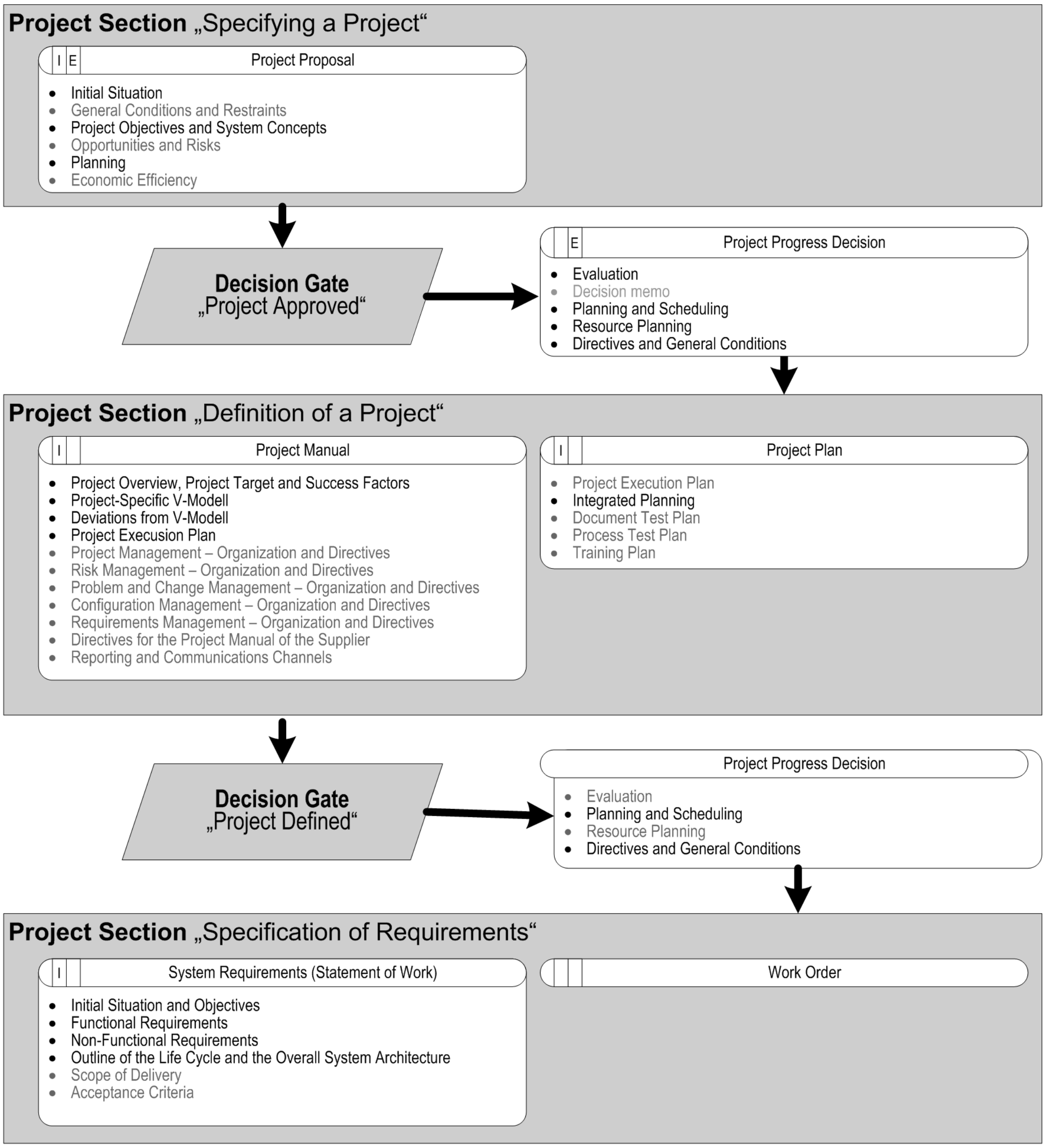


Figure 3: Summary of the Products of the Sample Project

In the following chapters, the history from the beginning of the pilot project to the specification of requirements will be described in a detailed manner and explained by product examples. The break-down of the chapters will follow the »Project Sections illustrated in Figure 3.

The presentation will follow the principles of a narration. Actions and motives of the participants will be explained by the author. Example:

„During his dissertation, Mr. Apollon, who works at the Technische Universität München, invents a trademark he wants to register. Colleagues have told him that the realization of this plan is difficult. Thus, he develops the idea for a project which is intended to support all members of the university in the application for trademarks and patents. Against this background, Mr. Apollon contacts the holder of his professorial chair, Professor Aristoteles. He tells him of his idea and Professor Aristoteles supports the project. He wants to realize it and appoints the future »Project Leader, Dr. Odysseus, a member of his chair who has experience in the handling of projects …“

3 Initializing a Project

V-Modell Description: »Decision Gate »Project Approved

In the decision gate »Project Approved, the »Steering Committee of the acquirer decides - based on the »Project Proposal - whether the »Request for Proposal shall be initiated.

After the idea for the project is born, the »Project Leader Dr. Odysseus prepares a »Project Proposal. The process for "initiating" a project is not specified in the V-Modell. The product »Project Proposal is marked as »External Product, and the V-Modell does not include any activity describing the preparation of a »Project Proposal. Nevertheless, Dr. Odysseus can use the proposed structure and contents of a »Project Proposal - which is included in the »V-Modell Reference Work Products - as orientation.

3.1 Project Proposal

V-Modell Description: »Project Proposal

The project proposal is intended to systematically present information and data showing that the execution of a project such as developing a product or system or improving a process is required, profitable and useful.

The »Project Leader Dr. Odysseus contacts the "inventor" of the project, Mr. Apollon. During his dissertation Mr. Apollon has made an invention, which he wants to register as a trademark. Colleagues have told Mr. Apollon that his intention is difficult to realize. Dr. Odysseus and Mr. Apollon describe these facts.

Project Proposal: Initial Situation

If an employee of the Technische Universität München, who has an idea for a trademark or patent, directly applies to the German Patent and Trademark Office, the trademark or patent will only be registered under his/her name. However, this is inconsistent with the »Contract, which has to be signed by employees of the Technische Universität München. According to this contract, all work results "belong" to the Technische Universität München and may only be published under both names - employee and university. On the other hand an employee alone cannot register a trademark or patent under both names at the German Patent and Trademark Office. For this purpose he/she needs the responsible member of the university, Dipl.-Ing. Platon.

Based on these facts, it seems reasonable to establish a dedicated administration within the university which supports all university members applying for trademarks and patents.

This proposal is supported by the argument that many members do not even try to register their trademarks or patents due to the high effort. However, this cannot be in the interest of the Technische Universität München since many registrations increase the reputation of a university. In addition, costs can be saved by a prior examination within the university. Only probably successful candidates would be funded and forwarded to the German Patent and Trademark Office.

In addition to a dedicated administration within the university, the realization of the idea - to support employees during the application for trademarks and patents - requires a technical system. Mr. Apollon as future user knows the required capabilities of the system, but he does not know how his requirements can be implemented at software level.

Therefore Dr. Odysseus contacts his colleague, Mr. Sokrates, and explains the situation. Mr. Sokrates proposes the development of a Trademark and Patent Information System for executing the administrative processes.

He describes his concept of the system as follows.

Project Proposal: Objectives of the Project and System Concepts

The Trademark and Patent Information System is required in order to fulfill the administrative tasks arising due to the founding of the university-intern Trademark and Patent Administration.

Alternatively, an administration based on folders and paper documents would be conceivable. This would be more cost-effective in the procurement, but it would require a considerably greater personnel effort. In view of the great number of applications, it is impossible to cope with the flood of paper. Furthermore it would be almost impossible to operate transparent to the public.

The Trademark and Patent Information System will be available to all members of the university.

Is is a database-based information system which can be used on all computers within the university. Up to now, no German university has a comparable system.

The system will support

- the preparation of trademark and patent applications,
- the examination of trademark and patent applications by the Trademark and Patent Administration,
- the rejection of trademark and patent applications by the Trademark and Patent Administration,
- the submission of trademark and patent applications to the German Patent and Trademark Office by the Trademark and Patent Application,
- the administration of trademarks and patents.

An electronic data file will be prepared, examined and - if appropriate - faxed to the German Patent and Trademark Office for every trademark and patent to be registered.

All files available will be made accessible to the public in an electronic information system.

The Trademark and Patent Information System must be user-friendly and reliable. Every employee of the Technische Universität München must be able to use it without a long familiarization time.

Since the acceptance of the users is decisive, it is recommended to subdivide the project into »Project Stage, which should be executed successively. In case of success - i.e., if the system is economical, used frequently and accepted by the users - the following project stages will be initiated.

Accordingly, the success of the system mainly depends on most of the employees using the Trademark and Patent Information system and that a maximum number of promising patents and trademarks will be applied for.

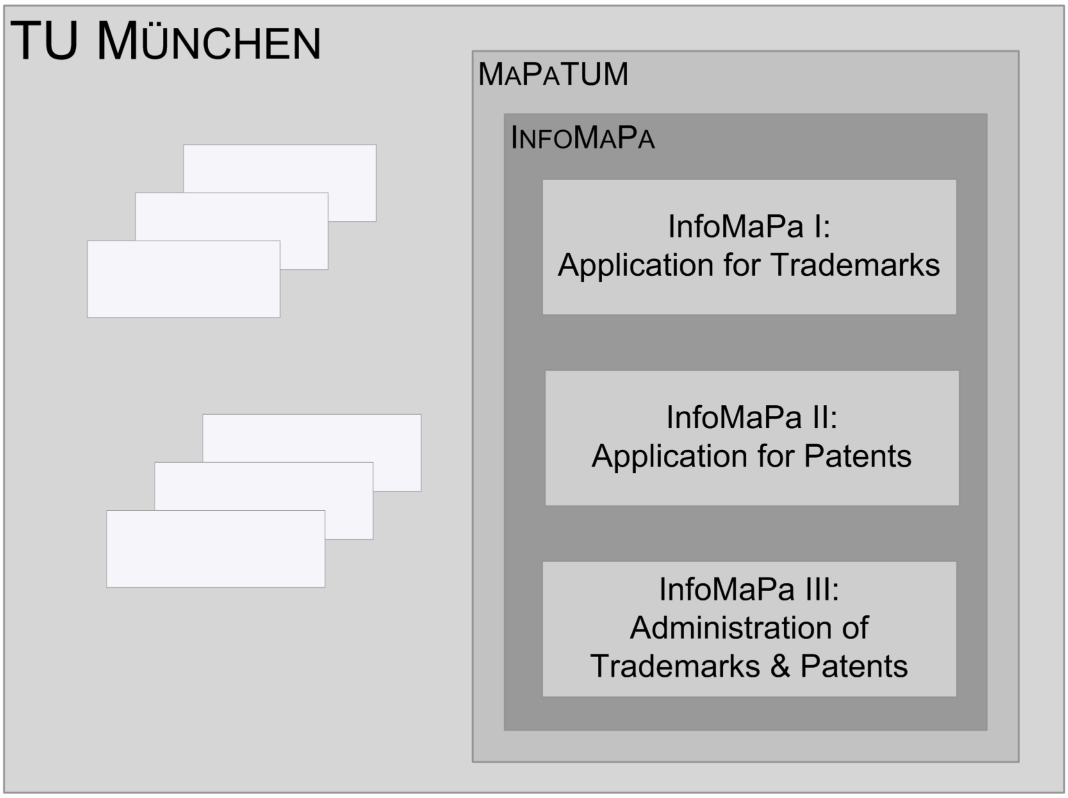
The Project Leader Dr. Odysseus completes the »Project Proposal, by considering additional »Opportunities and Risks and the »Economic Efficiency without forgetting the potential benefit.

He has already discussed the funding with Dipl.-Ing. Platon who is Administrative Director of the Trademark and Patent Administration of the Technische Universität München. However, the available budget is not unlimited, and the Administration Board has not yet approved the »Project Proposal. In order to facilitate the decision for the Administration Board, Dr. Odysseus plans the project to be executed in three project stages, with only the first project stage having to be funded in the beginning. He roughly estimates the costs for these three project stages in order to give the Administration Board a feeling for the scope of the project.

The Project Leader Dr. Odysseus sends the following »Project Proposal in written and electronic form to Dipl.-Ing. Platon for a review. In the meantime Dipl.-Ing. Platon has already attended to staffing the »Steering Committee for the project. Some of the members of the university administration have already shown great interest the idea of an electronic system for the administration of trademarks and patents.

Project Proposal: Planning

The Trademark and Patent Information System will be subdivided into three project stages and integrated into the organization of the university as shown in the following figure.

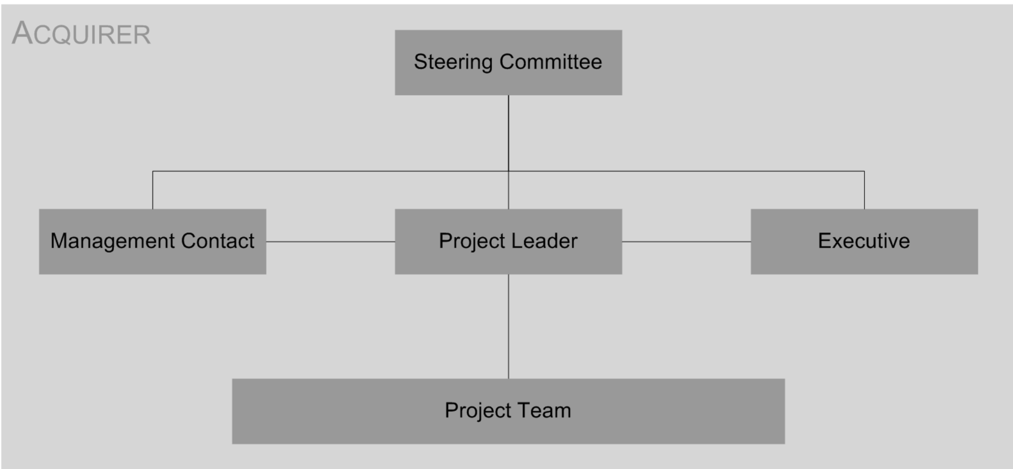


The Trademark and Patent Administration decides for the overall Trademark and Patent Information System project and on the progress during the project stages.

Personell	Name
Person in Charge InfoMaPa	Mr. Professor Aristoteles
Project Management InfoMaPa	Mr. Dr. Odysseus
Additional Team Members	To Be Announced
Schedule	**Target Date**
InfoMaPa I	38 months
InfoMaPa II	20 months
InfoMaPa III	9 months
Start Date InfoMaPa I	01.05.2005
End Date InfoMaPa I	14.06.2008
Estimated Budget	**In Thousand €uro**
InfoMaPa I	2000*
InfoMaPa II	1000*
InfoMaPa III	700*

The budget was determined by a rough estimate and is subject to a margin of error of ± 60%.

The following resources are available at the Technische Universität München.



System development personnel cannot be provided. Therefore a potential supplier will be determined by a public »Request for Proposal. The execution of this request for proposal, the support of the supplier's project and the acceptance of the developed system will be executed by the above-mentioned Project Team of the Technische Universität München and supervised by the Management of the Trademark and Patent Administration of the Technische Universität München.

3.2 Project Progress Decision "Project Approved"

V- Model Description: »Project Progress Decision

Based on the »Product Instance to be submitted, a decision on the accomplishment of the respective »Project Progress Stage will made at every »Decision Gate and the result will be recorded in the project progress decision

The first project progress decision to be made during the decision gate »Project Approved represents the authorization of the project by the higher-ranking management.

The »Project Progress Decision will be made during the first meeting of the newly founded »Steering Committee. After the »Project Leader has submitted and explained the »Project Proposal, it will be discussed under the chairmanship of the »Executive Professor Aristoteles.

The Project Leader Dr. Odysseus takes the minutes and records the statements made during the meeting - e.g. the financing commitment. The document »Project Progress Decision is used for documenting decisions and adopting the directives stated by the Trademark and Patent Administration in cooperation with the Project Team into the Trademark and Patent Information System project. Since this decision is based on the »Project Proposal, this proposal will be examined and evaluated first.

Project Progress Decision »Project Approved: Evaluation

The proposals submitted in the project proposal are accepted.

This document records additional mandatory directives in writing. Additional products to be prepared shall adopt any relevant directives stated in this document. Otherwise, the descriptions of the project proposal are effective.

In the »Project Progress Decision the subject »Planning of the »Project Proposal will again be discussed. The Trademark and Patent Administration will add additional directives or change existing statements. In contrast to the "proposals" of the »Project Proposal, these delineations are mandatory.

Project Progress Decision »Project Approved: Planning of Contents and Schedule

Within the university administration, a new department - the Trademark and Patent Administration headed by Dipl.-Ing. Platon - will be founded. On behalf of the Trademark and Patent Administration, Dipl.-Ing. Platon is also responsible for the project Trademark and Patent Information System I.

Target Dates

Schedule	Termin	
Start Date InfoMaPa I	01.05.2005	
End Date InfoMaPa I	14.06.2008	
Date of next Meeting	21.05.2005	
Decision Gates		**Products to be Submitted**
Project Defined	21.05.2005	Project Manual, QA-Manual, Product Library, Project Plan, Project Status Report, QS-Report, Project Progress Decision

Quality Objectives

The project will be planned and executed based on documented procedures which correspond to the regulations of the V-Modell and will be coordinated with the procedures and planning of the Trademark and Patent Administration Management.

The fulfillment of the schedule and budget requirements will be decisive.

In the further course of the project, these dates will be integrated into the »Project Manual and the »Project Plan. The fulfillment of the schedule is as decisive as the fulfillment of the quality objectives, which are integrated into »QA Manual, where they will be refined and implemented by appropriate measures.

In addition to schedule and product quality, the available personnel, the appointment of persons in charge and the available funds are decisive.

Project Progress Decision »Project Approved: Resource Planning

Responsibility:

Steering Committee	Name
Person in Charge InfoMaPa	Mr. Dipl. Ing. Platon
Executive InfoMaPa	Mr. Professor Aristoteles
Project Leader InfoMaPa	Mr. Dr. Odysseus

Execution:

Project Team InfoMaPa	Name & Project Share*
Project Manager InfoMaPa I	Mr. Dr. Odysseus 70%
QA Manager	Mr. Prometheus 30%
Configuration Manager	Mrs. Dr. Artemis 10%

* The figures for the participation in the project apply to »Project Stage Trademark and Patent Information System I and indicate the percentage of the overall 38 working hours per week.

Details of the work scheduling are coordinated at bilateral level by the Project Team of the Technische Universität München and the Steering Committee.

Budget:

Budget Release	In Thousand Euro
for the Project Sections: Definition of Project, Requirements Specification	900

A total of 900.000 € were released for the »Project Section project definition and specification of requirements. The decision on the funds for the following project sections of the project stage Trademark and Patent Information System I will be made after the first two project sections have been completed successfully.

In order to prepare this funding decision, a detailed »Estimation of costs based on the specified requirements shall be submitted.

This defines the three corner stones of each project - quality, costs and schedule. The funds available for the development and the provisions specified by the Trademark and Patent Administration for the project considerably determine how the Project Team of the Technische Universität München designs the Trademark and Patent Information System.

Project Progress Decision »Project Approved: Directives and General Conditions

The project stage Trademark and Patent Information System I includes the realization of a system intended to support the application for trademarks. The requirements will be determined by the team of Project Leader Odysseus, which still has to be built up. The realization of the system will be put up for bidding.

The Trademark and Patent Information System Project and the supplier's project for realizing the system proceed in accordance with the V-Modell.

The »Project Progress Decision and the »Project Proposal specify the desired and mandatory framework for the project Trademark and Patent Information System I.

4 Definition of a Project

V-Modell Description: »Decision Gate »Project Defined

The decision gate »Project Defined examines whether the »Project Manual and the »QA Manual describe the project correctly. In case of a positive assessment, the »Project Manual and the »QA Manual specify the first directives and conditions for the project which - in the course of the project - enable the acquirer to specify requirements and the supplier to design the system.

The »Project Leader Dr. Odysseus has received the approval for the Project Trademark and Patent Information System I and the directives relevant to the Trademark and Patent Administration of the Technische Universität München. In order to define the project, he must refine and extend the general framework in this »Project Section. The provisions of the V-Modell apply; it is necessary to execute a project-specific adaptation of the V-Modell - the so-called »Tailoring – and to document the same in the »Project Manual.

Dr. Odysseus finds the description of the decision gate »Project Defined, which is common to all »V-Modell Project, in the »V-Modell Reference Tailoring. Descriptions of the work products are included in the »V-Modell Reference Work Products.

In addition to Dr. Artemis, who will be responsible for »Configuration Management, Dr. Odysseus includes additional experienced and competent members in his team. He appoints Mr. Prometheus as »QA Manager and Mr. Sokrates as »Requirements Engineer (Acquirer).

At a joint meeting - the so-called kick-off meeting - the project members discuss their concepts for the future tasks. In the near future, i.e., until the next decision gate »Project Defined, the »Project Manual, the »Project Plan, the »QA Manual, a »Project Status Report and a »Quality Status Report shall be prepared. Furthermore, the »Product Library has to be set up.

4.1 Project Manual

V-Modell Description: »Project Manual

The V-Modell is a generic process standard which must be adapted and concretized for an actual project. The »Project Manual specifies the adaptations and shapings required for management and development. Thus it documents how and to what extent the V-Modell is applied to the project and is a source of information and guideline for all stakeholders.

The Project Leader Dr. Odysseus wants to provide his team with project information in order to familiarize all team members with its contents. This summary will also be used as basis for all team members joining the project at a later stage. The following summary chapter of the »Project Manual will later also be included into the request for proposal and is an introduction into the project for the supplier.

Just like the team, who was introduced into the Trademark and Patent Information System project by the summary of Dr. Odysseus, the V-Modell must be "introduced" into the project. The adaptation process is called Tailoring. This tailoring is required since the V-Modell is applicable to numerous different project constellations.

In order to adapt the V-Modell to the specific project requirements for the Trademark and Patent Information System, the Project Leader Dr. Odysseus selects the adequate values from the available project characteristics. The tailoring mechanism of the V-Modell is described in detail in the »V-Modell Reference Tailoring in chapter »Directives and Instructions for Tailoring. As shown in Figure 4, the tailoring may be executed by means of the available V-Modell Project Assistant or simply by hand on a piece of paper.

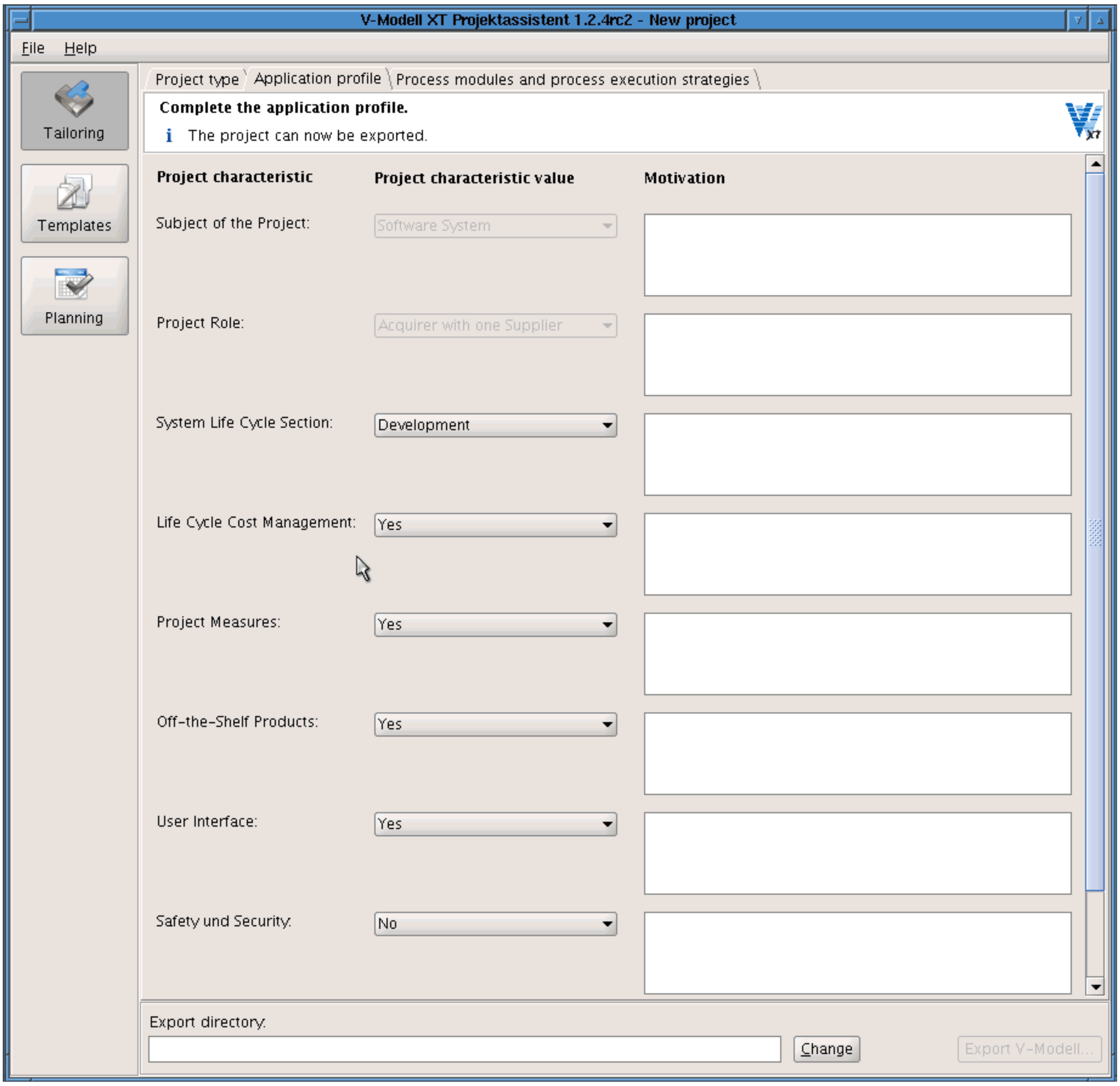


Figure 4: Characterization of the Project

The result of this characterization specifies the process modules to be used in the project and the project execution strategy. Dr. Odysseus documents this result in the Subject »Project-Specific V-Modell of the »Project Manual.

3 Project-Specific V-Modell

Project Type:

- System Development Project (Acquirer)

Application Profile:

- Subject of the Project: SW-System.
- Project Role: Acquirer with a Supplier.
- System Life Cycle Section: Development.
- Life Cycle Cost Management: No.
- Quantitative Project Code: No.
- Off-the-Shelf Products: No.
- User Interface: Yes.
- Safety and Security: No.
- High Realization Risks: No.

Selected Process Modules:

- Project Management
- Quality Assurance
- Configuration Management
- Problem and Change Management
- Specification of Requirements
- Delivery and Acceptance (Acquirer)
- Conclusion of the Contract (Acquirer)

Selected Project Execution Strategies:

- Award and Conduct of an System Development Project (A)

The project type variant is »Project (Acquirer) with One Supplier.

The activities and work products for the project are based on the process modules. Using the project assistant, the Project Leader Dr. Odysseus can generate a V-Modell documentation which only comprises the descriptions of work products, activities, roles and other V-Modell elements of the process modules relevant for the project. Alternatively, he can use the »V-Modell Reference Tailoring in order to determine which products and activities are assigned to the process modules selected for the project.

Dr. Odysseus deals with the remaining process modules and considers if they are useful for the development of a Trademark and Patent Information System. He thinks that a further adaptation is not required.

The project type variant »Project (Acquirer) with One Supplier is specified by adapting the V-Modell specifically to the Trademark and Patent Information System.

This project type variant also determines the decision gates. First, Dr. Odysseus prepares a rough schedule for the decision gates, taking into account the requirements of the »Project Progress Decision (see Chapter »Project Progress Decision "Project Approved"). The bidding line for potential suppliers is the only important milestone which does not follow directly from the specification of the decision gates.

ID	*Activities*	*Products to be completed*	*2005*				*2006*			
			Q1	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*
1	DG: Project Approved	**Project Progress Decision_04-04-05**		◇ 04.04.2005						
2	DG: Project Defined	*Project Progress Decision_21-05-05* *Project Plan* *Project Status Report_21-05-05* *QS-Report_21-05-05* **Project Manual** **QA-Manual** **Product Library**		◇ 21.05.2005						
3	DG: Requirements Specified	*Project Progress Decision_01-10-05* *Project Plan* *Project Status Report_01-10-05* *QS-Report_01-10-05* **Requirements Specification** **Requirements Evaluation** **RFP Concept_01-10-05**				◇ 01.10.2005				
4	DG: Request For Proposal Released	*Project Progress Decision_31-12-05* *Project Plan* *Project Status Report_31-12-05* *QS-Report_31-12-05* **Request for Proposal_31-12-05** **Crit. Cat. for Assessment of Offers_31-12-05**				◇ 31.12.2005				
5	Deadline for Offer	---					◇ 04.03.2006			
6	DG: Contract Awarded	*Project Progress Decision_02-06-06* *Project Plan* *Project Status Report_02-06-06* *QS-Report_02-06-06* **Offer Assessment_02-06-06** **Contract_02-06-06** **Evaluation Specification Delivery_02-06-06**							02.09.2006 ◇	
7	DG: Iteration Planed	*Project Progress Decision_01-10-06* *Project Plan* *Project Status Report_01-10-06* *QS-Report_01-10-06* **Project Manual** **QA-Manual**								01.10.2006 ◇

This »Project Execution Plan is intended to specify the dates for meetings with the Trademark and Patent Administration of the Technische Universität München and the products to be submitted on these meetings in accordance with the V-Modell. A detailed planning is included in the »Project Plan.

4.2 Project Plan

V-Modell Description: »Project Plan

An adequate project plan is indispensable for the safe and organized execution of a project. The project plan describes the selected approach to the project, specifying in detail what shall be done when and by whom. It is the basis for monitoring and controlling the project. The »Project Leader is responsible for the project plan, which will be prepared and developed in cooperation with all participants.

The project leader Dr. Odysseus uses the »Decision Gate as basic framework and top ordering criterion for project planning. In order to develop the »Integrated Planning in the »Project Plan, Dr. Odysseus first plans the activities required for developing the »Work Product for the respective decision gates, i.e. the work products which must be submitted to the Trademark and Patent Administration of the Technische Universität München. To be on the safe side, he includes a buffer so the products can be »Submitted in any case in time before the decision gate.

ID	Activities	Products to be completed	Q2 05 / Q3 05 / Q4 05 (Apr – Dez)
1	Establishing and Maintaining Product Library	Product Library	
2	Preparing QA-Manual	QS-Manual	
3	Preparing Project Manual	Project Manual	
4	Planning Project	Project Plan	
5	Preparing Quality Status Report	QS-Report_21-05-05	
6	Preparing Project Status Report	Project Status Report_21-05-05	
7	Coming to a Project Progress Decision	Project Progress Decision_21-05-05	
8	**DG: Project Defined**		21.05.2005
9	Specifying Requirements	Requirements Specification	
10	Preparing Requirements Evaluation	Requirements Evaluation	
11	Determing RFP Concept	RFP Concept_01-10-05	
12	Planning Project	Project Plan	
13	Preparing Quality Status Report	QS-Report_01-10-05	
14	Preparing Project Status Report	Project Status Report_01-10-05	
15	Coming to a Project Progress Decision	Project Progress Decision_01-10-05	
16	**DG: Specify Requirements**		01.10.2005
17	Preparing Request for Proposal	Request for Proposal_31-12-05	
18	Preparing Criteria Catalog for Assessment of Offers	Criteria Catalog for Assessment of Offers_31-12-05	
19	Planning Project	Project Plan	
20	Preparing Quality Status Report	QS-Report_31-12-05	
21	Preparing Project Status Report	Project Status Report_31-12-05	
22	Coming to a Project Progress Decision	Project Progress Decision_31-12-05	
23	**DG: Request for Proposal Released**		31.12.2005

The Project Leader Dr. Odysseus can repeat activities, as shown by the activity »Planning Project. During the course of the project, the schedule must be re-adapted frequently since there will be delays caused by risks or unforeseen events. The »Project Plan will then be updated, and the activity »Planning Project will be repeated.

Dr. Odysseus updates the »Project Plan continually. However, the »Project Execution Plan of the »Project Manual will only be prepared once at the beginning of the project unless there are changes which require a new processing, e.g. delays of the decision gates planned in the »Project Manual.

An other example for the repetition of activities is the activity »Preparing Project Status Report. In contrast to the activity »Planning Project, however, this is not an activity which repeatedly develops the same product, but it includes several identical activities for different products. »Project Status Reports must be prepared anew at the end of each »Project Section and submitted at each decision gate.

Up to now, Dr. Odysseus has planned the activities relating to the products to be submitted at the decision gates. Now he deals with the remaining products.

ID	Activities	Products to be completed	Apr 2005: 3.4, 10.4, 17.4, 24.4 / Mai 2005: 1.5, 8.5, 15.5
1	Establishing and Maintaining Product Library	Product Library	
2	Preparing QA-Manual	QA-Manual	
3	Preparing Project Manual	Project Manual	
4	Planing Project	Project Plan	
5	Preparing Quality Status Report	QS-Report_21-05-05	
6	Preparing Project Status Report	Project Status Report_21-05-05	
7	Coming to a Project Progress Decision	Project Progress Decision_21-05-05	
8	Establishing and Maintaining a Project Management Infrastructure	Project Management Infrastructure_21-05-05	
9	**WP: Supporting Project Section**		
10	Managing Risks	Risk List_21-05-05	
11	Keeping a Project Diary	Project Diary_21-05-05	
12	Maintaining Change Status List	Change Status List_21-05-05	
13	**DG: Project Defined**		21.05.2005 ◇

Dr. Odysseus plans the establishment of the »Project Management Infrastructure – e.g. the technical infrastructure for filing the electronic project data, which is clearly important - also in the project section leading to the decision gate »Project Defined.

He regards some activities as too small for the overall plan of the Trademark and Patent Information system. Nevertheless, he wants to include them into his plan in order to prevent them from being forgotten. Therefore he introduces »Work Package, e.g., the work package "Supporting project section", the processing of which is scheduled from the beginning to the end of the project section. Dr. Odysseus associates, for example, the activity »Keeping a Project Diary, which is not intended to be planned with a start and end date, with this work package.

The »CM Manager Dr. Artemis has informed Dr. Odysseus, that she wants to design the »Configuration Management for the project in such a way that the products can alway be entered into the configuration management tool by the participants themselves. Therefore it is not necessary to plan the activity »Managing Product Library. Dr. Odysseus assigns this activity to the work package "Supporting project section".

The V-Modell offers the »Product Dependency concept as an aid for planning. Dr. Odysseus considers this concept when planning quality assurance evaluations.

ID	Activities	Products to be completed	Q3 05	Q4 05		
			Sep	Okt	Nov	Dez
1	Preparing Request for Proposal	Request for Proposal_31-12-05				
2	Evaluating Request for Proposal	Evaluation Report Request for Proposal_31-12-05				
3	Peparing Criteria Catalog for Assessment of Offers	Criteria Catalog for Assessment of Offers_31-12-05				
4	Evaluating Criteria Catalog	Evaluation Criteria Catalog_31-12-05				
5	Planning Project	Project Plan				
6	Preparing Quality Status Report	QS-Report_31_12_05				
7	Preparing Project Status Report	Project Status Report_31-12-05				
8	Coming to a Project Progress Decision	Project Progress Decision_31-12-05				
9	**DG: Request for Proposal Released**					31.12.2005

Certain products are marked with an "i" for initial in the V-Modell; they must be prepared exactly once in every V-Modell project. In addition to these initial products, the V-Modell also includes non-initial products, e.g. evaluation reports.

These are products which are not developed directly in the project but will be derived from other products. These interconnections are documented in the V-Modell by the generative product dependencies which are specified in the V-Modell. For example, an evaluation report will be generated by a »Generative Product Dependency, which will be derived from the »QA Manual and the »Project Plan. An evaluation report includes the evaluation history records made by the »Inspector.

The Project Leader Dr. Odysseus must consult the »QA Manual and the »Project Plan when planning the evaluations. The »QA Manager, Mr. Prometheus, has already prepared the »QA Manual and submitted it to Dr. Odysseus to obtain his opinion. In the QA Manual, Dr. Prometheus specified - among other things - the products which shall undergo thorough evaluations. He included the products of the decision gates, complementing them by other products he wants to be evaluated.

From the »QA Manual Dr. Odysseus knows that products »Request for Proposal and »Criteria Catalog for Assessment of Offers are intended to be evaluated. Thus he plans evaluations for these products. As shown in the above example, the planning shall ensure that the comments made by Mr. Prometheus after the evaluation will be included.

Now Dr. Odysseus has completed the »Project Manual and the »Project Plan and these products can be submitted at the decision gates »Project Defined after being examined by Mr. Prometheus.

At present, the planning of Dr. Odysseus is not yet complete, for he plans only so far into the future as he considers useful at the respective point in time. While having prepared a rough plan based on the decision gates in the »Project Manual, the detailed planning in the »Project Plan only covers the time until the decision gate »Request for Proposal Released.

4.3 Project Progress Decision "Project Defined"

V-Modell Description: »Project Progress Decision

Based on the »Product Instance to be submitted, the persons in charge decide at each »Decision Gate if the respective »Project Progress Stage has been reached, and record the result in the project progress decision.

Dipl.-Ing. Platon, member of the Trademark and Patent Administration of the Technische Universität München, two additional members of the administration, the »Project Leader Dr. Odysseus and the »Requirements Engineer (Acquirer) participate in the meeting deciding on the project progress. This meeting is intended to obtain the confirmation from the Trademark and Patent Administration that the submitted products reflect the project correctly, thus defining the project Trademark and Patent Information System I.

After a positive assessment of the submitted products, Dr. Odysseus wants to determine the schedule for future meetings between the Trademark and Patent Administration and the Project Team of the Technische Universität München. The participants accept the proposal of Prof. Aristoteles, according to which the dates for the decision gates will also be used as dates for the decision meetings.

Dr. Odysseus records this and other decisions in writing in the »Project Progress Decision.

Project Progress Decision »Project Defined: »Planning and Scheduling

Quality Objectives

It is decisive to comply with the schedule and the budget. The user acceptance, which was included as objective in the project proposal, has also to be ensured.

The quality objectives of ease of use, functionality, reliability, efficiency and changeability are defined in the requirements and will be verified and validated by the »Requirements Evaluation and the final evaluations.

Schedule

Project Directives	Date	
Start Date InfoMaPa I	01.05.2005	
End Date InfoMaPa I	14.06.2008	
Meeting Project Progress Decision		**Products to be submitted**
Requirements Specification	01.10.2005	Requirements Specifications, Requirements Evaluation, RFP Concept, Project Plan, Project Status Report, Project Quality Report, Project Progress Decision
Request for Proposal released	31.12.2005	Request for Proposal, Crit. Cat. for Proposal Evaluation, Project Plan, Project Status Report, Project Quality Report, Project Progress Decision
Offer Period	04.03.2006	Report on Submitted Offers
Contract Awarded	02.09.2006	Assessment of Offers, Contract, Evaluation Specification Delivery, Project Plan, Project Status Report, Project Quality Report, Project Progress Decision
Iteration planed	01.10.2006	Project Manual, QA-Manual, Project Plan, Project Status Report, Project Quality Report, Project Progress Decision

The above quality objectives and the procedure for achieving them are discussed for a long time. The idea to submit the »Requirements Specification not only to project members but also to a group of future users in order to increase the acceptance is accepted and integrated as specification into the project Trademark and Patent Information System I.

Project Progress Decision »Project Defined: Specifications and Framework Conditions

Before being evaluated formally, the requirements will be submitted to a selected group of future users for evaluation.

The regulations of the Technische Universität München, which are specified by laws and orders (e.g. regarding data privacy protection), shall be observed during the specification of requirements.

The technical solution shall be an advanced system based on proven information and communication technology.

Thus, the project Trademark and Patent Information System I is defined, and the specification of requirements may begin.

5 Specification of Requirements

V-Modell Description: »Decision Gate »Requirements Specified

In the decision gate »Requirements Specified, the »Steering Committee of the acquirer or the end users, resp., check the completeness and correctness of the developed requirements and their prioritization. In case of a positive evaluation, the requirements will be documented in form of the work product »Requirements Specification. In addition an evaluation of requirements in accordance with the priority assigned to the individual requirements by the acquirer will be submitted. Based on these documents, the system may be developed by the supplier after the contract has been awarded.

The Trademark and Patent Information System team has reached the »Project Progress Stage for defining the project and begins to analyze the requirements using the V-Modell as basis. »Project Leader Dr. Odysseus intends to prepare the requirements in several iterations.

The Requirements Analyst Mr. Sokrates is tasked with preparing a first version of the »Requirements Specification. Then Dr. Odysseus will evaluate these requirements thoroughly with respect to technical feasibility, affordability, economic efficiency and importance. He records this in writing in the »Requirements Evaluation. Based on this evaluation, Mr. Sokrates will review the requirements. This second version of requirements will then be submitted to some users - including but not limited to Mr. Apollon, who had the idea for the Trademark and Patent Information System - for assessment. This early and intensive integration of the future users of the system will significantly reduce the risk that the system will possibly not be accepted.

5.1 Work Order

V-Modell Description: »Work Order

The work order is an instrument used by the »Project Leader for internal project control. The Project Leader can give work orders to the project members. The required information - e.g. task description, person in charge and date of completion - shall be recorded for each work order in accordance with the specifications in the »Project Manual. Work orders can be summarized and collected in one action list.

The following example shows a part of the action list used by Dr. Odysseus for entering the tasks of his team and following the processing state.

Work Order

#	Description	Status	Who	Date
...				
28	Preparing Requirements initially	finished	Mr. Sokrates	09.07.05
29	Evaluating Requirements initially	finished	Dr. Odysseus	16.07.05
30	Integrating Requirement Evaluation	delayed	Mr. Sokrates	23.07.05
31	External Requirement Evaluation by user	unfinished	Mr. Apollon	03.08.05
32	Integrating Requirement Evaluation	unfinished	Mr. Sokrates	14.09.05
...				

At this time, the Requirements Analyst Mr. Sokrates has already submitted a first version of requirements to Dr. Odysseus.

5.2 Requirements Specification

V- Model Description: »Requirements Specification

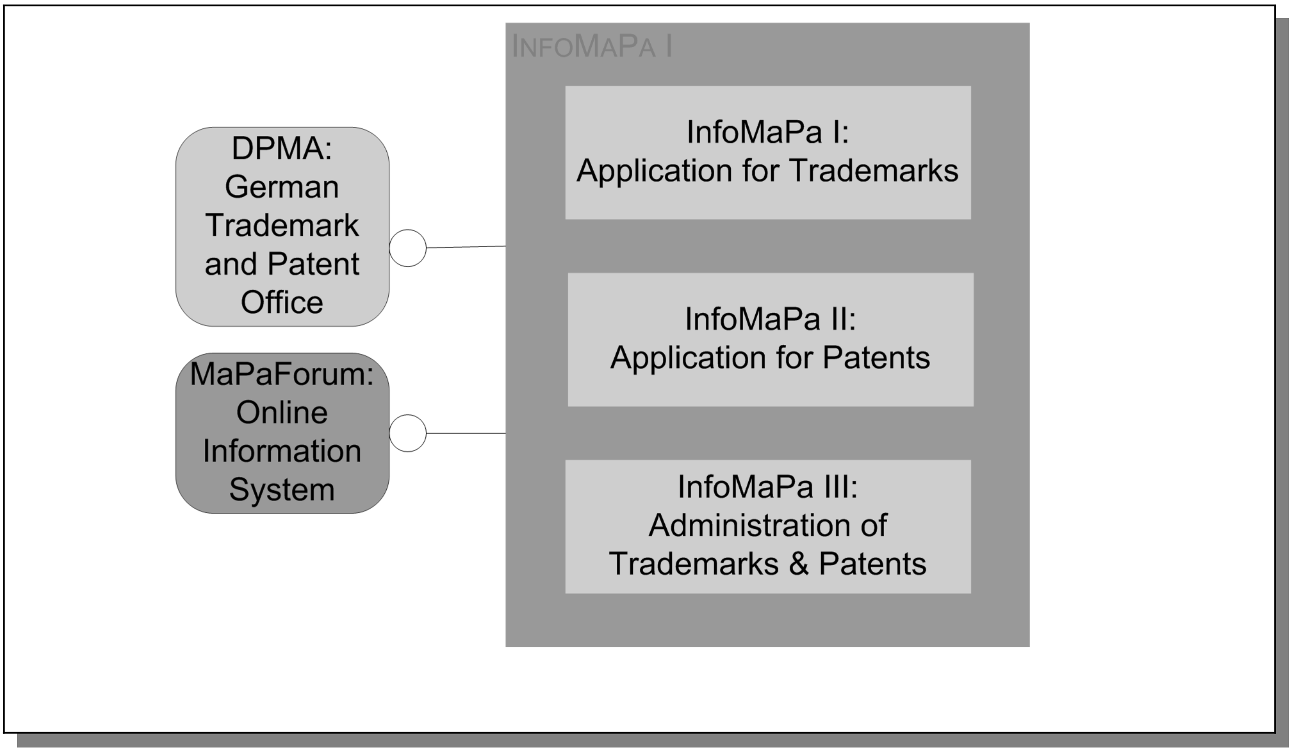
The product »Requirements Specification includes all requirements identified for the system to be developed. It is the basis for the request for proposal and the contract, and thus the most important specification for the preparation of an offer. The requirements specification is part of the contract between acquirer and supplier. The requirements specify the framework conditions for the development, which will be detailed by the supplier in the »Overall System Specification.

When preparing the »Requirements Specification the Requirements Analyst Mr.Sokrates considers the specifications of the »Project Proposal and of the previous »Project Progress Decision. He uses the finished chapter »Project Objectives and System Concepts of the »Project Proposal as basis and adapts it specifically to the project stage Trademark and Patent Information System I.

In the course of further research, Mr. Sokrates discovers that the Trademark and Patent Administration of the Technische Universität München has an information system called Trademark and Patent Forum, which is accessible via Internet. This system is used for presenting available files to the public. Thus the idea to establish an interface between the Trademark and Patent Information System I and the already existing Trademark and Patent Forum suggests itself.

Requirements Specification: Initial Situation and Objectives

The management and processing of the files of the Trademark and Patent Administration of the Technische Universität München is intended to be supported electronically by the Trademark and Patent Information System.



The first project stage, **Trademark and Patent Information System I**, will only support the application of trademarks.

In detail, the Trademark and Patent Information System I will support the following

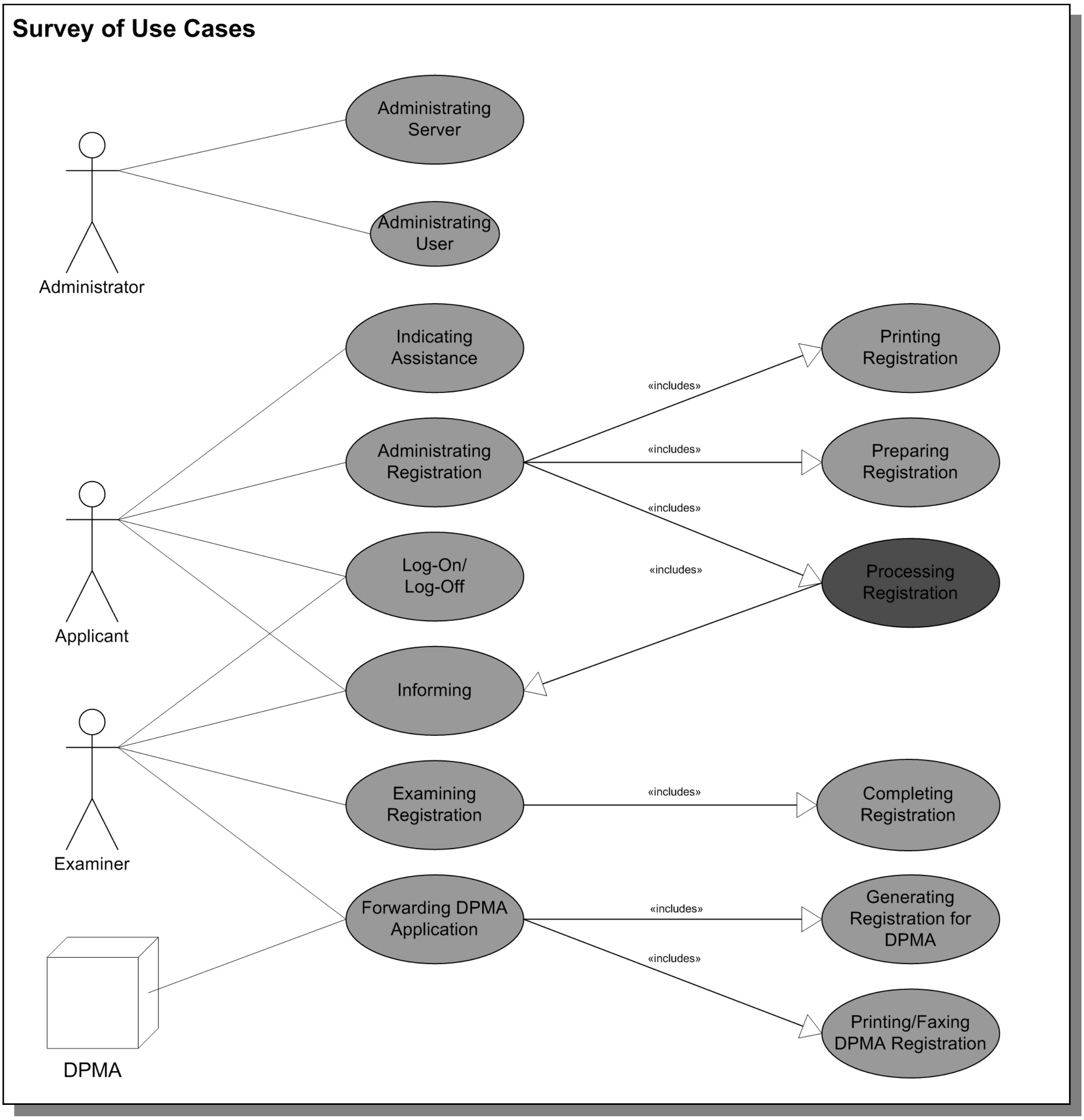
- the preparation of trademark applications,
- the examination of trademark applications by the Trademark and Patent Administration of the Technische Universität München,
- the rejection of trademark applications by the Trademark and Patent Administration of the Technische Universität München,
- the submission of trademark applications to the German Patent and Trademark Office by the Trademark and Patent Application of the Technische Universität München
- the publication of the existing files in the existing Trademark and Patent Forum.

For every trademark to be registered, a data file will be prepared, examined and submitted to the the German Patent and Trademark Office as required.

As a first step for preparing the chapter »Functional Requirements, the Requirement Analyst Mr. Sokrates defines the actors interacting with the Trademark and Patent Information System. By determining the individual tasks which should be fulfilled by the system for these actors, he can derive the requirements. He sketches these use cases in a survey diagram.

System Requirements: Functional Requirements

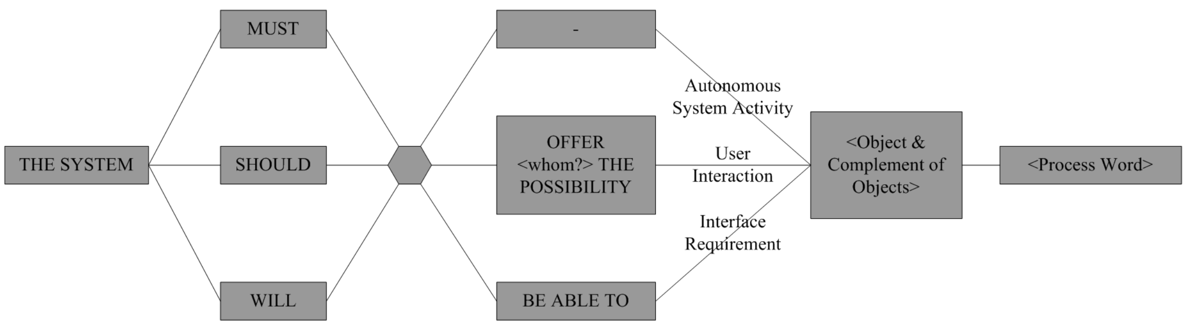
Actor	Description
Administrator	Technical Administration of the System
Applicant	Person submitting an Application
Examiner	Person examining and forwarding the Application as required
DPMA	Office which receives, examines and registers the trademark applications



After completing the survey diagram, the Requirement Analyst Dr. Sokrates describes the exact profile of the use cases. For this purpose, he uses a uniform description method which is not specified by the V-Modell but has proven its worth in previous projects. All use cases will be described uniformly by this method (see Figure 5). This facilitates the preparation of unambiguous, repeatable, verifiable and complete requirements (Reference: »RD02).

Point of Contact: Person in Charge

Brief Description: in accordance with the following template



Priority: high/medium/low

Notes: additional hints

Extension Points: Points still uncleared

Integration and Survey: Superior Use Case, Component

Precondition: Which previous state is required?

Trigger: What triggered the Use Case?

Postconditions: Condition after successful execution

Normal Flow of Events: User steps without fault cases or alternatives

Alternative Paths: Deviations from the normal flow of events

Figure 5: Use Case Form

The following example shows the application of this template to the use case "Processing registration"

Requirements Specification *(continued)*

Use case 4.3: <<Processing registration>>

Point of contact:

Requirement Engineer, Mr. Sokrates, Trademark and Patent Administration, Technische Universität München

Brief description:

The system must enable the applicant to process his registration.

Priority:

High

Notes:

The reference number will be assigned automatically, making the registration unambiguously identifiable.

Open questions:

None

Integration and survey:

Administering registration

Preconditions:

All documents required are available in electronic form.

Trigger:

The applicant wants to submit an application for the registration of his/her trademark.

Postconditions:

Applicant and examiner receive a notification including the reference number.

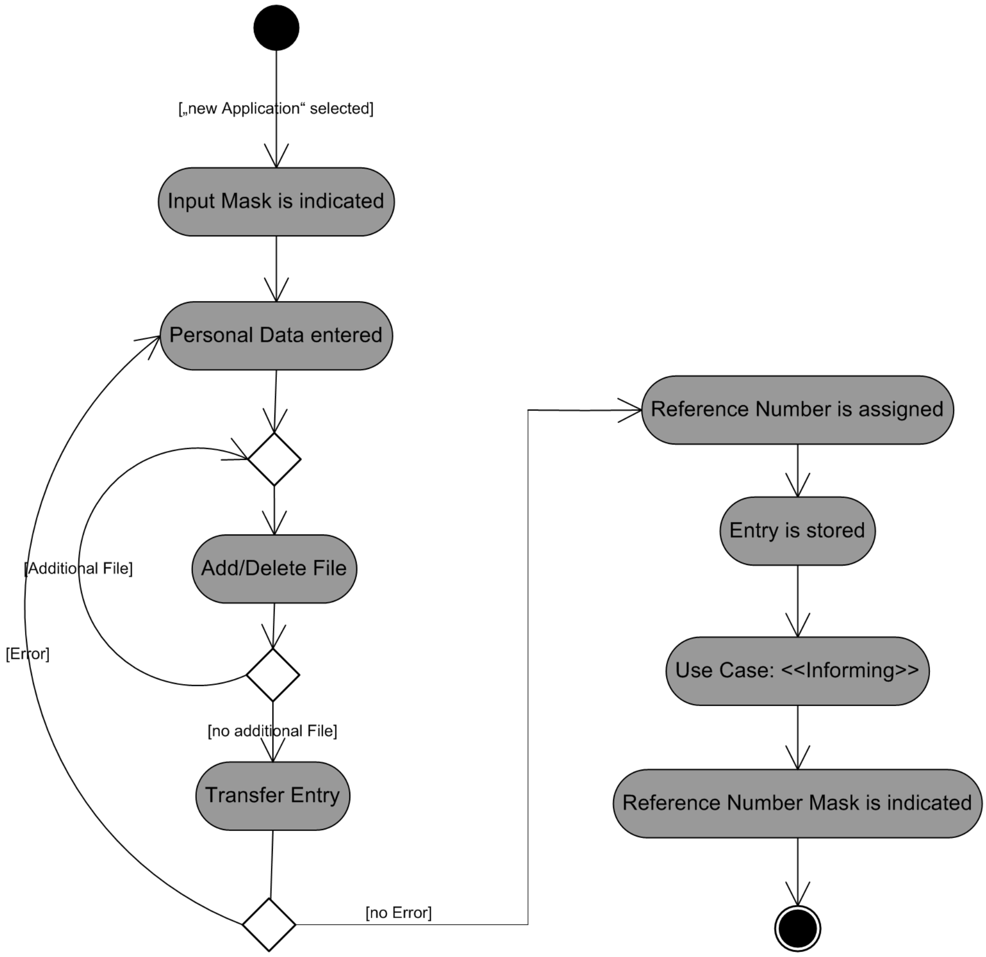
Normal flow of events:

1. The applicant selects the functionality for preparing a new application
2. The system shows an input mask.
3. The applicant can enter his/her personal data (name, address, telephone, e-mail).
4. The applicant can add or delete files.
5. The applicant transmits the entry.
6. The system assigns a registration number.
7. The system stores the entry.
8. Use use case 6 <<Informing>> (<<Benachrichtigen>>)
9. The system indicates the registration number.

Alternative flow of events:

- Before the entry is transmitted, the process can be aborted at any time. The entry will not be stored and the application case is terminated.
- The applicant does not load a file. The system informs him/her that a trademark file must be attached to every application. A transmission is impossible unless this fault is corrected.
- The applicant enters incomplete or wrong personal data. The system induces the applicant to correct the data; otherwise a transmission is impossible.

Activity Diagram



...

The Requirements Analyst Mr. Sokrates describes requirements regarding additional quality characteristics of the system - e.g. user-friendliness and reliability - or the system development process in the chapter »Non-Functional Requirements.

Requirements Specification: Non-Functional Requirements

The specified system shall correspond to the state of the art and fulfill the organizational and legal framework conditions of the Technische Universität München. It shall fit smoothly into the existing data processing environment. The following requirements were specified:

Quality Requirements

User-friendliness

- NF 1: Faults and wrong inputs shall be indicated in near real time (response time < 0,5s) to the user. The application shall be supported by a help mode.

- NF 2: The graphical user interfaces shall be clear and robust, have a uniform structure and provide the required functionality. An intuitive operation must be possible, i.e., the user bust be able to operate the system without instruction, only using the help mode.
- NF 3: The user input interface shall be adapted to the web-based surface of the German Patent and Trademark Office.

Reliability and Protection

- NF 4: The system shall always respond reliably - even under high workloads. Uncontrolled system crashes and data losses shall be avoided. In case of a malfunction, it must be ensured that at least the data of the previous day can be used.
- NF 5: Programs and data shall be protected against inadvertent modifications.

System Creation Requirements

Technical Requirements

- NF 7: Java shall be used as implementation language.
- NF 8: Windows XP is the target system.
- NF 9: The system shall be based on components in order to facilitate maintainability and extendability.
- NF 10: As far as possible, the system architecture shall be documented in the Unified Modeling Language (UML).

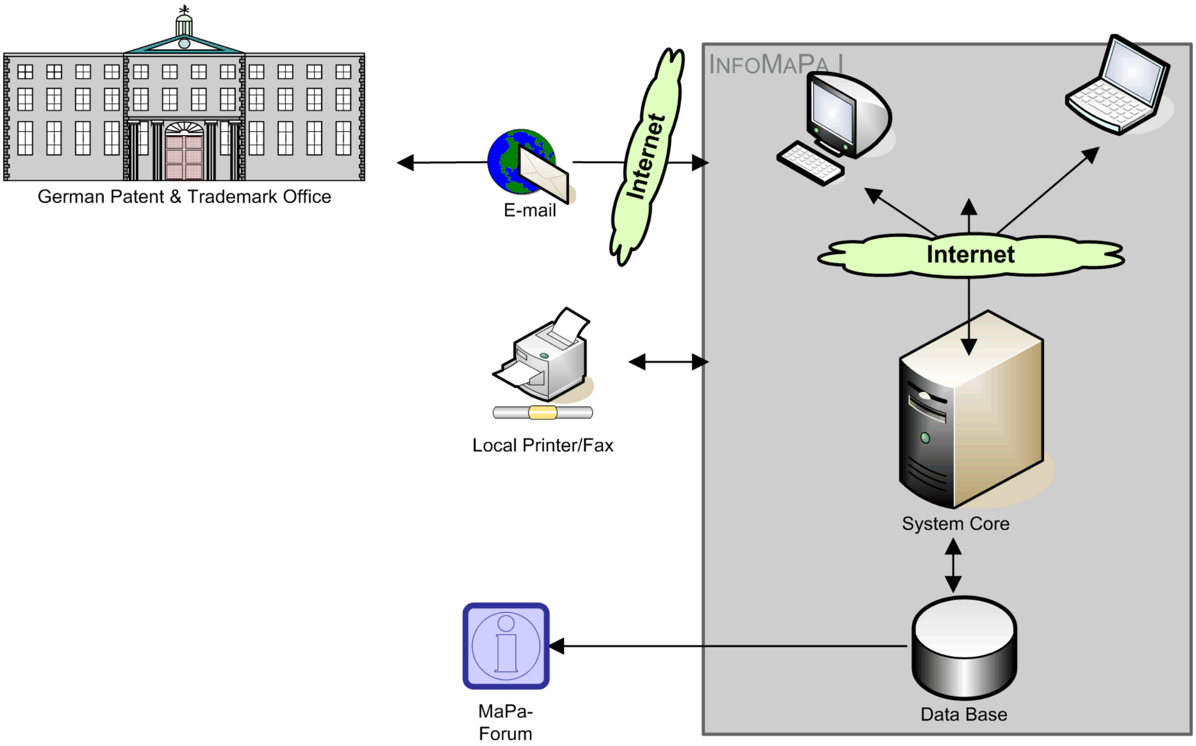
Logistic Requirements

- NF 11: Suitable training and instruction documents for the system's end users are to be prepared.
- ...

...

Together with a colleague, the »Requirements Engineer (Acquirer) Mr. Sokrates defines a rough architecture of the system in order to clarify the specified requirements and ensure that the requirements are technically feasible. He describes this architecture in the chapter »Outline of the Life Cycle and the Overall System Architecture.

Requirements Specification: Outline of the Life Cycle and the Overall System Architecture



The architecture of Trademark and Patent Information System I is intended to be designed as web-based client-server model comprising database, system core and a web-based user interface. Trademark and Patent Information System I transmits trademark applications via E-mail to the German Patent and Trademark Office.

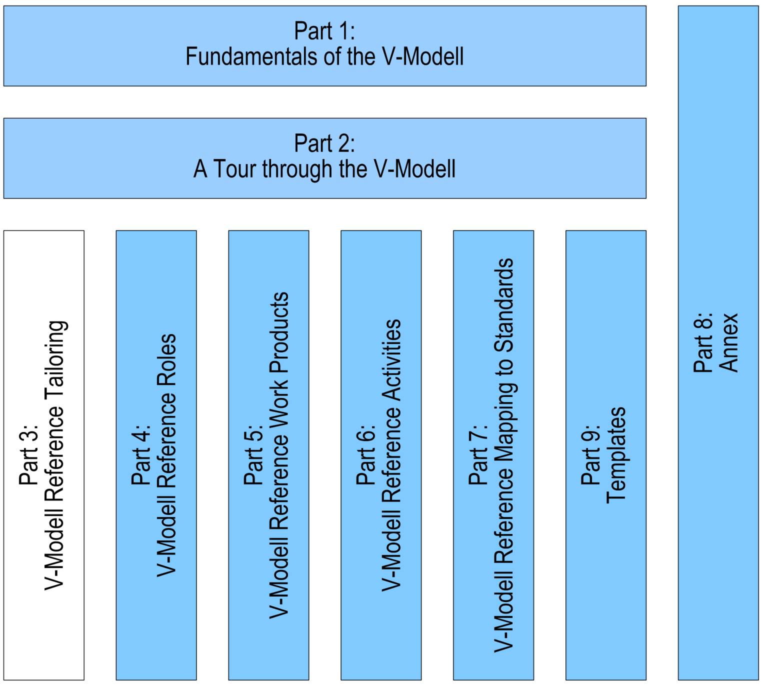
The »Requirements Engineer (Acquirer) Mr. Sokrates submits this version of the requirements to a group of future users for evaluation.

In this text, we have followed the way of the project by means of the project results - i.e. the products - and their interconnections within the development process in order to illustrate the processing of a project in accordance with the V-Modell. The following procedural steps include request for proposal, commissioning and acceptance of the system. The processing of these project sections in a real project and the processing of a supplier project are left to the reader.

6 List of Figures

Part 3: V-Modell Reference Tailoring

V-Modell® XT



This document was created based on:

Export templates	Version 1.3 English
Export environment	Version 2.1.3
V-Modell XT	V-Modell® XT Version 1.3

Table of Contents

1 Introduction

1.1 Objectives of the V-Model Reference

The »V-Modell Reference Tailoring describes the »Project Characteristics which are used as basis for preparing a project-specific »Application Profile. In addition, it provides a summary of the significant contents of the V-Modell »Process Module and describes the »Decision Gates , »Product Types and »Project Type Variants available in the V-Modell. Thus, this V-Modell Reference provides all information required for »Tailoring.

1.2 Audience of the V-Modell Reference

This V-Modell Reference is mainly addressed to all project members who have a »Role, which is responsible for the project-specific adaptation of the V-Modell, e.g., the »Project Leader and the Quality Manager. In addition, this V-Modell Reference provides the other project members with a good summary of the significant contents of the V-Modell.

1.3 Contents and Structure of the V-Modell Reference

The V-Modell Reference comprises the following chapters:

»Directives and Instructions for Tailoring

This chapter describes the project-specific adaptation of the V-Modell, the so-called tailoring.

»Project Characteristics

This chapter describes the individual »Project Characteristics and the meaning of their possible parameters. Based on these parameters, a specific evaluation of project characteristics - the so-called »Application Profile - can be prepared for each project. This application profile is used as basis for the automatic tailoring, which determines the process modules required for the project and a suitable work flow in form of a »Project Execution Strategy.

»Project Types

This chapter describes the relevant project characteristics and the possible »Decision Gates and »Process Modules for every »Project Type.

»Project Type Variant

This chapter describes the possible project type variants and the process modules and process characteristics optional for a project type variant. For each project type variant, the specifications regarding the logical sequence of decision gates will be explained in detail.

»Process Modules

This chapter introduces the individual process modules. The »Roles, »Disciplines, »Work Products, and »Activityies assigned to each process module are specified.

»Decision Gates

This chapter describes the »Decision Gates defined in the V-Modell. The products on which the respective »Project Progress Decision is based are specified for every decision gate.

»Tailoring-Related Product Dependencies

This chapter describes the dynamic tailoring standards of the V-Modell. These standards are subdivided into standards of the Acquirer, the Project Manual, the Overall System Specification and the architecture of the system or »Enabling System.

»Process Module Index

This index completely lists all components of each process module. It explains the dependencies between the process modules, demonstrating - for example - how the process modules add subjects to the work products of other process modules.

»Process Module Index (Alphabetical)

This chapter lists all process modules in alphabetical order.

1.4 Notes on the Presentation in the V-Modell Reference

In the following paragraphs, the basic V-Modell concepts relevant for the V-Modell Reference Tailoring will be explained in detail.

The chapter »Project Types modifies the pictorial diagrams showing all process modules and decision gates of the V-Modell section »Fundamentals of the V-Modell in such a way that only the model elements applicable to the respective project type are depicted.

The chapter »Process Modules introduces the individual process modules of the V-Modell. The pictorial diagrams for the individual process modules follow the pattern shown in Figure 1. This figure is subdivided into two columns. The left column includes the »Roles, the right column comprises the »Discipline and »Work Product, and the right column includes the activity groups and activities relevant for the respective »Process Module. Activities are always assigned to the discipline of the work product, which is completed by the respective activity.

Elements defined in another process module are marked by a dashed edging. Initial products - i.e. products which must always be created once and only once - are marked by an "I" at the left edge of the product symbol. External products - i.e. products which are not generated within the scope of the »V-Modell Project - are marked by an "E". In addition, each product is assigned to one and only one responsible role by a connecting line. Roles which are not connected to a product contribute to the processing of one or more products of the respective process module without being responsible for it. The activity completing a certain product is also connected to the product by a connecting line.

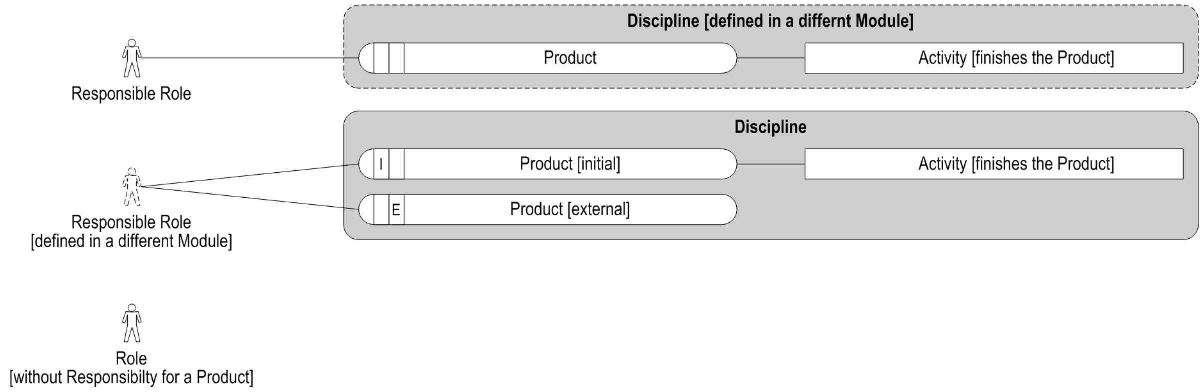


Figure 1: Legend for Pictorial Diagrams of Process Modules

The illustrations of the »Project Type Variant in chapter »Project Type Variants visualize the project flow through the individual »Decision Gates by means of arrows. Figure Figure 2 shows the semantics of the individual arrows.

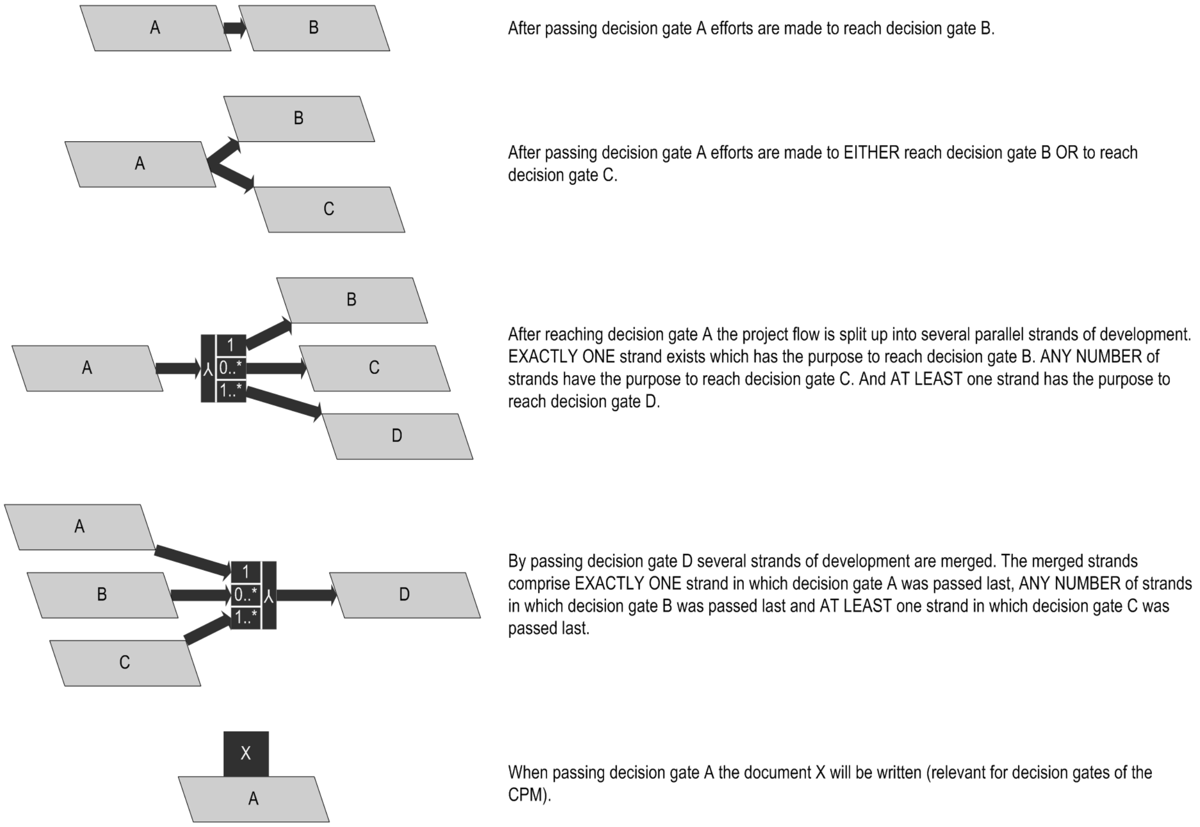


Figure 2: Legend for Pictorial Diagrams of Project Execution Strategies

2 Directives and Instructions for Tailoring

The »V-Modell is a guideline for planning and executing development projects, taking into account the entire system life cycle. It regulates the results to be prepared in a project and describes the concrete procedures for preparing these results. In addition, the V-Modell specifies the responsibilities of the individual project members.

The V-Modell is a generic process model, which can be employed in different project constellations, the so-called »Project Types. The different project types, which can be based on an approach offered by the V-Modell, are described in the chapter »Project Types.

A project type describes a concrete project constellation and the mandatory »Process Modules. A process module realizes a concrete task which may arise within the scope of a »V-Modell Project, e.g. project management or software development. A process module comprises the »Work Product s and »Activityies which are relevant for fulfilling this task and thus belong together with regard to their contents. In addition, process modules describe which V-Modell »Roles are responsible for completing the products and which roles cooperate in the development. Moreover, different »Project Characteristics providing additional selectable process modules are assigned to each project type. Finally, a project type specifies a rough framework for the execution of the project, which will be devoped further in the following steps and concretized in a »Project Execution Strategy.

Process modules describe the result structure of a project, but do not specify in which sequence the results have to be prepared. A sequence of this type is specified by the so-called »Project Execution Strategy. The project execution strategy of a project is largely determined by the selected »Project Type Variant and may, in individual cases, be influenced by project characteristics. In the V-Modell, project type variants are assigned unambiguously to a project type, thus refining it.

Each project type offers at least one project type variant. Complementing the project type, project type variants specify not only the project execution strategy but also additional mandatory process modules. Depending on the selected project type variant, the tailoring process assigns values to the project characteristics, making it possible to add additional process modules and certain procedural steps of the project execution strategy to the project. The concrete project execution strategy for a project is specified if the tailoring is completed and all »Project Characteristics have been assigned a value. During the tailoring process, the possible project type variant for a concrete project will be selected.

Tailoring Process

The poject-specific adaptation of the V-Model, the so-called »Tailoring, only determines the »Project Type, selects the possible »Project Type Variant and assigns values to the appropriate »Project Characteristics. It is not necessary to select or delete the activities and products of the V-Modell individually.The tailoring process creates an »Application Profile by following the above-mentioned steps. The step-by-step selection restricts further options in accordance with the situation. For example, after selection of a project type, it is only possible to select project type variants assigned to the selected project type. This restriction does not only affect the process modules, but also the »Decision Gates required by the project execution strategy resulting from the project type variant. From the comprehensive V-Modell, the tailoring process only selects only those components required for the current project constellation and combines them in a consistent manner.

Normally, this application profile will be defined at the beginning of a project and remain stable during project execution. This is designated as »Static Tailoring. However, it may happen that certain project characteristics change during project execution, e.g., it could be possible that hardware portions are identified in the course of a project which was at first dedicated exclusively to software development purposes. In this case, it is possible to select additional process modules and to adapt work flows in the project execution strategy during project execution. This process is designated as »Dynamic Tailoring.

The Tailoring is described in detail by the sub-activities (cf. »V-Modell Reference Activities)

- »Preparing and Analyzing an Application Profile,
- »Realizing Project-Specific Adaptation and
- »Performing Project-Specific Adaption during Project Execution

of the process module »Project Management.

Tailoring Documentation

The Tailoring documented in the »Project Manual is limited to the selection of the process modules and the project execution strategy decisive for the planning. It is not necessary to select or delete individual products or activities. The adaptation of the V-Modell exceeding the Tailoring process, the determination of » Product Instances and »Activity Instances will be executed during the project planning in accordance with the specifications of the generative »Product Dependency (see also »Project Planning).

Project Type	**Project Execution Strategies**	
Mandatory Process Modules	Optional Process Modules	Decision Gates
System Development Project (Acquirer/Supplier)	**Incremental System Development (Acquirer/Supplier)** **Component-Based System Development (Acquirer/Supplier)**	**System Maintenance (Acquirer/Supplier)** **Agile System Development (Acquirer/Supplier)**
Project Management Quality Assurance Configuration Management Problem and Change Management	Measurement and Analysis Life Cycle Cost Management	Project Approved Project Defined Iteration Scheduled Project Completed
System Development Specification of Requirements	Hardware Development Software Development Integrated Logistic Support Evaluation of Off-the-Shelf Products Enhancement and Migration of Legacy Systems Usability and Ergonomics Safety and Security Safety and Security (Supplier)	Requirements Specified System Specified System Designed Detail Design Completed System Elements Realized
Delivery and Acceptance (Supplier) Delivery and Acceptance (Acquirer)	Drafting and Conclusion of Contract (Acquirer)	Delivery Conducted Acceptance Completed Request for Proposal Released Contract Awarded Project Progress Revised
System Development Project (Acquirer)	**Award and Conduct a single System Development Project (Acquirer)** **Award and Conduct multiple System Development Projects (Acquirer)**	
Project Management Quality Assurance Configuration Management Problem and Change Management	Measurement and Analysis Life Cycle Cost Management	Project Approved Project Defined Iteration Scheduled Project Completed
Specification of Requirements	Evaluation of Off-the-Shelf Products Safety Management of Multiple Projects	Requirements Specified
Delivery and Acceptance (Acquirer) Drafting and Conclusion of Contract (Acquirer)		Request for Proposal Released Contract Awarded Project Progress Revised Acceptance Completed Overall Project Partitioned Overall Project Progress Revised

Figure 3: Tailoring Facilities

Project Type	**Project Execution Strategies**	
Mandatory Process Modules	Optional Process Modules	Decision Gates
System Development Project (Supplier)	**Incremental System Development (Supplier)** **Component-Based System Development (Supplier)**	**System Maintenance (Supplier)** **Agile System Development (Supplier)**
Project Management Quality Assurance Configuration Management Problem and Change Management	Measurement and Analysis Life Cycle Cost Management	Project Approved Project Defined Iteration Scheduled Project Completed
System Development	Hardware Development Software Development Integrated Logistic Support Evaluation of Off-the-Shelf Products Enhancement and Migration of Legacy Systems Usability and Ergonomics Safety and Security Safety and Security (Supplier)	System Specified System Designed Detail Design Completed System Elements Realized
Delivery and Acceptance (Supplier) Drafting and Conclusion of Contract (Supplier)	Delivery and Acceptance (Acquirer) Drafting and Conclusion of Contract (Acquirer)	Delivery Conducted Acceptance Completed Request for Proposal Released Contract Awarded Project Progress Revised
Introduction and Maintenance of an Organization-Specific Process Model	**Introduction and Maintenance of an Organization-Specific Process Model**	
Project Management Quality Assurance Configuration Management Problem and Change Management	Measurement and Analysis Life Cycle Cost Management	Project Approved Project Defined Iteration Scheduled Project Completed
Introduction and Maintenance of an Organization-Specific Process Model		Process Model Analyzed Process Model Improvement Specified Process Model Improvement Implemented

Figure 4: Tailoring Facilities (continued)

If a product model must be created in the project due to the specifications of the generative product dependencies, the structure is specified in form of subjects (see also »Templates). Subjects must not be deleted so that the uniformity of the documents of projects compliant to the V-Modell will be ensured. In individual cases, however, subjects may be marked as "not relevant in the special context of the project" in the product model.

3 Project Characteristics

The »Project Characteristics are used for characterizing a project. They can be assigned to a »Project Type and to a project type variant. Within the framework of the tailoring process, every project characteristic is marked by one if its possible values, which will be explained in this chapter. The selection of a value for each project characteristic generates a so-called »Application Profile. This application profile is no accurate description of a project. It is used for selecting additional optional process modules - in addition to the mandatory »Process Module of the project type and the project type variant - and for adapting the project execution strategy provided by the »Project Type Variant as required. The project characteristic »Security (Supplier) includes work products to be provided by the supplier into the project, which are not included in the project characteristic »Security (Acquirer).

3.1 Security (Acquirer)

Question

Are Safety and Security of the system critical?

Description

If the safety and security aspects of a system must be considered particularly, extended measures for evaluating the integrity, authenticity, confidentiality, availability and the failure risk of system components and design measures for preventing failures will have to be taken into account during system development. An example for a safety- and security-critical system is a reactor control. Also applications requiring the consideration of data privacy protection aspects - e.g. homebanking software - are safety- and security-critical systems.

Values

Yes	Safety and security aspects must be considered particularly for this project.
No	Safety and security aspects need not be considered particularly for this project.

3.2 Security (Supplier)

Question

Are Safety and Security of the system critical?

Description

If the safety and security aspects of a system must be considered particularly, extended measures for evaluating the integrity, authenticity, confidentiality, availability and the failure risk of system components and design measures for preventing failures will have to be taken into account during system development. An example for a safety- and security-critical system is a reactor control. Also applications requiring the consideration of data privacy protection aspects - e.g. homebanking software - are safety- and security-critical systems.

Values

Yes	Safety and security aspects must be considered particularly for this project.
No	Safety and security aspects need not be considered particularly for this project.

3.3 Life Cycle Cost Management

Question

Is a commercial project planning and tracing required?

Description

The commercial project planning and tracing includes the project cost planning and the respective project control. If high costs are projected, this is particularly important in order to ensure the success of a project.

Values

Yes	Economic planning and tracing are required for the project.
No	Economic planning and tracing are not required for the project.

3.4 Project Measures

Question

Is the determination of quantitative project parameters required?

Description

The determination of quantitative project parameters by measurements and »Metrics is required in order to make comparative statements on project results over an extended period of time. This can be important for example to evaluate the effectivity of a development process.

Values

Yes	The determination of quantitative project parameters is required.
No	The determination of quantitative project parameters is not required.

3.5 Subject of the Project

Question

What is the subject matter of the project?

Description

The subject matter of the project is the result to be achieved by the project. It may be a system or an organization-wide process to be improved, like the introduction of the V-Modell.

Values

HW	The main subject matter of the project is a system which is composed of hardware components, e.g., a CAN Bus Controller.
SW	The main subject matter of the project is a software system, i.e., a program in the broadest sense. Examples for software systems include E-Commerce applications and address administration programs.
HW and SW	A Hardware and Software System / Embedded System normally includes hardware, software and embedded components. A project which includes a Hardware and Software System / Embedded System as subject matter would be - e.g.- the development of the Eurofighter or of a ship. Furthermore a Hardware and Software System / Embedded System is characterized through the property that it uses sensors and actuators to acquire and influence its environment. This definition also addresses smaller systems as for example a microcontroller, which administers the behavior of an airbag system in a vehicle.
Integration	The project deals with the integration of components, which already exist or may still have to be developed or selected, into a system. An example for a system integration would be the Airbus production, which includes numerous components, or the SAP connection of existing systems.

3.6 Off-the-Shelf Products

Question

Are the evaluation and use of off-the-shelf products intended if reasonable and possible?

Description

If the use of off-the-shelf products is intended, measures must be taken at an early system development stage in order to determine system elements which could be candidates for off-the-shelf products. In addition, the appropriate commercial off-the-shelf solutions must be determined and evaluated. The use of finished components is particularly reasonable if a project includes components for which there are already numerous off-the-shelf solutions.

Values

Yes	The use of off-the-shelf products is desired in the project.
No	The use of off-the-shelf products is not desired in the project.

3.7 User Interface

Question

Is the user interface a success criterion?

Description

If the user interface is critical for the success of a project, special analytical measures and design specifications are required. Examples include systems which must be particularly intuitively operable due to the great number of users to be expected.

Values

Yes	The user interface is particularly important for project success.
No	The user interface is not particularly important for project success.

3.8 Subcontract

Question

Is the award of subcontracts intended during system development?

Description

In case of larger Projects (Supplier) or larger projects (Acquirer/Supplier), it is possible to award one or more subcontracts. By awarding subcontracts, the Supplier (or the Acquirer/Supplier) fulfills tasks of the Acquirer, like Request for Proposal, Contract Award and Project Monitoring.

If the value »Yes is assigned to this project characteristic, this will also influence the project execution strategy.

Values

Yes	The award of subcontracts is intended in this system.

No	The award of subcontracts is not intended in this project.

3.9 Legacy System

Question

Is the migration of a legacy system intended in this project?

Description

The project deals with the enhancement and/or migration of an existing (legacy) system. The focus of the project lies on the development of additional functionalities for or the replacement of an existing system.

Values

Yes	The project deals with the enhancement and/or migration of a legacy system.
No	Legacy systems are not considered in this project.

3.10 Prototype Development

Question

Is the development of prototypes intended within the framework of System Development?

Description

If not all requirements are specified at the beginning of a project or if the development of one or more prototypes is intended for demonstrating/proving realization possibilities, the value »Yes must be assigned to this project characteristic. As a consequence, the project execution strategy enables the Project Leader to select a development strategy which permits a rapid realization of prototypes - at first without specification/documentation.This approach can be used as prestage, e.g., for an Incremental or Component-Based System Development.

Values

Yes	A prototypic system development strategy is provided, which permits the rapid realization of prototypes without documentation effort.
No	Additional process modules or sequences will not be provided. Only the standard elements of the respective project type are available.

4 Project Types

A »Project Type unites several projects. The project type is determined initially during the tailoring process. For every project type, at least one »Project Type Variant and several mandatory »Process Module will be specified. Different »Project Characteristics, which enable the selection of optional process modules, are assigned to each projet type.

4.1 System Development Project (Acquirer)

Description

This project type deals with V-Modell projects on acquirer side, i.e., during the project a request for proposal must be prepared and a supplier must be selected based on the offers. This supplier is responsible for system development and delivers a system, which must be accepted by the acquirer. The mandatory and optional process modules for this project type are depicted in Figure 5. The »Decision Gates of the possible »Project Execution Strategy for this »Project Type are listed in Figure 6.

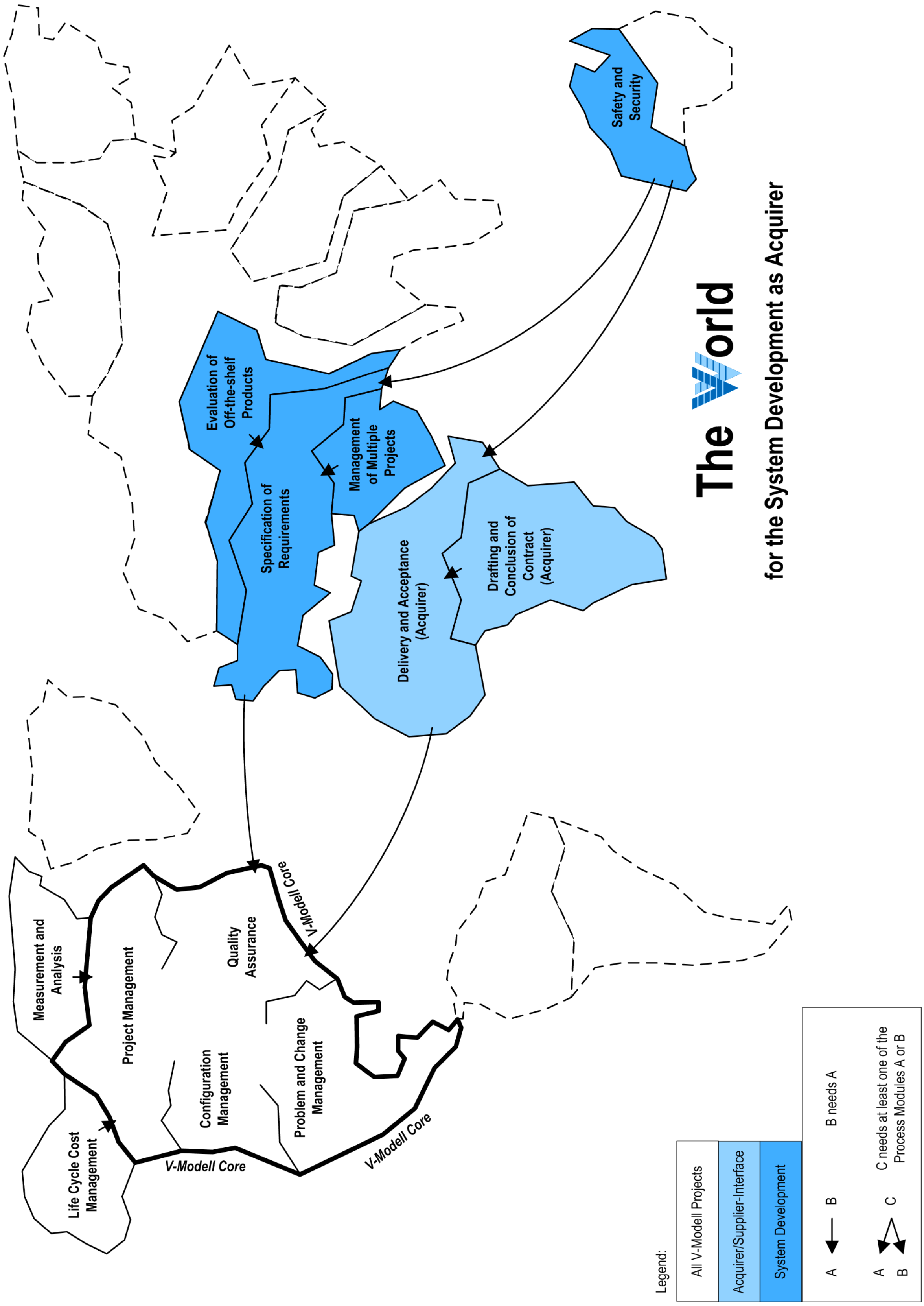


Figure 5: Relations between the »Process Module for the Project Type »System Development Project (Acquirer)

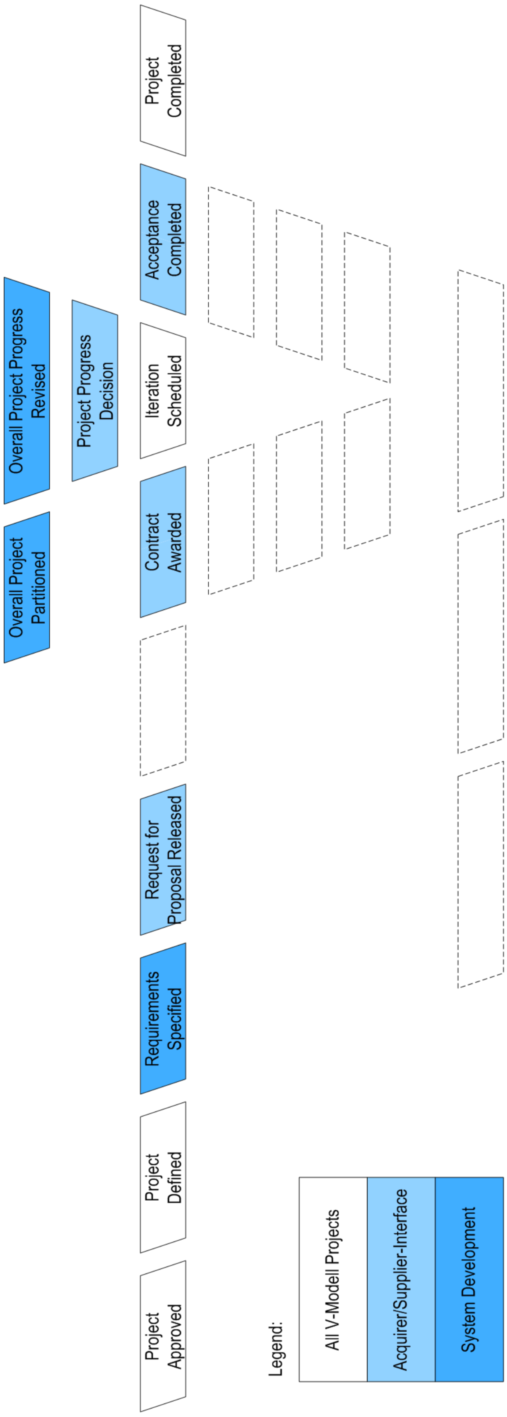


Figure 6: Decision Gates of the Project Execution Strategies Available for Projects of the Type System Development Project (Acquirer)

Possible project type variants: Project (Acquirer) with One Supplier, Project (Acquirer) with Several Suppliers

Process Modules to be used:	Specification of Requirements, Configuration Management, Delivery and Acceptance (Acquirer), Problem and Change Management, Project Management, Quality Assurance, Drafting and Conclusion of Contract (Acquirer)
Project characteristics to be determined during tailoring:	Security (Acquirer), Life Cycle Cost Management, Project Measures, Off-the-Shelf Products

4.2 System Development Project (Supplier)

Description

This project type deals with V-Modell projects on supplier side. During a project of this type, an offer must be prepared and - in case of a contract award - a system must be developed in accordance with the »Project Execution Strategy of one of the offered »Project Type Variant. The system will then be delivered to the acquirer for acceptance. The mandatory and optional process modules for this project are depicted in Figure 7. The »Decision Gate of the possible project execution strategy for this »Project Type are listed in Figure 8.

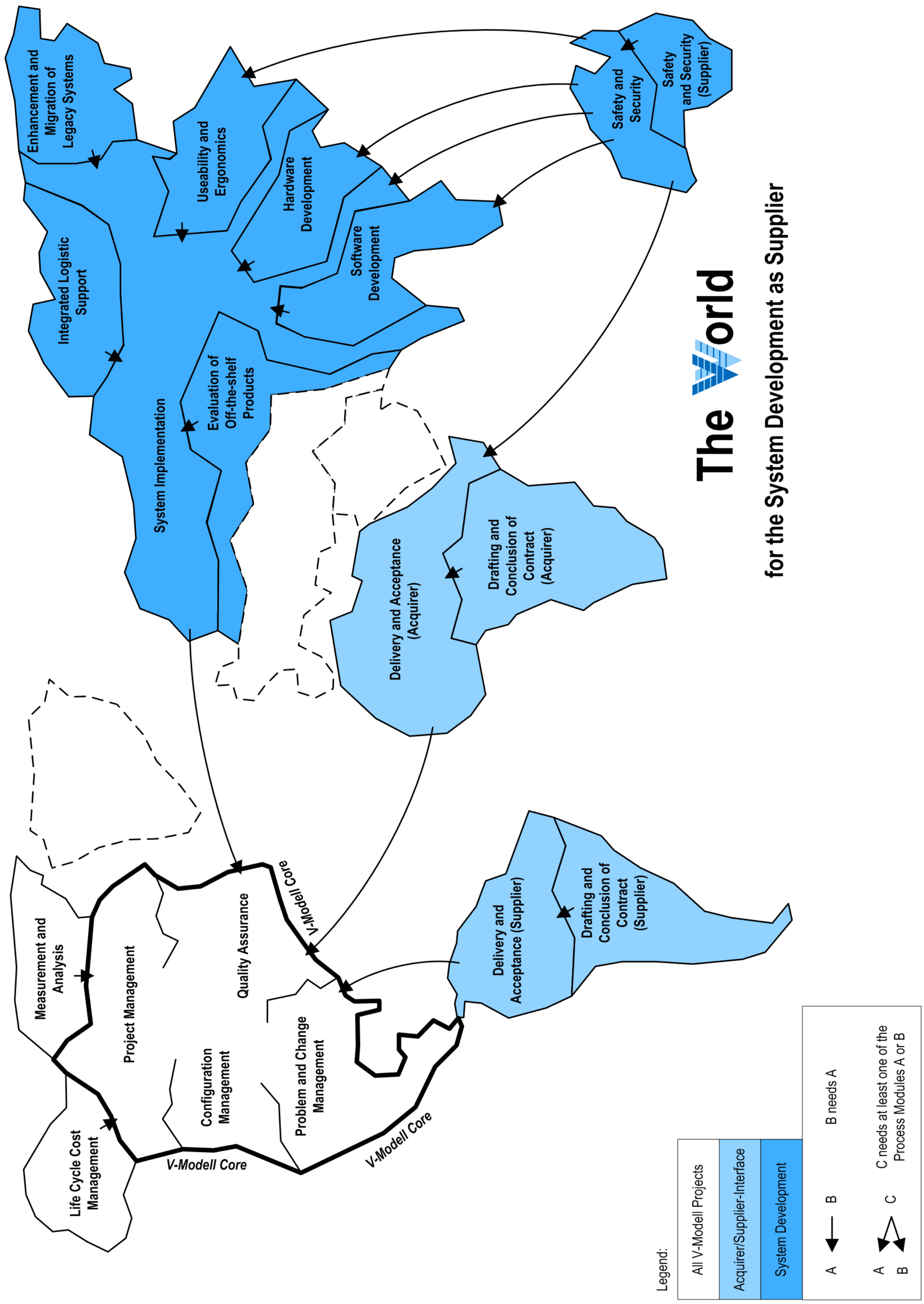


Figure 7: Relations between the »Process Module for the Project Type »System Development Project (Supplier)

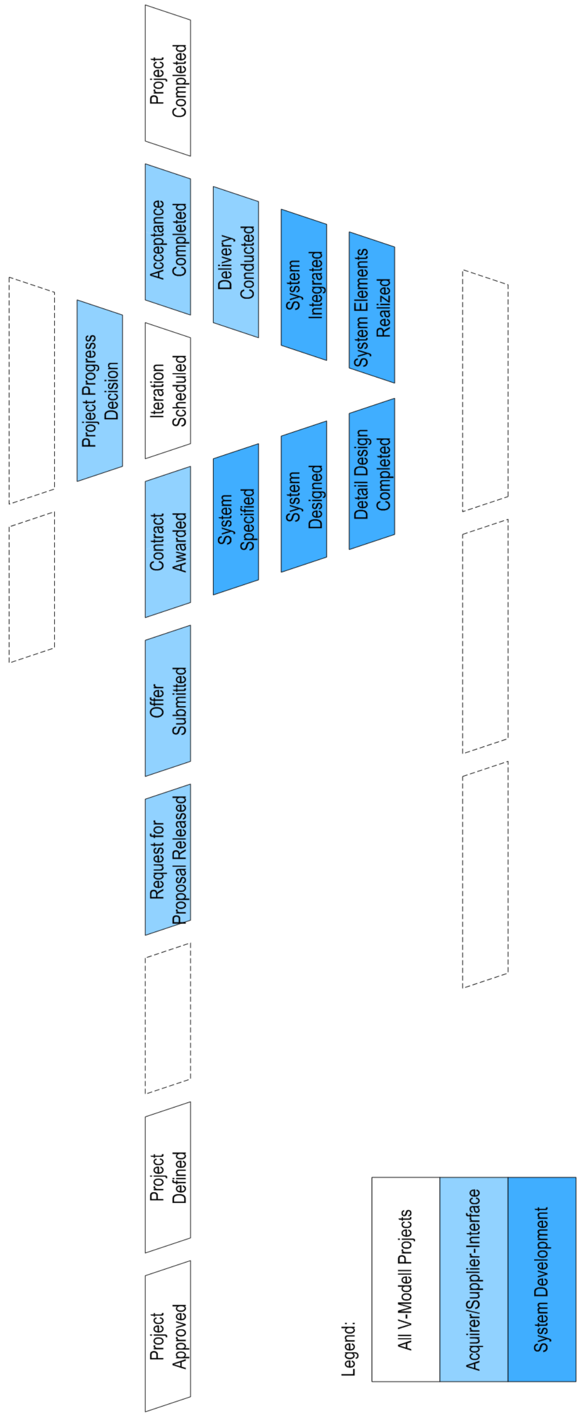


Figure 8: Decision Gates of the Available Project Execution Strategies for System Development Projects of a Supplier

Possible project type variants: Project (Acquirer) Including Development, Enhancement or Migration, Project (Acquirer) Including System Maintenance

Process Modules to be used:	Configuration Management, Delivery and Acceptance (Supplier), Problem and Change Management, Project Management, Quality Assurance, System Development, Drafting and Conclusion of Contract (Supplier)
Project characteristics to be determined during tailoring:	Security (Supplier), Life Cycle Cost Management, Project Measures, Off-the-Shelf Products, User Interface, Subject of the Project

4.3 System Development Project (Acquirer/Supplier)

Description

This project type deals with V-Modell projects which need not be separated into a project on the acquirer side and a project on the supplier side. This may be possible if the system development project is executed by one organization or if several organizations participating in a project cooperate deliberately. In contrast to the separated »System Development Project (Acquirer) and »System Development Project (Supplier), the System Development Project (Acquirer/Supplier) does not require the work product Supply and Contracting and the double project organization with two Project Leaders. Tasks of the acquirer side may - for example - be fulfilled by a functional department, and tasks of the supplier side may be fulfilled by the IT department.

The mandatory and optional process modules for this project are depicted in Figure Figure 9. The »Decision Gate of the possible »Project Execution Strategy for this »Project Type are listed in Figure Figure 10.

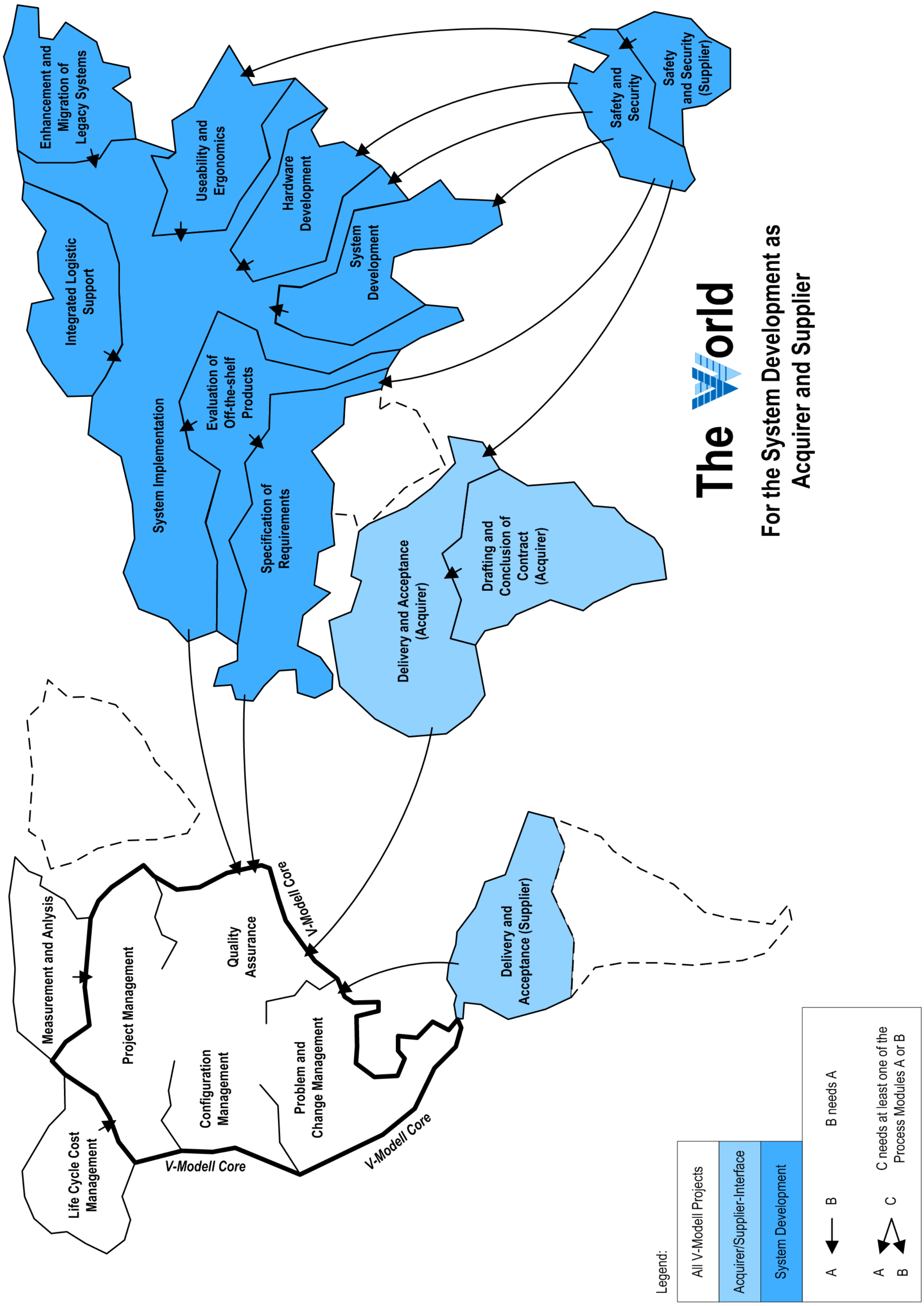


Figure 9: Relations between the »Process Module for the Project Type »System Development Project (Acquirer/Supplier)

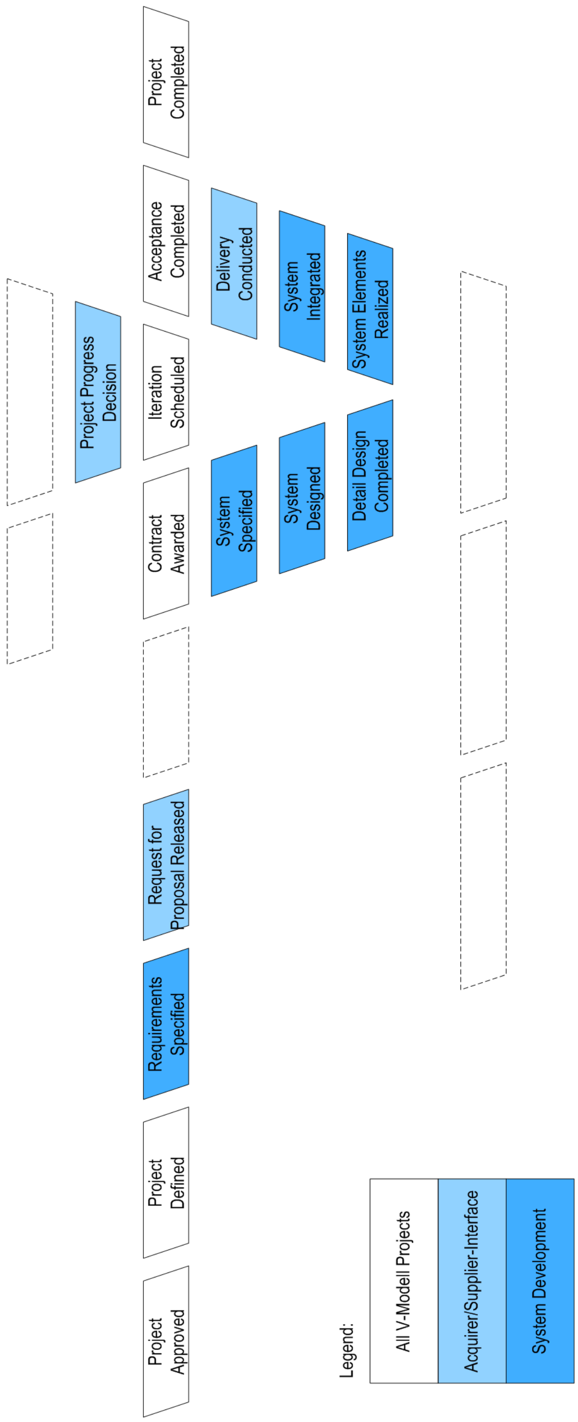


Figure 10: Decision Gates of the Project Execution Strategies Available for Projects of the Type System Development Project (Acquirer/Supplier)

Possible project type variants:	Project (Acquirer/Supplier) Including Development, Enhancement or Migration, Project (Acquirer/Supplier) Including System Maintenance

Process Modules to be used:	Specification of Requirements, Configuration Management, Delivery and Acceptance (Acquirer), Delivery and Acceptance (Supplier), Problem and Change Management, Project Management, Quality Assurance, System Development
Project characteristics to be determined during tailoring:	Security (Supplier), Life Cycle Cost Management, Project Measures, Off-the-Shelf Products, User Interface, Subject of the Project

4.4 Introduction and Maintenance of an Organization-Specific Process Model

Description

This project type deals with V-Modell projects intended to establish a process model within an organization. For this purpose, any existing process model should be analyzed, and improvement possibilities should be developed and executed. The mandatory and optional process modules for this model are shown in Figure 11. The »Decision Gate of the possible »Project Execution Strategy of for this »Project Type are listed in Figure 12.

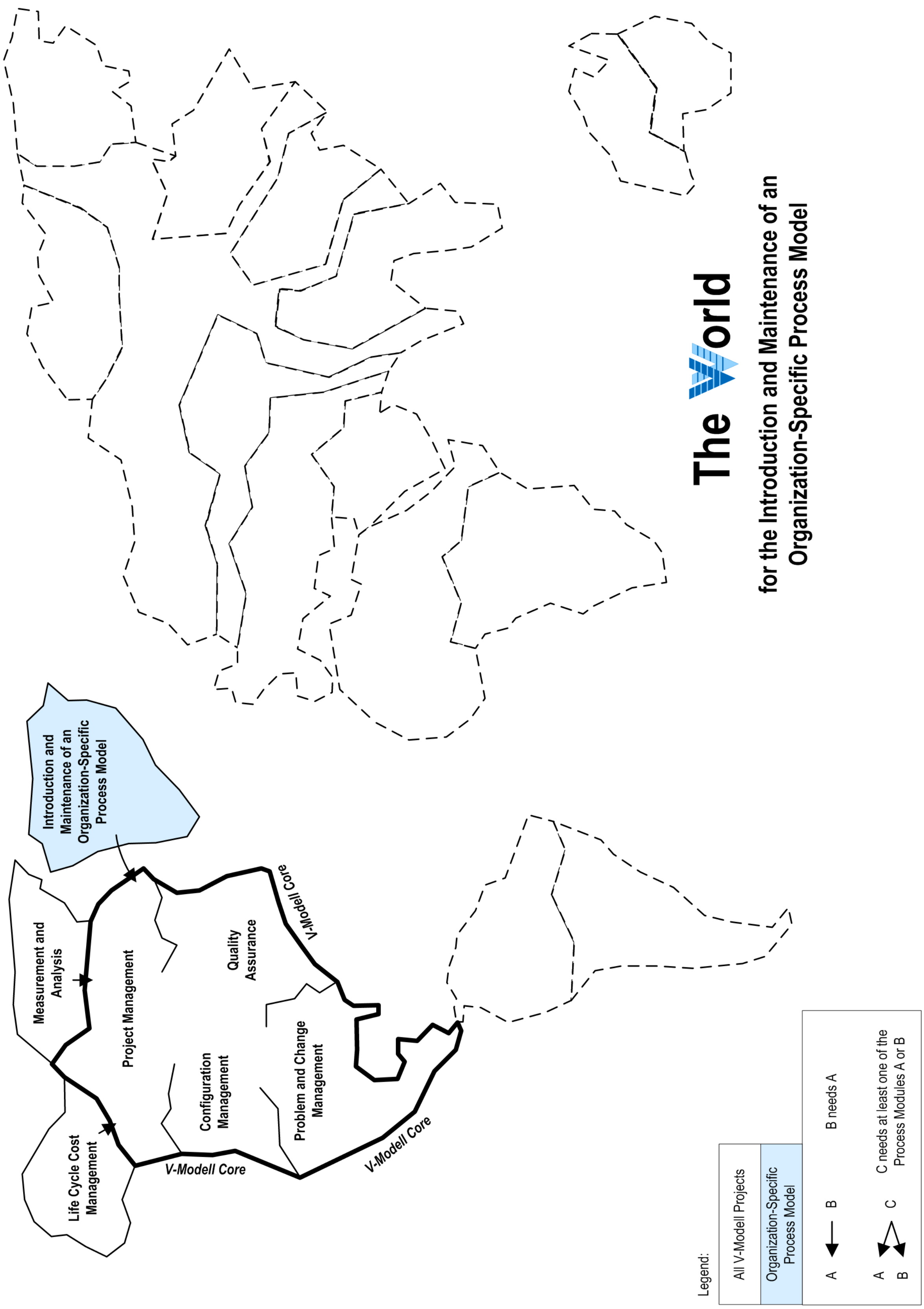


Figure 11: Relations between the »Process Module for the Project Type Development of an Organization-Specific Process Model

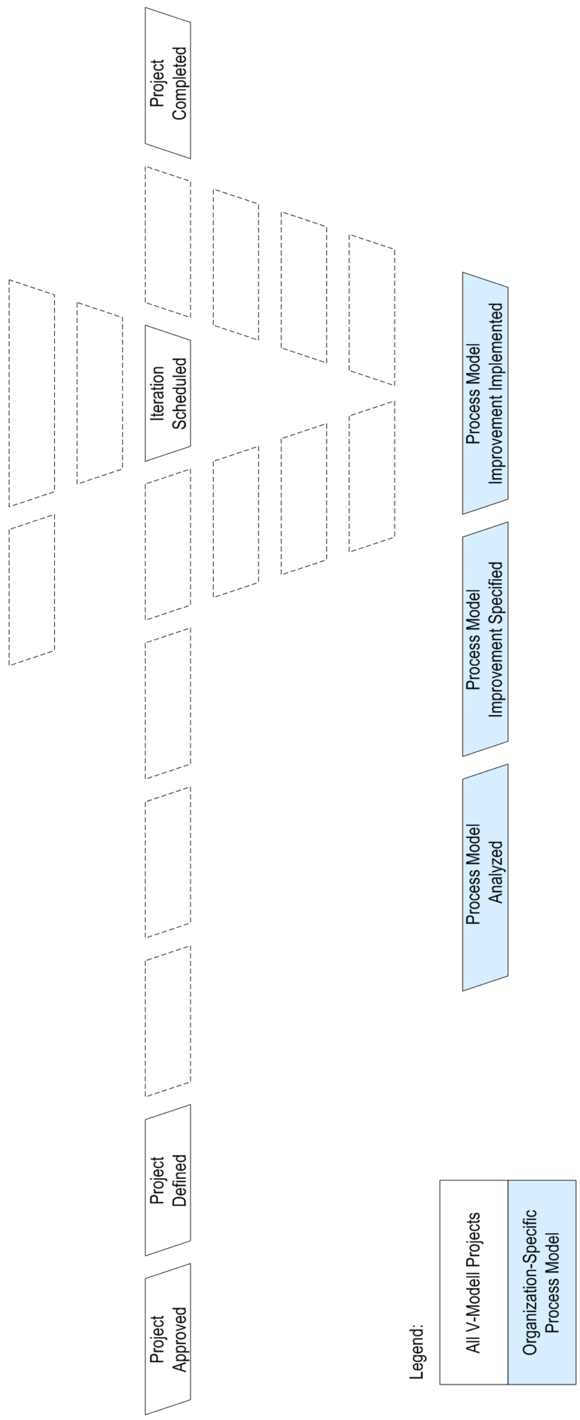


Figure 12: Decision Gates of the Available Project Execution Strategies for Projects of the Type Development of an Organization-Specific Process Modell

Possible project type variants: Introduction and Maintenance of an Organization-Specific Process Model

Process Modules to be used:	Introduction and Maintenance of an Organization-Specific Process Model, Configuration Management, Problem and Change Management, Project Management, Quality Assurance
Project characteristics to be determined during tailoring:	Life Cycle Cost Management, Project Measures

5 Project Type Variants

A project type variant determines the »Project Execution Strategy, which specifies a sequence of relevant »Decision Gates, and thus a chronological order for project execution. In addition, a project type variant can specify additional mandatory »Process Modules. The conditional »Project Characteristics also provide optional process modules and adaptations of the project execution strategy.

The descriptions of project type variants are structured as follows: At first the purpose of the project type variant and the framework conditions for its use are described.Then, a detailed description of the sequence follows. This sequence comprises a general part, which also displays the overall sequence. Afterwards, the individual decision gates of the project execution strategy are described in detail. For each decision gate, the transitions to the following decision gates are described under"MöglicheÜbergängeausgehendvon 'Entscheidungspunkt'" ("Possible transitions from 'Decision Gate'").

Transitions already listed may reappear if they can be used at another place of the project execution strategy. In this case, the transition will not be described again. Instead, reference will be made to the previous description.

5.1 Project (Acquirer) with One Supplier

Extended project type:	System Development Project (Acquirer)

Descriptions

As already described in Part1: "»Fundamentals of the V-Modell", the V-Modell provides specific project type variants, which are adapted to different »Project Types. The project type variant »Project (Acquirer) with One Supplier describes the appropriate procedure for the project type »System Development Project (Acquirer).

The award and execution of system development projects is based on the fundamental idea that the Acquirer has recognized the necessitiy for a system development project, but does not want to develop the project himself. Thus, he must specify the Requirements for the system. The development of the system (or of individual configuration levels of a system) will be carried out by a Supplier. After completing a Request for Proposal procedure, the supplies and services to be provided will be specified in a »Contract between the Acquirer and the Supplier. The supplies and services provided by the Supplier will be subject to acceptance by the Acquirer.

The project type variant »Project (Acquirer) with One Supplier should always be employed if a project is intended to have a Supplier develop a system.

Process Modules to be used

Due to the project type:	Specification of Requirements, Configuration Management, Delivery and Acceptance (Acquirer), Problem and Change Management, Project Management, Quality Assurance, Drafting and Conclusion of Contract (Acquirer)

Project characteristics to be determined during tailoring

Due to the project type: Security (Acquirer), Life Cycle Cost Management, Project Measures, Off-the-Shelf Products

Activity Flow

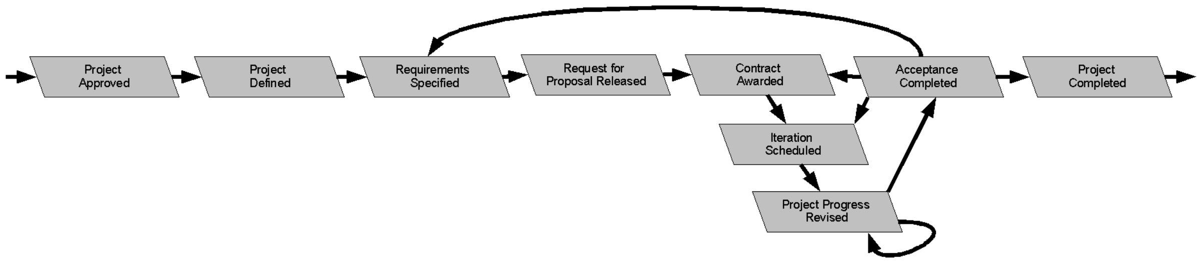


Figure 13: Project type variant Project (Acquirer) with One Supplier

The decision gates and the sequence of the project type variant »Project (Acquirer) with One Supplier are shown in figure Figure 13. In the following, the award and execution of the project will be described by means of the decision gates carried out.

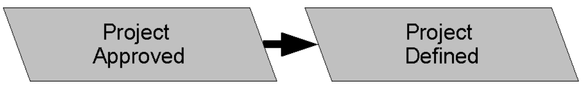
Possible transitions based on 'Projektstart'

From 'Project beginning' to 'Project Approved'

The potential acquirer, operating under the custodianship of a sponsor, prepares a »Project Proposal which includes all information required for deciding on the implementation of the proposal in form of a project. A sponsor is defined as person or department providing a budget for project acquisition. The project proposal is discussed in the decision gate »Project Approved, which ends with the decision as to whether or not the project should be started.

Possible transitions based on 'Project Approved'

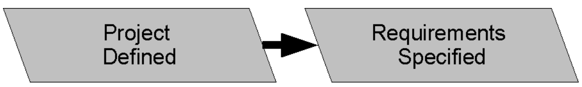
From 'Project Approved' to 'Project Defined'



In case of a positive decision, a Project Manual and a QA Manual will be prepared, which will be examined in order to determine if they are suitable for project execution on side of the acquirer. These activities are intended to reach the decision gate »Project Defined.

Possible transitions based on 'Project Defined'

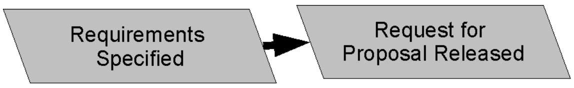
From 'Project Defined' to 'Requirements Specified'



After project definition, the user requirements will be prepared and subjected to a »Requirements Evaluation. The user will examine the requirements for completeness and correctness. In case of a positive assessment, the acquirer specifies and prioritizes the requirements in form of the »Requirements Specification. In addition, an »RFP Concept will be prepared in order to ensure that the contract award law will be observed during the request for proposal. These activities are intended to reach the decision gate »Requirements Specified.

Possible transitions based on 'Requirements Specified'

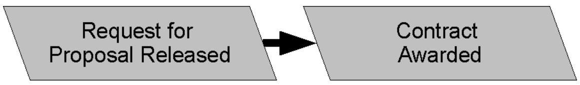
From 'Requirements Specified' to 'Request for Proposal Released'



Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

Possible transitions based on 'Request for Proposal Released'

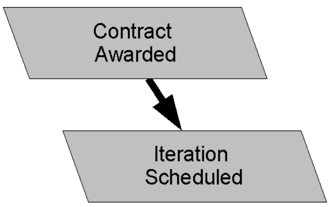
From 'Request for Proposal Released' to 'Contract Awarded'



The »Offers received after the »Request for Proposal will be evaluated in accordance with the »Criteria Catalog for Assessment of Offers. A provider with whom negotiations will be conducted will be selected. The acquirer decides - based on the assessment of the offers and the result of the contract negotiations - if the offer of the selected provider should be accepted. In case of a positive decision, a »Contract will be concluded between acquirer and supplier. In case of public acquirers and suppliers, contract negotiations are only possible under strict conditions. The public acquirer employs the »Offer Assessment in order to decide which offer is the most economical offer. The contract award commits the supplier to execute the project for the acquirer in accordance with the contractual agreements. These activities are intended to reach the decision gate »Contract Awarded.

Possible transitions based on 'Contract Awarded'

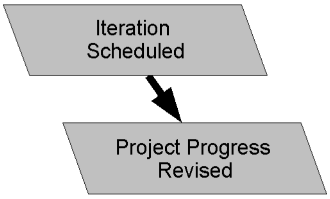
From 'Contract Awarded' to 'Iteration Scheduled'



After a »Contract has been concluded, the system development process, i.e., the decision gates to be achieved and the extent of the requirements to be implemented, will be planned. In addition, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. Otherwise these products will be adapted. These activities are intended to reach the decision gate »Iteration Scheduled.

Possible transitions based on 'Iteration Scheduled'

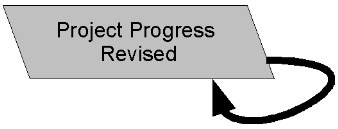
From 'Iteration Scheduled' to 'Project Progress Revised'



Then the acquirer is then tasked with supporting the execution of the supplier's project at the current »Project Stage in accordance with the specifications made in the contract. This is intended to ensure the success of the project and is a decisive acquirer task in this project execution strategy. The supplier will submit a Project Status Report (Supplier) for controlling the project progress. This report will determine which results have been achieved at the agreed project milestones. For this purpose, the acquirer will prepare a Project Status Report of his/her own. These activities are intended to reach the decision gate »Project Progress Revised.

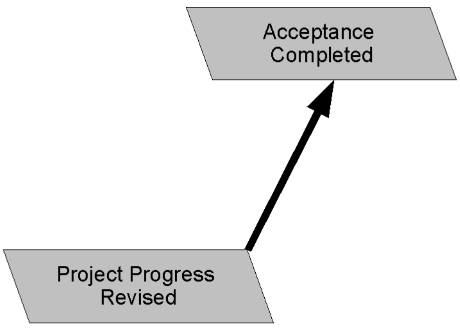
Possible transitions based on 'Project Progress Revised'

From 'Project Progress Revised' to 'Project Progress Revised'



The supplier will submit the Project Status Report to the acquirer at regular intervals, which may be adapted to the sequence of the supplier's Project Progress Decisions. At these points, the acquirer will also prepare a Project Status Report. These activities are intended to reach the decision gate »Project Progress Revised.

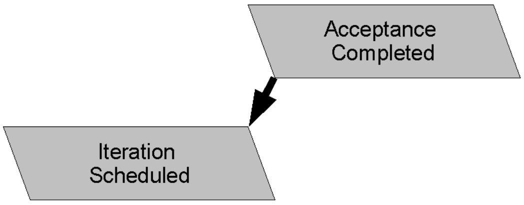
From 'Project Progress Revised' to 'Acceptance Completed'



If the supplier has achieved a specified system development status, the acquirer will receive the contractually agreed deliveries. The acquirer examines whether the »Delivery (Supplier) meets the requirements. This leads to the project progress decision of the decision gate »Acceptance Completed.

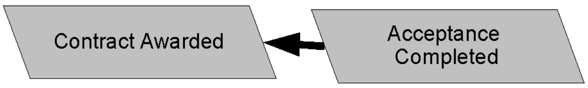
Possible transitions based on 'Acceptance Completed'

From 'Acceptance Completed' to 'Iteration Scheduled'



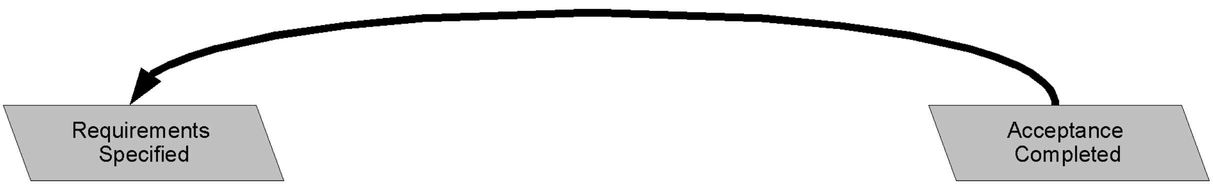
In order to plan a new iteration after the acceptance, the acquirer will check the open change requests of the »Change Status List in cooperation with the supplier. At the decision gate »Iteration Scheduled, this list is used for deciding which change requests will be included into the new iteration and which will be postponed for the time being. In addition, it will be specified, which of the components that have not yet been implemented will be taken into account in the new iteration. The change requests and the open requirements are the basis for a new development cycle. Again, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Contract Awarded'



If acquirer and supplier have determined previously that one or a few iterations will first be implemented before the overall scope is fixed contractually, a new »Contract will possibly be concluded after the acceptance has been completed. If necessary, a »Contract Addendum will be agreed with the supplier. These activities are intended to reach the decision gate »Contract Awarded.

From 'Acceptance Completed' to 'Requirements Specified'



If the experiences gained show that the requirements must be modified and the modifications cannot be made within the scope of the contract, a new »Requirements Evaluation will be conducted and new requirements will be specified. These activities are intended to achieve the decision gate »Requirements Specified and to award a new contract to a supplier.

After project definition, the user requirements will be prepared and subjected to a »Requirements Evaluation. The user will examine the requirements for completeness and correctness. In case of a positive assessment, the acquirer specifies and prioritizes the requirements in form of the »Requirements Specification. In addition, an »RFP Concept will be prepared in order to ensure that the contract award law will be observed during the request for proposal. These activities are intended to reach the decision gate »Requirements Specified.

5.2 Project (Acquirer) with Several Suppliers

Extended project type:	System Development Project (Acquirer)

Descriptions

As already described in Part 1: "»Fundamentals of the V-Modell", the V-Model provides specific project type variants, which are adapted to the different »Project Types. The project type variant »Project (Acquirer) with Several Suppliers describes the appropriate procedure for the project type »System Development Project (Acquirer).

The project type variant »Project (Acquirer) with Several Suppliers is based on the fundamental idea that the Acquirer has recognized the requirement for a system development project, but does not want tor develop the project himself/herself and that the realization in several Sub-Projects will probably offer technical, organizational and economic advantages. It is thus necessary to specify the Requirements of the overall system. In addition, it must be possible to reasonably subdivide the Requirements into Sub-Projects based on the overall system architecture. In this context, a Sub-Project must always be defined in such a way that the integration includes the results of the other Sub-Projects. The development of the system (or of individual configuration levels of a system) will be carried out in several Sub-Projects by one or several Suppliers.

However, this project type is only useful if the effort required for integrating the results of the individual Sub-Projects does not exceed the above-mentioned advantages of a development in Sub-Projects.

After completion of a Request for Proposals procedure, the supplies and serviced to be provided in the Sub-Projects will be specified in contracts to be defined between Acquirer and Suppliers. The supplies and services provided by the Suppliers in the Sub-Projects will be subject to acceptance by the Acquirer.

The project type variant »Project (Acquirer) with Several Suppliers should always be employed if a project is intended to have one or several Suppliers develop a system in several Sub-Projectsl.

Process Modules to be used

Due to the project type:	Specification of Requirements, Configuration Management, Delivery and Acceptance (Acquirer), Problem and Change Management, Project Management, Quality Assurance, Drafting and Conclusion of Contract (Acquirer)
Due to the project type variant:	Management of Multiple Projects

Project characteristics to be determined during tailoring

Due to the project type:	Security (Acquirer), Life Cycle Cost Management, Project Measures, Off-the-Shelf Products

Activity Flow

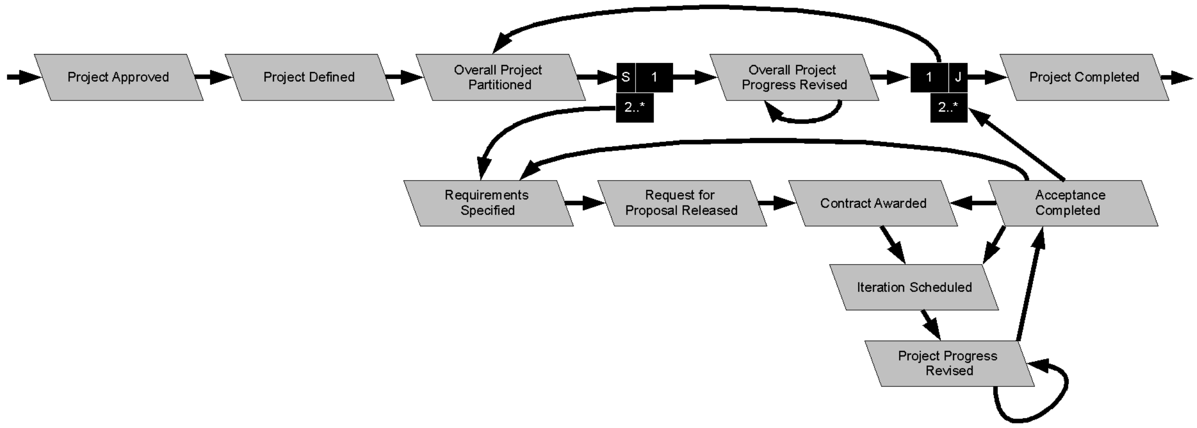


Figure 14: Project type variant Project (Acquirer) with Several Suppliers

The decision gates and the sequence of the project type variant »Project (Acquirer) with Several Suppliers are shown in figure Figure 14. In the following, the sequence will be described by means of the decision gates carried out.

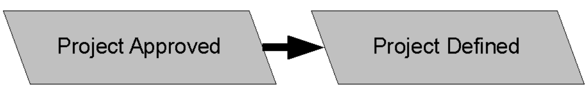
Possible transitions based on 'Projektstart'

From 'Project beginning' to 'Project Approved'

The potential acquirer, operating under the custodianship of a sponsor, prepares a »Project Proposal which includes all information required for deciding on the implementation of the proposal in form of a project. A sponsor is defined as person or department providing a budget for project acquisition. The project proposal is discussed in the decision gate »Project Approved, which ends with the decision as to whether or not the project should be started.

Possible transitions based on 'Project Approved'

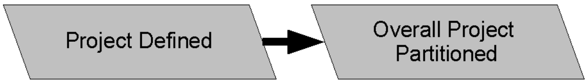
From 'Project Approved' to 'Project Defined'



In case of a positive decision, a Project Manual and a QA Manual will be prepared, which will be examined in order to determine if they are suitable for project execution on side of the acquirer. These activities are intended to reach the decision gate »Project Defined.

Possible transitions based on 'Project Defined'

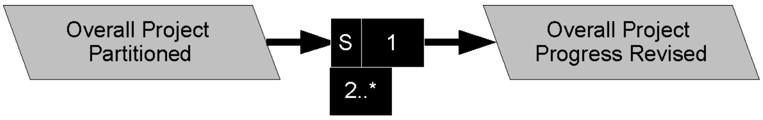
From 'Project Defined' to 'Overall Project Partitioned'



If the overall project is defined in one Project Manual and QA Manual, the product »Requirements Specification Overall Project should include an »Outline of the Life Cycle and the Overall System Architecture, which permits a subdivision of the overall project into feasible sub-projects. If this subidivision is technically, organizationally and economically feasible, the specification of the sub-projects and the sub-project Integration will be incorporated into Project Manual and »Project Plan. A sub-project Integration, which includes the integration of the sub-projects' results, must always be defined. The functional-and non-functional requirements specified in the Requirements Specification Overall Project will be assigned to the sub-projects. These activities are intended to reach the decision gate »Overall Project Partitioned.

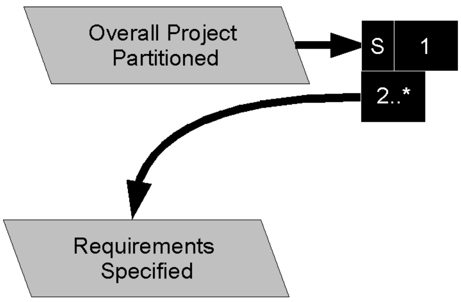
Possible transitions based on 'Overall Project Partitioned'

From 'Overall Project Partitioned' to 'Overall Project Progress Revised'



If the overall project is subdivided into sub-projects, the »Overall Project Progress shall be controlled based on the »Project Status Report(Supplier) prepared at the decision gate Overall »Project Progress Revised. The acquirer will integrated these sub-project data into a Project Status Report Overall Project. These activities are intended to reach the decision gate »Overall Project Progress Revised.

From 'Overall Project Partitioned' to 'Requirements Specified'

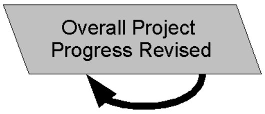


Based on all Project Status Reports (Supplier) of the individual sub-projects, a »Coming to a Project Progress Decision shall be made as to whether the overall project is still within the planning data specified in the Project Plan and as to whether and how the project shall be continued.

After project definition, the user requirements will be prepared and subjected to a »Requirements Evaluation. The user will examine the requirements for completeness and correctness. In case of a positive assessment, the acquirer specifies and prioritizes the requirements in form of the »Requirements Specification. In addition, an »RFP Concept will be prepared in order to ensure that the contract award law will be observed during the request for proposal. These activities are intended to reach the decision gate »Requirements Specified.

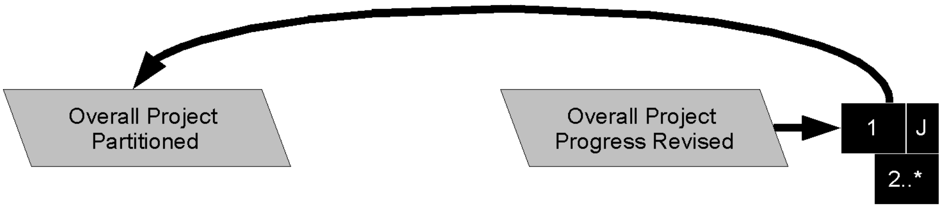
Possible transitions based on 'Overall Project Progress Revised'

From 'Overall Project Progress Revised' to 'Overall Project Progress Revised'



Based on all Project Status Reports (Supplier) of the individual sub-projects, a »Coming to a Project Progress Decision shall be made as to whether the overall project is still within the planning data specified in the Project Plan and as to whether and how the project shall be continued.

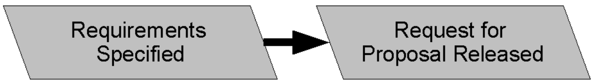
From 'Overall Project Progress Revised' to 'Overall Project Partitioned'



If the acceptance of all sub-projects and the results of the decision gate »Overall Project Progress Revised show that the objectives of the overall project cannot be not fulfilled, the overall project shall be subdivided into new sub-projects. However, this decision must stand the most stringent economical tests.

Possible transitions based on 'Requirements Specified'

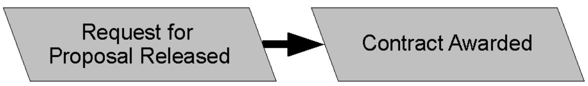
From 'Requirements Specified' to 'Request for Proposal Released'



Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

Possible transitions based on 'Request for Proposal Released'

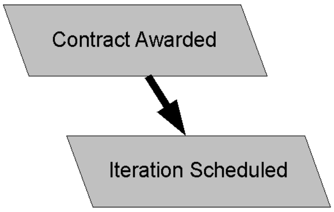
From 'Request for Proposal Released' to 'Contract Awarded'



The »Offers received after the »Request for Proposal will be evaluated in accordance with the »Criteria Catalog for Assessment of Offers. A provider with whom negotiations will be conducted will be selected. The acquirer decides - based on the assessment of the offers and the result of the contract negotiations - if the offer of the selected provider should be accepted. In case of a positive decision, a »Contract will be concluded between acquirer and supplier. In case of public acquirers and suppliers, contract negotiations are only possible under strict conditions. The public acquirer employs the »Offer Assessment in order to decide which offer is the most economical offer. The contract award commits the supplier to execute the project for the acquirer in accordance with the contractual agreements. These activities are intended to reach the decision gate »Contract Awarded.

Possible transitions based on 'Contract Awarded'

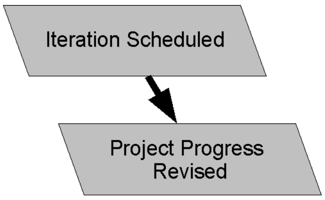
From 'Contract Awarded' to 'Iteration Scheduled'



After a »Contract has been concluded, the system development process, i.e., the decision gates to be achieved and the extent of the requirements to be implemented, will be planned. In addition, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. Otherwise these products will be adapted. These activities are intended to reach the decision gate »Iteration Scheduled.

Possible transitions based on 'Iteration Scheduled'

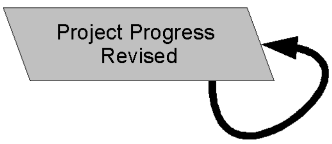
From 'Iteration Scheduled' to 'Project Progress Revised'



Then the acquirer is then tasked with supporting the execution of the supplier's project at the current »Project Stage in accordance with the specifications made in the contract. This is intended to ensure the success of the project and is a decisive acquirer task in this project execution strategy. The supplier will submit a Project Status Report (Supplier) for controlling the project progress. This report will determine which results have been achieved at the agreed project milestones. For this purpose, the acquirer will prepare a Project Status Report of his/her own. These activities are intended to reach the decision gate »Project Progress Revised.

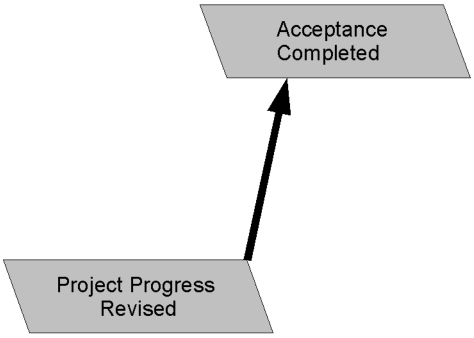
Possible transitions based on 'Project Progress Revised'

From 'Project Progress Revised' to 'Project Progress Revised'



The supplier will submit the Project Status Report to the acquirer at regular intervals, which may be adapted to the sequence of the supplier's Project Progress Decisions. At these points, the acquirer will also prepare a Project Status Report. These activities are intended to reach the decision gate »Project Progress Revised.

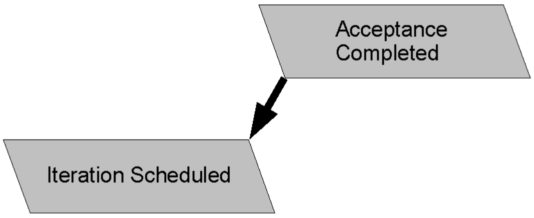
From 'Project Progress Revised' to 'Acceptance Completed'



If the supplier has achieved a specified system development status, the acquirer will receive the contractually agreed deliveries. The acquirer examines whether the »Delivery (Supplier) meets the requirements. This leads to the project progress decision of the decision gate »Acceptance Completed.

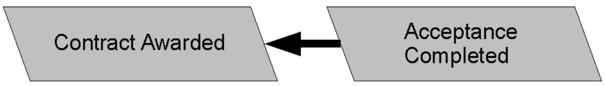
Possible transitions based on 'Acceptance Completed'

From 'Acceptance Completed' to 'Iteration Scheduled'



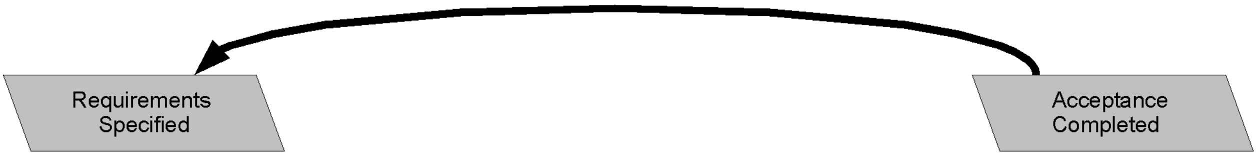
In order to plan a new iteration after the acceptance, the acquirer will check the open change requests of the »Change Status List in cooperation with the supplier. At the decision gate »Iteration Scheduled, this list is used for deciding which change requests will be included into the new iteration and which will be postponed for the time being. In addition, it will be specified, which of the components that have not yet been implemented will be taken into account in the new iteration. The change requests and the open requirements are the basis for a new development cycle. Again, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Contract Awarded'



If acquirer and supplier have determined previously that one or a few iterations will first be implemented before the overall scope is fixed contractually, a new »Contract will possibly be concluded after the acceptance has been completed. If necessary, a »Contract Addendum will be agreed with the supplier. These activities are intended to reach the decision gate »Contract Awarded.

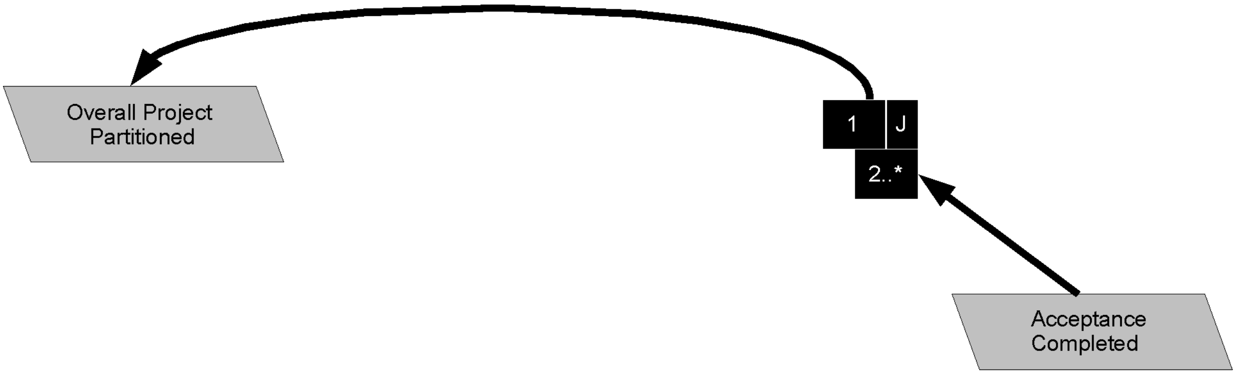
From 'Acceptance Completed' to 'Requirements Specified'



If the experiences gained show that the requirements must be modified and the modifications cannot be made within the scope of the contract, a new »Requirements Evaluation will be conducted and new requirements will be specified. These activities are intended to achieve the decision gate »Requirements Specified and to award a new contract to a supplier.

After project definition, the user requirements will be prepared and subjected to a »Requirements Evaluation. The user will examine the requirements for completeness and correctness. In case of a positive assessment, the acquirer specifies and prioritizes the requirements in form of the »Requirements Specification. In addition, an »RFP Concept will be prepared in order to ensure that the contract award law will be observed during the request for proposal. These activities are intended to reach the decision gate »Requirements Specified.

From 'Acceptance Completed' to 'Overall Project Partitioned'



If the acceptance of all sub-projects and the results of the decision gate »Overall Project Progress Revised show that the objectives of the overall project cannot be not fulfilled, the overall project shall be subdivided into new sub-projects. However, this decision must stand the most stringent economical tests.

5.3 Project (Acquirer) Including Development, Enhancement or Migration

Extended project type: System Development Project (Supplier)

Descriptions

As already described in Part 1: "»Fundamentals of the V-Modell", the V-Model provides specific project type variants, which are adapted to the different »Project Types. The project type variant »Project (Acquirer) Including Development, Enhancement or Migration describes the appropriate procedure for the project type »System Development Project (Supplier).

The project type variant »Project (Acquirer) Including Development, Enhancement or Migration is based on the fundamental idea that the Acquirer has defined the user requirements relatively clearly at the beginning of the project. After the Requirements have been defined in the »Contract (Acquirer), subsequent changes of the Requirements can only be executed via the problem and change management and the »Decision Gate »Iteration Scheduled and will be regulated by additional contracts. The Supplier designs, realizes and delivers the system in individual stages, which are also referred to as »Increment. Each stage will be accepted individually by the Acquirer. The different stages are contractually agreed in advance. In addition, Contract Addenda can specify complementing increments during the Project Progress. The Supplier may execute several internal iterations before delivering the increment to the Acquirer.

In this project type variant, the Acquirer should avoid changes within one increment. These changes should be included by the Change Management into the following increment. Important changes, which could - for example - influence the system architecture significantly, should be forwarded to the Supplier as early as possible. For the Acquirer, this procedure has the advantage of providing a prestage, which already realizes the system's most important basic functionalities at an early time.

The project type variant »Project (Acquirer) Including Development, Enhancement or Migration is particularly suitable if the system requirements are regarded as relatively stable and technological risks are rather small. It is possible to use off-the-shelf products, but the main part of the system will be developed within the scope of the project.

The project type variant »Project (Acquirer) Including Development, Enhancement or Migration is not only suitable for the development of new systems. It can also be used for the enhancement or migration of legacy systems. In this case, a »Legacy System Analysis must be prepared in addition. The execution of a »Legacy System Analysis depends on the condition of the legacy system and its documentation. It will be prepared within the framework of the Overall System Specification (»System Specified).

During the enhancement of legacy systems, the new System Requirements, which will be included in the enhancement process, are documented. The enhancement or migration of a system in maintenance is indicated if System Requirements would entail effects on the system architecture.

If the system is migrated to a new enviroment, e.g. a new hardware platform or a new running time environment, the Requirements will be based on existing functionalities as determined by the »Legacy System Analysis, Requirements of the change status list, and new Requirements of the Acquirer. A complete migration is not always necessary. In case of a partial migration, parts of the legacy system remain on their original platform while the access to the new system is provided by integration technologies.

Process Modules to be used

Due to the project type:	Configuration Management, Delivery and Acceptance (Supplier), Problem and Change Management, Project Management, Quality Assurance, System Development, Drafting and Conclusion of Contract (Supplier)

Project characteristics to be determined during tailoring

Due to the project type: Security (Supplier), Life Cycle Cost Management, Project Measures, Off-the-Shelf Products, User Interface, Subject of the Project

Due to the project type variant: Subcontract, Legacy System, Prototype Development

Activity Flow

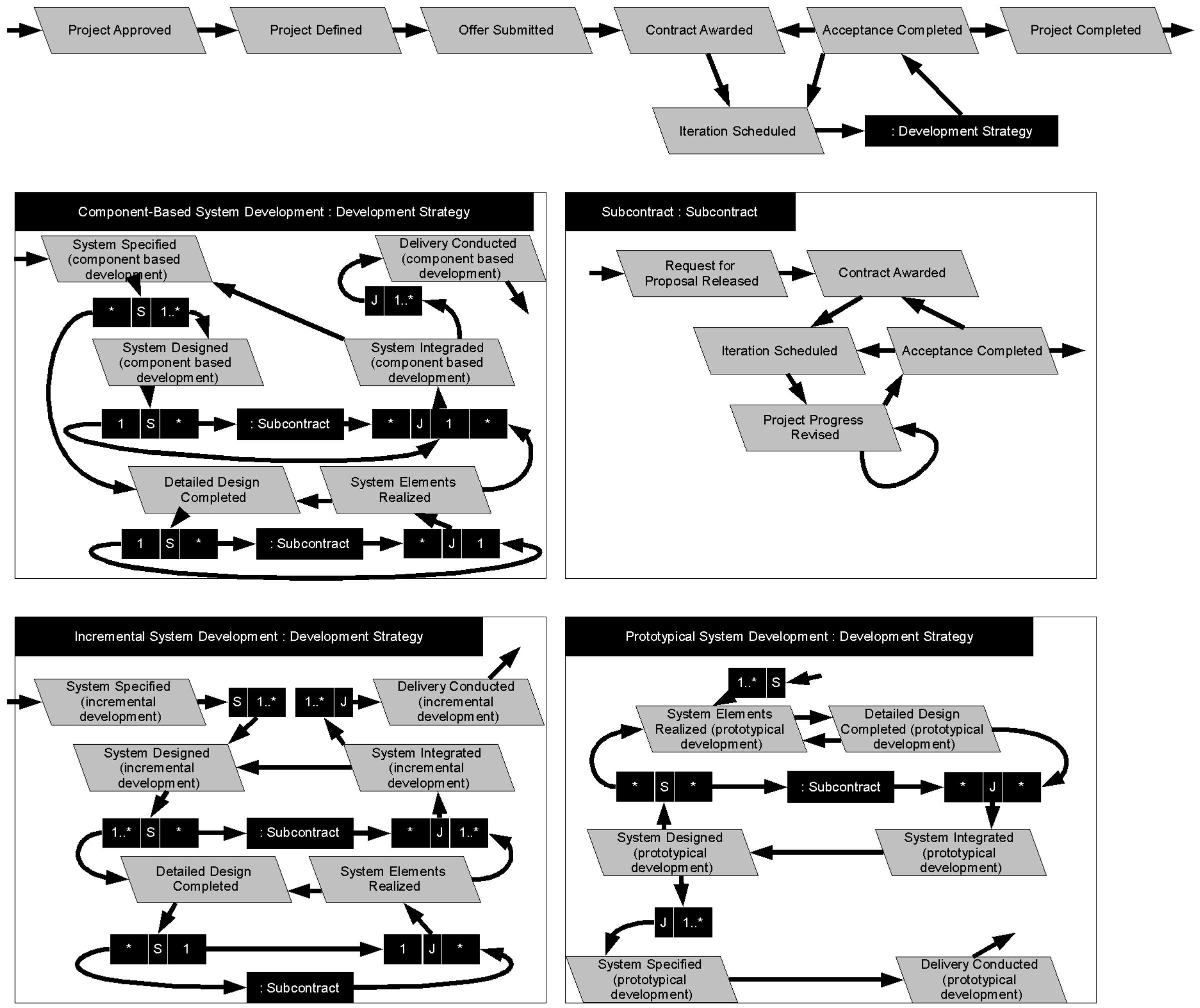


Figure 15: Project type variant Project (Acquirer) Including Development, Enhancement or Migration

The decision gates and the sequence of the project type variant »Project (Acquirer) Including Development, Enhancement or Migration are shown in figure Figure 15. This project type variant permits the application of different development strategies:

1. »Incremental Development
2. »Component-Based Development
3. »Prototypic Development

The decision for a development strategy is always made after the decision gate »Iteration Scheduled has been scheduled. If there are high realization risks, it is possible to execute an early iteration by means of a prototypic development.

In the following, the sequence will be described by means of the decision gates carried out.

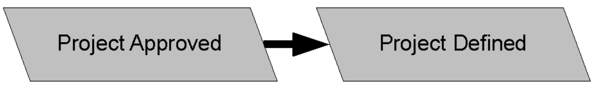
Possible transitions based on 'Projektstart'

From 'Project beginning' to 'Project Approved'

The »Acquirer with one Supplier sends a »Request for Proposal (Acquirer) including the requirements posed on the system to be developed to the »Supplier without Subcontractors. After examining the requirements, the supplier decides whether an »Offer for this request for proposal is reasonable from an economic and strategic point of view. Depending on this decision, the project will be approved (»Project Approved).

Possible transitions based on 'Project Approved'

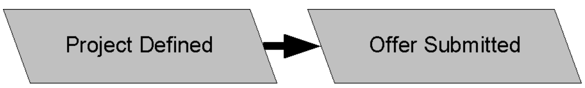
From 'Project Approved' to 'Project Defined'



If the project was approved, the supplier defines the project on a small scale by preparing simple versions of the »Project Manual and »QA Manual including the components relevant for the offer. At the decision gate »Project Defined, it will be examined whether these products are suitable for the conclusion of a contract.

Possible transitions based on 'Project Defined'

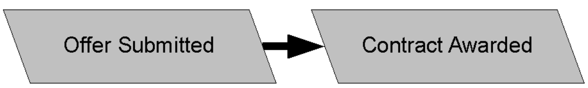
From 'Project Defined' to 'Offer Submitted'



After the project definition, the supplier prepares an »Offer concerning the specified requirements. After examining this offer, the supplier decides whether the offer will be submitted to the acquirer (»Offer Submitted).

Possible transitions based on 'Offer Submitted'

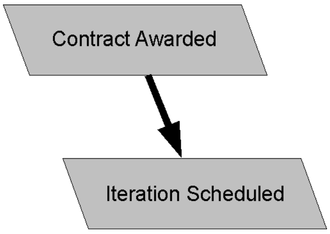
From 'Offer Submitted' to 'Contract Awarded'



If the acquirer accepts the offer, acquirer and supplier will conclude a »Contract, which specifies the system requirements and the framework conditions of the project in writing. (»Contract Awarded).

Possible transitions based on 'Contract Awarded'

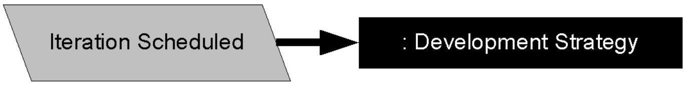
From 'Contract Awarded' to 'Iteration Scheduled'



After the contract has been awarded, the system development procedure, i.e. the decision gates to be passed until the product is accepted, and the scope of the requirements to be implemented will be planned. In addition, it will be examined whether the products »Project Manual and »QA Manual are appropriate for the project. If necessary, these products must be adapted to the requirements. The project and quality management aspects, which have possibly not been taken into account appropriately, will be defined in more detail. These activities are intended to reach the decision gate »Iteration Scheduled.

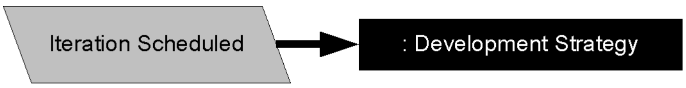
Possible transitions based on 'Iteration Scheduled'

From 'Iteration Scheduled' to 'System Elements Realized (prototypical development)'



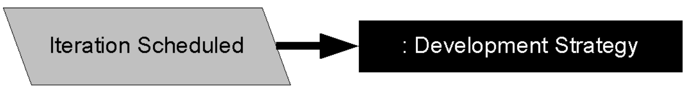
After the iteration has been planned, the realization of the individual software units of the system and the enabling systems will begin. Of course, this requires a basic understanding of the system architecture and the information which system elements should be realized. However, this is not reflected in a decision gate, since the agile system development permits the architecture and additional design decisions to be changed without problems during the implementation. At this point, the evaluation reports are used in order to check whether the individual system elements were realized in accordance with the acquirer requirements. The realization finally leads to the decision gate »System Elements Realized.

From 'Iteration Scheduled' to 'System Specified (component based development)'



In the project, the requirements planned will be evaluated, and a first preliminary design will be prepared. Requirements and preliminary design will be documented in the »Overall System Specification, which is the basis for the further development of the system. If the project includes the enhancement or migration of a legacy system, a »Legacy System Analysis will be prepared together with the Overall System Specification. These activities are intended to reach the decision gate »System Specified.

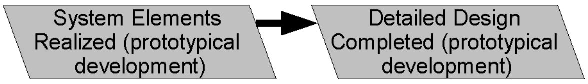
From 'Iteration Scheduled' to 'System Specified (incremental development)'



In the project, the requirements planned at the decision gate »Iteration Scheduled will be evaluated in cooperation with the acquirer, and a first preliminary design will be prepared. Requirements and preliminary design will be documented in the »Overall System Specification, which is the basis for the further development of the system. If the project includes the enhancement or migration of a legacy system, a »Legacy System Analysis will be prepared together with the Overall System Specification. These activities are intended to reach the decision gate »System Specified.

Possible transitions based on 'System Elements Realized (prototypical development)' (Ablaufbaustein Prototypical System Development)

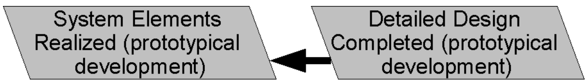
From 'System Elements Realized (prototypical development)' to 'Detailed Design Completed (prototypical development)'



The specification and documentation of the elements can be prepared based on the realized system elements. The correctness of the specifications will be examined at the decision gate »Detailed Design Completed.

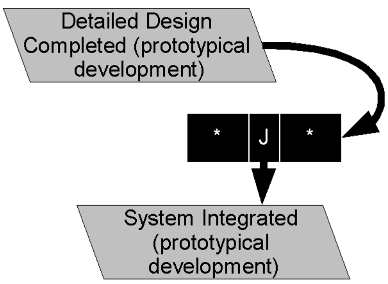
Possible transitions based on 'Detailed Design Completed (prototypical development)' (Ablaufbaustein Prototypical System Development)

From 'Detailed Design Completed (prototypical development)' to 'System Elements Realized (prototypical development)'



After the detailed designed has been specified, software elements can be realized anew. This provides a possibility for planning internal iterations in the software development. These activities are intended to reach the decision gate »System Elements Realized.

From 'Detailed Design Completed (prototypical development)' to 'System Integrated (prototypical development)'



After specification of the detailed design, the elements will be integrated, and the correct functionality of the system will be examined based on the evaluation reports of the system. If there are separate suborders, their results will now be integrated. These activities are intended to reach the decision gate »System Integrated.

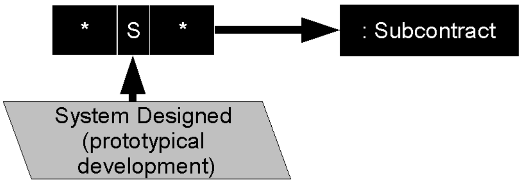
Possible transitions based on 'System Integrated (prototypical development)' (Ablaufbaustein Prototypical System Development)

From 'System Integrated (prototypical development)' to 'System Designed (prototypical development)'

If the integrated systems and enabling systems are available, the architecture of the systems and enabling systems can be specified. The capacity of these architectures will be examined. These activities are intended to reach the decision gate »System Designed.

Possible transitions based on 'System Designed (prototypical development)' (Ablaufbaustein Prototypical System Development)

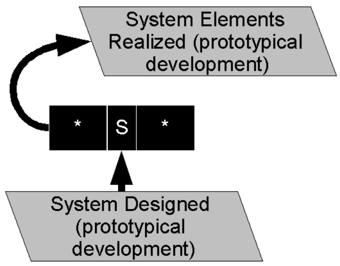
From 'System Designed (prototypical development)' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

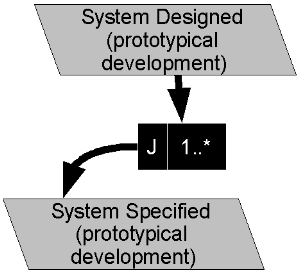
Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

From 'System Designed (prototypical development)' to 'System Elements Realized (prototypical development)'



The system design is the prerequisite for executing an additional realization iteration before the overall system is specified. For this purpose, software elements already realized will be developed further or components not yet processed will be implemented. These activities are intended to reach the decision gate »System Elements Realized.

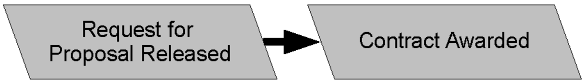
From 'System Designed (prototypical development)' to 'System Specified (prototypical development)'



After the decision gate »System Designed has been reached and all internal iterations have been completed, the specification for the developed overall system will be prepared, taking into account all systems and enabling systems which have been realized and designed up to now. Afterwards, the correctness of the »Overall System Specification will be rechecked. These activities are intended to reach the decision gate »System Specified.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

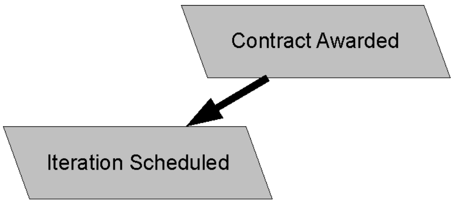
From 'Request for Proposal Released' to 'Contract Awarded'



The »Offers received after the »Request for Proposal will be evaluated in accordance with the »Criteria Catalog for Assessment of Offers. A provider with whom negotiations will be conducted will be selected. The acquirer decides - based on the assessment of the offers and the result of the contract negotiations - if the offer of the selected provider should be accepted. In case of a positive decision, a »Contract will be concluded between acquirer and supplier. In case of public acquirers and suppliers, contract negotiations are only possible under strict conditions. The public acquirer employs the »Offer Assessment in order to decide which offer is the most economical offer. The contract award commits the supplier to execute the project for the acquirer in accordance with the contractual agreements. These activities are intended to reach the decision gate »Contract Awarded.

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

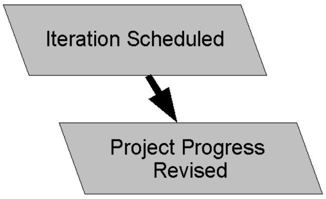
From 'Contract Awarded' to 'Iteration Scheduled'



After a »Contract has been concluded, the system development process, i.e., the decision gates to be achieved and the extent of the requirements to be implemented, will be planned. In addition, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. Otherwise these products will be adapted. These activities are intended to reach the decision gate »Iteration Scheduled.

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

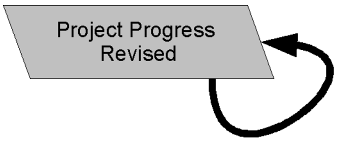
From 'Iteration Scheduled' to 'Project Progress Revised'



Then the acquirer is then tasked with supporting the execution of the supplier's project at the current »Project Stage in accordance with the specifications made in the contract. This is intended to ensure the success of the project and is a decisive acquirer task in this project execution strategy. The supplier will submit a Project Status Report (Supplier) for controlling the project progress. This report will determine which results have been achieved at the agreed project milestones. For this purpose, the acquirer will prepare a Project Status Report of his/her own. These activities are intended to reach the decision gate »Project Progress Revised.

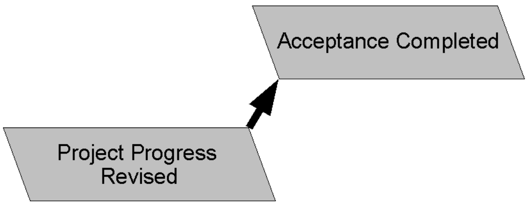
Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

From 'Project Progress Revised' to 'Project Progress Revised'



The supplier will submit the Project Status Report to the acquirer at regular intervals, which may be adapted to the sequence of the supplier's Project Progress Decisions. At these points, the acquirer will also prepare a Project Status Report. These activities are intended to reach the decision gate »Project Progress Revised.

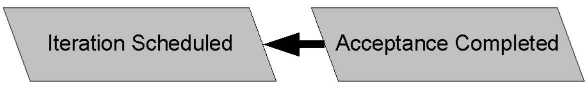
From 'Project Progress Revised' to 'Acceptance Completed'



If the supplier has achieved a specified system development status, the acquirer will receive the contractually agreed deliveries. The acquirer examines whether the »Delivery (Supplier) meets the requirements. This leads to the project progress decision of the decision gate »Acceptance Completed.

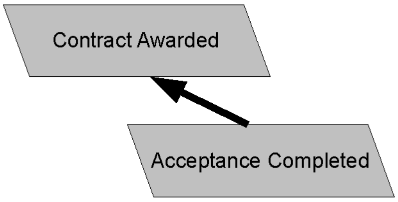
Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

From 'Acceptance Completed' to 'Iteration Scheduled'



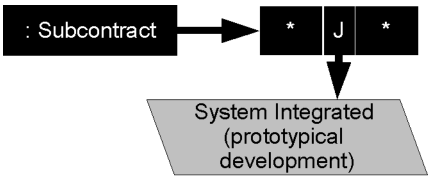
In order to plan a new iteration after the acceptance, the acquirer will check the open change requests of the »Change Status List in cooperation with the supplier. At the decision gate »Iteration Scheduled, this list is used for deciding which change requests will be included into the new iteration and which will be postponed for the time being. In addition, it will be specified, which of the components that have not yet been implemented will be taken into account in the new iteration. The change requests and the open requirements are the basis for a new development cycle. Again, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Contract Awarded'



If acquirer and supplier have determined previously that one or a few iterations will first be implemented before the overall scope is fixed contractually, a new »Contract will possibly be concluded after the acceptance has been completed. If necessary, a »Contract Addendum will be agreed with the supplier. These activities are intended to reach the decision gate »Contract Awarded.

From 'Acceptance Completed' to 'System Integrated (prototypical development)'



After specification of the detailed design, the elements will be integrated, and the correct functionality of the system will be examined based on the evaluation reports of the system. If there are separate suborders, their results will now be integrated. These activities are intended to reach the decision gate »System Integrated.

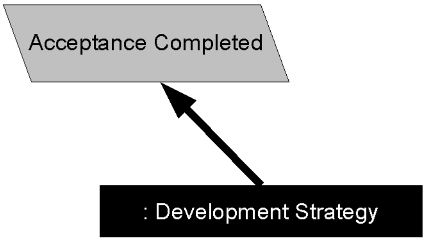
Possible transitions based on 'System Specified (prototypical development)' (Ablaufbaustein Prototypical System Development)

From 'System Specified (prototypical development)' to 'Delivery Conducted (prototypical development)'

After the overall system developed in an agile manner has been specified it will be checked whether a delivery is possible. In case of a positive decision, the current version of the system will be delivered to the acquirer, and the decision gate »Delivery Conducted is reached.

Possible transitions based on 'Delivery Conducted (prototypical development)' (Ablaufbaustein Prototypical System Development)

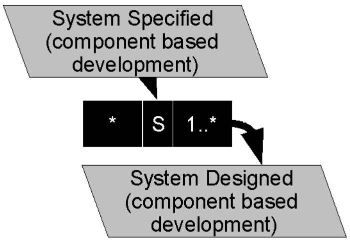
From 'Delivery Conducted (prototypical development)' to 'Acceptance Completed'



The acquirer tests the »Delivery in order to determine if the requirements are fulfilled. At the decision gate »Acceptance Completed, the acquirer will examine the results and decide whether a »Statement of Acceptance will be granted or corrective actions by the supplier are required. These activities are intended to reach the decision gate »Acceptance Completed.

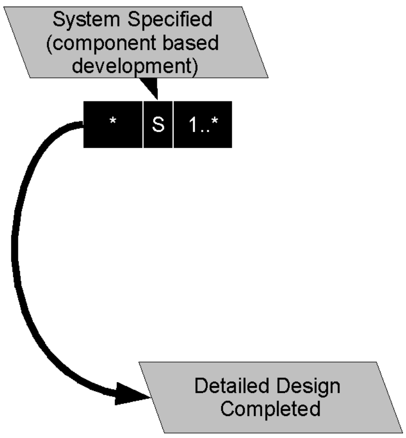
Possible transitions based on 'System Specified (component based development)' (Ablaufbaustein Component-Based System Development)

From 'System Specified (component based development)' to 'System Designed (component based development)'



Based on the preliminary design, architectures will be designed for the system and all identifiable »Enabling Systems . The architectures will define the »Segment s down to the level of hardware and software units. The requirements will be specified and assigned to system elements. Development process and evaluation strategy will be specified. The following decision gates to be executed until the project is delivered can be planned independently and executed simultaneously for the system and the various enabling systems. These activities are intended to reach the decision gate »System Designed for the system and every enabling system.

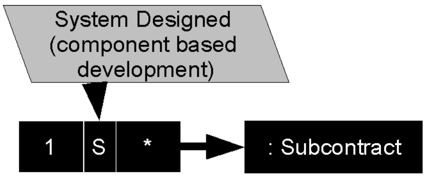
From 'System Specified (component based development)' to 'Detailed Design Completed'



After the decision gate »System Specified has been reached, the work on the detailed design may begin, which will happen simultaneously with the preparation of the system design at the Decision Gate System Designed. At this decision gate, the system is developed *top-down*, i.e., from the system down to the units, based on the »Overall System Specification. In the project execution strategy »Component-based System Development (Supplier), not only the »Overall System Specification, but also the specifications for external software/hardware modules are available. In order to integrate these modules into the system design, the detailed design for the modules will be prepared *bottom-up*, i.e., from modules to units. If system design and detailed design are developed in parallel, it must be ensured, that the common interfaces, i.e., »Software Unit, »Hardware Units and »External Unit, reflect the design coherently. In addition, the development process and test strategy will be specified, and external software/hardware specifications for any suborders will be prepared as required. These activities are intended develop the system design in parallel to the detailed design and to reach the decision gate »Detailed Design Completed.

Possible transitions based on 'System Designed (component based development)' (Ablaufbaustein Component-Based System Development)

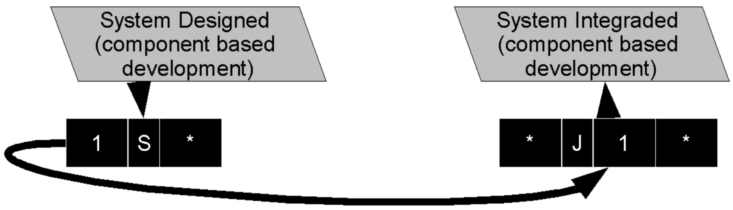
From 'System Designed (component based development)' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

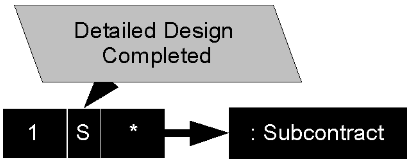
From 'System Designed (component based development)' to 'System Integraded (component based development)'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. In order to ensure the integration capability of the different units, the process aims at the Decision Gate System Integrated while awarding contracts for external units and providing for the project-own realization of units. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'Detailed Design Completed' (Ablaufbaustein Component-Based System Development)

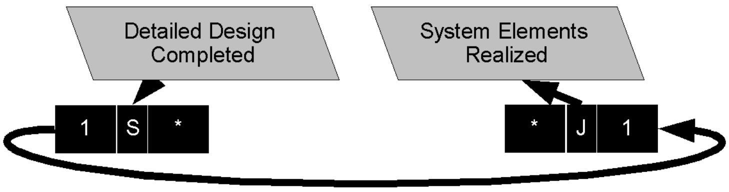
From 'Detailed Design Completed' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

From 'Detailed Design Completed' to 'System Elements Realized'



All hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements. In this context, also an iterative approach is possible, extending the detailed design after some system elements of the detailed design have been realized. If an External Hardware/Software Module Specifications were prepared during the detailed design, subcontracts may be awarded for the development of the software/hardware modules. If no subcontracts are awarded, all hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

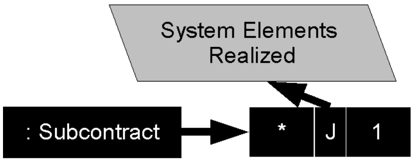
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

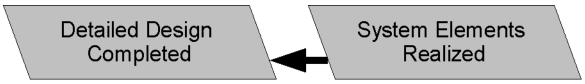
From 'Acceptance Completed' to 'System Elements Realized'



After acceptance, the units will be integrated into the project.

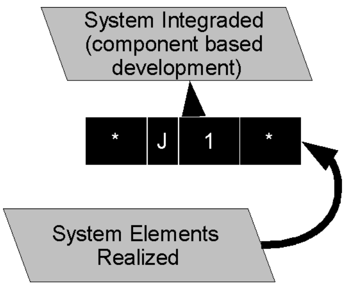
Possible transitions based on 'System Elements Realized' (Ablaufbaustein Component-Based System Development)

From 'System Elements Realized' to 'Detailed Design Completed'



In order to permit an iterative execution of detailed design and realization, it is possible to go back to the preparation of the detailed design after the realization. In this step, hardware and software units, which have not been included into the detailed design process during the previous iteration, will be designed in detail. These activities are intended to reach decision gate »Detailed Design Completed.

From 'System Elements Realized' to 'System Integraded (component based development)'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. In order to ensure the integration capability of the different units, the process aims at the Decision Gate System Integrated while awarding contracts for external units and providing for the project-own realization of units. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

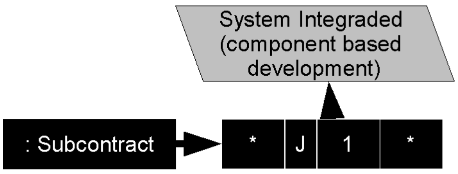
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

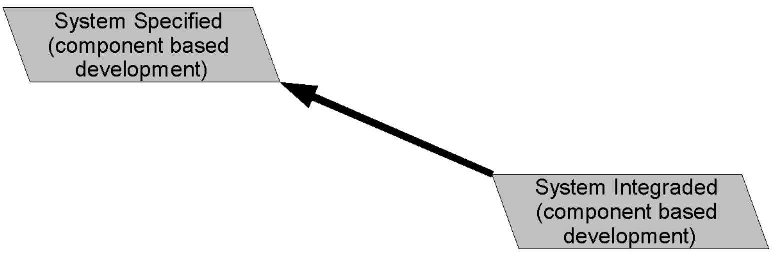
From 'Acceptance Completed' to 'System Integraded (component based development)'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. In order to ensure the integration capability of the different units, the process aims at the Decision Gate System Integrated while awarding contracts for external units and providing for the project-own realization of units. These activities are intended to reach the decision gate »System Integrated.

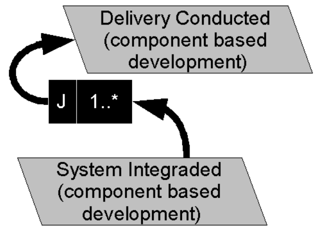
Possible transitions based on 'System Integraded (component based development)' (Ablaufbaustein Component-Based System Development)

From 'System Integraded (component based development)' to 'System Specified (component based development)'



Since internal iterations can be executed in this project execution strategy, a new internal iteration may be planned. For this purpose, a transition to the Decision Gate »System Specified can be established by extending the »Overall System Specification. These activities are intended to reach the decision gate »System Designed.

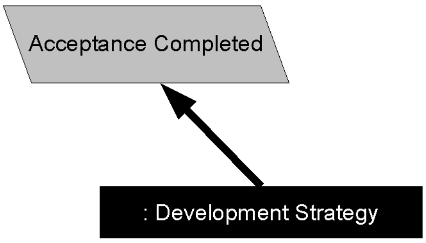
From 'System Integraded (component based development)' to 'Delivery Conducted (component based development)'



The overall system to be delivered will be assorted for delivery in accordance with the requirements. A delivery includes the system, any enabling systems and documentation. At the decision gate »Delivery Conducted, the results will be examined, and it will be decided whether the delivery will be sent to the acquirer for acceptance.

Possible transitions based on 'Delivery Conducted (component based development)' (Ablaufbaustein Component-Based System Development)

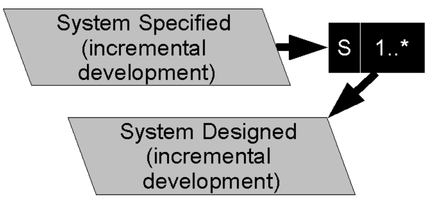
From 'Delivery Conducted (component based development)' to 'Acceptance Completed'



The acquirer tests the »Delivery in order to determine if the requirements are fulfilled. At the decision gate »Acceptance Completed, the acquirer will examine the results and decide whether a »Statement of Acceptance will be granted or corrective actions by the supplier are required. These activities are intended to reach the decision gate »Acceptance Completed.

Possible transitions based on 'System Specified (incremental development)' (Ablaufbaustein Incremental System Development)

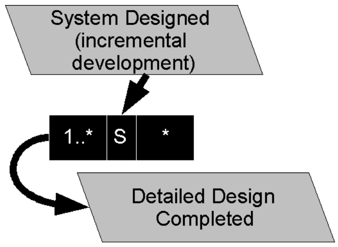
From 'System Specified (incremental development)' to 'System Designed (incremental development)'



Based on the preliminary design, architectures will be designed for the system and all identifiable »Enabling Systems . The architectures will define the »Segment s down to the level of hardware and software units. The requirements will be specified and assigned to system elements. Development process and evaluation strategy will be specified. The following decision gates to be executed until the project is delivered can be planned independently and executed simultaneously for the system and the various enabling systems. These activities are intended to reach the decision gate »System Designed for the system and every enabling system.

Possible transitions based on 'System Designed (incremental development)' (Ablaufbaustein Incremental System Development)

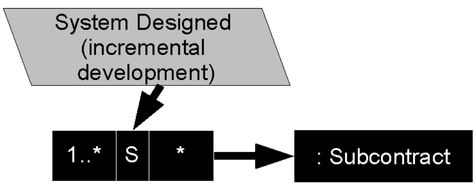
From 'System Designed (incremental development)' to 'Detailed Design Completed'



After the decision gate »System Designed has been reached, the work on the detailed design may begin. For the detailed design, the architectures of the hardware and software units will be developed into components and process modules, and external software/hardware specifications will be prepared as required. The requirements will be assigned to the hardware and software elements. Development process and test strategy will be specified. On the way towards the integration of realized system elements, it is possible to plan and conduct the design of hardware and software units simultaneously with the realization of other hardware and software units. These activities are intended to reach the decision gate »Detailed Design Completed for every workflow.

Due to possible parallel workflows, it is possible that the decision gate »Detailed Design Completed has been reached in some segments - and the realization may begin - while the detailed design for other segments is not yet completed.

From 'System Designed (incremental development)' to 'Request for Proposal Released'

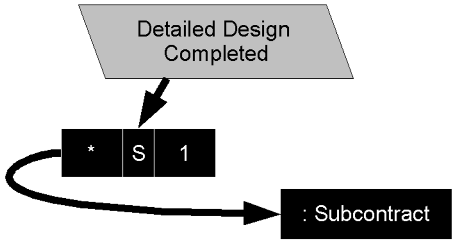


If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

Possible transitions based on 'Detailed Design Completed' (Ablaufbaustein Incremental System Development)

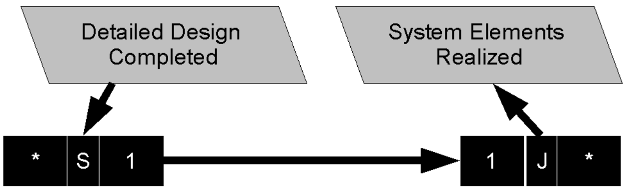
From 'Detailed Design Completed' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

From 'Detailed Design Completed' to 'System Elements Realized'



All hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements. In this context, also an iterative approach is possible, extending the detailed design after some system elements of the detailed design have been realized. If an External Hardware/Software Module Specifications were prepared during the detailed design, subcontracts may be awarded for the development of the software/hardware modules. If no subcontracts are awarded, all hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

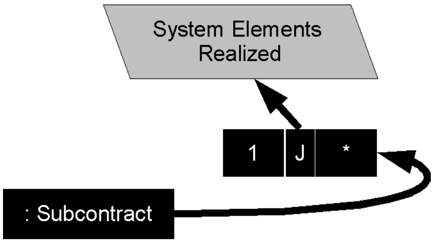
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

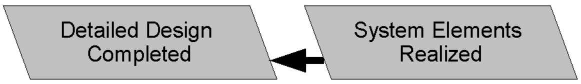
From 'Acceptance Completed' to 'System Elements Realized'



After acceptance, the units will be integrated into the project.

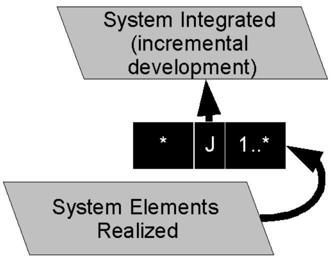
Possible transitions based on 'System Elements Realized' (Ablaufbaustein Incremental System Development)

From 'System Elements Realized' to 'Detailed Design Completed'



In order to permit an iterative execution of detailed design and realization, it is possible to go back to the preparation of the detailed design after the realization. In this step, hardware and software units, which have not been included into the detailed design process during the previous iteration, will be designed in detail. These activities are intended to reach decision gate »Detailed Design Completed.

From 'System Elements Realized' to 'System Integrated (incremental development)'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

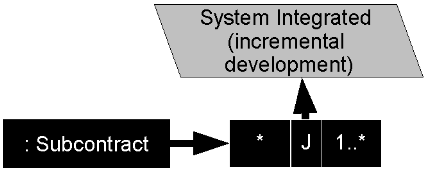
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

From 'Acceptance Completed' to 'System Integrated (incremental development)'



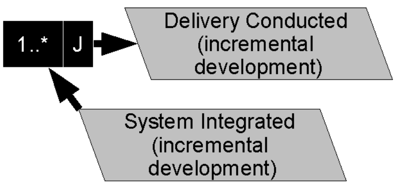
All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'System Integrated (incremental development)' (Ablaufbaustein Incremental System Development)

From 'System Integrated (incremental development)' to 'System Designed (incremental development)'

Since not only detailed design and realization, but also system design and integration can be executed in an iterative manner, a new internal iteration may be planned for system design. In the architectures, system elements not yet implemented are identified down to the level of hardware and software units. These activities are intended to reach the decision gate »System Designed.

From 'System Integrated (incremental development)' to 'Delivery Conducted (incremental development)'

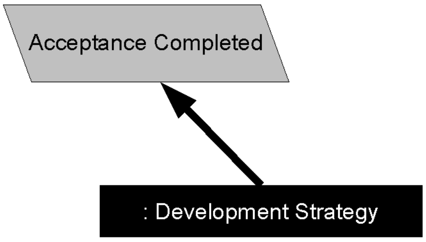


The overall system to be delivered will be assorted for delivery in accordance with the requirements. A delivery includes the system, any enabling systems and documentation. At the decision gate »Delivery Conducted, the results will be examined, and it will be decided whether the delivery will be sent to the acquirer for acceptance.

The overall system to be delivered will be assorted for delivery in accordance with the requirements. A delivery includes the system, any enabling systems and documentation. At the decision gate »Delivery Conducted, the results will be examined, and it will be decided whether the delivery will be sent to the acquirer for acceptance.

Possible transitions based on 'Delivery Conducted (incremental development)' (Ablaufbaustein Incremental System Development)

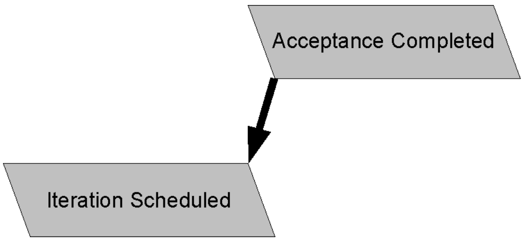
From 'Delivery Conducted (incremental development)' to 'Acceptance Completed'



The acquirer tests the »Delivery in order to determine if the requirements are fulfilled. At the decision gate »Acceptance Completed, the acquirer will examine the results and decide whether a »Statement of Acceptance will be granted or corrective actions by the supplier are required. These activities are intended to reach the decision gate »Acceptance Completed.

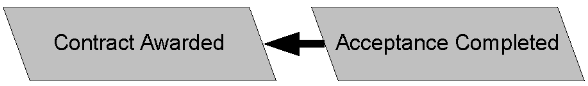
Possible transitions based on 'Acceptance Completed'

From 'Acceptance Completed' to 'Iteration Scheduled'



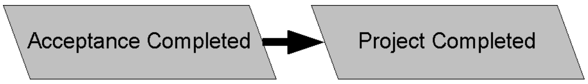
If the system development includes several increments, the detailed planning of the following increments may be initiated after the acceptance of the previous increments. In order to plan a new increment, all unfinished »Problem Report / Change Request s and the »Change Status List will be examined in cooperation with the acquirer. At the decision gate Iteration Planned, this list will be used in order to decide which change requests should be integrated into the new increment and which requests can be deferred for the time being. In addition, it will be specified which of the components that have not yet been implemented shall be included into the new increment. The change requests and any unfinished requests concerning the »Overall System Specification are the basis for a new development cycle. In addition, it will be examined whether the products »Project Manual and »QA Manual are appropriate for the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Contract Awarded'



If acquirer and supplier have agreed in advance that at first only one or a few iterations will be implemented before the overall project is specified contractually, a new »Contract may be awarded or a »Contract Addendum will be specified after the decision gate »Acceptance Completed. In this connection, public acquirers must observe the contract law. These activities are intended to reach the decision gate »Offer Submitted.

From 'Acceptance Completed' to 'Project Completed'



If all requirements have been taken into account and all change requests are completed, it will be decided to finish the project. A »Final Project Report will be prepared and submitted to the acquirer. These activities are intended to reach the decision gate »Project Completed.

5.4 Project (Acquirer) Including System Maintenance

Extended project type: System Development Project (Supplier)

Descriptions

As already described in Part 1: "»Fundamentals of the V-Modell", the V-Model provides specific project type variants, which are adapted to the different »Project Types. The project type variant »Project (Acquirer) Including System Maintenance describes the appropriate procedure for the project type »System Development Project (Supplier).

The project type variant »Project (Acquirer) Including System Maintenance is based on the situation that a system in use must be adapted or changed, e.g. by correcting faults, introducing new technologies, improving the fulfilment of non-functional requirements or modifying or extending functionalities. These "change requirements" will be specified by the Acquirer at the beginning of the project. Additional change requirements, which arise during project execution, can only be managed by the »Problem and Change Management . The Supplier analyses the change requirements, executes the required system changes and delivers the system normally in several iterations. Each iteration will be accepted individually by the Acquirer.

Process Modules to be used

Due to the project type: Configuration Management, Delivery and Acceptance (Supplier), Problem and Change Management, Project Management, Quality Assurance, System Development, Drafting and Conclusion of Contract (Supplier)

Project characteristics to be determined during tailoring

Due to the project type: Security (Supplier), Life Cycle Cost Management, Project Measures, Off-the-Shelf Products, User Interface, Subject of the Project

Due to the project type variant: Subcontract, Legacy System

Activity Flow

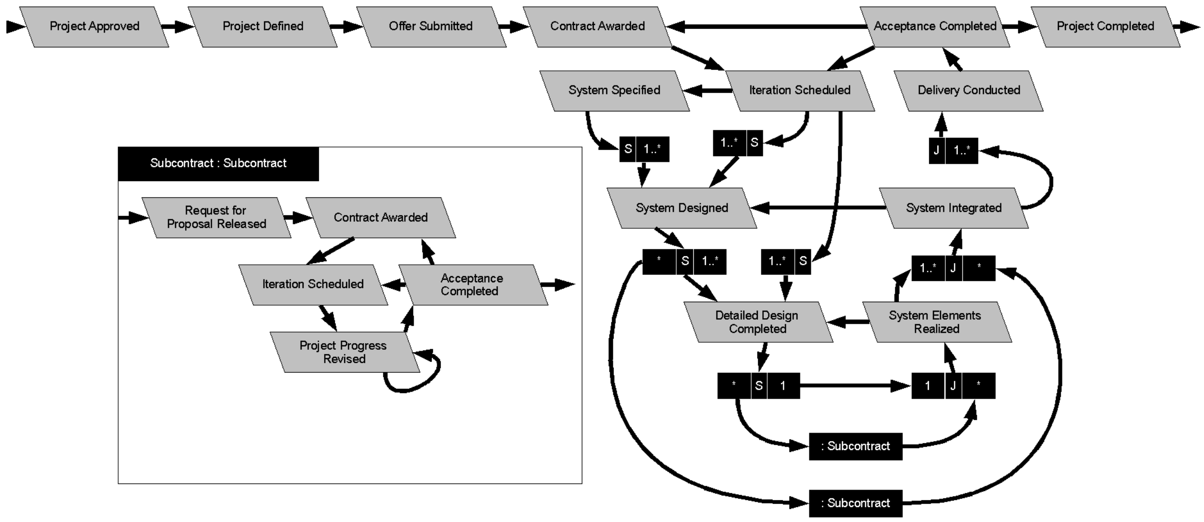


Figure 16: Project type variant Project (Acquirer) Including System Maintenance

The decision gates and the sequence of the project type variant »Project (Acquirer) Including System Maintenance are shown in figure Figure 16. The sequence differs significantly from that of the project type variant »Project (Acquirer) Including Development, Enhancement or Migration by the different system development entry points, which depend on the scope of the system changes to be executed. It may affect the Overall System Specification, the System Design or the Detail Design. In the following, the sequence of System Maintenance will be described by means of the decision gates carried out.

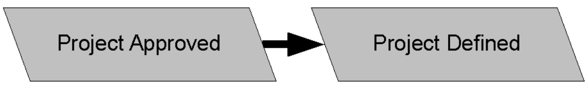
Possible transitions based on 'Projektstart'

From 'Project beginning' to 'Project Approved'

The »Acquirer with one Supplier sends a »Request for Proposal (Acquirer) including the requirements posed on the system to be developed to the »Supplier without Subcontractors. After examining the requirements, the supplier decides whether an »Offer for this request for proposal is reasonable from an economic and strategic point of view. Depending on this decision, the project will be approved (»Project Approved).

Possible transitions based on 'Project Approved'

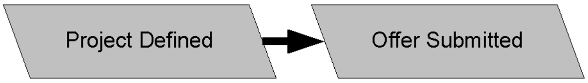
From 'Project Approved' to 'Project Defined'



If the project was approved, the supplier defines the project on a small scale by preparing simple versions of the »Project Manual and »QA Manual including the components relevant for the offer. At the decision gate »Project Defined, it will be examined whether these products are suitable for the conclusion of a contract.

Possible transitions based on 'Project Defined'

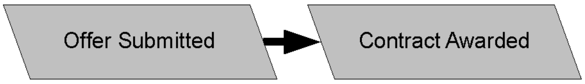
From 'Project Defined' to 'Offer Submitted'



After the project definition, the supplier prepares an »Offer concerning the specified requirements. After examining this offer, the supplier decides whether the offer will be submitted to the acquirer (»Offer Submitted).

Possible transitions based on 'Offer Submitted'

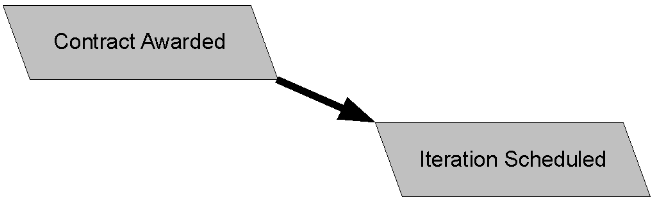
From 'Offer Submitted' to 'Contract Awarded'



If the acquirer accepts the offer, acquirer and supplier will conclude a »Contract, which specifies the system requirements and the framework conditions of the project in writing. (»Contract Awarded).

Possible transitions based on 'Contract Awarded'

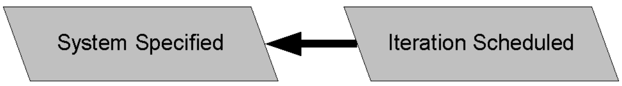
From 'Contract Awarded' to 'Iteration Scheduled'



After the contract has been awarded, the system development procedure, i.e. the decision gates to be passed until the product is accepted, and the scope of the requirements to be implemented will be planned. In addition, it will be examined whether the products »Project Manual and »QA Manual are appropriate for the project. If necessary, these products must be adapted to the requirements. The project and quality management aspects, which have possibly not been taken into account appropriately, will be defined in more detail. These activities are intended to reach the decision gate »Iteration Scheduled.

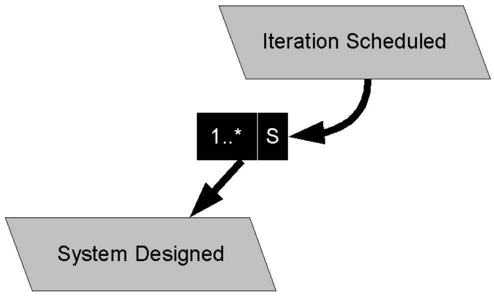
Possible transitions based on 'Iteration Scheduled'

From 'Iteration Scheduled' to 'System Specified'



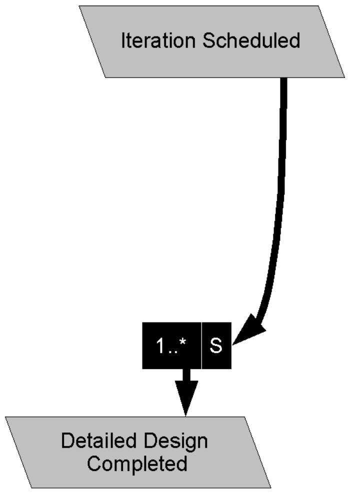
In the project, the requirements planned at the decision gate »Iteration Scheduled will be evaluated in cooperation with the acquirer, and a first preliminary design will be prepared. Requirements and preliminary design will be documented in the »Overall System Specification, which is the basis for the further development of the system. If the project includes the enhancement or migration of a legacy system, a »Legacy System Analysis will be prepared together with the Overall System Specification. These activities are intended to reach the decision gate »System Specified.

From 'Iteration Scheduled' to 'System Designed'



If the changes planned at the decision gate »Iteration Scheduled influence the system design, but do not affect the »Overall System Specification , the system design will be changed. The effects on the system and all identified enabling systems will be designed. This process may be executed independently for the system and each enabling system. These activities are intended to reach the decision gate »System Designed for the system and each enabling system.

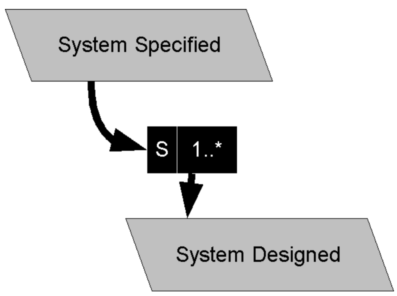
From 'Iteration Scheduled' to 'Detailed Design Completed'



If the changes planned at the decision gate »Iteration Scheduled influence the detailed design, but do not affect the Overall System Specification and the system design, the detailed design will be changed. For this purpose the architectures of hardware and software units will be subdivided into components and modules. These activities are intended to reach the decision gate »Detailed Design Completed.

Possible transitions based on 'System Specified'

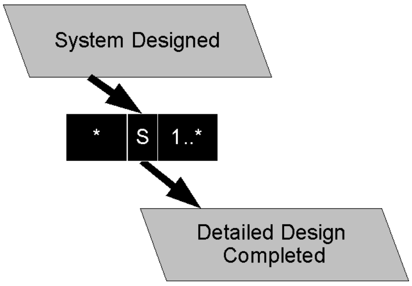
From 'System Specified' to 'System Designed'



Based on the preliminary design, architectures will be designed for the system and all identifiable »Enabling Systems . The architectures will define the »Segment s down to the level of hardware and software units. The requirements will be specified and assigned to system elements. Development process and evaluation strategy will be specified. The following decision gates to be executed until the project is delivered can be planned independently and executed simultaneously for the system and the various enabling systems. These activities are intended to reach the decision gate »System Designed for the system and every enabling system.

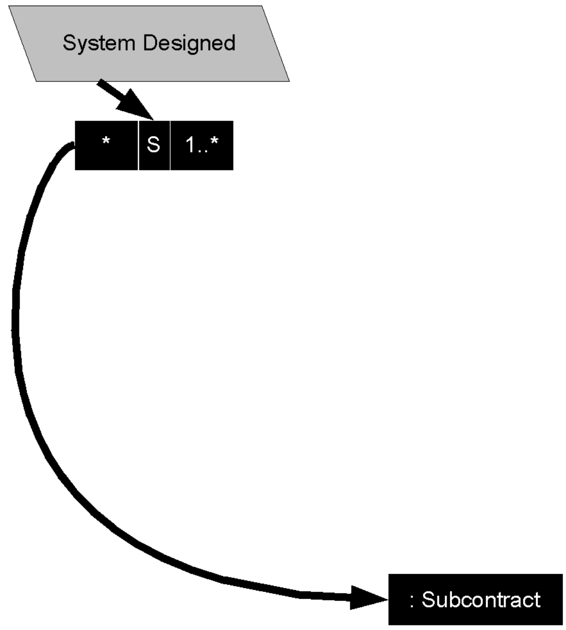
Possible transitions based on 'System Designed'

From 'System Designed' to 'Detailed Design Completed'



After the decision gate »System Designed has been reached, the work on the detailed design may begin. For the detailed design, the architectures of the hardware and software units will be developed into components and process modules, and external software/hardware specifications will be prepared as required. The requirements will be assigned to the hardware and software elements. Development process and test strategy will be specified. On the way towards the integration of realized system elements, it is possible to plan and conduct the design of hardware and software units simultaneously with the realization of other hardware and software units. These activities are intended to reach the decision gate »Detailed Design Completed for every workflow. Due to possible parallel workflows, it is possible that the decision gate »Detailed Design Completed has been reached in some segments - and the realization may begin - while the detailed design for other segments is not yet completed.

From 'System Designed' to 'Request for Proposal Released'

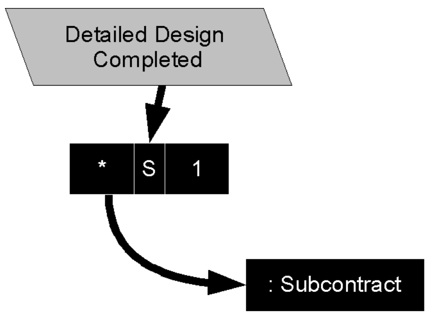


If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

Possible transitions based on 'Detailed Design Completed'

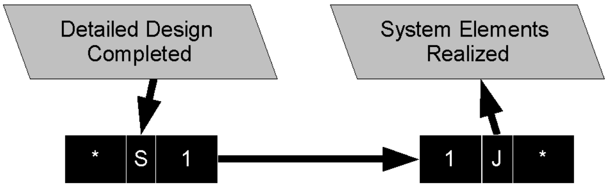
From 'Detailed Design Completed' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

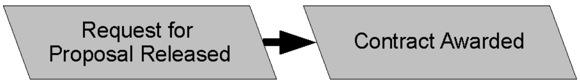
From 'Detailed Design Completed' to 'System Elements Realized'



All hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements. In this context, also an iterative approach is possible, extending the detailed design after some system elements of the detailed design have been realized. If an External Hardware/Software Module Specifications were prepared during the detailed design, subcontracts may be awarded for the development of the software/hardware modules. If no subcontracts are awarded, all hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

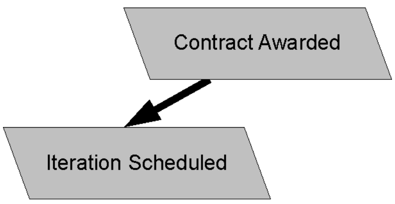
From 'Request for Proposal Released' to 'Contract Awarded'



The »Offers received after the »Request for Proposal will be evaluated in accordance with the »Criteria Catalog for Assessment of Offers. A provider with whom negotiations will be conducted will be selected. The acquirer decides - based on the assessment of the offers and the result of the contract negotiations - if the offer of the selected provider should be accepted. In case of a positive decision, a »Contract will be concluded between acquirer and supplier. In case of public acquirers and suppliers, contract negotiations are only possible under strict conditions. The public acquirer employs the »Offer Assessment in order to decide which offer is the most economical offer. The contract award commits the supplier to execute the project for the acquirer in accordance with the contractual agreements. These activities are intended to reach the decision gate »Contract Awarded.

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

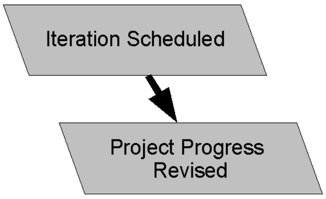
From 'Contract Awarded' to 'Iteration Scheduled'



After a »Contract has been concluded, the system development process, i.e., the decision gates to be achieved and the extent of the requirements to be implemented, will be planned. In addition, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. Otherwise these products will be adapted. These activities are intended to reach the decision gate »Iteration Scheduled.

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

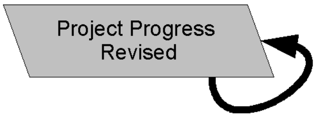
From 'Iteration Scheduled' to 'Project Progress Revised'



Then the acquirer is then tasked with supporting the execution of the supplier's project at the current »Project Stage in accordance with the specifications made in the contract. This is intended to ensure the success of the project and is a decisive acquirer task in this project execution strategy. The supplier will submit a Project Status Report (Supplier) for controlling the project progress. This report will determine which results have been achieved at the agreed project milestones. For this purpose, the acquirer will prepare a Project Status Report of his/her own. These activities are intended to reach the decision gate »Project Progress Revised.

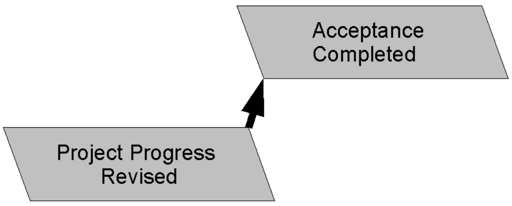
Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

From 'Project Progress Revised' to 'Project Progress Revised'



The supplier will submit the Project Status Report to the acquirer at regular intervals, which may be adapted to the sequence of the supplier's Project Progress Decisions. At these points, the acquirer will also prepare a Project Status Report. These activities are intended to reach the decision gate »Project Progress Revised.

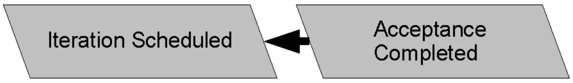
From 'Project Progress Revised' to 'Acceptance Completed'



If the supplier has achieved a specified system development status, the acquirer will receive the contractually agreed deliveries. The acquirer examines whether the »Delivery (Supplier) meets the requirements. This leads to the project progress decision of the decision gate »Acceptance Completed.

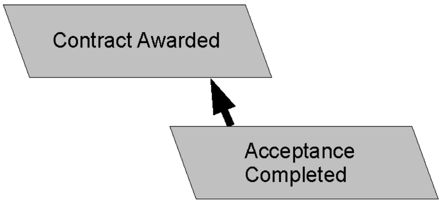
Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

From 'Acceptance Completed' to 'Iteration Scheduled'



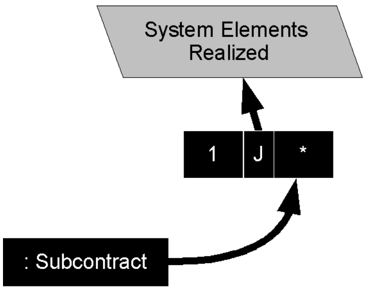
In order to plan a new iteration after the acceptance, the acquirer will check the open change requests of the »Change Status List in cooperation with the supplier. At the decision gate »Iteration Scheduled, this list is used for deciding which change requests will be included into the new iteration and which will be postponed for the time being. In addition, it will be specified, which of the components that have not yet been implemented will be taken into account in the new iteration. The change requests and the open requirements are the basis for a new development cycle. Again, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Contract Awarded'



If acquirer and supplier have determined previously that one or a few iterations will first be implemented before the overall scope is fixed contractually, a new »Contract will possibly be concluded after the acceptance has been completed. If necessary, a »Contract Addendum will be agreed with the supplier. These activities are intended to reach the decision gate »Contract Awarded.

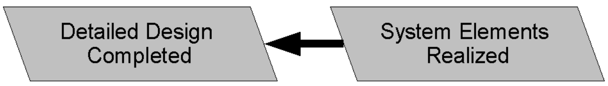
From 'Acceptance Completed' to 'System Elements Realized'



After acceptance, the units will be integrated into the project.

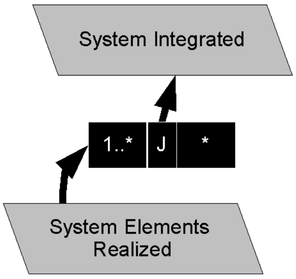
Possible transitions based on 'System Elements Realized'

From 'System Elements Realized' to 'Detailed Design Completed'



In order to permit an iterative execution of detailed design and realization, it is possible to go back to the preparation of the detailed design after the realization. In this step, hardware and software units, which have not been included into the detailed design process during the previous iteration, will be designed in detail. These activities are intended to reach decision gate »Detailed Design Completed.

From 'System Elements Realized' to 'System Integrated'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

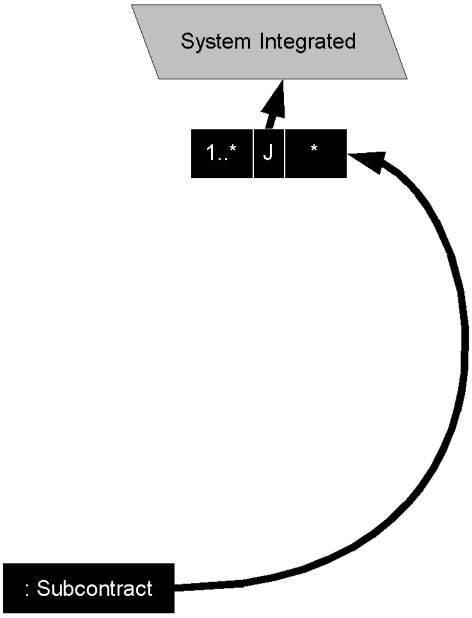
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

From 'Acceptance Completed' to 'System Integrated'



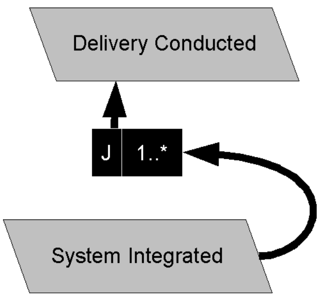
All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'System Integrated'

From 'System Integrated' to 'System Designed'

Since not only detailed design and realization, but also system design and integration can be executed in an iterative manner, a new internal iteration may be planned for system design. In the architectures, system elements not yet implemented are identified down to the level of hardware and software units. These activities are intended to reach the decision gate »System Designed.

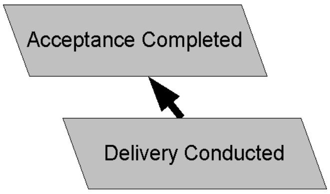
From 'System Integrated' to 'Delivery Conducted'



The overall system to be delivered will be assorted for delivery in accordance with the requirements. A delivery includes the system, any enabling systems and documentation. At the decision gate »Delivery Conducted, the results will be examined, and it will be decided whether the delivery will be sent to the acquirer for acceptance.

Possible transitions based on 'Delivery Conducted'

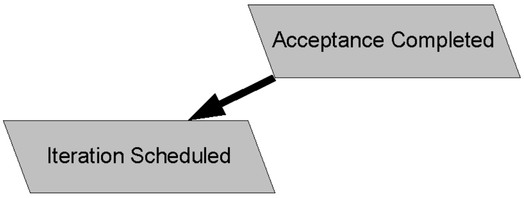
From 'Delivery Conducted' to 'Acceptance Completed'



The acquirer tests the »Delivery in order to determine if the requirements are fulfilled. At the decision gate »Acceptance Completed, the acquirer will examine the results and decide whether a »Statement of Acceptance will be granted or corrective actions by the supplier are required. These activities are intended to reach the decision gate »Acceptance Completed.

Possible transitions based on 'Acceptance Completed'

From 'Acceptance Completed' to 'Iteration Scheduled'

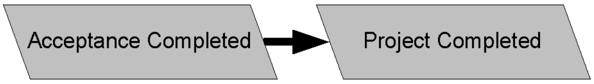


If the system development includes several increments, the detailed planning of the following increments may be initiated after the acceptance of the previous increments. In order to plan a new increment, all unfinished »Problem Report / Change Request s and the »Change Status List will be examined in cooperation with the acquirer. At the decision gate Iteration Planned, this list will be used in order to decide which change requests should be integrated into the new increment and which requests can be deferred for the time being. In addition, it will be specified which of the components that have not yet been implemented shall be included into the new increment. The change requests and any unfinished requests concerning the »Overall System Specification are the basis for a new development cycle. In addition, it will be examined whether the products »Project Manual and »QA Manual are appropriate for the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Contract Awarded'

If acquirer and supplier have agreed in advance that at first only one or a few iterations will be implemented before the overall project is specified contractually, a new »Contract may be awarded or a »Contract Addendum will be specified after the decision gate »Acceptance Completed. In this connection, public acquirers must observe the contract law. These activities are intended to reach the decision gate »Offer Submitted.

From 'Acceptance Completed' to 'Project Completed'



If all requirements have been taken into account and all change requests are completed, it will be decided to finish the project. A »Final Project Report will be prepared and submitted to the acquirer. These activities are intended to reach the decision gate »Project Completed.

5.5 Project (Acquirer/Supplier) Including Development, Enhancement or Migration

Extended project type: System Development Project (Acquirer/Supplier)

Descriptions

As already described in Part 1: "»Fundamentals of the V-Modell", the V-Model provides specific project type variants, which are adapted to the different »Project Types. The project type variant »Project (Acquirer/Supplier) Including Development, Enhancement or Migration can only be applied to the project type »System Development Project (Acquirer/Supplier), i.e. if it is not necessary to subdivide a system development project into two separate projects - one for the side of the Acquirer and one for the side of the Supplier. This is possible, if the system development project is executed within one organization or if several organizations, which deliberately cooperate closely in one project, participate in the project. As distinguished from a separate »System Development Project (Acquirer) und »System Development Project (Supplier), the Request for Proposals and Contracting and the dual project organization with two Project Leaders are not required.

The project type variant »Project (Acquirer/Supplier) Including Development, Enhancement or Migration is based on the fundamental idea that the user requirements are relatively clear at the beginning of the project. After the Requirements have been defined in the decision gate »Requirements Specified, subsequent changes of the Requirements can only be executed via the problem and change management and the »Decision Gate »Iteration Scheduled. The system will be designed, realized and delivered in individual stages, which are also referred to as »Increment. Each stage will be accepted individually. The System Developer may execute several internal iterations before delivering an increment.

In this »Project Execution Strategy, changes within one increment should be avoided and included by the Change Management into the following increment. Important changes, which could - for example - influence the system architecture significantly, should be forwarded as early as possible. This procedure has the advantage of providing the User with a prestage, which already realizes the system's most important basic functionalities at an early time.

The project type variant »Project (Acquirer/Supplier) Including Development, Enhancement or Migration is not only suitable for the development of new systems. During the enhancement of legacy systems, the new System Requirements, which will be included in the enhancement process, are documented. The enhancement or migration of a system in maintenance is indicated if System Requirements would entail effects on the system architecture.

If the system is migrated to a new enviroment, e.g. a new hardware platform or a new running time environment, the Requirements will be based on other features. These may include the existing functionalities as determined by the Overall System Specification (»System Specified) within the scope of the »Legacy System Analysis, Requirements of the change status list, and new Requirements of the User. A complete migration is not always necessary. In case of a partial migration, parts of the legacy system remain on their original platform while the access to the new system is provided by integration technologies.

Process Modules to be used

Due to the project type:	Specification of Requirements, Configuration Management, Delivery and Acceptance (Acquirer), Delivery and Acceptance (Supplier), Problem and Change Management, Project Management, Quality Assurance, System Development

Project characteristics to be determined during tailoring

Due to the project type:	Security (Supplier), Life Cycle Cost Management, Project Measures, Off-the-Shelf Products, User Interface, Subject of the Project
Due to the project type variant:	Subcontract, Legacy System, Prototype Development

Activity Flow

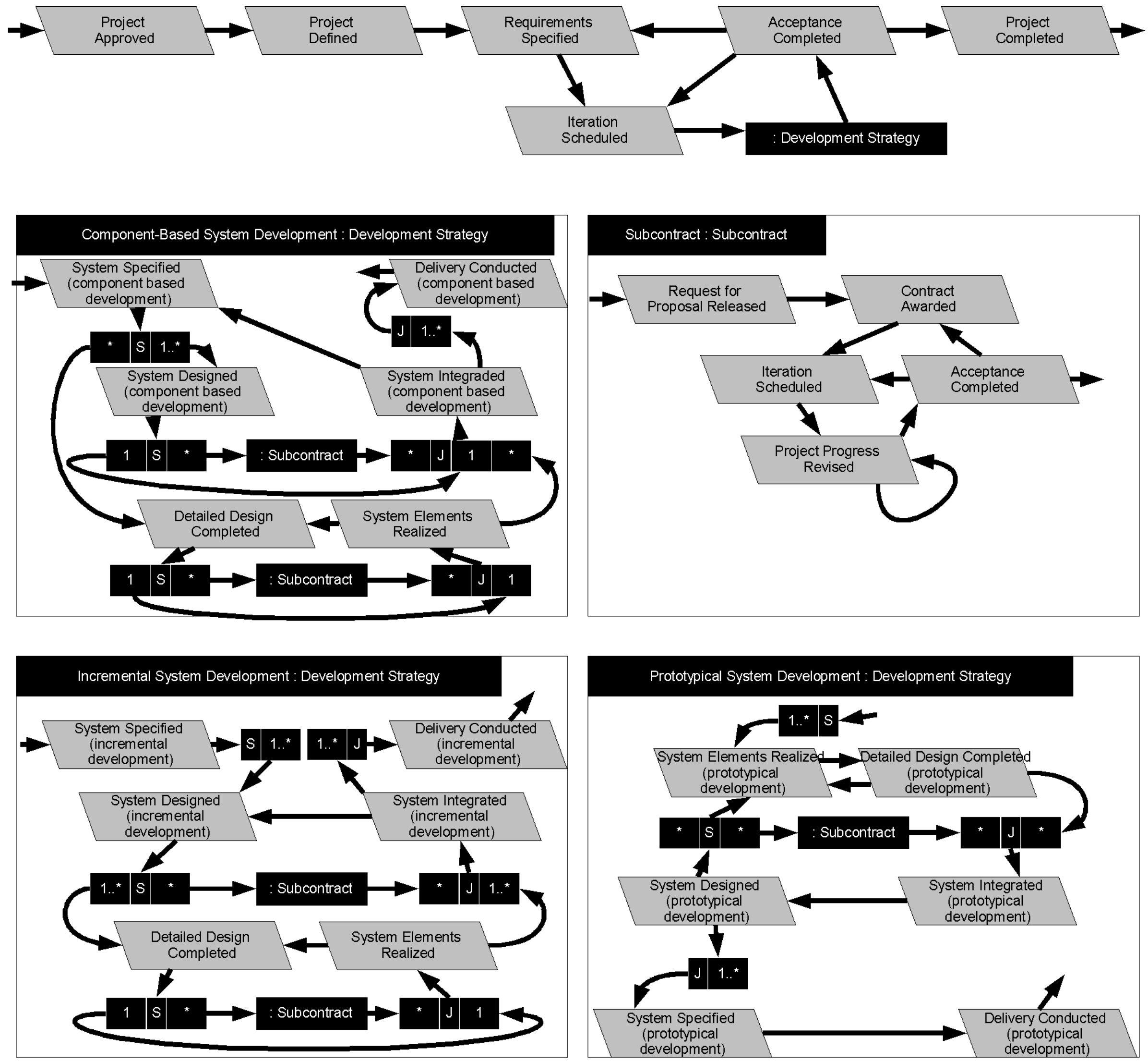


Figure 17: Project type variant Project (Acquirer/Supplier) Including Development, Enhancement or Migration

The decision gates and the sequence of the project type variant »Project (Acquirer/Supplier) Including Development, Enhancement or Migration are shown in figure Figure 17. This project type variant permits the application of different development strategies:

1. »Incremental Development
2. »Component-Based Development
3. »Prototypic Development

The decision for a development strategy is always made after the decision gate »Iteration Scheduled has been scheduled. If there are, for example, high realization risks, it is possible to execute an early iteration by means of a prototypic development.

In the following, the sequence will be described by means of the decision gates carried out.

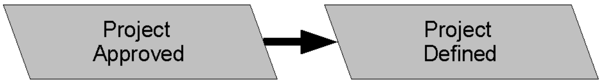
Possible transitions based on 'Projektstart'

From 'Project beginning' to 'Project Approved'

The potential acquirer, operating under the custodianship of a sponsor, prepares a »Project Proposal which includes all information required for deciding on the implementation of the proposal in form of a project. A sponsor is defined as person or department providing a budget for project acquisition. The project proposal is discussed in the decision gate »Project Approved, which ends with the decision as to whether or not the project should be started.

Possible transitions based on 'Project Approved'

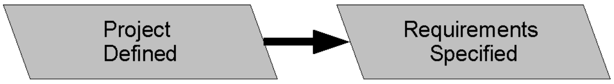
From 'Project Approved' to 'Project Defined'



In case of a positive decision, a Project Manual and a QA Manual will be prepared, which will be examined in order to determine if they are suitable for project execution on side of the acquirer. These activities are intended to reach the decision gate »Project Defined.

Possible transitions based on 'Project Defined'

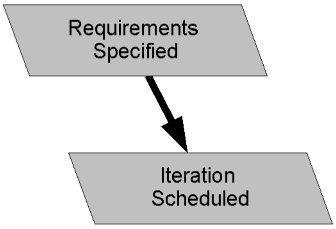
From 'Project Defined' to 'Requirements Specified'



After project definition, the user requirements will be prepared and subjected to a »Requirements Evaluation. The user will examine the requirements for completeness and correctness. In case of a positive assessment, the acquirer specifies and prioritizes the requirements in form of the »Requirements Specification. In addition, an »RFP Concept will be prepared in order to ensure that the contract award law will be observed during the request for proposal. These activities are intended to reach the decision gate »Requirements Specified.

Possible transitions based on 'Requirements Specified'

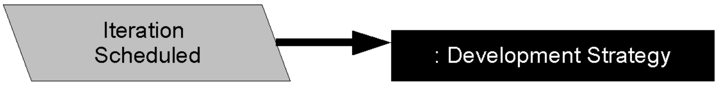
From 'Requirements Specified' to 'Iteration Scheduled'



If the product Requirements Specification includes functional requirements, the scope of the requirements implemented in the respective iteration will be planned. In addition, it will be examined whether the products »Project Manual and »QA Manual are appropriate for the project. If necessary, these products must be adapted to the requirements. These activities are intended to reach the decision gate »Iteration Scheduled.

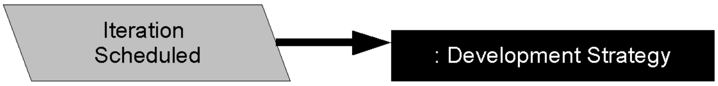
Possible transitions based on 'Iteration Scheduled'

From 'Iteration Scheduled' to 'System Elements Realized (prototypical development)'



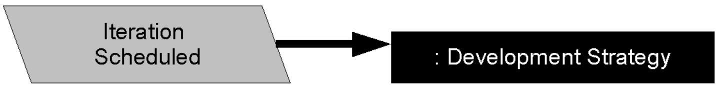
After the iteration has been planned, the realization of the individual software units of the system and the enabling systems will begin. Of course, this requires a basic understanding of the system architecture and the information which system elements should be realized. However, this is not reflected in a decision gate, since the agile system development permits the architecture and additional design decisions to be changed without problems during the implementation. At this point, the evaluation reports are used in order to check whether the individual system elements were realized in accordance with the acquirer requirements. The realization finally leads to the decision gate »System Elements Realized.

From 'Iteration Scheduled' to 'System Specified (component based development)'



In the project, the requirements planned will be evaluated, and a first preliminary design will be prepared. Requirements and preliminary design will be documented in the »Overall System Specification, which is the basis for the further development of the system. If the project includes the enhancement or migration of a legacy system, a »Legacy System Analysis will be prepared together with the Overall System Specification. These activities are intended to reach the decision gate »System Specified.

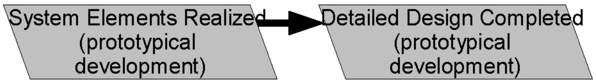
From 'Iteration Scheduled' to 'System Specified (incremental development)'



In the project, the requirements planned at the decision gate »Iteration Scheduled will be evaluated in cooperation with the acquirer, and a first preliminary design will be prepared. Requirements and preliminary design will be documented in the »Overall System Specification, which is the basis for the further development of the system. If the project includes the enhancement or migration of a legacy system, a »Legacy System Analysis will be prepared together with the Overall System Specification. These activities are intended to reach the decision gate »System Specified.

Possible transitions based on 'System Elements Realized (prototypical development)' (Ablaufbaustein Prototypical System Development)

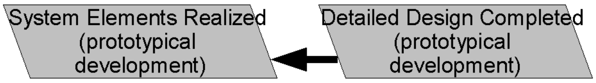
From 'System Elements Realized (prototypical development)' to 'Detailed Design Completed (prototypical development)'



The specification and documentation of the elements can be prepared based on the realized system elements. The correctness of the specifications will be examined at the decision gate »Detailed Design Completed.

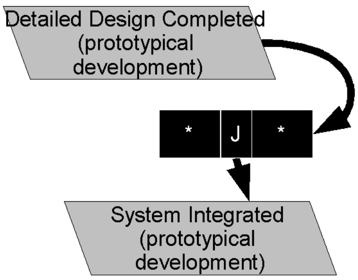
Possible transitions based on 'Detailed Design Completed (prototypical development)' (Ablaufbaustein Prototypical System Development)

From 'Detailed Design Completed (prototypical development)' to 'System Elements Realized (prototypical development)'



After the detailed designed has been specified, software elements can be realized anew. This provides a possibility for planning internal iterations in the software development. These activities are intended to reach the decision gate »System Elements Realized.

From 'Detailed Design Completed (prototypical development)' to 'System Integrated (prototypical development)'



After specification of the detailed design, the elements will be integrated, and the correct functionality of the system will be examined based on the evaluation reports of the system. If there are separate suborders, their results will now be integrated. These activities are intended to reach the decision gate »System Integrated.

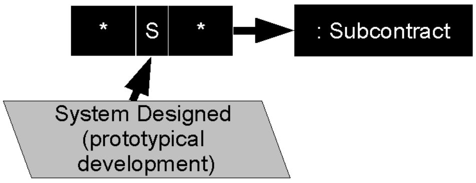
Possible transitions based on 'System Integrated (prototypical development)' (Ablaufbaustein Prototypical System Development)

From 'System Integrated (prototypical development)' to 'System Designed (prototypical development)'

If the integrated systems and enabling systems are available, the architecture of the systems and enabling systems can be specified. The capacity of these architectures will be examined. These activities are intended to reach the decision gate »System Designed.

Possible transitions based on 'System Designed (prototypical development)' (Ablaufbaustein Prototypical System Development)

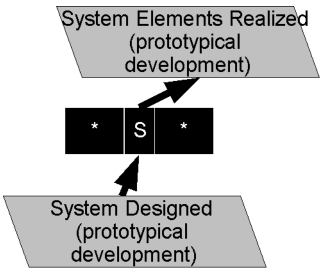
From 'System Designed (prototypical development)' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

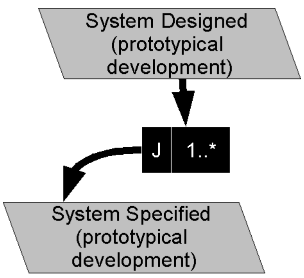
Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

From 'System Designed (prototypical development)' to 'System Elements Realized (prototypical development)'



The system design is the prerequisite for executing an additional realization iteration before the overall system is specified. For this purpose, software elements already realized will be developed further or components not yet processed will be implemented. These activities are intended to reach the decision gate »System Elements Realized.

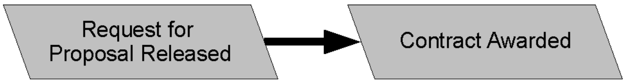
From 'System Designed (prototypical development)' to 'System Specified (prototypical development)'



After the decision gate »System Designed has been reached and all internal iterations have been completed, the specification for the developed overall system will be prepared, taking into account all systems and enabling systems which have been realized and designed up to now. Afterwards, the correctness of the »Overall System Specification will be rechecked. These activities are intended to reach the decision gate »System Specified.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

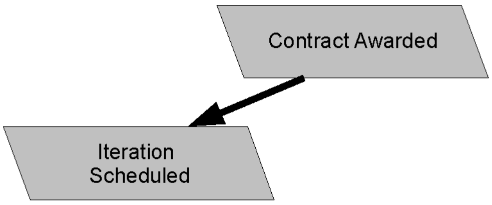
From 'Request for Proposal Released' to 'Contract Awarded'



The »Offers received after the »Request for Proposal will be evaluated in accordance with the »Criteria Catalog for Assessment of Offers. A provider with whom negotiations will be conducted will be selected. The acquirer decides - based on the assessment of the offers and the result of the contract negotiations - if the offer of the selected provider should be accepted. In case of a positive decision, a »Contract will be concluded between acquirer and supplier. In case of public acquirers and suppliers, contract negotiations are only possible under strict conditions. The public acquirer employs the »Offer Assessment in order to decide which offer is the most economical offer. The contract award commits the supplier to execute the project for the acquirer in accordance with the contractual agreements. These activities are intended to reach the decision gate »Contract Awarded.

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

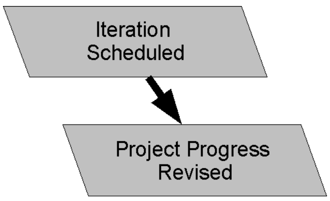
From 'Contract Awarded' to 'Iteration Scheduled'



After a »Contract has been concluded, the system development process, i.e., the decision gates to be achieved and the extent of the requirements to be implemented, will be planned. In addition, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. Otherwise these products will be adapted. These activities are intended to reach the decision gate »Iteration Scheduled.

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

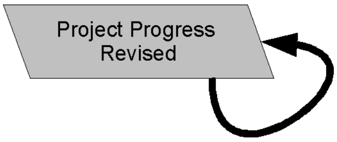
From 'Iteration Scheduled' to 'Project Progress Revised'



Then the acquirer is then tasked with supporting the execution of the supplier's project at the current »Project Stage in accordance with the specifications made in the contract. This is intended to ensure the success of the project and is a decisive acquirer task in this project execution strategy. The supplier will submit a Project Status Report (Supplier) for controlling the project progress. This report will determine which results have been achieved at the agreed project milestones. For this purpose, the acquirer will prepare a Project Status Report of his/her own. These activities are intended to reach the decision gate »Project Progress Revised.

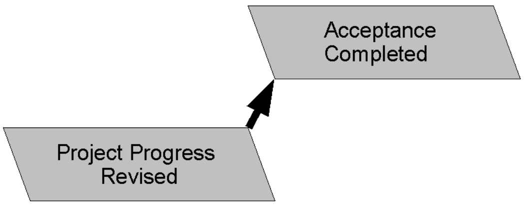
Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

From 'Project Progress Revised' to 'Project Progress Revised'



The supplier will submit the Project Status Report to the acquirer at regular intervals, which may be adapted to the sequence of the supplier's Project Progress Decisions. At these points, the acquirer will also prepare a Project Status Report. These activities are intended to reach the decision gate »Project Progress Revised.

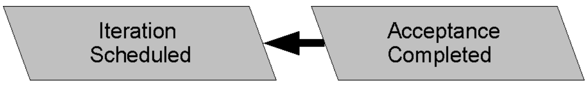
From 'Project Progress Revised' to 'Acceptance Completed'



If the supplier has achieved a specified system development status, the acquirer will receive the contractually agreed deliveries. The acquirer examines whether the »Delivery (Supplier) meets the requirements. This leads to the project progress decision of the decision gate »Acceptance Completed.

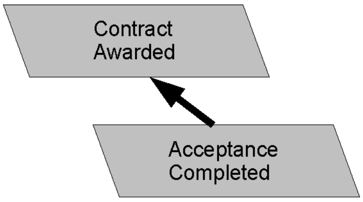
Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

From 'Acceptance Completed' to 'Iteration Scheduled'



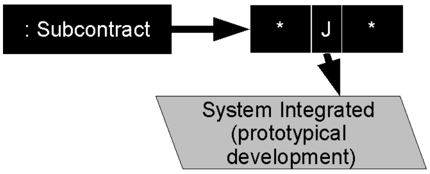
In order to plan a new iteration after the acceptance, the acquirer will check the open change requests of the »Change Status List in cooperation with the supplier. At the decision gate »Iteration Scheduled, this list is used for deciding which change requests will be included into the new iteration and which will be postponed for the time being. In addition, it will be specified, which of the components that have not yet been implemented will be taken into account in the new iteration. The change requests and the open requirements are the basis for a new development cycle. Again, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Contract Awarded'



If acquirer and supplier have determined previously that one or a few iterations will first be implemented before the overall scope is fixed contractually, a new »Contract will possibly be concluded after the acceptance has been completed. If necessary, a »Contract Addendum will be agreed with the supplier. These activities are intended to reach the decision gate »Contract Awarded.

From 'Acceptance Completed' to 'System Integrated (prototypical development)'



After specification of the detailed design, the elements will be integrated, and the correct functionality of the system will be examined based on the evaluation reports of the system. If there are separate suborders, their results will now be integrated. These activities are intended to reach the decision gate »System Integrated.

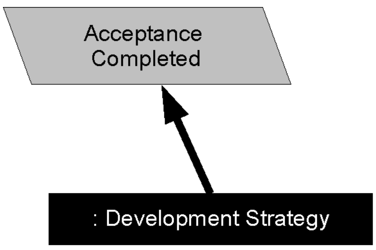
Possible transitions based on 'System Specified (prototypical development)' (Ablaufbaustein Prototypical System Development)

From 'System Specified (prototypical development)' to 'Delivery Conducted (prototypical development)'

After the overall system developed in an agile manner has been specified it will be checked whether a delivery is possible. In case of a positive decision, the current version of the system will be delivered to the acquirer, and the decision gate »Delivery Conducted is reached.

Possible transitions based on 'Delivery Conducted (prototypical development)' (Ablaufbaustein Prototypical System Development)

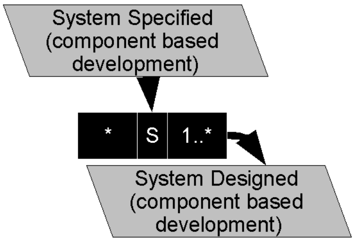
From 'Delivery Conducted (prototypical development)' to 'Acceptance Completed'



The acquirer tests the »Delivery in order to determine if the requirements are fulfilled. At the decision gate »Acceptance Completed, the acquirer will examine the results and decide whether corrective actions are required. These activities are intended to reach the decision gate »Acceptance Completed .

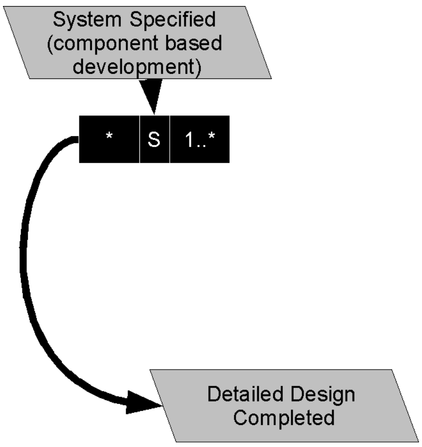
Possible transitions based on 'System Specified (component based development)' (Ablaufbaustein Component-Based System Development)

From 'System Specified (component based development)' to 'System Designed (component based development)'



Based on the preliminary design, architectures will be designed for the system and all identifiable »Enabling Systems . The architectures will define the »Segment s down to the level of hardware and software units. The requirements will be specified and assigned to system elements. Development process and evaluation strategy will be specified. The following decision gates to be executed until the project is delivered can be planned independently and executed simultaneously for the system and the various enabling systems. These activities are intended to reach the decision gate »System Designed for the system and every enabling system.

From 'System Specified (component based development)' to 'Detailed Design Completed'

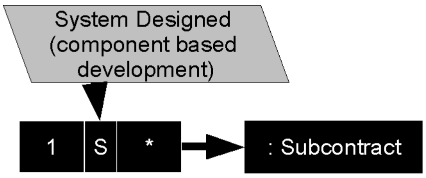


After the decision gate »System Specified has been reached, the work on the detailed design may begin, which will happen simultaneously with the preparation of the system design at the Decision Gate System Designed. At this decision gate, the system is developed *top-down*, i.e., from the system down to the units, based on the »Overall System Specification. In the project execution strategy »Component-based System Development (Supplier), not only the »Overall System Specification, but also the specifications for external software/hardware modules are available. In order to integrate these modules into the system design, the detailed design for the modules will be prepared *bottom-up*, i.e., from modules to units. If system design and detailed design are developed in parallel, it must be ensured, that the common interfaces, i.e., »Software Unit, »Hardware Units and »External

Unit, reflect the design coherently. In addition, the development process and test strategy will be specified, and external software/hardware specifications for any suborders will be prepared as required. These activities are intended develop the system design in parallel to the detailed design and to reach the decision gate »Detailed Design Completed.

Possible transitions based on 'System Designed (component based development)' (Ablaufbaustein Component-Based System Development)

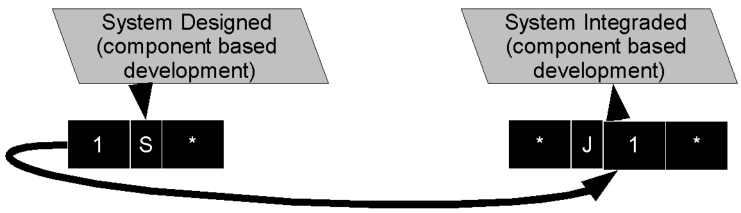
From 'System Designed (component based development)' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

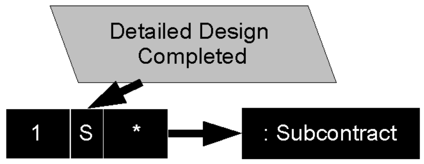
From 'System Designed (component based development)' to 'System Integraded (component based development)'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. In order to ensure the integration capability of the different units, the process aims at the Decision Gate System Integrated while awarding contracts for external units and providing for the project-own realization of units. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'Detailed Design Completed' (Ablaufbaustein Component-Based System Development)

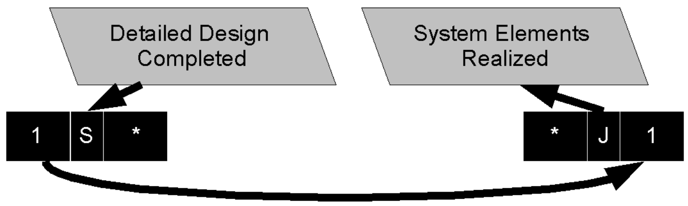
From 'Detailed Design Completed' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

From 'Detailed Design Completed' to 'System Elements Realized'



All hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements. In this context, also an iterative approach is possible, extending the detailed design after some system elements of the detailed design have been realized. If an External Hardware/Software Module Specifications were prepared during the detailed design, subcontracts may be awarded for the development of the software/hardware modules. If no subcontracts are awarded, all hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

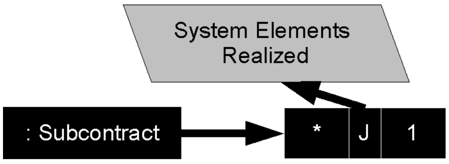
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

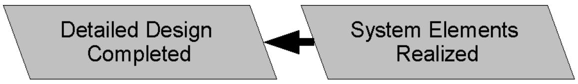
From 'Acceptance Completed' to 'System Elements Realized'



After acceptance, the units will be integrated into the project.

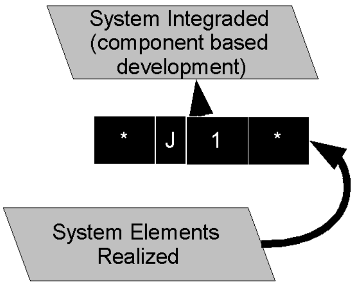
Possible transitions based on 'System Elements Realized' (Ablaufbaustein Component-Based System Development)

From 'System Elements Realized' to 'Detailed Design Completed'



In order to permit an iterative execution of detailed design and realization, it is possible to go back to the preparation of the detailed design after the realization. In this step, hardware and software units, which have not been included into the detailed design process during the previous iteration, will be designed in detail. These activities are intended to reach decision gate »Detailed Design Completed.

From 'System Elements Realized' to 'System Integraded (component based development)'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. In order to ensure the integration capability of the different units, the process aims at the Decision Gate System Integrated while awarding contracts for external units and providing for the project-own realization of units. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

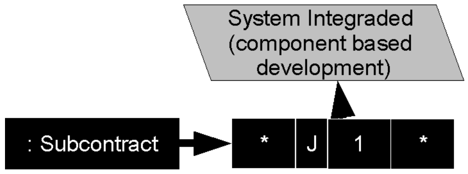
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

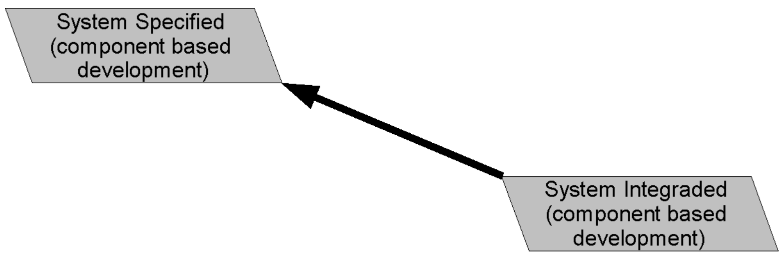
From 'Acceptance Completed' to 'System Integraded (component based development)'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. In order to ensure the integration capability of the different units, the process aims at the Decision Gate System Integrated while awarding contracts for external units and providing for the project-own realization of units. These activities are intended to reach the decision gate »System Integrated.

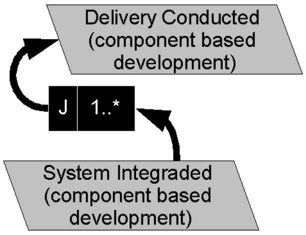
Possible transitions based on 'System Integraded (component based development)' (Ablaufbaustein Component-Based System Development)

From 'System Integraded (component based development)' to 'System Specified (component based development)'



Since internal iterations can be executed in this project execution strategy, a new internal iteration may be planned. For this purpose, a transition to the Decision Gate »System Specified can be established by extending the »Overall System Specification. These activities are intended to reach the decision gate »System Designed.

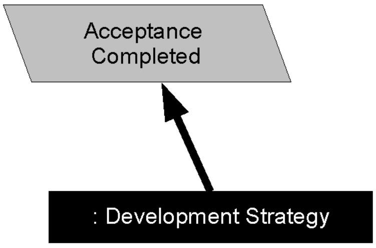
From 'System Integraded (component based development)' to 'Delivery Conducted (component based development)'



The overall system to be delivered will be assorted for delivery in accordance with the requirements. A delivery includes the system, any enabling systems and documentation. At the decision gate »Delivery Conducted, the results will be examined, and it will be decided whether the delivery will be sent to the acquirer for acceptance.

Possible transitions based on 'Delivery Conducted (component based development)' (Ablaufbaustein Component-Based System Development)

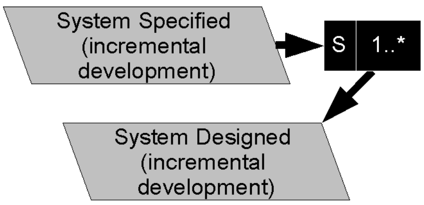
From 'Delivery Conducted (component based development)' to 'Acceptance Completed'



The acquirer tests the »Delivery in order to determine if the requirements are fulfilled. At the decision gate »Acceptance Completed, the acquirer will examine the results and decide whether corrective actions are required. These activities are intended to reach the decision gate »Acceptance Completed .

Possible transitions based on 'System Specified (incremental development)' (Ablaufbaustein Incremental System Development)

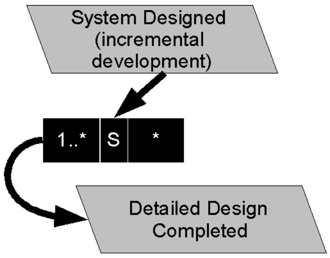
From 'System Specified (incremental development)' to 'System Designed (incremental development)'



Based on the preliminary design, architectures will be designed for the system and all identifiable »Enabling Systems . The architectures will define the »Segment s down to the level of hardware and software units. The requirements will be specified and assigned to system elements. Development process and evaluation strategy will be specified. The following decision gates to be executed until the project is delivered can be planned independently and executed simultaneously for the system and the various enabling systems. These activities are intended to reach the decision gate »System Designed for the system and every enabling system.

Possible transitions based on 'System Designed (incremental development)' (Ablaufbaustein Incremental System Development)

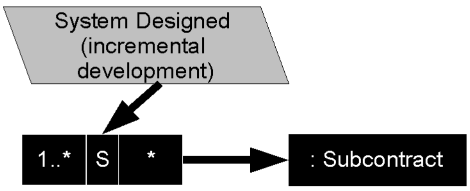
From 'System Designed (incremental development)' to 'Detailed Design Completed'



After the decision gate »System Designed has been reached, the work on the detailed design may begin. For the detailed design, the architectures of the hardware and software units will be developed into components and process modules, and external software/hardware specifications will be prepared as required. The requirements will be assigned to the hardware and software elements. Development process and test strategy will be specified. On the way towards the integration of realized system elements, it is possible to plan and conduct the design of hardware and software units simultaneously with the realization of other hardware and software units. These activities are intended to reach the decision gate »Detailed Design Completed for every workflow.

Due to possible parallel workflows, it is possible that the decision gate »Detailed Design Completed has been reached in some segments - and the realization may begin - while the detailed design for other segments is not yet completed.

From 'System Designed (incremental development)' to 'Request for Proposal Released'

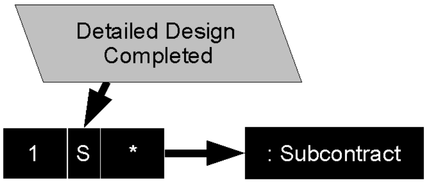


If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

Possible transitions based on 'Detailed Design Completed' (Ablaufbaustein Incremental System Development)

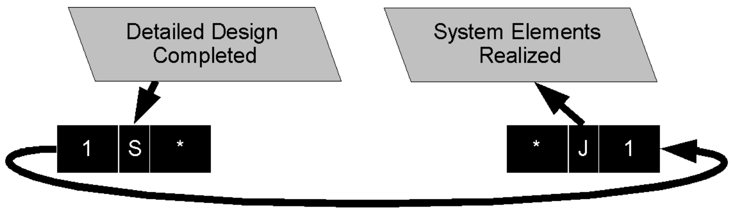
From 'Detailed Design Completed' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

From 'Detailed Design Completed' to 'System Elements Realized'



All hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements. In this context, also an iterative approach is possible, extending the detailed design after some system elements of the detailed design have been realized. If an External Hardware/Software Module Specifications were prepared during the detailed design, subcontracts may be awarded for the development of the software/hardware modules. If no subcontracts are awarded, all hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

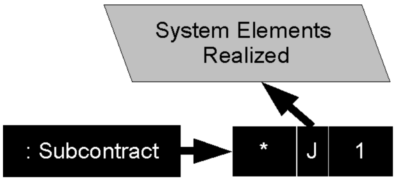
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

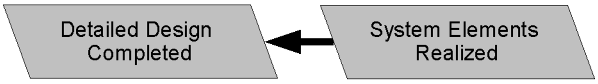
From 'Acceptance Completed' to 'System Elements Realized'



After acceptance, the units will be integrated into the project.

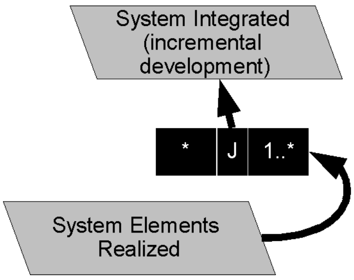
Possible transitions based on 'System Elements Realized' (Ablaufbaustein Incremental System Development)

From 'System Elements Realized' to 'Detailed Design Completed'



In order to permit an iterative execution of detailed design and realization, it is possible to go back to the preparation of the detailed design after the realization. In this step, hardware and software units, which have not been included into the detailed design process during the previous iteration, will be designed in detail. These activities are intended to reach decision gate »Detailed Design Completed.

From 'System Elements Realized' to 'System Integrated (incremental development)'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

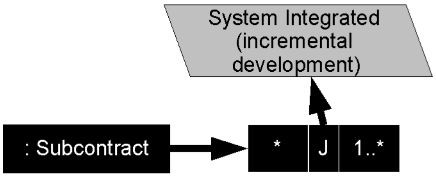
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

From 'Acceptance Completed' to 'System Integrated (incremental development)'



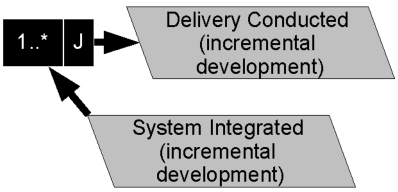
All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'System Integrated (incremental development)' (Ablaufbaustein Incremental System Development)

From 'System Integrated (incremental development)' to 'System Designed (incremental development)'

Since not only detailed design and realization, but also system design and integration can be executed in an iterative manner, a new internal iteration may be planned for system design. In the architectures, system elements not yet implemented are identified down to the level of hardware and software units. These activities are intended to reach the decision gate »System Designed.

From 'System Integrated (incremental development)' to 'Delivery Conducted (incremental development)'

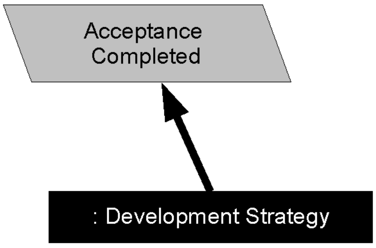


The overall system to be delivered will be assorted for delivery in accordance with the requirements. A delivery includes the system, any enabling systems and documentation. At the decision gate »Delivery Conducted, the results will be examined, and it will be decided whether the delivery will be sent to the acquirer for acceptance.

The overall system to be delivered will be assorted for delivery in accordance with the requirements. A delivery includes the system, any enabling systems and documentation. At the decision gate »Delivery Conducted, the results will be examined, and it will be decided whether the delivery will be sent to the acquirer for acceptance.

Possible transitions based on 'Delivery Conducted (incremental development)' (Ablaufbaustein Incremental System Development)

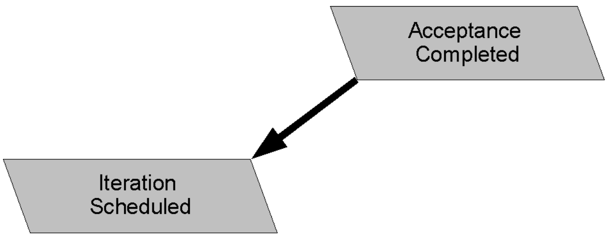
From 'Delivery Conducted (incremental development)' to 'Acceptance Completed'



The acquirer tests the »Delivery in order to determine if the requirements are fulfilled. At the decision gate »Acceptance Completed, the acquirer will examine the results and decide whether corrective actions are required. These activities are intended to reach the decision gate »Acceptance Completed .

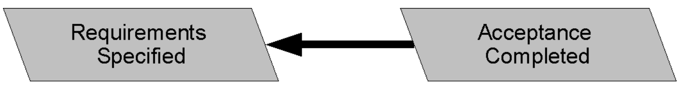
Possible transitions based on 'Acceptance Completed'

From 'Acceptance Completed' to 'Iteration Scheduled'



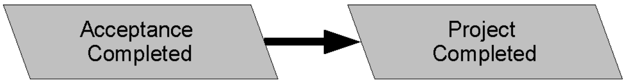
If the system development includes several increments, the detailed planning of the following iteration may be initiated after the acceptance of the previous iteration. In order to plan a new iteration, all unfinished »Problem Report / Change Request s and the »Change Status List will be examined in cooperation with the acquirer. At the decision gate Iteration Planned, this list will be used in order to decide which change requests should be integrated into the new iteration and which requests can be deferred for the time being. In addition, it will be specified which of the components that have not yet been implemented shall be included into the new iteration. The change requests and any unfinished requests concerning the »Overall System Specification are the basis for a new development cycle. In addition, it will be examined whether the products »Project Manual and »QA Manual are appropriate for the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Requirements Specified'



After project definition, the user requirements will be prepared and subjected to a »Requirements Evaluation. The user will examine the requirements for completeness and correctness. In case of a positive assessment, the acquirer specifies and prioritizes the requirements in form of the »Requirements Specification. In addition, an »RFP Concept will be prepared in order to ensure that the contract award law will be observed during the request for proposal. These activities are intended to reach the decision gate »Requirements Specified.

From 'Acceptance Completed' to 'Project Completed'



If all requirements have been taken into account and all change requests are completed, it will be decided to finish the project. A »Final Project Report will be prepared and submitted to the acquirer. These activities are intended to reach the decision gate »Project Completed.

5.6 Project (Acquirer/Supplier) Including System Maintenance

Extended project type: System Development Project (Acquirer/Supplier)

Descriptions

As already described in Part 1: "»Fundamentals of the V-Modell", the V-Model provides specific project type variants, which are adapted to the different »Project Types. The project type variant »Project (Acquirer/Supplier) Including System Maintenance can only be applied to the project type »System Development Project (Acquirer/Supplier), i.e. if it is not necessary to subdivide a system development project into two separate projects - one for the side of the Acquirer and one for the side of the Supplier. This is possible, if the system development project is executed within one organization or if several organizations, which deliberately cooperate closely in one project, participate in the project. As distinguished from a separate »System Development Project (Acquirer) und »System Development Project (Supplier), the Request for Proposals and Contracting and the dual project organization with two Project Leaders are not required.

The project type variant »Project (Acquirer/Supplier) Including System Maintenance»Project (Acquirer) Including System Maintenance is based on the situation that a system in use must be adapted or changed, e.g. by correcting faults, introducing new technologies, improving the fulfilment of non-functional requirements or modifying or extending functionalities. These "change requirements" will be specified by the Acquirer at the beginning of the project. Additional change requirements, which arise during project execution, can only be managed by the »Problem and Change Management. The System Developer analyses the change requirements, executes the required system changes and delivers the modified system normally in several iterations. Each iteration will be accepted individually by the User.

Process Modules to be used

Due to the project type: Specification of Requirements, Configuration Management, Delivery and Acceptance (Acquirer), Delivery and Acceptance (Supplier), Problem and Change Management, Project Management, Quality Assurance, System Development

Project characteristics to be determined during tailoring

Due to the project type: Security (Supplier), Life Cycle Cost Management, Project Measures, Off-the-Shelf Products, User Interface, Subject of the Project

Due to the project type variant: Subcontract, Legacy System

Activity Flow

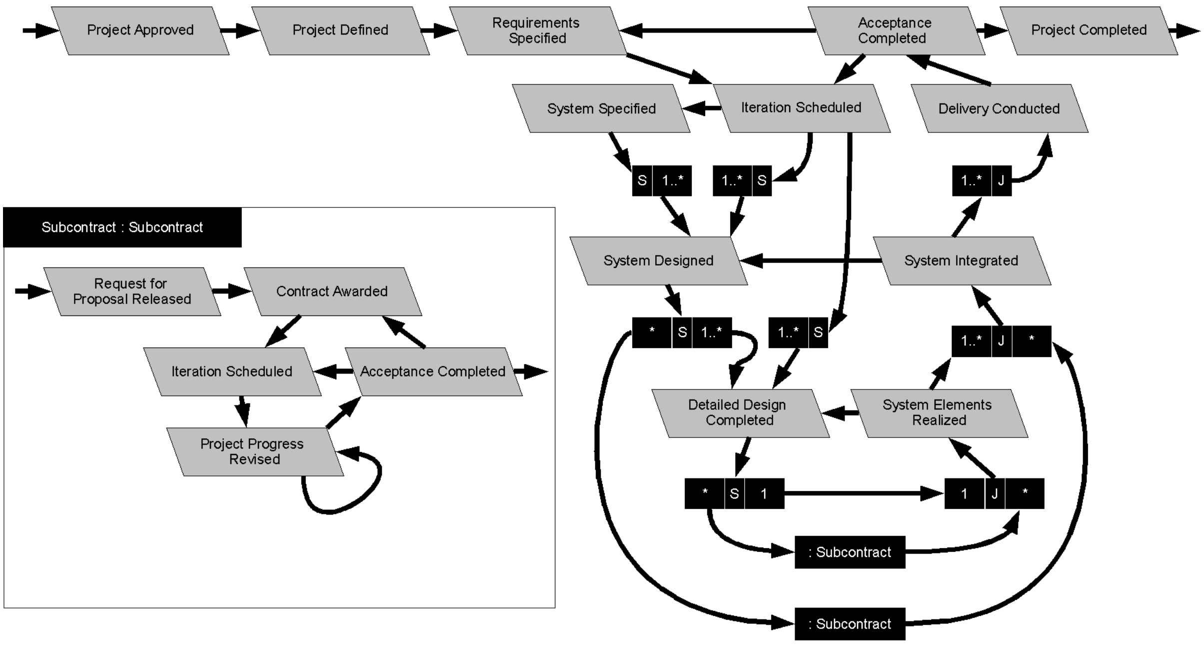


Figure 18: Project type variant Project (Acquirer/Supplier) Including System Maintenance

The decision gates and the sequence of the project type variant »Project (Acquirer/Supplier) Including System Maintenance are shown in figure Figure 18. The sequence differs significantly from that of the project type variant »Project (Acquirer/Supplier) Including Development, Enhancement or Migration by the different system development entry points, which depend on the scope of the system changes to be executed. It may affect the Overall System Specification, the System Design or the Detail Design. In the following, the sequence of a System Maintenance »Iteration will be described by means of the decision gates carried out.

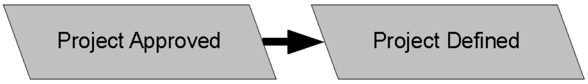
Possible transitions based on 'Projektstart'

From 'Project beginning' to 'Project Approved'

The potential acquirer, operating under the custodianship of a sponsor, prepares a »Project Proposal which includes all information required for deciding on the implementation of the proposal in form of a project. A sponsor is defined as person or department providing a budget for project acquisition. The project proposal is discussed in the decision gate »Project Approved, which ends with the decision as to whether or not the project should be started.

Possible transitions based on 'Project Approved'

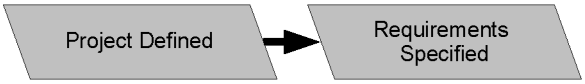
From 'Project Approved' to 'Project Defined'



In case of a positive decision, a Project Manual and a QA Manual will be prepared, which will be examined in order to determine if they are suitable for project execution on side of the acquirer. These activities are intended to reach the decision gate »Project Defined.

Possible transitions based on 'Project Defined'

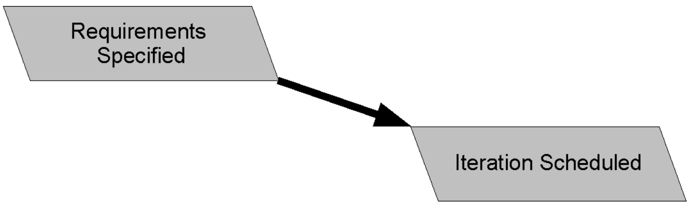
From 'Project Defined' to 'Requirements Specified'



After project definition, the user requirements will be prepared and subjected to a »Requirements Evaluation. The user will examine the requirements for completeness and correctness. In case of a positive assessment, the acquirer specifies and prioritizes the requirements in form of the »Requirements Specification. In addition, an »RFP Concept will be prepared in order to ensure that the contract award law will be observed during the request for proposal. These activities are intended to reach the decision gate »Requirements Specified.

Possible transitions based on 'Requirements Specified'

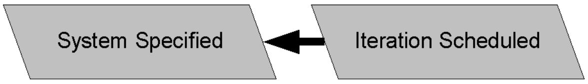
From 'Requirements Specified' to 'Iteration Scheduled'



If the product Requirements Specification includes functional requirements, the scope of the requirements implemented in the respective iteration will be planned. In addition, it will be examined whether the products »Project Manual and »QA Manual are appropriate for the project. If necessary, these products must be adapted to the requirements. These activities are intended to reach the decision gate »Iteration Scheduled.

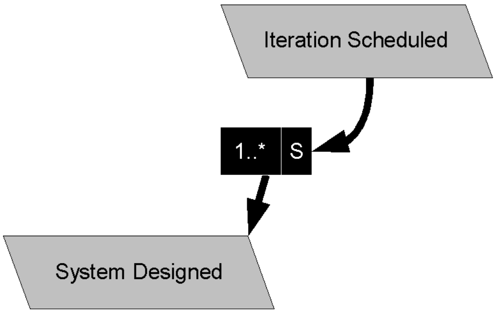
Possible transitions based on 'Iteration Scheduled'

From 'Iteration Scheduled' to 'System Specified'



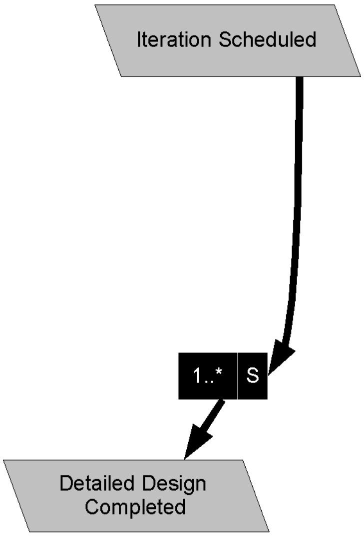
In the project, the requirements planned at the decision gate »Iteration Scheduled will be evaluated in cooperation with the acquirer, and a first preliminary design will be prepared. Requirements and preliminary design will be documented in the »Overall System Specification, which is the basis for the further development of the system. If the project includes the enhancement or migration of a legacy system, a »Legacy System Analysis will be prepared together with the Overall System Specification. These activities are intended to reach the decision gate »System Specified.

From 'Iteration Scheduled' to 'System Designed'



If the changes planned at the decision gate »Iteration Scheduled influence the system design, but do not affect the »Overall System Specification , the system design will be changed. The effects on the system and all identified enabling systems will be designed. This process may be executed independently for the system and each enabling system. These activities are intended to reach the decision gate »System Designed for the system and each enabling system.

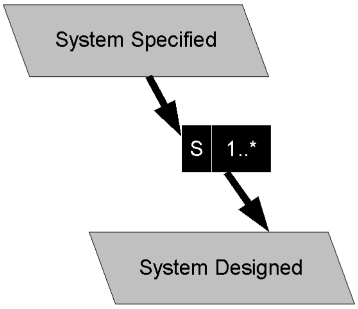
From 'Iteration Scheduled' to 'Detailed Design Completed'



If the changes planned at the decision gate »Iteration Scheduled influence the detailed design, but do not affect the Overall System Specification and the system design, the detailed design will be changed. For this purpose the architectures of hardware and software units will be subdivided into components and modules. These activities are intended to reach the decision gate »Detailed Design Completed.

Possible transitions based on 'System Specified'

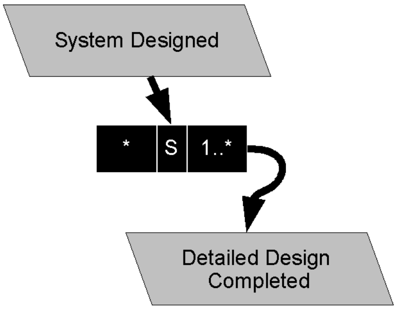
From 'System Specified' to 'System Designed'



Based on the preliminary design, architectures will be designed for the system and all identifiable »Enabling Systems . The architectures will define the »Segment s down to the level of hardware and software units. The requirements will be specified and assigned to system elements. Development process and evaluation strategy will be specified. The following decision gates to be executed until the project is delivered can be planned independently and executed simultaneously for the system and the various enabling systems. These activities are intended to reach the decision gate »System Designed for the system and every enabling system.

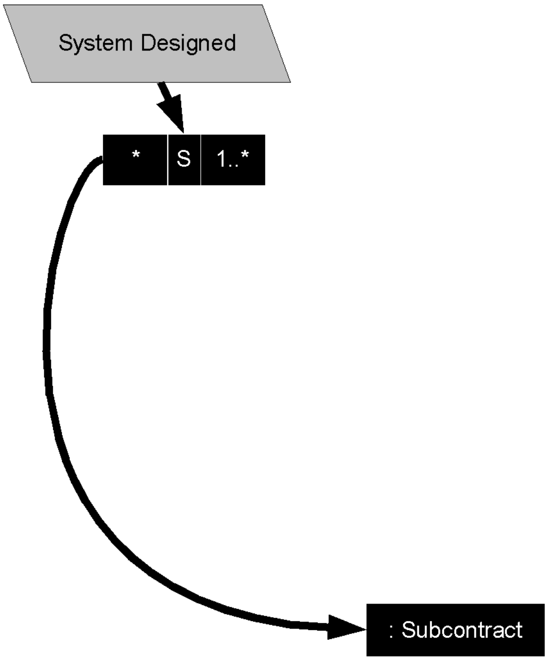
Possible transitions based on 'System Designed'

From 'System Designed' to 'Detailed Design Completed'



After the decision gate »System Designed has been reached, the work on the detailed design may begin. For the detailed design, the architectures of the hardware and software units will be developed into components and process modules, and external software/hardware specifications will be prepared as required. The requirements will be assigned to the hardware and software elements. Development process and test strategy will be specified. On the way towards the integration of realized system elements, it is possible to plan and conduct the design of hardware and software units simultaneously with the realization of other hardware and software units. These activities are intended to reach the decision gate »Detailed Design Completed for every workflow. Due to possible parallel workflows, it is possible that the decision gate »Detailed Design Completed has been reached in some segments - and the realization may begin - while the detailed design for other segments is not yet completed.

From 'System Designed' to 'Request for Proposal Released'

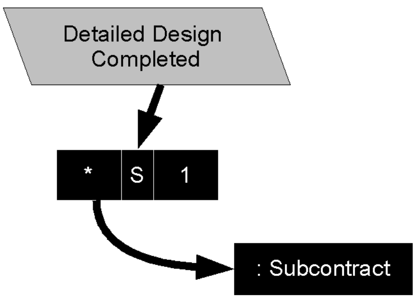


If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

Possible transitions based on 'Detailed Design Completed'

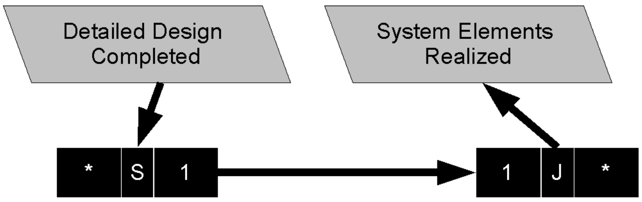
From 'Detailed Design Completed' to 'Request for Proposal Released'



If External Units are identified within the scope of the system design (decision gate »System Designed), the supplier shall execute a sub-project (acquirer). At first, a »Request for Proposal (Acquirer) is conducted, and the first target of the suborder is the decision gate »Request for Proposal Released. The decision gates of the suborder are executed like the respective decision gates in the Project Execution Strategy »Project (Acquirer) with One Supplier.

Based on the specification of requirements, the »Request for Proposal will be prepared. For this purpose, the RFP documents will be prepared based on the »RFP Concept specified in the decision gate »Requirements Specified, and a »Criteria Catalog for Assessment of Offers will be developed. Afterwards, it will be examined if the request for proposal can be released. In case of a positive decision, the request for proposal will be published in accordance with the procedures specified in the RFP concept. These activities are intended to reach the decision gate »Request for Proposal Released.

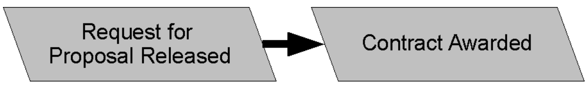
From 'Detailed Design Completed' to 'System Elements Realized'



All hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements. In this context, also an iterative approach is possible, extending the detailed design after some system elements of the detailed design have been realized. If an External Hardware/Software Module Specifications were prepared during the detailed design, subcontracts may be awarded for the development of the software/hardware modules. If no subcontracts are awarded, all hardware and software elements identified in the detailed design will be realized and evaluated in accordance with the requirements.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

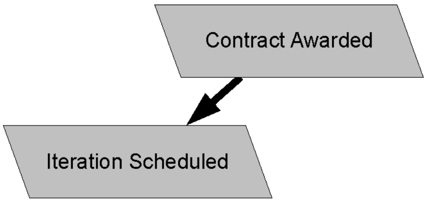
From 'Request for Proposal Released' to 'Contract Awarded'



The »Offers received after the »Request for Proposal will be evaluated in accordance with the »Criteria Catalog for Assessment of Offers. A provider with whom negotiations will be conducted will be selected. The acquirer decides - based on the assessment of the offers and the result of the contract negotiations - if the offer of the selected provider should be accepted. In case of a positive decision, a »Contract will be concluded between acquirer and supplier. In case of public acquirers and suppliers, contract negotiations are only possible under strict conditions. The public acquirer employs the »Offer Assessment in order to decide which offer is the most economical offer. The contract award commits the supplier to execute the project for the acquirer in accordance with the contractual agreements. These activities are intended to reach the decision gate »Contract Awarded.

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

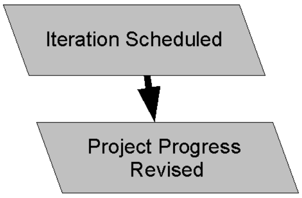
From 'Contract Awarded' to 'Iteration Scheduled'



After a »Contract has been concluded, the system development process, i.e., the decision gates to be achieved and the extent of the requirements to be implemented, will be planned. In addition, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. Otherwise these products will be adapted. These activities are intended to reach the decision gate »Iteration Scheduled.

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

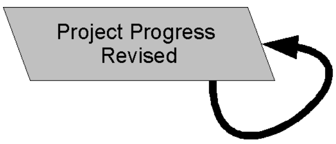
From 'Iteration Scheduled' to 'Project Progress Revised'



Then the acquirer is then tasked with supporting the execution of the supplier's project at the current »Project Stage in accordance with the specifications made in the contract. This is intended to ensure the success of the project and is a decisive acquirer task in this project execution strategy. The supplier will submit a Project Status Report (Supplier) for controlling the project progress. This report will determine which results have been achieved at the agreed project milestones. For this purpose, the acquirer will prepare a Project Status Report of his/her own. These activities are intended to reach the decision gate »Project Progress Revised.

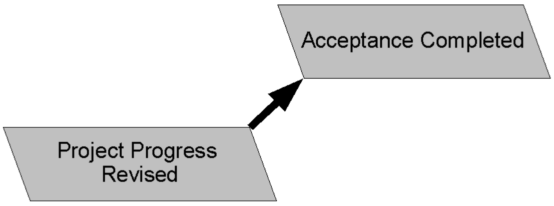
Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

From 'Project Progress Revised' to 'Project Progress Revised'



The supplier will submit the Project Status Report to the acquirer at regular intervals, which may be adapted to the sequence of the supplier's Project Progress Decisions. At these points, the acquirer will also prepare a Project Status Report. These activities are intended to reach the decision gate »Project Progress Revised.

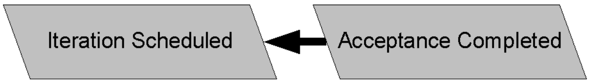
From 'Project Progress Revised' to 'Acceptance Completed'



If the supplier has achieved a specified system development status, the acquirer will receive the contractually agreed deliveries. The acquirer examines whether the »Delivery (Supplier) meets the requirements. This leads to the project progress decision of the decision gate »Acceptance Completed.

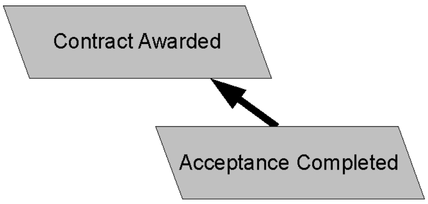
Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

From 'Acceptance Completed' to 'Iteration Scheduled'



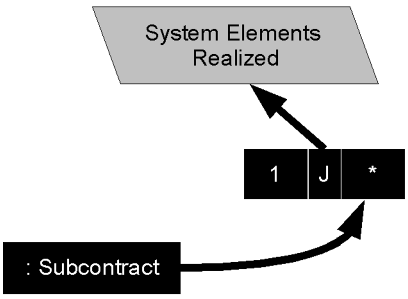
In order to plan a new iteration after the acceptance, the acquirer will check the open change requests of the »Change Status List in cooperation with the supplier. At the decision gate »Iteration Scheduled, this list is used for deciding which change requests will be included into the new iteration and which will be postponed for the time being. In addition, it will be specified, which of the components that have not yet been implemented will be taken into account in the new iteration. The change requests and the open requirements are the basis for a new development cycle. Again, it will be examined if the products »Project Manual and »QA Manual still correctly reflect the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Contract Awarded'



If acquirer and supplier have determined previously that one or a few iterations will first be implemented before the overall scope is fixed contractually, a new »Contract will possibly be concluded after the acceptance has been completed. If necessary, a »Contract Addendum will be agreed with the supplier. These activities are intended to reach the decision gate »Contract Awarded.

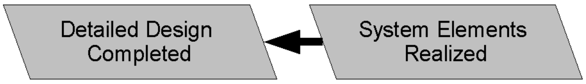
From 'Acceptance Completed' to 'System Elements Realized'



After acceptance, the units will be integrated into the project.

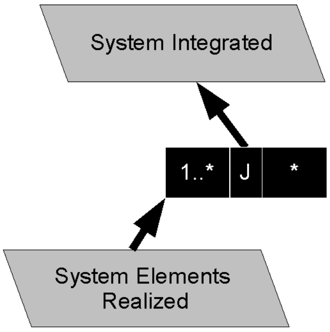
Possible transitions based on 'System Elements Realized'

From 'System Elements Realized' to 'Detailed Design Completed'



In order to permit an iterative execution of detailed design and realization, it is possible to go back to the preparation of the detailed design after the realization. In this step, hardware and software units, which have not been included into the detailed design process during the previous iteration, will be designed in detail. These activities are intended to reach decision gate »Detailed Design Completed.

From 'System Elements Realized' to 'System Integrated'



All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'Request for Proposal Released' (Ablaufbaustein Subcontract)

»From 'Request for Proposal Released' to 'Contract Awarded' (see above)

Possible transitions based on 'Contract Awarded' (Ablaufbaustein Subcontract)

»From 'Contract Awarded' to 'Iteration Scheduled' (see above)

Possible transitions based on 'Iteration Scheduled' (Ablaufbaustein Subcontract)

»From 'Iteration Scheduled' to 'Project Progress Revised' (see above)

Possible transitions based on 'Project Progress Revised' (Ablaufbaustein Subcontract)

»From 'Project Progress Revised' to 'Project Progress Revised' (see above)

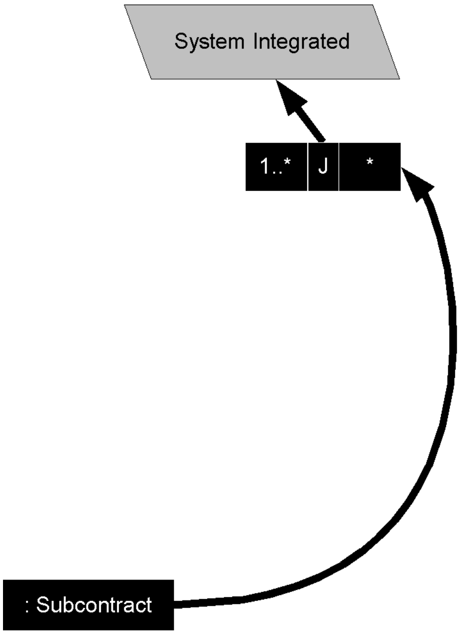
»From 'Project Progress Revised' to 'Acceptance Completed' (see above)

Possible transitions based on 'Acceptance Completed' (Ablaufbaustein Subcontract)

»From 'Acceptance Completed' to 'Iteration Scheduled' (see above)

»From 'Acceptance Completed' to 'Contract Awarded' (see above)

From 'Acceptance Completed' to 'System Integrated'



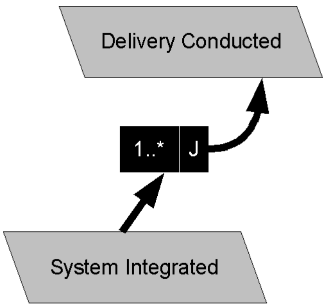
All realized hardware and software elements and External Units, which were developed within the scope of suborders, will be integrated into system elements and finally into a system or enabling system. The integrated elements will be tested. These activities are intended to reach the decision gate »System Integrated.

Possible transitions based on 'System Integrated'

From 'System Integrated' to 'System Designed'

Since not only detailed design and realization, but also system design and integration can be executed in an iterative manner, a new internal iteration may be planned for system design. In the architectures, system elements not yet implemented are identified down to the level of hardware and software units. These activities are intended to reach the decision gate »System Designed.

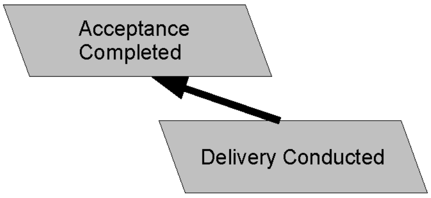
From 'System Integrated' to 'Delivery Conducted'



The overall system to be delivered will be assorted for delivery in accordance with the requirements. A delivery includes the system, any enabling systems and documentation. At the decision gate »Delivery Conducted, the results will be examined, and it will be decided whether the delivery will be sent to the acquirer for acceptance.

Possible transitions based on 'Delivery Conducted'

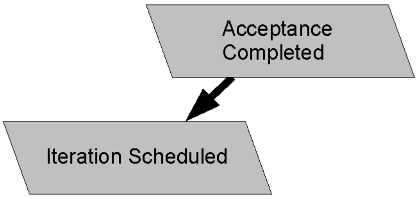
From 'Delivery Conducted' to 'Acceptance Completed'



The acquirer tests the »Delivery in order to determine if the requirements are fulfilled. At the decision gate »Acceptance Completed, the acquirer will examine the results and decide whether corrective actions are required. These activities are intended to reach the decision gate »Acceptance Completed .

Possible transitions based on 'Acceptance Completed'

From 'Acceptance Completed' to 'Iteration Scheduled'

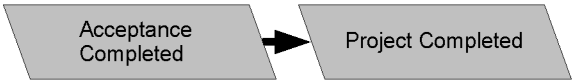


If the system development includes several increments, the detailed planning of the following iteration may be initiated after the acceptance of the previous iteration. In order to plan a new iteration, all unfinished »Problem Report / Change Request s and the »Change Status List will be examined in cooperation with the acquirer. At the decision gate Iteration Planned, this list will be used in order to decide which change requests should be integrated into the new iteration and which requests can be deferred for the time being. In addition, it will be specified which of the components that have not yet been implemented shall be included into the new iteration. The change requests and any unfinished requests concerning the »Overall System Specification are the basis for a new development cycle. In addition, it will be examined whether the products »Project Manual and »QA Manual are appropriate for the project. These activities are intended to reach the decision gate »Iteration Scheduled.

From 'Acceptance Completed' to 'Requirements Specified'

After project definition, the user requirements will be prepared and subjected to a »Requirements Evaluation. The user will examine the requirements for completeness and correctness. In case of a positive assessment, the acquirer specifies and prioritizes the requirements in form of the »Requirements Specification. In addition, an »RFP Concept will be prepared in order to ensure that the contract award law will be observed during the request for proposal. These activities are intended to reach the decision gate »Requirements Specified.

From 'Acceptance Completed' to 'Project Completed'



If all requirements have been taken into account and all change requests are completed, it will be decided to finish the project. A »Final Project Report will be prepared and submitted to the acquirer. These activities are intended to reach the decision gate »Project Completed.

5.7 Introduction and Maintenance of an Organization-Specific Process Model

Extended project type: Introduction and Maintenance of an Organization-Specific Process Model

Descriptions

As already described in Part 1: "»Fundamentals of the V-Modell", the V-Model provides specific project type variants, which are adapted to the different »Project Types. The project type variant »Introduction and Maintenance of an Organization-Specific Process Model describes the appropriate procedure for the project type »Introduction and Maintenance of an Organization-Specific Process Model .

This project type variant is based on the idea that:

- an organization wants to introduce a new specific process model or
- wants to improve an already existing process model.

This will be executed within the scope of a spearate project, planned and controlled like any other project by means of the Project Plan, »Project Status Report and Commercial Project Status Report.

Process Modules to be used

Due to the project type: Introduction and Maintenance of an Organization-Specific Process Model, Configuration Management, Problem and Change Management, Project Management, Quality Assurance

Project characteristics to be determined during tailoring

Due to the project type: Life Cycle Cost Management, Project Measures

Activity Flow

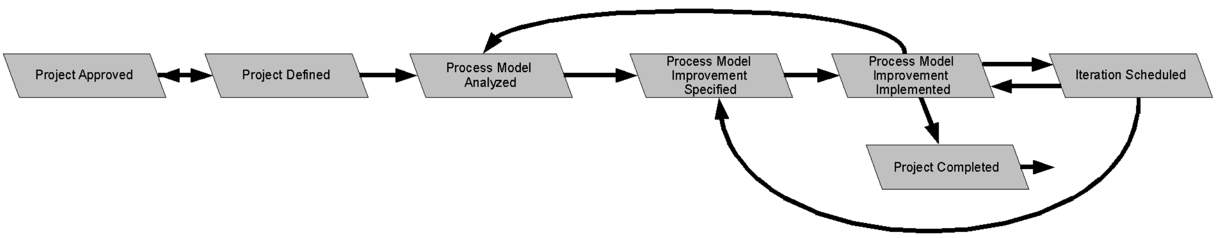


Figure 19: Project type variant Introduction and Maintenance of an Organization-Specific Process Model

The decision gates and the sequence of the project type variant »Introduction and Maintenance of an Organization-Specific Process Model are shown in figure Figure 19. In the following, the introduction and maintenance of an organization-specific process model will be described by means of the decision gates carried out.

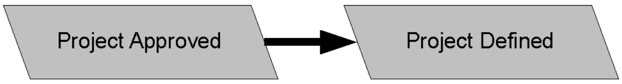
Possible transitions based on 'Projektstart'

From 'Project beginning' to 'Project Approved'

If an organization recognizes the need to introduce or improve an organization-specific process model, a »Proposal for the Introduction and Maintenance of an Organization-Specific Process Model will be prepared. Based on this »Proposal for the Introduction and Maintenance of an Organization-Specific Process Model, the management decides at the decision gate »Project Approved if a project should be executed.

Possible transitions based on 'Project Approved'

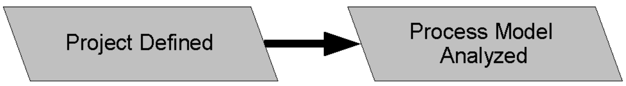
From 'Project Approved' to 'Project Defined'



A Project Manual and a QA Manual will be prepared. At the decision gate »Project Defined, it will be examined whether these two products are adequate for the project.

Possible transitions based on 'Project Defined'

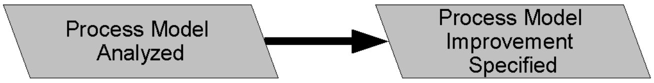
From 'Project Defined' to 'Process Model Analyzed'



After successful definition of the project, the current state of the processes in the organiation will be evaluated by an independent assessor and/or process assessments (e.g. in accordance with the V-Modell XT conformance, V-Modell XT assessment, »CMMI® or »SPICE model). This assessment results in the preparation and presentation of a report including the strength and weakness profile and proposals for improvement. At the decision gate »Process Model Analyzed, this report is used as basis for the further development. In case of a continuous improvement process, the decision gate »Process Model Analyzed may be executed several times. At the beginning of a new cycle, a brief process evaluation will be conducted, which is limited to the review of changes in the process portions modified during the previous improvement cycle.

Possible transitions based on 'Process Model Analyzed'

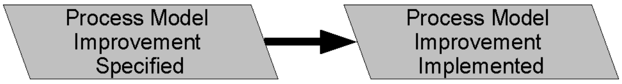
From 'Process Model Analyzed' to 'Process Model Improvement Specified'



If the requirements and concepts for the project are specified, based on the evaluation of the process model, the decision gate »Process Model Improvement Specified will be reached. The decision gate »Process Model Improvement Specified may be reached several times if change requests entailing new requirements and/or a modified concept are submitted and accepted during the realization of the process model.

Possible transitions based on 'Process Model Improvement Specified'

From 'Process Model Improvement Specified' to 'Process Model Improvement Implemented'



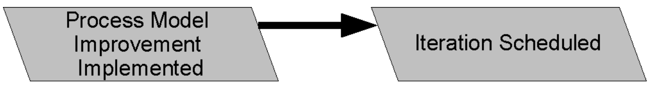
The »Organization-Specific Process Model will be developed and piloted on the basis of the process defined in the »Process Model Improvement Concept. At the end of the broad implementation, the decision gate »Process Model Improvement Implemented will be reached.

Possible transitions based on 'Process Model Improvement Implemented'

From 'Process Model Improvement Implemented' to 'Process Model Analyzed'

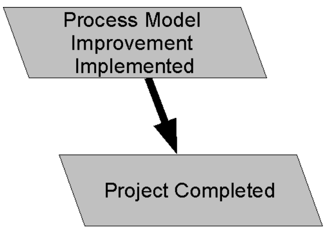
After Roll Out, the decision gate »Process Model Improvement Implemented is reached. From this gate, it is again possible to proceed to the decision gate »Process Model Analyzed in order to realize a continuous improvement process.

From 'Process Model Improvement Implemented' to 'Iteration Scheduled'



If modifications of the organization-specific process model are required, they will be considered and included in the modification plan. Thus, the decision gate »Iteration Scheduled is reached. Modifications can partly be integrated during the realization of the project.

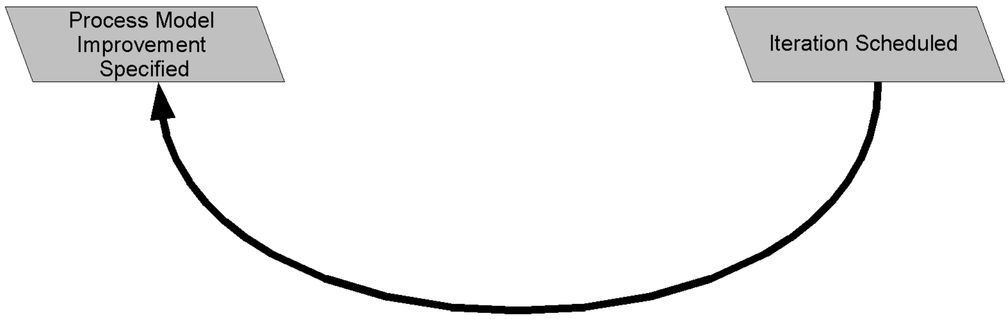
From 'Process Model Improvement Implemented' to 'Project Completed'



If all requirements have been taken into account and all change requests are completed, it will be decided to finish the project after the acceptance has been completed. A »Final Project Report will be prepared and submitted to the acquirer. These activities are intended to reach the decision gate »Project Completed.

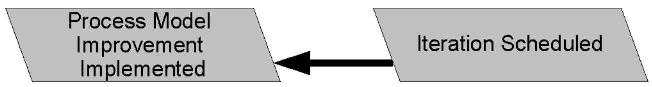
Possible transitions based on 'Iteration Scheduled'

From 'Iteration Scheduled' to 'Process Model Improvement Specified'



If an organization-specific process model must be changed to an extent that cannot be implemented within the framework of an iteration, change requests and/or improvement measures shall be processed separately. This will lead again to the decision gate »Process Model Improvement Specified.

From 'Iteration Scheduled' to 'Process Model Improvement Implemented'



In an additional iteration step, the functionality planned for the respective iteration - including the specified changes - will be developed and piloted. If the Roll Out has been completed, the decision gate »Process Model Improvement Implemented is reached.

6 Process Modules

»Process Modules are the decisive elements of the V-Modell. They include a number of »Activitys and »Work Products arranged in logical groups. Static »Tailoring deals with the selection of the process modules required for the project.

6.1 Project Management

Overview

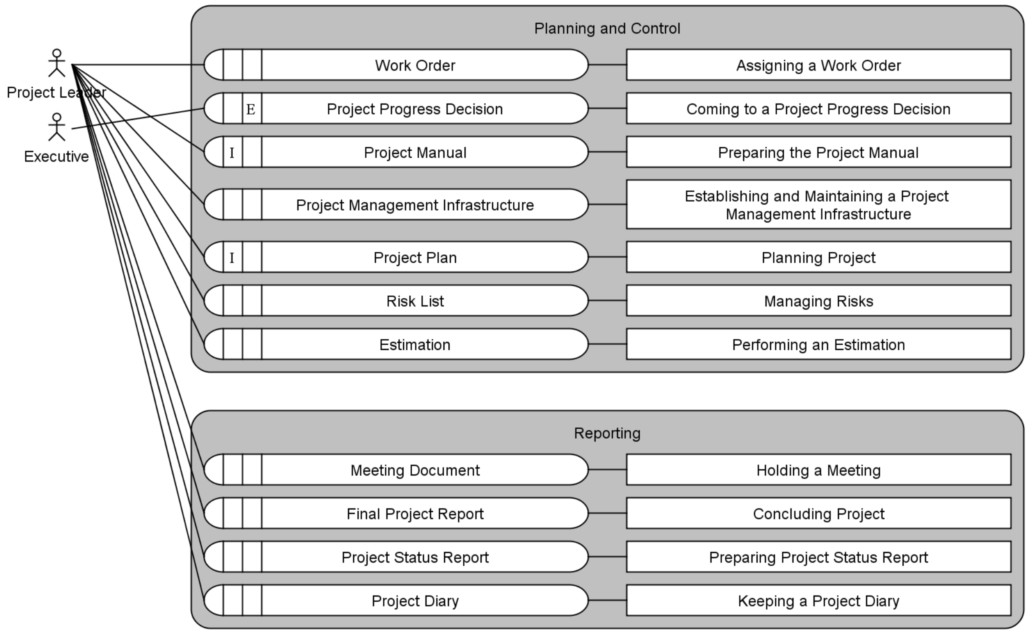


Figure 20: Process module Project Management

Purpose

The project management includes all tasks required for planning and controlling the activities of the project team in order to safely achieve the objective of project and to early recognize and correct any problems. For this purpose, the »Process Module Project Management defines a process for planning and controlling projects. The management of a project has a decisive influence on the success of the project.

The project management describes the initialization, planning, execution and conclusion of a project. Important products include the »Project Manual, which specifies the organizational framework conditions, the »Project Plan, the »Risk List and the »Reporting products, which are intended to document all project events and results and ensure the internal and external distribution.

The »Project Leader prepares the »Project Manual, an initial »Project Plan and a »Risk List in co-operation with the acquirer. In the course of the project, these documents will be updated. At regular intervals - at least before pending »Project Progress Decisions, a »Project Status Report shall be prepared for the acquirer and the in-house management. A the end of the project, a »Final Project Report will be prepared.

Project types that may include this process module

System Development Project (Acquirer), System Development Project (Supplier), System Development Project (Acquirer/Supplier), Introduction and Maintenance of an Organization-Specific Process Model

6.2 Quality Assurance

Needs: Project Management

Overview

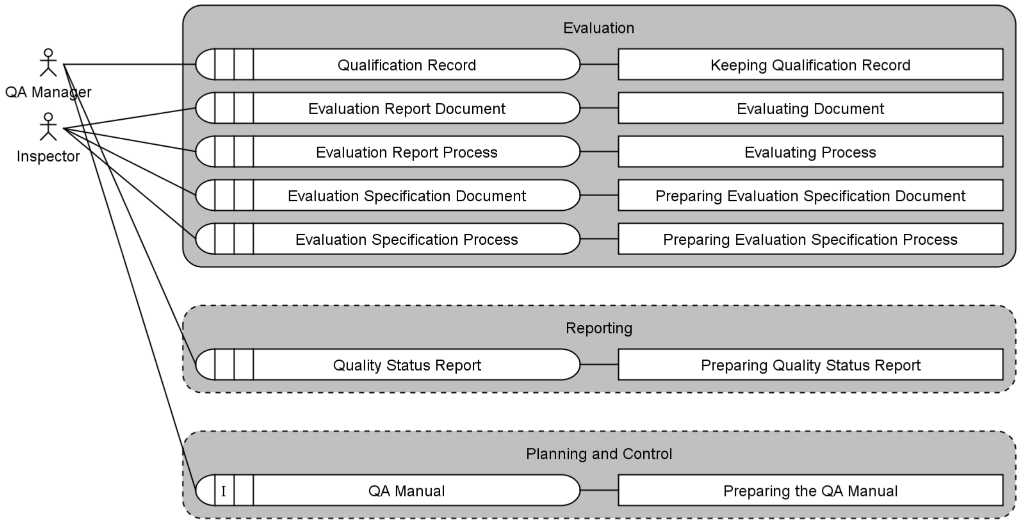


Figure 21: Process module Quality Assurance

Purpose

The »Process Module Quality Assurance (QA) defines the basic processes for planning and executing quality assurance measures. It describes how and by which means the project quality is intended to be ensured (QA Manual). In addition, products and activities of this process module are used for

- Planning (evaluation plan)
- Preparing (evaluation environment, evaluation specification)
- Executing (testing) and
- Documenting (evaluation report)

tests.

Test activities are included in the corresponding process modules (system development, software development, hardware development). If the project does not include the respective development activities, test activities are not required.

In contrast to the development tests, all formal tests shall be executed by an independent »Inspector (e.g. developer colleague). In addition, they must be repeatable (evaluation specification, evaluation procedure, evaluation report). The rule that the producer shall not test his/her own product (four-eyes principle) applies to all formal tests.

The regulations of the process module Quality Assurance (QA) shall in no way affect organizational specifications, i.e., quality assurance tasks need not be executed in one organizational unit, but can be executed within the scope of the development - however, the four-eyes principle must always be ensured.

Product States in Tests

If quality assurance measures are not planned for specific system products (system components, software, hardware), these products proceed from the state "in processing" to the state "finished" after the development tests have been completed.

Products which are intended to undergo quality assurance measures proceed at first to the state "submitted". After the tests have been completed successfully, they from the state "submitted" to the state "finished".

Project types that may include this process module

System Development Project (Acquirer), System Development Project (Supplier), System Development Project (Acquirer/Supplier), Introduction and Maintenance of an Organization-Specific Process Model

6.3 Configuration Management

Needs: Project Management, Quality Assurance

Overview

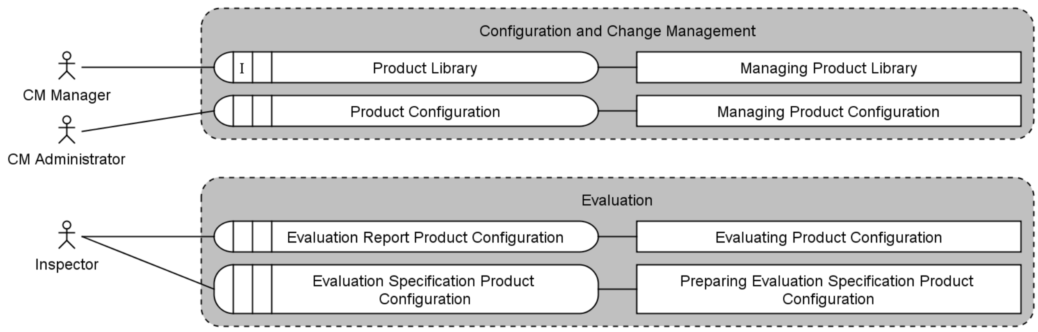


Figure 22: Process module Configuration Management

Purpose

A »Product Configuration is defined as a quantity of associated products and tools, e.g. hardware evaluation environment, software development environment etc., in a certain version and a certain product state. The configuration management monitors product configurations in such a way that the connections and differences between previous and current product configurations are always recognizable. It ensures that a recourse to previous product versions is always possible. Thus product changes can always be repeated and verified.

The assessment of and decision on change requests is regulated in the »Process Module »Problem and Change Management . The configuration management documents the implementation of product changes in a repeatable way.

The configuration management (CM) is intended to ensure that functional and physical characteristics of a products can always be identified unambiguously. This identification is used for a systematic control of changes and ensures the integrity, also during the utilization phase of the product.

Project types that may include this process module

System Development Project (Acquirer), System Development Project (Supplier), System Development Project (Acquirer/Supplier), Introduction and Maintenance of an Organization-Specific Process Model

6.4 Problem and Change Management

Needs: Project Management

Overview

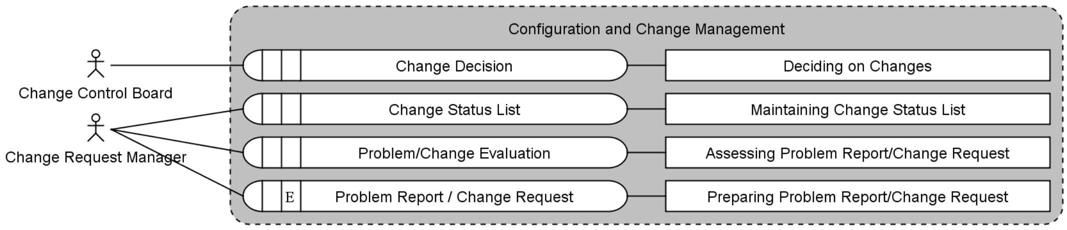


Figure 23: Process module Problem and Change Management

Purpose

The problem and change management deals with change requests, faults and problems arising during system development and utilization.

This procedure is initiated by a problem report or a change request which may be submitted by all persons concerned (user, developer, acquirer, etc.). The status of all problem reports/change requests is documented in the change status list. For every problem report and every change request, a problem/change evaluation will be prepared, and a change decision will be made as to whether the problem shall be solved or the change shall be executed.

An acquirer or user may submit change requests e.g. because of system malfunctions, a lack of functionality and changes in the own environment. The supplier may also have change requests, e.g. due to problems with external supplies, misunderstandings in the order, or newly recognized dependencies.

The following principles, which shall be observed by all participants, apply:

- All participants must realize that there are no changes "on acclamation" or "on the quiet".
- Every change request which leads to a deviation from the ordered, released or accepted characteristics or refers to a system in the utilization phase shall be processed by means of a problem report or change request within the scope of problem and change management.
- Every change request shall be documented and evaluated.

The change management regulates the following

- required contents of a problem report or change request,
- analysis and assessment of change requests, and
- procedures for deciding on changes.

The changes themselves will not be executed in the »Process Module Problem and Change Management, but only initiated by the »Change Decision.

Project types that may include this process module

System Development Project (Acquirer), System Development Project (Supplier), System Development Project (Acquirer/Supplier), Introduction and Maintenance of an Organization-Specific Process Model

6.5 Delivery and Acceptance (Acquirer)

Needs: Quality Assurance

Overview

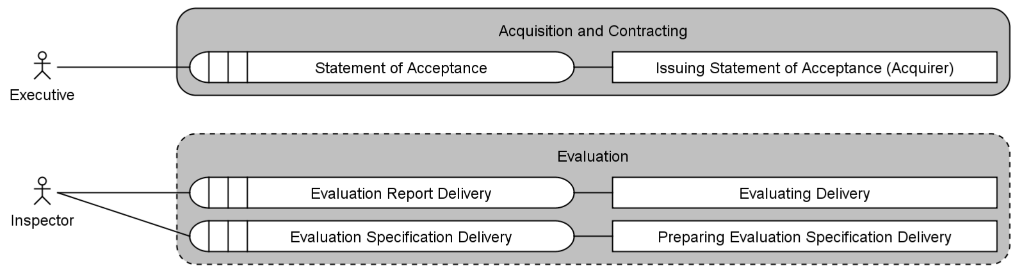


Figure 24: Process module Delivery and Acceptance (Acquirer)

Purpose

The process module Delivery and Acceptance (Acquirer) is intended to define the delivery and acceptance process on part of the acquirer. The acquirer accompanies the supplier's project during the individual project stages in order to ensure the success of the project. After realization and delivery of the respective items, the Inspector will conduct the acceptance test and prepare the Delivery Evaluation Record based on the Delivery Evaluation Specification. The supplier will repair any reported malfunction by conducting the respective corrective action. If required, a new acceptance test must be conducted.

Project types that may include this process module

System Development Project (Acquirer), System Development Project (Acquirer/Supplier)

Project characteristics that may include this process module

Subcontract

6.6 Drafting and Conclusion of Contract (Acquirer)

Needs: Delivery and Acceptance (Acquirer)

Overview

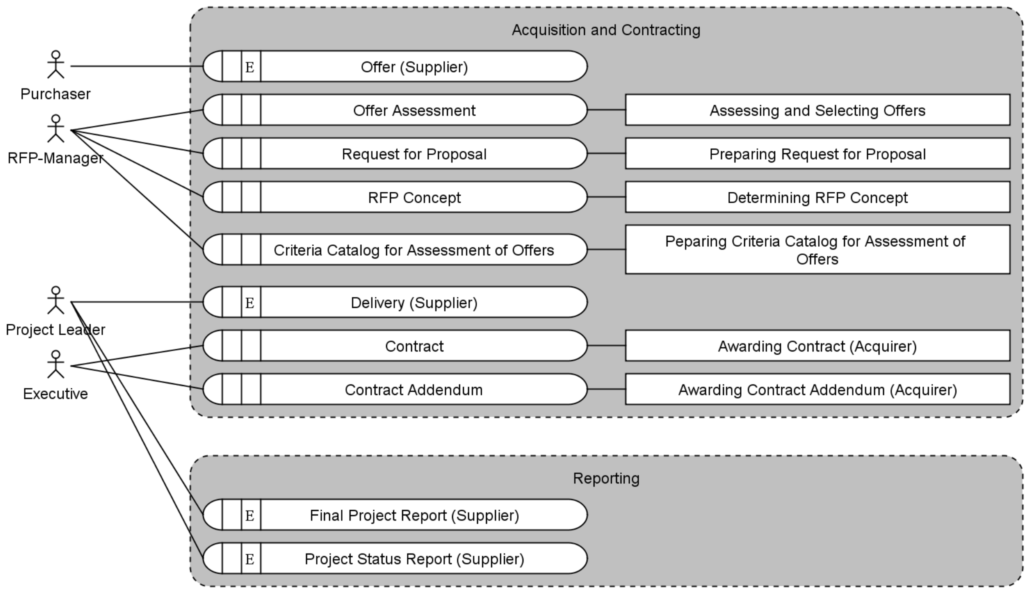


Figure 25: Process module Drafting and Conclusion of Contract (Acquirer)

Purpose

The »Process Module Drafting and Conclusion of Contract (Acquirer) is intended to define the acquirer side of the acquirer/supplier interface. Contracts to be awarded may refer to »Systems or »External Units. The contract specifies which »Work Products will be exchanged between supplier and acquirer and for which products the acquirer will be responsible. The supplier side of this interface is regulated in the process module »Drafting and Conclusion of Contract (Supplier).

The »Project Manual or a »Make-or-Buy Decision specifies whether contracts will be awarded and the process module Drafting and Conclusion of Contract (Acquirer) will be included into the project-specific V-Modell. When processing an order, the role »RFP-Manager specifies the »RFP concept, deciding how the contract will be awarded, e.g., in public competitions. The RFP Manager will prepare the »request for proposal based on the »Requirements Specification. Any suborder will be based on the »External Unit Specification. The »Request for Proposal will be mailed or published in accordance with the »RFP Concept. The assessment of »offers and the decision as to which supplier will be awarded the contract will be based on the work product »Criteria Catalog for Assessment of Offers. In this decision, a concrete »Offer (Supplier) will be selected.

Afterwards, the contract negotiations will begin. If the selected contract award procedure permits, it is possible to re-negotiate the requirements posed on the delivery (deliveries) to be developed. »Executive, »Purchaser and a Representative of the Supplier will conclude the »contract.

Since there are numerous contract award procedures, these are deliberately not modeled explicitly. The V-Modell only describes the work product »request for proposal, which is in the center of all contract award procedures. Any additional specifications necessary will be defined in the work product »RFP Concept.

Project types that may include this process module

System Development Project (Acquirer)

Project characteristics that may include this process module

Subcontract

6.7 Specification of Requirements

Needs: Project Management

Overview

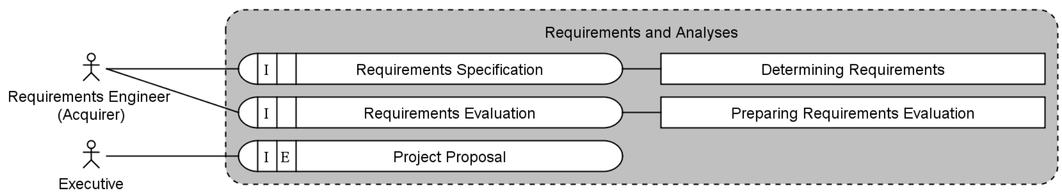


Figure 26: Process module Specification of Requirements

Purpose

The »Process Module »Specification of Requirements ensures that the reasons for executing a project are documented systematically based on unambiguous decisions. The decision on start and design of a project can be based on a project proposal which was submitted at the beginning of the project and not prepared within the scope of the V-Modell.

In addition, the process module Specification of Requirements supports the specification of unambiguous, complete, realistic, understandable, consistent, repeatable, prioritized and stable user requirements, which are suitable for an economic realization and acceptance of a system. The user requirements must be specified in detail in order to enable the developer or supplier of the system to design, offer and realize optimum technical solutions.

Project types that may include this process module

System Development Project (Acquirer), System Development Project (Acquirer/Supplier)

6.8 Evaluation of Off-the-Shelf Products

Needs at least one:	System Development, Specification of Requirements

Overview

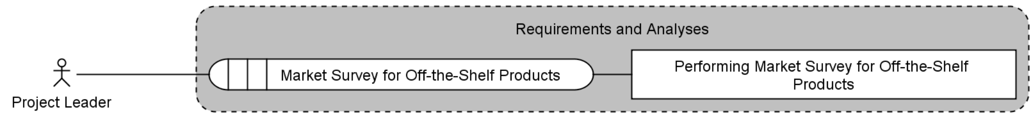


Figure 27: Process module Evaluation of Off-the-Shelf Products

Purpose

The »Process Module »Evaluation of Off-the-Shelf Products includes a procedure for the market survey and technical evaluation of off-the-shelf products for the system to be developed or for the »Enabling Systems required for developing, testing or operating the system.

Finished products are completed products or components which may be used as system elements, e.g., »Software Units, »Hardware Unit or »Segments. Examples for off-the-shelf products include the following:

- »COTS products, e.g. purchased software or library programs, test monitors, operating systems, compiler, tools or finished hardware, e.g. processors
- Usable software or hardware which was developed within the same organization but not with the scope of the current project
- Releasable open source products

The »Market Survey for Off-the-Shelf Products provides the »System Architect with a survey of the off-the-shelf products available on the market. The »Evaluation of Off-the-Shelf Products evaluates to what extent the different off-the-shelf products fulfill the requirements and if additional adaptations are necessary.

Frequently the result shows that there is a discrepancy between the requirements and the actual characteristics of potential off-the-shelf products. Either the off-the-shelf products do not fulfill the requirements completely, or they outperform the functionalities. In both cases, it must be examined if the requirements can be adapted accordingly. Thus the selection of an off-the-shelf product or the deliberate decision against using off-the-shelf products depends on the relation between price, performance and effort required for the adaptation. The results of the assessment will be documented - on acquirer side - in the evaluation of requirements and, on supplier side, in the »Evaluation of Off-the-Shelf Products which will contribute to the »Make-or-Buy Decision.

The integration into the system or enabling system to be developed poses a particular difficulty when using off-the-shelf products. Therefore, it is necessary to select the off-the-shelf products to be integrated as early as possible. The process module »Evaluation of Off-the-Shelf Products supports two different approaches:

- On acquirer side, the Requirements Engineer (Acquirer) can conduct a Market Survey for Off-the-Shelf products based on the Project proposal or the preliminary system architecture outlined in the Requirements Specification. Based on the results, the following Evaluation of Requirements can evaluate whether and, if yes, which off-the-shelf products may be used with which potential restrictions. The results will be integrated into the Requirements Specification and determine if the Request for Proposals refers to
  - a pure system development project or
  - a pure acquisition of off-the-shelf products or
  - a combination of acquisition and development elements.
- On supplier side:
  - At an early stage of the system architecture development, potential candidates for off-the-shelf products, which were selected based on a »Market Survey for Off-the-Shelf Products, are proposed to the System Architect. This market survey is based on the »Overall System Specification and »System Architecture design. Based on the results, a further development of the system architecture is possible.
  - If the »System Architecture is in a later stage and »External Unit have already been identified, the »Market Survey for Off-the-Shelf ProductsThe »Purchaser will be responsible for procuring off-the-shelf products. External Hardware Modules and External Software Modules will be integrated at hardware level and software level, External Units will be integrated at system level or subsystem level. After an initial inspection to be specified in the QA Manual, the off-the-shelf products will be tested like the other system elements.

Project characteristics that may include this process module

Off-the-Shelf Products

6.9 Safety and Security

Needs at least one:	Specification of Requirements, Usability and Ergonomics, Hardware Development, Software Development, System Development, Delivery and Acceptance (Acquirer)

Overview

The process module does not contain any products.

Purpose

Within the scope of the V-Modell XT, this term includes the aspects of functional safety (Safety), information security (Security), and data protection. Functional safety comprises procedural or operational safety and the aspects of reliability, fault tolerance and correctness. Information security is mainly intended to ensure the confidentiality, authenticity, and availability of information. Data protection regulates the implementation of legal data protection standards for the handling of personal data.

The process module Safety and Security includes the V-Modell XT elements, which are required in addition if safety and security aspects must be considered in the respective project, i.e., if risks which could arise from the operation of the system must be avoided or minimized. The elements in this process module are equally relevant for projects of Suppliers and Acquirers. Since the safety and security requirements are based on the system environment and the planned use of the system, a wholistic consideration of system and system environment is indispensable.

The process module does not include risks like realization risks (e.g. technological or organizational realization risks), risks for the business model (e.g. competition situation and demand behavior) or political risks.

The products (or subjects) and activities (or subactivities) of this process module refer to the following:

- the determination of directives for safety and security,
- the determination of system safety and security requirements.

Since the safety and security requirements are based on the system environment and the planned use of the system, a wholistic consideration of system and system environment is indispensable.

The process module does not include risks like realization risks (e.g. technological or organizational realization risks), risks for the business model (e.g. competition situation and demand behavior) or political risks.

The products (or subjects) and activities (or subactivities) of this process module refer to the specification of project-relevant safety and security directives and requirements.

Project characteristics that may include this process module

Security (Acquirer), Security (Supplier)

6.10 Safety and Security (Supplier)

Needs:	Safety and Security

Overview

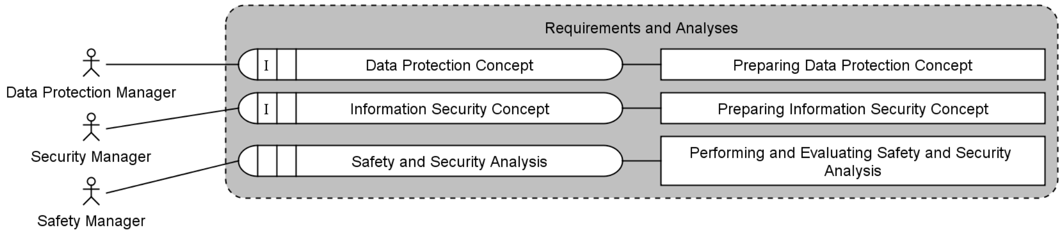


Figure 28: Process module Safety and Security (Supplier)

Purpose

The process module Safety and Security (Supplier) is based on the process module »Safety and Security , complementing the latter by supplier-specific aspects.That means this module is only relevant for projects of a supplier, which must consider safety and security aspects.

Safety and security analyses will be prepared in accordance with the specifications of the »Project Manual. The results of the analyses regarding functional safety will be included in the Implementation, Integration and Test Concept, while the results regarding information security will be included in the »Information Security Concept and the »Data Protection Concept.

Since the safety and security requirements are based on the system environment and the planned use of the system, a wholistic consideration of system and system environment is indispensable.

The Information Security Concept comprises all statements on Information Security contained in other V-Modell XT work products. It must be planned and implemented carefully and reviewed and updated regularly.

A Data Protection Concept shall be prepared if personal data are handled in the project.

Project characteristics that may include this process module

Security (Supplier)

6.11 Life Cycle Cost Management

Needs: Project Management

Overview

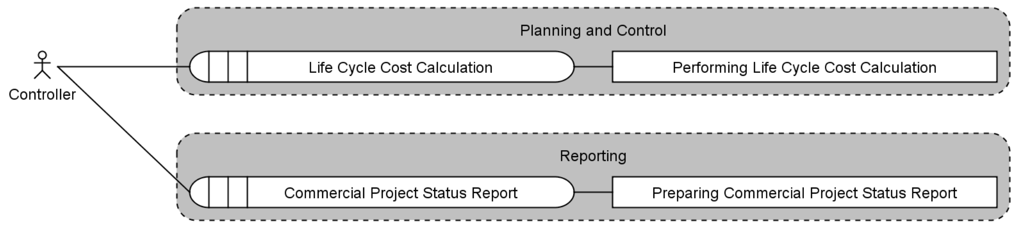


Figure 29: Process module Life Cycle Cost Management

Purpose

The »Process Module Life Cycle Cost Management describes the commercial aspects of Project Management. Every project must aim at achieving a positive commercial result. Thus, the process module »Life Cycle Cost Management defines a process for planning and controlling the life cycle costs to be expected. These include the costs for planning the project from the idea to contract award (planning costs), the costs for executing the V-Model project (project costs), the costs required for production (production costs) and the costs required for using the system (in-service costs) after the end of the V-Model project (e.g. for operation and maintenance, etc.). The latter will largely be determined during the development phase and must be taken into account at an early development stage. The life cycle specifications are outlined in the life cycle diagram and the overall system architecture.

In case of large systems, the planning costs can be specified in a separate V-Modell project. In most cases, the life cycle costs for the planned system are analyzed during this phase.

The project costs planned on the basis of the »Estimation of Effort will be transferred into a commercially repeatable »Account Structure by means of the project structure plan. In this context, "accounts" are generally defined as "cost units" and do not correspond to the account as defined by commercial accounting.

In addition, the product costs to be expected can be derived from the »Product Structure in order to fix a competitive market price for the system by employing appropriate procedures, e.g. target costing.

The in-service costs (costs for starting up, maintaining and disposing of the system) are important additional life cycle costs. Within the scope of logistic support, these costs will be described in detail together with their expected development during the entire life cycle of the system.

Based on the life cycle costs, the economic efficiency of the project will be planned and documented in the product »Life Cycle Cost Calculation. This »Life Cycle Cost Calculation prepared at the beginning of a project will be updated within the scope of the product »Commercial Project Status Report, which supervises the planning costs, the project costs, the product costs to be expected, the in-service costs and the economic efficiency. In case of deviations, the product »Problem Report / Change Request initiates controlling measures and, possibly, technical modifications in the overall system.

Project characteristics that may include this process module

Life Cycle Cost Management

6.12 Measurement and Analysis

Needs:	Project Management

Overview

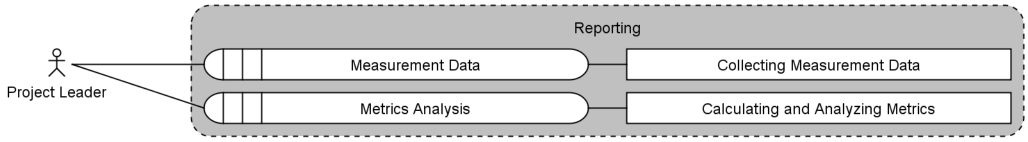


Figure 30: Process module Measurement and Analysis

Purpose

This »Process Module is intended to describe the processes for defining and using »Metrics (project parameters), which are an important instrument for controlling the project. The V-Modell deliberately does not specify which metrics will be used.

The use of metrics provides quantitative and qualitative statements on various project issues. These statements aid in achieving the project objectives. Interesting questions include, e.g., the state of a current project in order to be able to intervene, or the supervision of product characteristics in order to demonstrate the compliance with user requirements or other (legal/normative) requirements. In addition, metrics are used for developing experience-based knowledge within an organization, which, e.g., supports the planning of other projects, or for gaining information on the quality of sub-processes in order to recognize systematic errors. Metrics are not intended to control or assess the performance of individual staff members.

The metrics in a project or for an entire organization must be defined clearly. This ensures that they are equally understood and that the results are equally processed by all staff members. At the beginning of a project, the metrics are either defined directly in the »Project Manual or, if available, selected from an organization-wide »Metrics Catalog, which will be described in the organization-specific process model.

In the course of the project, the »Measurement Data required for calculating the metrics will be collected. A »Metrics Analysis, the results of which will be evaluated and communicated by means of the »Reporting system, will be prepared at regular intervals or as required.

Project characteristics that may include this process module

Project Measures

6.13 Delivery and Acceptance (Supplier)

Needs: Quality Assurance

Overview

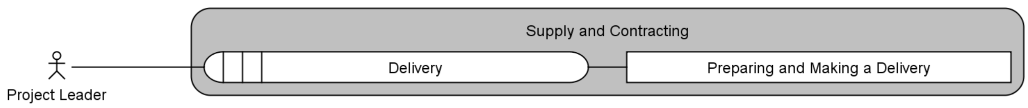


Figure 31: Process module Delivery and Acceptance (Supplier)

Purpose

The process module Delivery and Acceptance (Supplier) is intended to define the delivery and acceptance process on part of the supplier. Within the scope of the individual project stages, the supplier will develop deliveries, which will be delivered to the acquirer. The acceptance of the delivery on part of the acquirer is specified in the process module Delivery and Acceptance (Acquirer). After a successful acceptance, the »Statement of Acceptance signed by the Acquirer documents the successful provisioning of the agreed supplies and services for Acquirer and Supplier alike.

Project types that may include this process module

System Development Project (Supplier), System Development Project (Acquirer/Supplier)

6.14 Drafting and Conclusion of Contract (Supplier)

Needs: Delivery and Acceptance (Supplier)

Overview

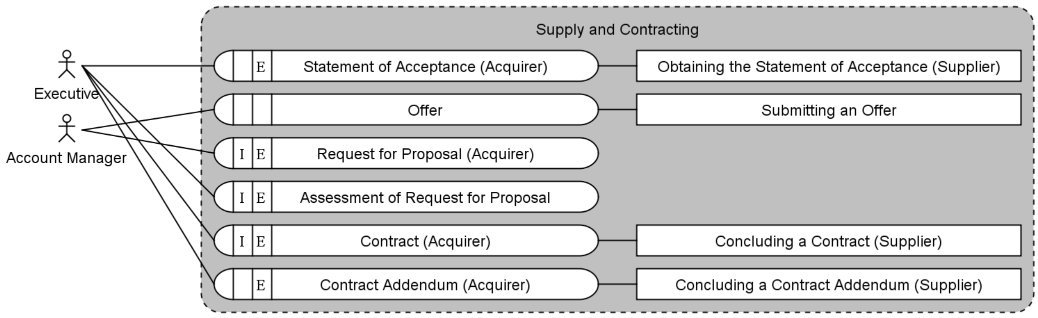


Figure 32: Process module Drafting and Conclusion of Contract (Supplier)

Purpose

The process module Drafting and Conclusion of Contract (Supplier) is intended to prepare an offer which is acceptable from a technical, engineering, organizational and economical point of view, to conclude a Contract (Acquirer) with the Acquirer on the basis of this offer, and finally to execute the project successfully. Thus, this process module extends the acquirer side of the acquirer/supplier interface contained in the process module Drafting and Conclusion of Contract (Acquirer). The previous project acquisition, which also includes the Assessment of Request for Proposal, is not included in this process module, but will be executed in accordance with the specifications of the respective supplier organization.

Based on the Assessment of Request for Proposal, the supplier will decide - at the decision gate Project Approved - whether he wants to prepare an offer. In case of a positive assessment, the responsible Account Manager will prepare an appropriate Offer based on the Request for Proposal (Acquirer) in close cooperation with the future Project Leader.

The offer outlines the contents of the offered system and the system development procedure. It focuses on accurate, verifiable information on functionality, quality, project life, effort and costs.

If the contract is concluded, the supplier is provided with an appropriate Contract (Acquirer), which includes the requirements posed on the overall system to be developed and the relevant parts of the Project Manual (Supplier) and the QA Manual (Supplier). In addition, it specifies schedule and scope of the deliveries.

In the course of the project, it may be necessary to prepare the work product Contract Addendum (Acquirer), possibly several times. In addition, the successful accomplishment of the contractually agreed supplies and services shall be documented by both sides in the Statement of Acceptance (Acquirer).

The work products marked by the addendum "(Acquirer)" have identical duplicates on the side of the acquirer in the process module Drafting and Conclusion of Contract (Supplier).

Project types that may include this process module

System Development Project (Supplier)

6.15 System Development

Needs:	Quality Assurance

Overview

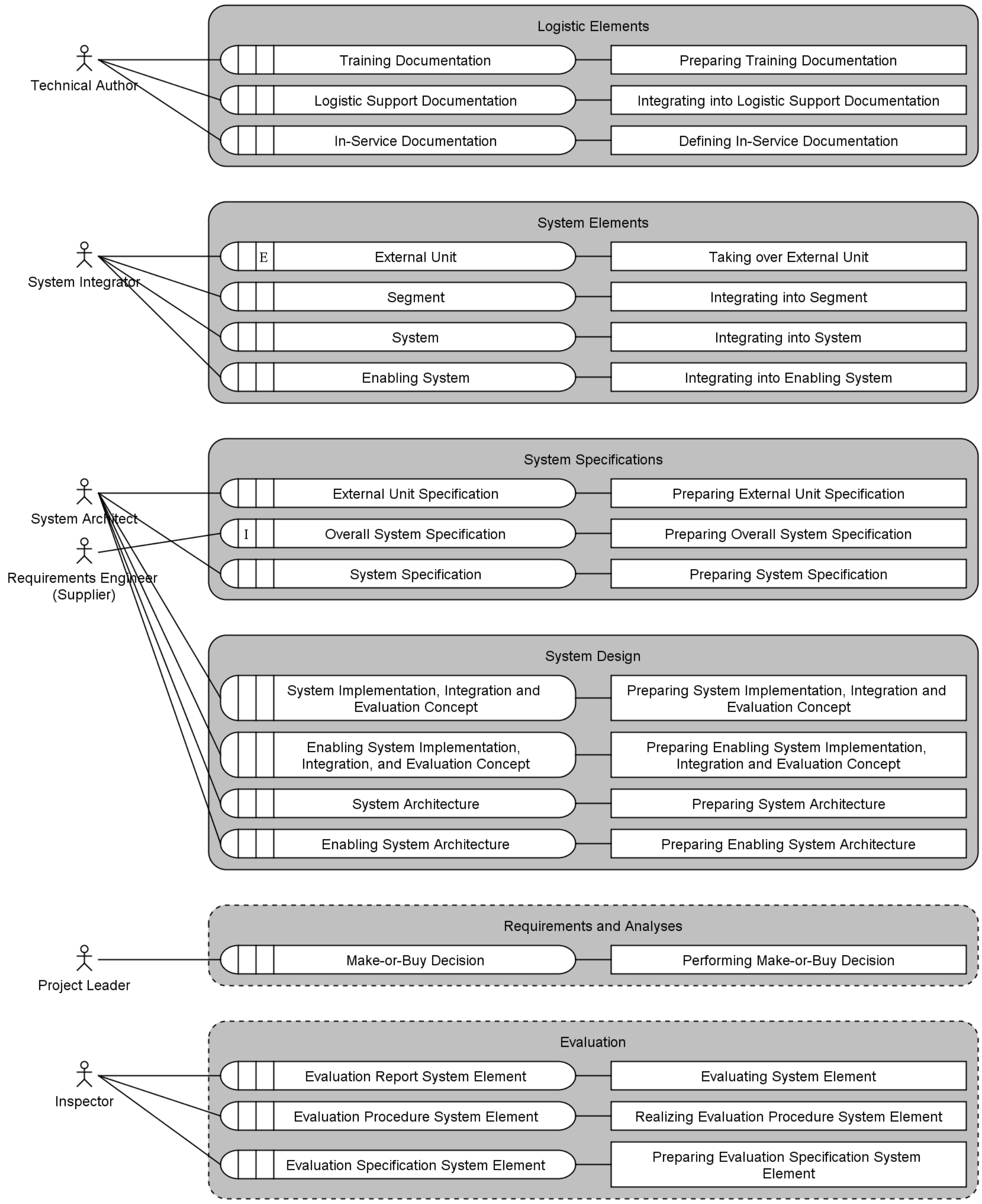


Figure 33: Process module System Development

Purpose

The »Process Module System Development defines the basic skeleton of system development which is the basis for additional process modules as Software Development and Hardware Development. The software and »Hardware Unit s defined in the system architecture will be realized in the process modules Software Development and Hardware Development. In addition off-the-shelf products or results from subcontracts can be integrated during the system integration.

For this purpose, the process module includes activities and products required for creating a system and the appropriate »Enabling System. The system is subdivided into the system elements »Segment and software, hardware and »External Unit . The enabling systems support the systems during the life cycle phases and ensure the operation of the system within the respective operational environment.

(In accordance with »ISO/IEC 12207) The system is defined as a uniform whole, capable of fulfilling specified requirements or achieving certain objectives. It is the subject matter of the order agreed between acquirer and supplier. This means that a segment or a »Software Unit may be the subject matter of an order and, thus, of the system.

In the »Overall System Specification, the system development requirements are derived from the user requirements, which are part of the »Contract, defined more precisely and transfered to the system, the enabling system and the logistic support. Based on the requirements, the system architecture, the »Enabling System Architecture and the appropriate »System Specifications will be prepared. Similarly, integration - including the assembly and quality assurance for the integration procedures - is defined in parallel to the system design. Based on these integration concepts, the system and the enabling systems will be integrated from the system elements. The system elements characterize the actually developed products, e.g., an automobile, aircraft or database.

Project types that may include this process module

System Development Project (Supplier), System Development Project (Acquirer/Supplier)

6.16 Hardware Development

Needs: System Development

Overview

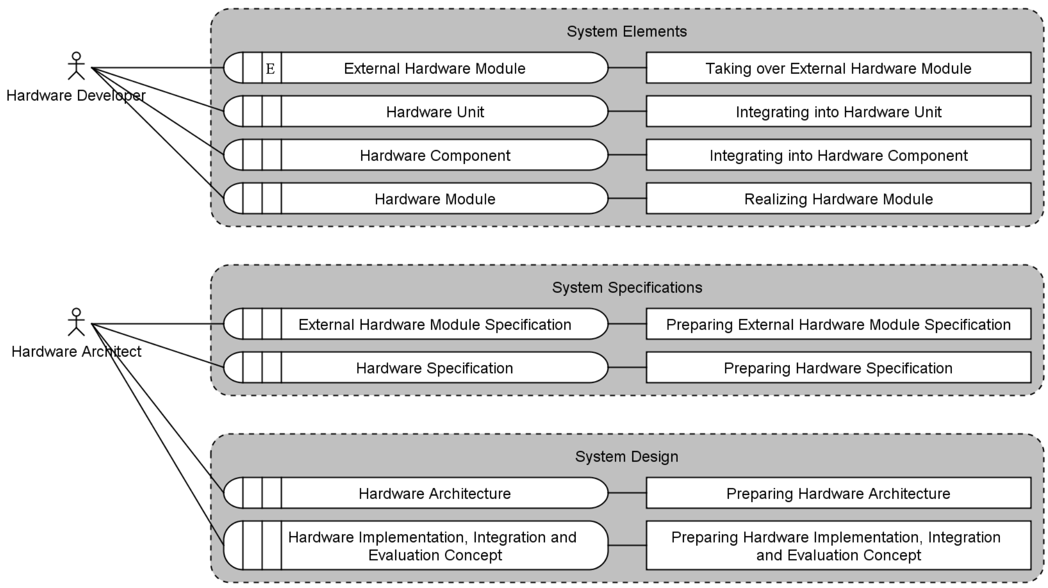


Figure 34: Process module Hardware Development

Purpose

The »Process Module Hardware Development is closely connected with the process module »System Development. It is intended to design or specify, to realize and to integrate the hardware based on the requirements and interfaces of system development. It concerns all hardware-relevant components of the system architecture.

The process module Hardware Development uses a model-based approach. The model is described by the »Hardware Architecture, the »Hardware Specification and the External Hardware Module Specification. The Hardware Specification must be defined for all hardware architecture elements which are not described in higher specifications.

The hardware creation procedure is subdivided into design, realization and integration. The design describes the specification and the concept. The realization defines the implementation of the design in hardware system elements. The integration describes assembly, initialization and testing.

The hardware creation is based on a continuous and repeatable development process which adopts and refines the system development requirements until »Hardware Modules and External Hardware Modules can be realized and integrated into »Hardware Components and »Hardware Units.

Project characteristics that may include this process module

Subject of the Project

6.17 Software Development

Needs: System Development

Overview

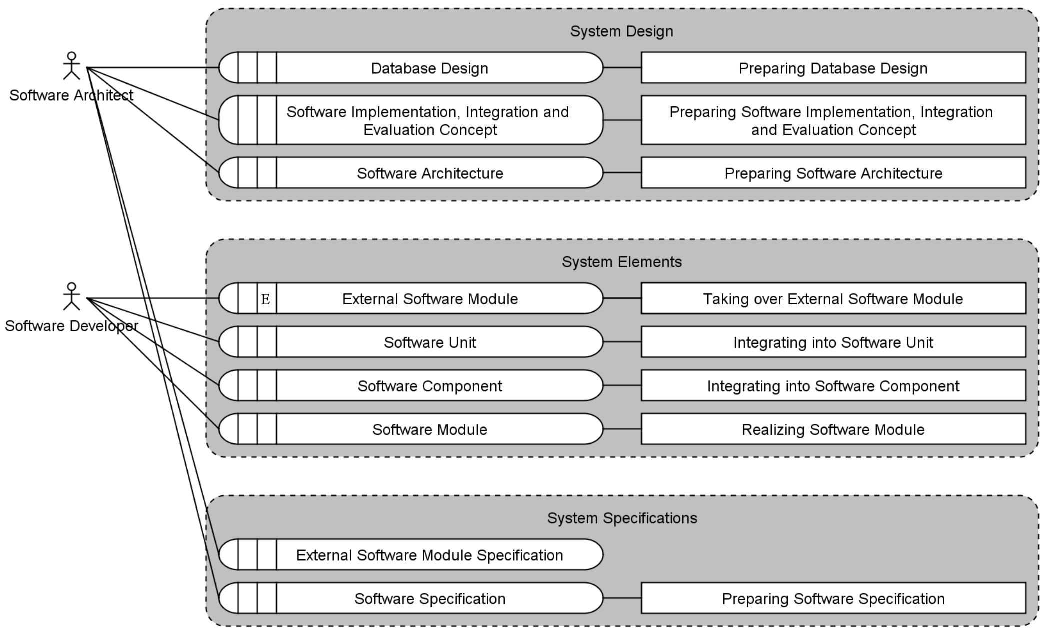


Figure 35: Process module Software Development

Purpose

The »Process Module »Software Development is closely connected with the process module »System Development. It is intended to provide the system development with a concrete realization of the »Software Unit s identified in the system architecture.

The initial product for developing a »Software Unit is the »Software Specification, which will be prepared during the system design process for every »Software Unit to be realized. The »Software Specification defines the requirements posed on the »Software Unit to be realized and the interfaces. The »Software Specification is the basis for the design of the »Software Architecture.

During the architectural design, the »Software Unit is conceptually subdivided into »Software Components, »Software Modules and products of the type »External Software Module. A »Software Specification or a product of the type »External Software Module Specification will also be prepared for every element identified in the »Software Architecture if this is required by the architecture. Otherwise, the specification of a higher element will be used as standard for the realization.

In addition to the products to be designed, the process module »Software Development includes all structural products required for realizing the »Software Unit, the »Software Unit itself, the »Software Component , the »Software Module, and the product »External Software Module. These will be designed in accordance with the »Software Architecture specifications and realized, integrated and tested in accordance with the process module »Software Implementation, Integration and Evaluation Concept. The completed »Software Unit will be integrated into the higher »Segment.

Project characteristics that may include this process module

Subject of the Project

6.18 Integrated Logistic Support

Needs: System Development

Overview

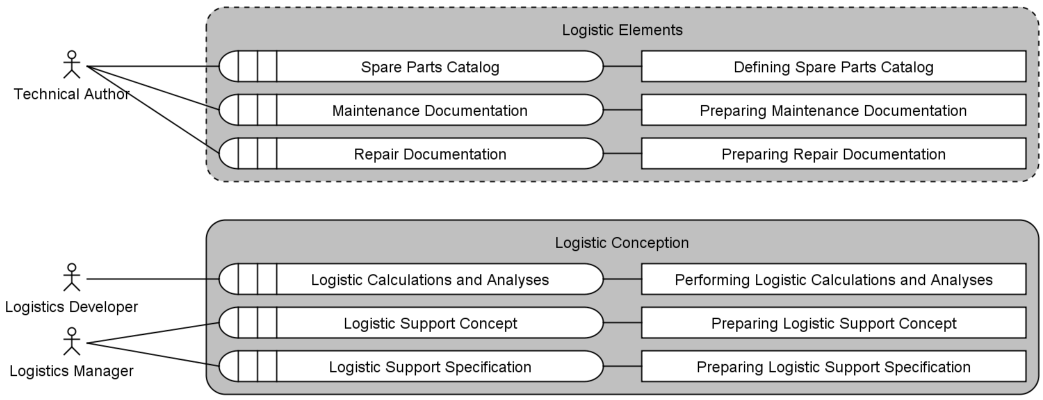


Figure 36: Process module Integrated Logistic Support

Purpose

The »Integrated Logistic Support deals with the definition and the logistic support of the system's life phases after delivery to the acquirer. The »Process Module »Integrated Logistic Support (ILS) includes activities and products necessary for fulfilling the logistic requirements.

The logistic concept specifies and structures the integrated logistic support. Depending on the complexity of the system, this may require comprehensive calculations and analyses. The significant objectives of the logistic concept include the following:

- Exerting systematic influence on technical system design and construction in order to optimally fulfill the system requirements regarding high availability and low life cycle costs.
- Planning, establishing and maintaining the operational readiness of a system by specifying logistic elements and taking into account additional logistic resources (e.g. special tools and training equipment).

The logistic elements include, but are not limited to, the »Logistic Support Documentation,»Training Documentation, »In-Service Documentation , »Maintenance Documentation, Repair Documentation and a Spare Parts Catalogue for each individual system. The In-Service Documentation includes all information on operation and administration.

The optimization of logistic support considers all significant costs and their probable development during the entire in-service life (system initialization, utilization, maintenance and repair, disposal) in order to ensure the planned availability with minimum costs. The main costs result from the following:

- procurement costs including documentation and training,
- planned maintenance,
- unscheduled repair,
- sparing,
- breakdown of production and nonavailability,
- procurement of backup devices, and
- disposal.

Planning funding and control of logistic support activities are management functions fulfilled by the role »Logistics Manager (ILS-Manager). Depending in the size of the project the role »Logistics Manager may have the function of a subproject manager.

Project characteristics that may include this process module

Subject of the Project

6.19 Usability and Ergonomics

Needs:	System Development

Overview

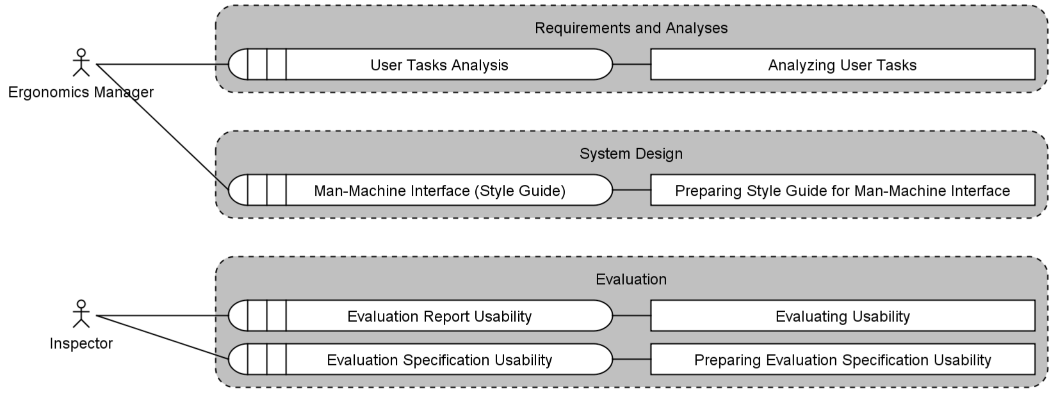


Figure 37: Process module Usability and Ergonomics

Purpose

The »Process Module »Usability and Ergonomics is intended to design the interface between user (man) and system (machine), i.e., the so-called man-machine interface. The interfaces are subdivided into interfaces between men and objects and interfaces between men and user interfaces (GUI).

The man-machine interface becomes increasingly important for the overall system:

- It is the interface where great portions of the system's overall functionality become visible (e.g. the user interface as "face" of the overall system).
- It becomes increasingly important as marketing and differentiating instrument in competition with other products.
- It is decisive for the acceptance by future users.

Therefore, the acquirer increasingly makes demands on the consideration of ergonomic aspects to be developed in close cooperation with the future clients.

Consequently, the supplier recognizes software and hardware ergonomics as necessary core competence.

Project characteristics that may include this process module

User Interface

6.20 Enhancement and Migration of Legacy Systems

Needs: System Development

Overview

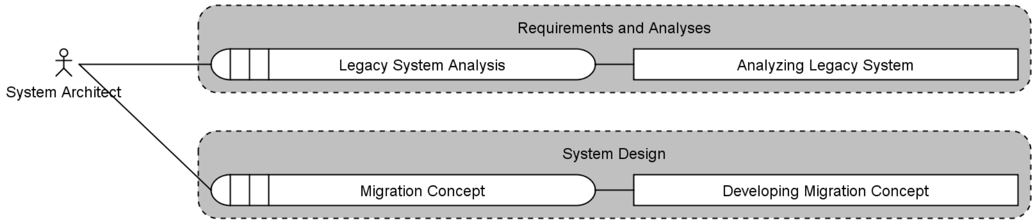


Figure 38: Process module Enhancement and Migration of Legacy Systems

Purpose

The process module »Enhancement and Migration of Legacy Systems is intended to plan and execute measures for further developing systems in maintenance or for planning and executing the migration of the system to new technologies.

At a certain time, preventive maintenance may require a comprehensive further development of the system, e.g., due to extensive changes of functionality.

Systems will frequently degenerate in the course of time. Therefore, a »Legacy System Analysis is recommendable, but not indispensable for the further development of the system. Based on this analysis, the documentation of the system can be adapted or prepared anew. The effort required for the analysis varies greatly, depending on the system's degeneration level and on the quality of the existing system documentation.

The further development normally includes the incorporation of new requirements, which will have to be included into »Overall System Specification and integrated into the »System Architecture. If components of the system are migrated due to the new requirements, a »Migration Concept must be prepared. This is the case, e.g., if new requirements lead to changes in the »Data Model.

If a technical and functional revision of the system is required, a migration will normally be necessary. In case of a migration, the functionality of the system will be developed completely anew, while the data and interfaces of the legacy system will be integrated into the new architecture or platform.

In case of a migration, a »Legacy System Analysis shall be executed in order to determine if components can be migrated. The »Migration Concept will be based on this analysis. The new system will be developed anew in the process module »System Development. The »Migration Concept defines data and interfaces to be migrated.

Project characteristics that may include this process module

Legacy System

6.21 Introduction and Maintenance of an Organization-Specific Process Model

Needs:	Project Management

Overview

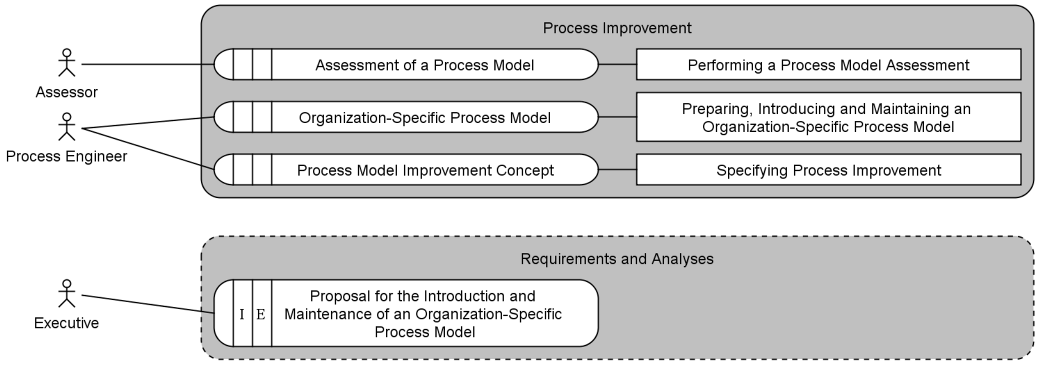


Figure 39: Process module Introduction and Maintenance of an Organization-Specific Process Model

Purpose

This »Process Module is intended to introduce, implement and continually improve a process model for an organization. The defined procedure is applied to two cases:

1. to the first introduction and implementation of organization-wide process descriptions
2. to the repeated execution of an organization-wide process improvement program

The continuous improvement process is based on the V-Modell with its sub-processes, products and activities. During the introduction of an organization-specific process model, the V-Modell can be adapted to the organization and complemented by organization-specific processes. At the beginning of the improvement project, it is necessary to specify which units belong to the organization.

The process improvement requirements are derived - on the one hand - from the requirements posed by the management and - on the other hand - from the results of the process evaluations, which are conducted based, e.g., on the following models

- V-Modell XT confomance check
- V-Modell XT Assessment
- »CMMI® (Capability Maturity Model Integration) developed by SEI (Software Engineering Institute of the Carnegie Mellon University)
- »SPICE-Model (ISO/IEC 15504)

The implementation of the requirements will then be prepared in the »Process Model Improvement Concept. Afterwards, process descriptions, »Training Documentation etc. will be prepared or revised and filed in the »Organization-Specific Process Model. This is the basis for piloting and introducing the organization-specific process model.

One of the most important conditions for a successful process improvement is the visible, clear support by the management which ensures the backing and the priority of the activities within the scope of process improvement.

The process module »Introduction and Maintenance of an Organization-Specific Process Model has interfaces to other process modules, e.g.,

- to the process module »Project Management, which derives the subject »Project-Specific V-Modell from the product »Organization-Specific Process Model, and
- to the process module »Measurement and Analysis via the »Metrics Catalog.

These are not modeled explicitly here.

Project types that may include this process module

Introduction and Maintenance of an Organization-Specific Process Model

6.22 Management of Multiple Projects

Needs: Specification of Requirements

Overview

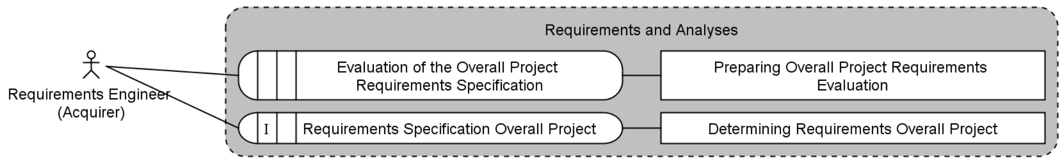


Figure 40: Process module Management of Multiple Projects

Purpose

The Management of Multiple Projects is a variation of »Project Management, intended to improve the controllability of complex and large projects by subdividing them into partial projects and intended to minimize the project risks. On the basis of a »Project Manual for the overall project, the »Process Module Management of Multiple Projects will prepare a »Requirements Specification Overall Project, which enables the »Project Leader to subdivide the overall project into partial projects which can be executed independently. In the end, the results of the partial project will again be reunited into one overall system.

Project type variants that may include this process module

Project (Acquirer) with Several Suppliers

7 Decision Gates

A »Decision Gate is a project point where the »Steering Committee decides whether a »Project Progress Stage has been achieved. Decision Gates subdivide the project history into »Project Sections.

7.1 Project Approved

Products: Proposal for the Introduction and Maintenance of an Organization-Specific Process Model, Assessment of Request for Proposal, Project Proposal, Project Progress Decision

Purpose

At the »Decision Gate »Project Approved, the »Steering Committee of the acquirer decides - based on the »Project Proposal - whether the project should be started with the »Request for Proposal.

The Management Board of the supplier decides - based on the »Assessment of Request for Proposal - whether an »Offer should be prepared.

If the project deals with the introduction and maintenance of an organization-specific process model, the »Steering Committee decides - based on the »Proposal for the Introduction and Maintenance of an Organization-Specific Process Model - whether the project should be started with the »Assessment of a Process Model.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.2 Project Defined

Products: Product Library, Project Progress Decision, Project Manual, QA Manual, Project Plan, Project Status Report, Quality Status Report

Purpose

The »Decision Gate »Project Defined includes the decision as to whether »Project Manual and »QA Manual correctly reflect the project.

In case of a positive assessment, »Project Manual and »QA Manual specify first framework conditions for the project, which - in the further course of the project - enable the acquirer to specify the requirements and the supplier to develop the project.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

All project-relevant data will be filed in the »Product Library, which is managed by the »Configuration Management. The structure of the product library will be specified at the latest at the »Decision Gate »Project Defined.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.3 Requirements Specified

Products: RFP Concept, Project Progress Decision, Requirements Specification, Requirements Evaluation, Project Plan, Project Status Report, Quality Status Report

Purpose

At the »Decision Gate »Requirements Specified, the »Steering Committee of the acquirer or the user checks the specified requirements and their priority for completeness and correctness.

In case of a positive assessment, the requirements will be documented as »Requirements Specification. In addition, the user submits a »Requirements Evaluation in accordance with the priority he/she assigns to the individual requirements. On the basis of these documents, the supplier can develop the system.

If the contract is awarded based on a »Request for Proposal, the appropriate preparation will begin already in this decision gate. It may be subject to certain regulations of the contract award law. The »RFP Concept is intended to ensure that these regulations are complied with. It specifies a legally correct procedure for developing a reasonable request for proposal.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.4 Request for Proposal Released

Products: Request for Proposal, Criteria Catalog for Assessment of Offers, Project Progress Decision, Project Plan, Project Status Report, Quality Status Report

Purpose

The »Decision Gate »Request for Proposal Released includes the decision as to whether the »Request for Proposal may be published.

In case of a positive assessment, an »Request for Proposal and a »Criteria Catalog for Assessment of Offers are submitted which permit an objective evaluation of received »Offers.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.5 Offer Submitted

Products: Offer, Project Progress Decision, Project Plan, Project Status Report, Quality Status Report

Purpose

At the »Decision Gate »Offer Submitted, the »Steering Committee of a potential supplier examines whether the »Offer prepared based on the »Request for Proposal shall be submitted in its present form to the acquirer.

In case of a positive assessment, the »Offer will be submitted to the acquirer.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.6 Contract Awarded

Products: Contract (Acquirer), Offer Assessment, Contract Addendum (Acquirer), Contract, Contract Addendum, Project Progress Decision, Evaluation Specification Delivery, Project Plan, Project Status Report, Quality Status Report

Purpose

At the »Decision Gate »Contract Awarded, the Steering Committees of acquirer and supplier decide on the conclusion of contract.

In this context, there are three possible initial situations:

1. The intended contract is the project's first contractual agreement between acquirer and supplier. The acquirer will make this decision based on the »Offer Assessment, while the supplier's decision will be based on the »Contract (Acquirer).
2. Acquirer and supplier have already concluded a contractual agreement and a part of the requirements has already been realized, possibly in form of a prototype. In this case, the acquirer decides whether - in view of the results achieved up to now - a cooperation with the supplier is desirable for the entire realization of the project. The supplier's decision will again be based on the Contract (Acquirer).
3. If the acquirer has achieved new knowledge about the requirements during the system development, he can specify new or modified requirements. This may lead to the specification of a contract addendum. In case of a public request for proposals, however, the applicable contract award law must be complied with.

In case of a positive decision, a »Contract will be concluded between acquirer and supplier, which commits the supplier to develop and, finally, to deliver the system to the acquirer.

The contents of the contract and the requirements contained therein influence the »Evaluation Specification Delivery , which is decisive for the acceptance test of the »Delivery (Supplier) at the decision gate »Acceptance Completed.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.7 Iteration Scheduled

Products: Project Progress Decision, Project Manual, QA Manual, Project Plan, Project Status Report, Quality Status Report

Purpose

The decision gate Iteration Scheduled specifies the planning for the following system development steps. The planning covers the period to the next increment, but may go even further.

For this purpose, the open Change Requests of the Change Status List are examined, and acquirer and supplier will agree on the subsequent proceedings.

The Acquirer plans the preparation of the products required for the acceptance test, e.g., the Evaluation Specification.

The Supplier plans the detailed proceedings through the system development decision gates to the Delivery and Acceptance.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.8 System Specified

Products: Overall System Specification, Project Progress Decision, Evaluation Specification Document, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis, Project Plan, Project Status Report, Quality Status Report

Purpose

The »Decision Gate »System Specified evaluates if the overall system specification has been prepared completely as planned and in accordance with the requirements.

In case of a positive assessment, the »Overall System Specification will be submitted, which will enable the system to be designed and realized. In addition, the »Evaluation Specification System Element will completed for every system element. If required, a »Evaluation Specification Document will be prepared for every document to be delivered.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project. In addition, the hazards connected with the project are documented in a »Safety and Security Analysis.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.9 System Designed

Products: Logistic Support Specification, System Architecture, System Specification, Enabling System Architecture, External Unit Specification, System Implementation, Integration and Evaluation Concept, Project Progress Decision, Enabling System Implementation, Integration, and Evaluation Concept, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis, Project Plan, Project Status Report, Quality Status Report

Purpose

The »Decision Gate »System Designed includes the final evaluation of the capacity of the »System Architecture and the »Enabling System Architecture.

In case of a positive assessment, the »System Specification, the »Logistic Support Specification and the »Evaluation Specification System Element are completed for the system and all designed system elements. The basic implementation, test and integration procedures are specified in the »System Implementation, Integration and Evaluation Concept and the »Enabling System Implementation, Integration, and Evaluation Concept. In addition, a »Evaluation Specification System Element is prepared for each system element. Thus, a following detailed design can be executed within a unit based on a stable preliminary design. In addition, an »External Unit Specification was prepared for external units.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project. In addition, the hazards connected with the project are documented in a »Safety and Security Analysis.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.10 Detailed Design Completed

Products: Logistic Support Concept, Hardware Architecture, Hardware Specification, Software Architecture, Software Specification, External Hardware Module Specification, External Software Module Specification, Project Progress Decision, Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, Evaluation Specification System Element, Information Security Concept, Safety and Security Analysis, Project Plan, Project Status Report, Quality Status Report

Purpose

The »Decision Gate »Detailed Design Completed includes the final evaluation of the capacity of the hardware and software architecture.

In case of a positive decision, the detailed »Hardware Specification and »Software Specification and the products of the types External Hardware Module Specification and External Software Module Specification are completed, which will be used for realizing the future units. In addition, the hardware and software test and integration concepts are completed, which will be used for checking the functionality of implemented units. The products »Hardware Architecture, »Software Architecture and a »Logistic Support Concept will be submitted. By means of these products, the system elements can be realized or suitable products of the types External Hardware Module, External Software Module and External Unit can be selected, which will later become »System Integrated. In addition, the »Evaluation Specification System Element will be completed for all system elements.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project. In addition, the hazards connected with the project are documented in a »Safety and Security Analysis.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.11 System Elements Realized

Products: Hardware Unit, Software Unit, External Hardware Module, Project Progress Decision, External Software Module, Evaluation Report System Element, Project Plan, Project Status Report, Quality Status Report

Purpose

Based on the product »Evaluation Report System Element, the »Decision Gate »System Elements Realized evaluates if all units work in accordance with their specifications.

In case of a positive result, the individual operational »Hardware Units and »Software Units are ready and can be integrated into the overall system.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.12 System Integrated

Products: System, Segment, External Unit, Project Progress Decision, Logistic Support Documentation, Evaluation Report System Element, Project Plan, Project Status Report, Quality Status Report

Purpose

At the »Decision Gate »System Integrated, the supplier employs the product »Evaluation Report System Element for checking whether the »System fulfills the requirements of the acquirer.

In case of a positive assessment, the integrated »System including all »Segments, Hardware Units, Software Units and products of the type »External Unit and the »Logistic Support Documentation exist in deliverable form.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.13 Delivery Conducted

Products: Delivery, Project Progress Decision, Evaluation Report Document, Evaluation Report System Element, Project Plan, Project Status Report, Quality Status Report

Purpose

The »Decision Gate »Delivery Conducted is intended to deliver the system to the acquirer or the user. For this purpose the system or the documents to be delivered will be evaluated, and the result will be recorded in the product »Evaluation Report System Element or the »Evaluation Report Document.

In case of a positive assessment, the (sub-)system shall delivered as »Delivery to the acquirer or user, who can then examine whether the (sub-)system fulfills his/her requirements.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.14 Project Progress Revised

Products: Project Progress Decision, Project Status Report (Supplier), Project Plan, Project Status Report, Quality Status Report

Purpose

At the decision gate Project Progress Revised, the Acquirer checks the project progress achieved by the Supplier. While the Supplier deals with the system development, the Acquirer is tasked with supporting the Supplier in technical questions and observing the project progress.

The schedule of this decision gate will be planned in dependence on the Supplier. The Supplier submits the Project Status Report (Supplier) as decision basis for this decision gate.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.15 Acceptance Completed

Products: Statement of Acceptance (Acquirer), Delivery (Supplier), Project Progress Decision, Statement of Acceptance, Evaluation Report Delivery, Project Plan, Project Status Report, Quality Status Report

Purpose

At the »Decision Gate »Acceptance Completed, the »Steering Committee of the acquirer or the user uses the »Evaluation Report Delivery for checking whether the delivered (sub-)system fulfills his/her requirements. In case of a positive result, the »Statement of Acceptance may be signed. Based on the »Statement of Acceptance of the acquirer, the Steering Committee of the supplier or the system developer checks at this decision gate, whether the project can enter the next development cycle or reach the state »Project Completed, or whether further corrective actions are required.

In case of a positive assessment by both sides, the (sub-)system is completed, and the possession is transferred to the acquirer within the scope of the »Delivery (Supplier), unless acquirer and supplier belong to the same organizational unit. The acquirer or user has tested the delivered products, recorded the results in the product »Evaluation Report Delivery and prepared an »Statement of Acceptance.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

If the delivery cannot be accepted due to a lack of quality, there are the following possibilities:

1. The payment of installments may depend on the acceptance. It is possible to specify that the installments for one iteration are transferred to the next iteration if the delivery is not accepted. In this case, the planned workflow is not interrupted, but the deficiencies must be remedied in the following iteration.
2. The project goes back for the required number of decision gates, and the procedures leading toward the acceptance are repeated.
3. The project is cancelled.

7.16 Project Completed

Products: Project Progress Decision, Final Project Report

Purpose

The »Decision Gate »Project Completed includes the decision as to whether the project will be completed.

In case of a positive assessment, the »Final Project Report is the basis for future analysis tasks.

7.17 Process Model Analyzed

Products: Assessment of a Process Model, Project Progress Decision, Project Plan, Project Status Report, Quality Status Report

Purpose

At the »Decision Gate »Process Model Analyzed, the Management of an organizational unit employs the »Assessment of a Process Model to decide whether the proposed improvement project should be executed.

In case of a positive assessment, the »Assessment of a Process Model provides a basis for future improvement measures.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.18 Process Model Improvement Specified

Products: Process Model Improvement Concept, Project Progress Decision, Project Plan, Project Status Report, Quality Status Report

Purpose

At the »Decision Gate »Process Model Improvement Specified, the management of an organization decides whether the proposed project should be continued. This decision will be based on the product »Process Model Improvement Concept.

In case of a positive assessment, an »Process Model Improvement Concept exists, which specifies how the process model should be improved in the further course of the project.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.19 Process Model Improvement Implemented

Products: Organization-Specific Process Model, Project Progress Decision, Project Plan, Project Status Report, Quality Status Report

Purpose

At the »Decision Gate »Process Model Improvement Implemented, the management of an organizational unit employs the product »Organization-Specific Process Model to decide whether the improvement project should be completed.

In case of a positive assessment, the improved process model is available, and its contents is subject to configuration management.

A detailed »Project Plan includes the planning for the following »Project Progress Stage. The »Project Status Report documents the project progress, and the »Quality Status Report describes the quality characteristics of the project.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.20 Overall Project Partitioned

Products: Project Progress Decision, Requirements Specification Overall Project, Evaluation of the Overall Project Requirements Specification, Project Manual, QA Manual, Project Plan, Project Status Report, Quality Status Report

Purpose

At the decision gate Overall Project Partitioned, the project will be partitioned into feasible partial projects in accordance with Outline of the Life Cycle and the Overall System Architecture in the Requirements Specification. If this partition into partial projects is feasible, the specification of the partial projects will be integrated into the Project Manual and the Project Plan.

A »Project Progress Decision will be made in order to proceed to the next decision gate.

7.21 Overall Project Progress Revised

Products: Project Progress Decision, Project Status Report (Supplier), Project Plan, Project Status Report, Quality Status Report

Purpose

On the basis of all Project Status Reports (Supplier), a »Project Progress Decision will be made as to whether the overall project still fulfills the planning data specified in the Project Plan and as to whether and how the project shall be continued.

8 Tailoring-Related Product Dependencies

Tailoring-related product dependencies describe the relations between »Products and »Process Modules, which are relevant for »Tailoring. For a description of tailoring product dependencies, refer to V-Model Part 1: »Fundamentals of the V-Modell, Chapter »Tailoring .

8.1 Procurement of Off-the-Shelf Products

Tailoring influenced by:	Project Proposal

If the Project Proposal recommends or specifies that off-the-shelf products be used if possible, an evaluation of off-the-shelf products shall be conducted.

8.2 Optional Procurement of Off-the-Shelf Products

Tailoring influenced by:	Requirements Specification, Requirements Specification Overall Project

During the requirements specification, the outline of the life cycle and the overall system architecture may show that it is not necessary to develop all system components and that some components or the overall system can possibly be procured as off-the-shelf products. If it is decided that off-the-shelf products should be used, an evaluation of off-the-shelf products shall be conducted.

8.3 Directives from the Overall System Specification

Tailoring influenced by:	Overall System Specification

The contents of the »Overall System Specification is decisive for the »Tailoring Result, which will be documented in the »Project Manual. If requirements were assigned to the integrated logistic support or to logistic elements, maintenance documentation, repair documentation or spare parts catalogs in the product »Overall System Specification under the subject »Requirements Tracing, the »Process Module »Integrated Logistic Support must be selected.

8.4 Directives from the Acquirer

Tailoring influenced by:	Request for Proposal (Acquirer), Contract (Acquirer), Contract Addendum (Acquirer)

The acquirer may specify mandatory »Process Modules to be selected by the supplier. If the acquirer has made specifications of this type referring to the »Project Manual of the supplier in the products »Request for Proposal (Acquirer), »Contract (Acquirer) and »Contract Addendum (Acquirer), these shall be taken into account during the »Tailoring process.

8.5 Specifying a Management of Multiple Projects

Tailoring influenced by:	Project Proposal

If the Project Proposal recommends or specifies that the overall project be subdivided into sub-projects, a management of multiple projects shall be conducted.

8.6 Directives from the System Architecture

Tailoring influenced by: System Architecture

The contents of the »System Architecture is decisive for the »Tailoring Result, which will be documented in the »Project Manual . The following provisions shall be observed:

- If at least one »Software Unit or one External Software Module has been identified in the product System Architecture, the »Process Module »Software Development must be selected in the Project Manual.
- If at least one »Hardware Unit or one External Hardware Module has been selected in the product System Architecture, the process module »Hardware Development must be selected in the Project Manual.
- If at least one »External Unit or one External Hardware Module or External Software Module to be bought has been selected in the product System Architecture, the process module »Evaluation of Off-the-Shelf Products must be selected in the Project Manual.
- If at least one »External Unit or one External Hardware Module or External Software Module to be awarded as subcontract has been selected in the product System Architecture, the process module »Delivery and Acceptance (Acquirer) must be selected in the Project Manual.
- If at least one »External Unit or one External Hardware Module or External Software Module to be adopted from a legacy system has been selected in the product System Architecture, the process module »Enhancement and Migration of Legacy Systems must be selected in the Project Manual.

8.7 Directives from the Project Manual

Tailoring influenced by: Project Manual

The »Tailoring Result will be documented in the »Project Manual under the subject »Project-Specific V-Modell. In addition, there are other subjects in the »Project Manual which influence the tailoring result, e.g. the subject »Project Execution Plan.

8.8 Directives from the Enabling System Architecture

Tailoring influenced by: Enabling System Architecture

The contents of the »Enabling System Architecture is decisive for the »Tailoring Result, which will be documented in the »Project Manual. The following provisions shall be observed:

- If at least one »Software Unit or one External Software Module has been identified in the product Enabling System Architecture, the »Process Module »Software Development must be selected in the Project Manual.
- If at least one »Hardware Unit or one External Hardware Module has been identified in the product Enabling System Architecture, the process module »Hardware Development must be selected in the Project Manual.

- If at least one »External Unit or one External Hardware Module or External Software Module to be bought as off-the-shelf product has been identified in the product Enabling System Architecture, the process module »Evaluation of Off-the-Shelf Products must be selected in the Project Manual.
- If at least one »External Unit or one External Hardware Module or External Software Module to be awarded as subcontract has been identified in the product Enabling System Architecture, the process module »Delivery and Acceptance (Acquirer) must be selected in the Project Manual.
- If at least one »External Unit or one External Hardware Module or External Software Module to be adopted from a legacy system has been identified in the product Enabling System Architecture, the process module »Enhancement and Migration of Legacy Systems must be selected in the Project Manual.

9 Process Module Index

Activities

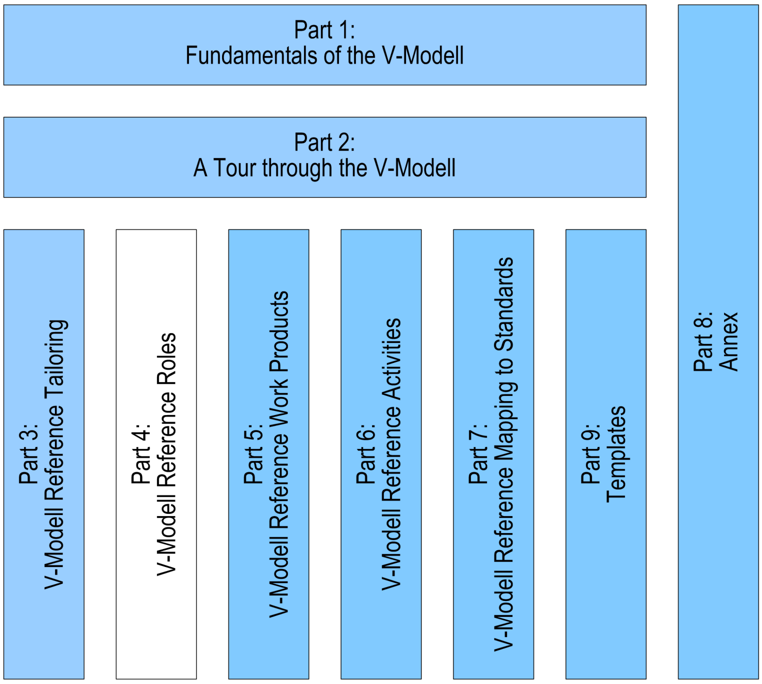
Activities

10 Process Module Index (Alphabetical)

11 List of Figures

Part 4: V-Modell Reference Roles

V-Modell® XT



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Export templates	Version 1.3 English
Export environment	Version 2.1.3
V-Modell XT	V-Modell® XT Version 1.3

Table of Contents

1 Introduction

1.1 Objectives of the V-Modell Reference

The »V-Modell Reference Roles provides a survey of all roles of the V-Modell. In addition to a detailed description of roles, the reference specifies the »Work Product and »Activity for which each role is responsible and the products and activities in which each role cooperates.

For project management, it is necessary to concentrate the staff in project teams, with the roles for each team member being specified in order to ensure a joint achievement of project goals in time, with the appropriate quality and at adequate costs.

1.2 Audience

This V-Modell reference is the guideline for the assignment of roles and provides the project members with a first orientation regarding the future tasks and authorizations.

1.3 Contents and Structure of the V-Modell Reference

This V-Modell reference comprises the following chapters:

»Roles

This chapter comprises the description of all roles in alphabetical order. The roles are explained by a summary description and a description of their tasks and authorizations as well as a capability profile. In addition, the chapter includes advisory remarks on appointments, if these remarks are necessary for the understanding. The dashed lists must be applied in a project-specific manner. In addition, the products for which the respective role is responsible and the products in which the role cooperates are listed.

»Role Index

This chapter completely lists all roles included in the V-Modell.

1.4 Notes on the Presentation in the V-Modell Reference

A role is a definition with capabilities and knowledge which is independent of the organization and which is assigned responsibilities and authorizations. Each role includes a capabilitiy profile which can be used for selecting suitable project staff members. If particular framework conditions must be observed when the role is staffed, these are indicated under the headline "Appointment".

The above-mentioned descriptions are a general list. The subjects valid for a specific project must be selected from this list. The following role and function designations refer equally to members of both genders.

Roles, which either have the participation "responsible" or "cooperating", will be assigned to each product.

Participation of Role "Responsible":

- assuming the responsibillity for creating the product with the planned quality, at the planned date and with the planned budget,
- delivering the created/changed product to CM,
- reporting the start and the end of the activity/sub-activity of the product/subject to be created/changed to the »CM Manager,
- coordinating the participating roles.

Participation of Role "Cooperating"

- participating in the creation of products/subjects,
- participating in votings,
- generally, the products can only be created by cooperation,
- providing knowledge and experience in order to execute the development project at the planned date, with the planned budget and with the adapted quality,
- finding more economic solutions for the product life in accordance with product management.

The following rules always apply to the assignment of roles to products:

- All roles for the products required for a project shall be staffed.
- One role may be staffed by several persons.
- One person may occupy several roles of a project.
- Of course, it is permitted and desirable to employ know-how providers in addition to the presented roles.
- All specialties involved in the course of a product life should be integrated as early as possible.

2 Roles

2.1 Account Manager

Description

The Account Manager is responsible for planning the order intake of his sales department and for maintining the existing and developing new acquirer relations. He is also responsible for »Request for Proposal with are of relevance for the submission of a proposal.

He provides the stewardship for the bid/no-bid decision and is the responsible point of contact for acquirers and external partners. His activities are intended to continuously increase or stabilize the number of orders received in his sales department. He should initiate the improvement of existing products or the development of new products by providing a feedback on the demands of the market.

Tasks and Responsibilities

- Analyzing acquirer decision structures,
- examining acquirer satisfaction,
- observing and communicating competitor activities,
- developing acquirer-oriented strategies (particularly win strategy),
- controlling the success in acquirer relations,
- establishing contact to acquirers/partners,
- building confidence and maintaining relations to acquirers,
- generating ideas for promoting cooperation/interest,
- coordinating all acquirer activities,
- acting as ”solicitor of the acquirers”,
- preparing the bid/no-bid decision,
- controlling the offer until it is submitted,
- negotiating the contract with the acquirer,
- negotiating contracts with sub-suppliers, partners and suppliers,
- requesting and managing the required funds.

Skill profile

- Strategic capability of thinking,
- understanding of complex connections,
- profound technical and economic knowledge,

- thorough export experience with respect to the specific countries,
- foreign language skills in speaking and writing,
- communication capability,
- self assertion regarding the internal implementation of sales actions,
- resilience.

Responsible for

Offer, Request for Proposal (Acquirer)

2.2 Assessor

Description

The »Assessor is an independent consultant. He assesses the documented and practiced processes of the process model of an organization.

Tasks and Responsibilities

- Planning and preparing the process assessment,
- interviewing all participants (e.g. interview with the Project Leader on the subject Project Planning and Project Controlling),
- and/or inspecting documents on the defined and practiced processes,
- analysing the results of the interviews and/or document inspection,
- preparing an assessment and developing proposals for improvement, which will be documented in a report,
- presenting the assessment results,
- assuming responsibility for the adequate and correct execution of the assessment (result, schedule, budget, acquirer satisfaction),
- assuming responsibility for the interviews with project staff and management,
- assuming responsibility for the assessment of the documented and practiced process,
- assuming responsibility for proposing an improvement project.

Skill profile

- Thorough knowledge of the respective process fields (e.g. PM, QA, CM) and in project management,
- thorough knowledge of the employed process model,
- familiarity with contents and processes of reference documents and standards, e.g., V-Modell XT conformance, CMMI®, ISO 900x, V-Modell, SPICE,
- expertise in moderation and interview techniques,

- experience from previous assessments,
- trustworthiness, objectivity and integrity.

Role Allocation

The Assessor is an external consultant or a staff member who is independent of the organizational unit to be assessed.

Responsible for

Assessment of a Process Model

2.3 Change Control Board

Description

The Change Control Board will be convoked in case of important (for definition, refer to Project Manual) changes and will decide how one or more interconnected changes should be processed. The execution of the change will be planned and initiated by the project management.

Tasks and Responsibilities

- Evaluating the project situation as initial basis for the decision to be made,
- developing management-specific decision criteria as basis for the decision to be made,
- making the decision on one or more problem reports/change requests based on the problem/change assessment,
- determining the future approach for implementing change requests.

Skill profile

- Experience in project management and in the assessment of unforeseen project situations,
- experience in the assessment of possible effects caused by the changes (effort, time, budget, resources, quality) and the consequences for the success of the project,
- competence in evaluating the relevance of change requests for the success of the project,
- communication and consensus-building capabilities in case of controversial approach concepts (negotiating skills),
- self assertion within the scope of the project.

Role Allocation

Depending on the type of change request to be assessed, the Change Control Board is composed of internal representatives and - if the change request is submitted by the acquirer - of internal and external representatives. Project-Specific conflict management and escalation strategies shall be specified in the »Project Manual under the subject »Problem and Change Management - Organization and Directives.

The internal Change Control Board is composed of project internal representatives working at the operational level, e.g., from the project steering committee, development departments, QA and CM.

Responsible for

Change Decision

2.4 Change Request Manager

Description

The Change Request Manager is an experienced expert in his field. He will be selected by the »Project Leader depending on the subject of the problem report or change request and will process the subject independently by

- analysing the problem,
- developing suggested solutions for the problem,
- assessing these solutions and making a recommendation.

Tasks and Responsibilities

- Searching the cause of the described problem,
- determining technical decision criteria for assessing the solutions,
- searching a suitable solution for the described problem,
- recommending the technically most reasonable solution.

Skill profile

- Expertise in the matter which is subject of the problem report or change request,
- technical understanding and knowledge of the system (application/use/technology),
- profound expertise for determining suitable suggested solutions for the submitted problem/fault/improvement proposal,
- experience in the technical assessment of the proposed solutions (advantages/disadvantages),
- profound knowledge of the V-Modell in order to identify the action point of the required change,
- capability to recognize dependencies and effects,
- capability to recognize whether the change request exceeds the scope of the agreed user requirements (change of contract).

Role Allocation

The role Change Request Manager should always be manned. The Change Request Manager is allways responsible for problem and change requests even if, depending on the subject of the change requests, there may be several persons in charge of changes for different fields (e.g. system, software, hardware, logistics).

Responsible for

Change Status List, Problem/Change Evaluation, Problem Report / Change Request

Participating in

Change Decision, Project Status Report

2.5 CM Administrator

Description

The »CM Administrator is responsible for the project-specific »Product Configuration and for saving and archiving products and configurations in such a way that the present and previous product configurations of the systems can be traced and restored during the entire system life cycle.

Tasks and Responsibilities

- Estabishing configuration management and product library,
- initializing and administering products and product configurations,
- saving and archiving products and configurations,
- documenting delivery data,
- executing the CM procedures regarding the data exchange e.g. with acquirers/partners/subsuppliers.

Skill profile

- Knowledge and mastery of configuration management processes, procedures, methos and tools,
- communication and team capabilities.

Role Allocation

If reasonable and required (e.g. in case of small projects), the role of CM Adminstrator and the role of »CM Manager may be staffed by one person.

Responsible for

Product Configuration

Participating in

Product Library, Project Management Infrastructure

2.6 CM Manager

Description

The CM manager manages, coordinates and controls the »Configuration Management and specifies all necessary project-specific conditions in the »Project Manual. He reports on the project progress to the »Project Leader.

Tasks and Responsibilities

- Preparing the configuration management section in the Project Manual,
- appointing the CM Administrator,
- controlling the establishment of configuration management,
- establishing and administering access authorizations,
- controlling the initialization and administration of the product library,
- controling the initialization and updating of the product configuration,
- implementing the requirements on product saving and archiving,
- evaluating the product library and reporting to the Project Leader,
- specifying and coordinating the CM procedures, e.g. with acquirers/partners/sub-suppliers.

Skill profile

- Experience in project execution,
- knowledge of the contractual framework conditions,
- knowledge and mastery of the configuration management processes, precedures, methods and tools required for the respective functional area,
- knowledge of the framework conditions/regulations for configuration and product management (uniform identification system),
- knowledge of application and operational areas of the system to be developed,
- knowledge of the different system versions,
- organization and communication capabilities.

Role Allocation

The role of CM Manager must be staffed in every project. Since product and configuration changes will be adopted in the »Problem and Change Management, the CM Manger must be member of the »Change Control Board. If reasonable and required, tasks of the CM Manager may be delegated to the CM Administrator under certain conditions.

Responsible for

Product Library

Participating in

Evaluation Specification Product Configuration, Change Decision, Problem/Change Evaluation, Final Project Report, Project Manual, Project Plan, Project Status Report

2.7 Coach

Description

The coach cooperates in the specification of a training concept and the preparation of the training documentation. During piloting and roll out, he instructs the pilot users and the staff.

Tasks and Responsibilities

- Cooperation in the specification of a training concept;
- preparation of the training documentation;
- instructing pilot users,
- instructing personnel for the roll out.

Skill profile

- Task-specific knowledge,
- process understanding,
- capability to convert technical facts and connections into target group-oriented training programs,
- didactic/rhetoric capabilities,
- foreign language skills as required by the project,
- knowledge of relevant regulations, processes, procedures, methods and tools.

Participating in

Organization-Specific Process Model

2.8 Controller

Description

The »Controller is responsible for all commercial tasks connected with the project, including all control and management tasks required for realizing the economic objectives of the project.

Tasks and Responsibilities

- Tracking the costs,
- specifying the commercial conditions in internal and external orders,
- safeguarding the economic interests when the conditions of internal and external orders are negotiated,
- preparing calcuations of offers and orders,
- checking the acceptance of contracts, possibly with the assistance of the legal branch,
- conducting commercial order administration until the accounts are rendered and settled, including the award of sub-contracts to internal and external agencies,
- preparing a co-calculation based on the work packages specified in the workload breakdown structure and ensuring the connection to the partial plans of other working fields,
- continuously monitoring and publicating contract effects (e.g. warranties, contractual penalties, liabilities),
- determining project-related risks,
- Executing planned/actual comparisons and analyses if plans, budgets and project objectives deviate in the field of commercial concerns,
- contributing to the regular internal and external reporting on the project status report,
- cooperating in the preparation of price review documents,
- cooperating in the preparation of offers and contracts,
- cooperating in the preparation of the commercial sections of the work breakdown structure,
- cooperating in the preparation of the post/final calculation of the project and the final project report, including the evaluation of measurable quantities of the project and the internal lessons learned report.

Skill profile

- Economic knowledge,
- capability to work independently,
- comprehensive economic awareness for costs and risks.

Responsible for

Life Cycle Cost Calculation, Commercial Project Status Report

Participating in

Final Project Report, Project Manual, Project Plan, Project Status Report, Project Diary, Make-or-Buy Decision, Offer Assessment, Request for Proposal, RFP Concept, Criteria Catalog for Assessment of Offers, Contract, Contract Addendum, Offer

2.9 Data Protection Manager

Description

The Data Protection Manager shall be integrated into a project if the project deals with personal data. He evaluates the type of personal data, which are collected and processed, and the legal data protection requirements of the project. The Data Protection Specialist cooperates closely with the Safety and the Security Manager.

Tasks and Responsibilities

- Peparing the »Data Protection Concept,
- providing advice and support in all data protection issues,
- evaluating the legal data protection requirements,
- determining technical, organizational, personnel and material data protection measures.

Skill profile

- Knowledge of the applicable data protection regulations,
- assertiveness,
- capability to recognize weak points, hazards and the resulting risks,
- knowledge of the application and use of the system.

Role Allocation

The Data Protection Specialist is only required in projects dealing with personal data. The Data Protection Specialist is normally an organization-wide role.

Responsible for

Data Protection Concept

Participating in

Requirements Specification, Requirements Specification Overall Project, Project Manual, Overall System Specification

2.10 Ergonomics Manager

Description

The Manager for Ergonomics is responsible for the usability and ergonomics of the system. He shall ensure the implementation of ergonomic requirements in the overall system (i.e., for system, software, hardware, logistics, etc.) and is a decisive link between user and supplier.

In addition, the Manager for Ergonomics is responsible for the overall design of the user interfaces. He is decisively involved in the specification of the display and control concept and in the specification of the regulations for the design of the man-machine interface.

Tasks and Responsibilities

- Executing the user task analysis and the analysis of business processes,
- preparing and harmonizing a styleguide,
- preparing the »Evaluation Specification Usability.

Skill profile

- Knowledge and experience in the field of ergonomics and usability,
- experience in the design of user interfaces,
- experience in the handling of usability engineering tools,
- capability to proceed systematically,
- capability to moderate,
- communication capability,
- knowledge of application and use of the system,
- capability to abstract, to model and to simplify,
- capability to recognize dependencies.

Responsible for

User Tasks Analysis, Man-Machine Interface (Style Guide)

Participating in

Evaluation Report Usability, Evaluation Specification Usability, External Hardware Module Specification, Hardware Specification, Logistic Calculations and Analyses, External Software Module Specification, Software Specification, External Unit Specification, Overall System Specification, In-Service Documentation, System Specification

2.11 Executive

Description

The »Executive is responsible to his superior and the »Steering Committee for the economically and technically successful planning, execution and completion of a project.

He represents the project to suppliers and external partners/syndicates.

Tasks and Responsibilities

- Specifying the framework conditions for the project organization,
- initializing and coordinating the project, coordinating several projects, if required,

- initializing and cooperating in the award of contract,
- controlling and complying with contractual agreements,
- developing problem and conflict solutions for project planning, project execution and project completion,
- sharing in the decision-making process of the Steering Committee.

Skill profile

- Knowledge of business principles, but also technical understanding,
- experience in project organization,
- knowledge of application and use of the system,
- leadership abilities,
- organization and delegation capabilities.

Responsible for

Project Proposal, Proposal for the Introduction and Maintenance of an Organization-Specific Process Model, Statement of Acceptance, Project Progress Decision, Contract, Contract Addendum, Statement of Acceptance (Acquirer), Assessment of Request for Proposal, Contract (Acquirer), Contract Addendum (Acquirer)

Participating in

Requirements Specification, Requirements Evaluation, Evaluation of the Overall Project Requirements Specification, Requirements Specification Overall Project, Project Manual, Project Plan, Offer Assessment, Request for Proposal, Criteria Catalog for Assessment of Offers, Offer

2.12 Hardware Architect

Description

The role of »Hardware Architect includes particularly the engineering and integration of hardware systems. He is responsible for hardware architecture, hardware specification, external hardware module specification and the hardware implementation, integration and evaluation concept.

Tasks and Responsibilities

- Developing the hardware architecture of the hardware unit,
- specifying the technical requirements and interfaces for the hardware,
- specifying the product external hardware module in the external hardware module specification,
- preparing the hardware implementation, integration and evaluation concept,
- selecting mechanical and electronic components,
- defining the common use and reuse of hardware units/components/modules and products of the type external hardware module,

- supporting the realization activities,
- organizing and controlling the integration process,
- cooperating in the integration into segments and - possibly - systems,
- identfying and editing operational data, user and diagnostic information from the hardware development for the utilization phase.

Skill profile

- Understanding of the system context,
- understanding of the system functions and interfaces,
- knowledge of the available standard hardware, the market and the competitors,
- knowledge of the commercially available technologies,
- knowledge of the commercially available methods and tools,
- capability to interpret the applicable EMC, environmental and reliability requirements,
- capability to recognize weak points of the hardware design,
- capability to identify and analyse risks and initiate countermeasures at an early stage,
- capability to decompose and proceed in a structured manner,
- capability to recognize and understand technological connections,
- modeling capability,
- knowledge of test possibilities and strategies applicable during development and production.

Responsible for

External Hardware Module Specification, Hardware Architecture, Hardware Specification, Hardware Implementation, Integration and Evaluation Concept

Participating in

Maintenance Documentation, Repair Documentation, Logistic Calculations and Analyses, Change Decision, Problem/Change Evaluation, Training Documentation, External Unit Specification, Make-or-Buy Decision, In-Service Documentation, Evaluation Specification System Element, System Architecture, Enabling System Architecture

2.13 Hardware Developer

Description

The role of »Hardware Developer comprises the realization of hardware elements. The resulting responsibility refers to »Hardware Unit, »Hardware Component and »Hardware Module.

Tasks and Responsibilities

- Cooperating in hardware specification,

- cooperating in the development of hardware architecture,
- cooperating in the development of the hardware implementation, integration and evaluation concept,
- cooperating in the selection of mechanical and electronic components,
- realizing hardware process modules,
- integrating hardware components,
- integrating hardware units,
- conducting laboratory tests during the implementation and step-by-step integration,
- cooperating in the integration into segments and - possibly - systems,
- cooperating in the identification and editing of operational data, user and diagnostic information from the hardware development for the user.

Skill profile

- Knowledge of the development environment,
- knowledge of the commercially available hardware technologies,
- knowledge of production technologies and environment,
- knowledge of the hardware/software interfaces,
- knowledge of hardware development processes,
- capability to communicate with hardware/software developers and users,
- knowledge of commercially available methods and tools,
- knowledge of the evaluation of cost effects and the fundamentals of cost planning,
- capability to recognize and understand technological connections,
- capability to implement ergonomic requirements,
- knowledge of test possibilities and strategies applicable during development and production.

Responsible for

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module

Participating in

External Hardware Module Specification, Hardware Architecture, Hardware Specification, Hardware Implementation, Integration and Evaluation Concept, Maintenance Documentation, Repair Documentation, Logistic Calculations and Analyses, Training Documentation, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept, In-Service Documentation, Evaluation Report System Element

2.14 Inspector

Description

The »Inspector prepares the evaluation specifications, which he uses as basis for testing the project results. He records the evaluation results in an evaluation report.

Tasks and Responsibilities

- Using the measurement and evaluation environment in accordance with the specifications of the test documentation,
- preparing the evaluation specification,
- testing and evaluating the evaluation objects using the specified evaluation specification/evaluation procedure and initiating corrective action if required,
- documenting the evaluation results in an evaluation report.

Skill profile

- Knowledge of test methods and tools,
- knowledge of application, realization and use of the evaluation objects,
- capability to identify weak points and risks.

Role Allocation

Normally, the inspector is a member of the project team, in most cases a competent developer or a person familiar with the evaluation object.

The inspector must not be the creator of the evaluation object.

Responsible for

Evaluation Report Usability, Evaluation Specification Usability, Evaluation Report Product Configuration, Evaluation Specification Product Configuration, Evaluation Report Delivery, Evaluation Specification Delivery, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Document, Evaluation Specification Process, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element

Participating in

External Hardware Module Specification, External Software Module Specification, Software Specification, External Unit Specification, Overall System Specification, System Specification

2.15 Logistics Developer

Description

The »Logistics Developer is responsible for »Logistic Calculations and Analyses and cooperates in the preparation of the »Logistic Support Specification and the integrated logistic support concept.

Tasks and Responsibilities

- Defining technical requirements from a logistic point of view,
- cooperating in the development of the system architecture,
- cooperating in the development of logistic concepts,
- cooperating in the selection of suitable logistic tools,
- cooperating in reviews,
- preparing and submitting change proposals for optimizing the system design,
- conducting logistic analyses, calculations and verifications (RM&T, LCC, etc.),
- determining/calculating the required logistic resources,
- recording the technical information and development data required for logistic analyses, later use, operation and repair,
- editing the information and data, assigning them to various target groups (operator, user, administrator, maintenance and repair personnel),
- transmitting the edited information and data to the »Technical Author,
- cooperating in the development of evaluation strategies and product-related evaluation concepts in accordance with the audit requirements.

Skill profile

- Knowledge of logistic procedures and tasks (Integrated Logistic Support)
- team and communication capabilities,
- knowledge and mastery of the processes, procedures, methods and tools required for »Logistic Calculations and Analyses (see application aids),
- technical understanding and knowledge of the system (application, use, technolgy),
- capability to develop and present change proposals for optimizing the design,
- basic knowledge in system modeling.

Role Allocation

If comprehensive logistic calculations and analyses are required (particularly in case of long-life capital goods, e.g., airborne systems), the role of Logistic Developer shall be staffed.

Responsible for

Logistic Calculations and Analyses

Participating in

User Tasks Analysis, External Hardware Module Specification, Hardware Specification, External Software Module Specification, Software Specification, External Unit Specification, System Specification

2.16 Logistics Manager

Description

The Logistic Manager is responsible for planning and implementing logistic concept, particularly the »Logistic Support Specification and the product Integrated Logistic Support Concept.

Tasks and Responsibilities

- Planning, controlling and executing measures and activities for developing the logistic enabling system and optimizing the logistic system characteristics,
- developing logistic concepts for products and systems in accordance with external and internal specifications and determining the required logistic resources,
- planning and coordinating the external and internal support for logistic activities,
- guiding and coordinating the activities of assigned personnel,
- cooperating in the selection of suitable data processing tools and aids for fulfilling the tasks,
- cooperating in reviews,
- cooperating in the development of system development products, e.g. for the »Enabling System and the system, and in the architecture development in the process modules System Development, Hardware Development and Software Development,
- reporting to the project management.

Skill profile

- Mastery of Integrated Logistic Support (ILS),
- team and communication capabilities,
- leadership, motivation and moderation capabilities,
- basic knowledge of the processes, procedures, methods and tools required for »Logistic Calculations and Analyses (see application aids),
- understanding of business principles,
- knowledge of the legal regulations, standards and provisions on export,
- capability to negotiate with internal and external acquirers,
- knowledge of project management and controlling techniques,
- knowledge of the system (application-related/use/technology),
- knowledge of evaluation environment, production, integration and system initialization,
- self-assertion and acceptance within the project,
- capability to identify and assess weak points, risks and chances,
- capability to provide objective and constructive evaluations,
- logistically relevant knowledge of the market and competitors.

Role Allocation

If the logistic concept is intended to be developed and optimized for a system, the role of Logistic Manager should be staffed.

Responsible for

Logistic Support Concept, Logistic Support Specification

Participating in

Market Survey for Off-the-Shelf Products, Logistic Calculations and Analyses, Change Decision, Problem/Change Evaluation, Project Plan, External Unit Specification, Overall System Specification, Enabling System Implementation, Integration, and Evaluation Concept, System Architecture, System Specification, Enabling System Architecture

2.17 Process Engineer

Description

The »Process Engineer supports the participants of the improvement project in the development, maintenance and introduction of an organization-specific process model.

Tasks and Responsibilities

- Developing and maintaining the organization-specific process model in coordination with the responsible specialties, e.g., Requirements Analyst (Acquirer), Requirements Analyst (Supplier), System Architect, and QA Manager,
- developing concepts for introducing and improving processes,
- managing the introduction of the process model in pilot projects and the broad rollout,
- monitoring and assessing the effectiveness of the processes
- developing training concepts,
- conducting process training,
- defining, collecting and evaluating metrics and proposing measures derived from them,
- planning, controlling and introducing processes,
- developing a standard process,
- developing process change procedures within the organization,
- cooperating in the assessment of the process model,
- cooperating in the comprehensive process harmonization,
- determining the strategic training requirements.

Skill profile

- Knowledge of structure, contents and application of the business system, particularly of the contents of the allocated processes,
- thorough knowledge of the respective process fields (e.g. project management, CM, QA),
- thorough knowledge of the process model employed,
- knowledge of contents and processes of references and standards, e.g. V-Modell XT conformance, CMMI®, ISO 900x, SPICE,
- capability to clearly explain the contents of a process,
- experience in process management techniques (e.g. cause-effect diagrams),
- experience in the coaching of operational projects and knowledge of the operational project,
- capability to moderate,
- capability to judge objectively and constructively.

Responsible for

Organization-Specific Process Model, Process Model Improvement Concept

2.18 Project Leader

Description

The »Project Leader assumes the operational management of the project. He plans, coordinates, monitors and controls the project sequence, the project team and the project as a whole. Thus, he is tasked with montoring the project results of the other stakeholders and requesting corrective actions from the respective product managers if required.

Tasks and Responsibilities

In addition to the responsibilities and cooperation rights specified in the V-Modell, the Project Leader has the following tasks:

- Preparing regular and unscheduled reports for the Steering Committee if problems arise,
- assuming responsibility for the technical solution and its realization,
- controlling deadlines, degree of fulfillment of the work packages and funds flow schedule and reporting to the Steering Committee in case of specified project progress decisions,
- cooperating in the selection of (sub-)suppliers and suppliers and the monitoring of their performance.

Skill profile

- Knowledge and experience in project execution,
- knowledge of business principles,
- knowledge of application, use and technical design of the system,
- knowledge of project management tools,

- self-assertion and acceptance among the participants of the project,
- leadership, motivation and moderation capabilities,
- organization and communication capabilities.

Role Allocation

- The role of Project Leader must be staffed in every project.
- Larger projects should be subdivided into several sub-projects with independent Sub-project Leaders. In this case, an Overall Project Leader would assume the overall responsibility. The administrative tasks could be delegated to other team members.
- The Project Leader is member of the Steering Committee and the »Change Control Board.

Responsible for

Market Survey for Off-the-Shelf Products, Delivery, Measurement Data, Metrics Analysis, Work Order, Meeting Document, Final Project Report, Project Manual, Project Management Infrastructure, Project Plan, Project Status Report, Project Diary, Risk List, Estimation, Make-or-Buy Decision, Delivery (Supplier), Final Project Report (Supplier), Project Status Report (Supplier)

Participating in

Requirements Specification, Requirements Evaluation, Life Cycle Cost Calculation, Product Library, Statement of Acceptance, Evaluation of the Overall Project Requirements Specification, Requirements Specification Overall Project, Project Progress Decision, QA Manual, Offer Assessment, Request for Proposal, Criteria Catalog for Assessment of Offers, Contract, Contract Addendum, Offer

2.19 Purchaser

Description

The »Purchaser supports projects in the award of contract or the procurement of off-the-shelf products. Futhermore the purchaser is responsible for the proposals submitted by the supplier. The Purchaser is an organization-wide role which provides services for projects.

Tasks and Responsibilities

- Establishing and maintaining a supplier database,
- collecting reports on experiences with suppliers/off-the-shelf products and assessing and filing these experiences in a supplier database,
- executing supplier assessments,
- performing strategic activities, e.g. selecting preferred suppliers/off-the-shelf products,
- concluding framework contracts and negotiating the price.

The Purchasing Agent supports projects e.g. in

- the selection of potential suppliers/off-the-shelf products,

- the negotiation of individual contracts,
- the execution of ordering processes.

Skill profile

- Knowledge of legal fundamentals for invitations for bids and contracts,
- experience knowledge of possible risks in the cooperation with suppliers or the use of off-the-shelf products,
- awareness of the economic aspects to be considered in the award of contracts or the use of off-the-shelf products.

Responsible for

Offer (Supplier)

Participating in

Market Survey for Off-the-Shelf Products, External Hardware Module, Statement of Acceptance, External Software Module, External Unit, Make-or-Buy Decision, Offer Assessment, Request for Proposal, RFP Concept, Criteria Catalog for Assessment of Offers, Contract, Contract Addendum

2.20 QA Manager

Description

The QA Manager is responsible for monitoring the quality in the project, and thus for the quality of the project results.

Tasks and Responsibilities

- Cooperating in the Change Control Board,
- executing audits,
- ensuring function and availability of the required measurement and evaluation environment in cooperation with the inspector,
- sharing the decision-making process of the Project Team,
- exercising unlimited access to all quality-related processes and all rights in order to execute the above tasks,
- exercising co-signing rights for all releases in his area of responsibility,
- developing the QA Manual and the QA reporting system,
- cooperating in the planning of all QA-related tasks.

Skill profile

- Experience in project execution,
- knowledge of test methods and test tools,

- self-assertion in the Project Team,
- capability to identify weak points and risks,
- capability to provide objective and constructive assessments,
- organization and communication capabilities.

Role Allocation

There will be a QA Manager in every project. In small projects, this role can easily be combined with other roles, e.g. the role of CM Manager. The role of QA Manager should not be combined with the role of Executive since this could lead to a conflict of interest (Executive - responsible for time and budget - versus QA Manager - responsible for quality).

Responsible for

Qualification Record, Quality Status Report, QA Manual

Participating in

Statement of Acceptance, Maintenance Documentation, Repair Documentation, Change Decision, Problem/Change Evaluation, Final Project Report, Project Plan, Project Status Report, Training Documentation, Overall System Specification, In-Service Documentation, Safety and Security Analysis

2.21 Quality Manager

Description

The »Quality Manager has cross-service tasks and is responsible for preparing, maintaining, coordinating and distributing quality management regulations in the entire organization. He is in charge of implementing the quality policy and of all multi-project quality aspects in the system/software/hardware development. He is responsible for the standard-conform contents, economic efficiency, effectivity, and the permanent updating of the quality management system.

Tasks and Responsibilities

- Preparing and maintaining the - company-wide - Quality Management Manual (quality policy),
- systematically developing a strategic quality management (CIP - continuous improvement process),
- initiating process improvements within the company,
- establishing and maintining a know-how center for quality issues,
- preparing standards for the quality management reporting system of the projects (as basis for the improvment of the quality management system),
- analysing the effectivity of the quality management system by evaluating the quality reports,
- providing quality statistics and improvement proposals to the projects,

- developing mandatory standards as to how QA Manuals, evaluation plans and evaluation specifications shall be prepared - before the project starts,
- specifying regulations and procedures in accordance with which the projects shall plan and execute quality assurance measures,
- advising and supporting the projects in all quality management questions,
- determining constructional and analytical QA measures,
- cooperating in the specifications of project-specific QA measures,
- specifying the framework conditions and reguations for the organization of QA measures,
- releasing evaluation plans/test flowcharts/QA Manuals,
- cooperating in the agreement of quality assurance measures with suppliers,
- providing support in the selection of sub-suppliers,
- executing project and sub-supplier audits,
- executing audits as required,
- exercising unlimited access to all quality-related processes and all rights required to fulfill the above tasks.

Skill profile

- Expertise in quality management tasks,
- knowledge of legal regulations and national and international quality management standards,
- knowledge of QA methods and tools,
- technical experience and knowledge of application, realization and use of the product,
- experience in project execution and in the application of QA methods to orders,
- capability to organize, delegate and communciate,
- self-assertion and capability to develop a consensus in the project/program organization,
- capability to identify weak points and risks,
- capability to provide objective and constructive evaluations.

Role Allocation

The Quality Manager is an organization-wide role which must exist in all companies certified in accordance with ISO 9001. He is responsible for the quality management in his company.

Participating in

Organization-Specific Process Model, Process Model Improvement Concept, QA Manual

2.22 Requirements Engineer (Acquirer)

Description

After the project contract has been awarded, the »Requirements Engineer (Acquirer) will be responsible for the products »Requirements Specification and »Requirements Evaluation. If required, he conducts a »Market Survey for Off-the-Shelf Products, the results of which will be evaluated during the »Requirements Evaluation and taken into account as in the case of a »Make-or-Buy Decision.

He shall ensure the quality of user requirements and create the prerequisites for ensuring trackability and changeability of the requirements throughout the entire life cycle. The »Requirements Engineer (Acquirer) shall observe the fundamentals of the specialty "Requirements Engineering" and "Procurement Planning" when executing his tasks.

Tasks and Responsibilities

- Preparing the fundamentals for the development and management of requirements,
- selecting and implementing the tools for the acquisition and administration of requirements,
- analysing business processes,
- cooperating in realization studies,
- analysing threat and risk,
- executing weak point, safety and performance analyses,
- collecting and describing functional and non-functional requirements,
- coordinating an harmonizing the collected requirements with all participants,
- systematizing and prioritizing the collected requirements,
- developing acceptance criteria,
- preparing a draft requirements document,
- conducting quality assurance tests of the requirements in accordance with prespecified quality criteria,
- checking the system design for compliance with the user requirements,
- correcting deficiencies of the requirements,
- preparing requirements for requirements controlling,
- assessing requirements in accordance with prespecified criteria,
- analysing the operational necessity and technical feasibility of requirements,
- assessing the economic efficiency of the requirements (cost-benefit analysis),
- preparing a requirements document ready to be used as request for proposal.

Skill profile

- Knowledge and experience in the fields of "Requirements Engineering" (preparation and management of requirements) and "Procurement Planning"

- knowledge of the application and intended use of the system,
- experience in the assessment of architectures,
- experience in handling Requirements Engineering tools,
- capability to abstract, to model and to simplify,
- capability to recognize dependencies,
- capability to moderate,
- capability to proceed systematically,
- capability to communicate with the supplier/user and the project staff.

Responsible for

Requirements Specification, Requirements Evaluation, Evaluation of the Overall Project Requirements Specification, Requirements Specification Overall Project

Participating in

Market Survey for Off-the-Shelf Products, Offer Assessment, Request for Proposal, Criteria Catalog for Assessment of Offers, Contract

2.23 Requirements Engineer (Supplier)

Description

After receiving the Requirements Specification, the »Requirements Engineer (Supplier) will be responsible for the preparation of the product »Overall System Specification. In order to fulfill this complex task, he shall cooperate with specialists in order to ensure the quality of the requirements and create the prerequisites for tracking the requirements during the entire life cycle. The Requirements Analyst (Supplier) shall observe the fundamentals of the specialty Requirements Engineering when fulfilling his tasks.

Tasks and Responsibilities

- Developing the principles for the preparation and management of requirements,
- selecting and establishing the tools for collecting and managing requirements,
- analysing business processes,
- assessing, refining and specifying functional requirements,
- assessing, refining and specifying non-functional requirements,
- coordinating and harmonizing the requirements with all participants,
- systematizing and prioritizing the requirements,
- developing the preliminary architecture for the system, enabling system and logistic support,
- specifying development criteria,
- preparing the draft requirements document,

- conducting quality assurance tests of the requirements in accordance with prespecified quality criteria,
- correcting deficiencies of requirements,
- preparing the requirements for requirement controlling,
- assessing the requirements in accordance with prespecified criteria,
- analysing the operational necessity and technical feasibility of requirements,
- assessing the economic efficiency of requirements (cost-benefit analysis),
- preparing a master system specification,
- assigning requirements to product life cycles,
- cooperating in realization studies,
- analysing threat and risk,
- conducting weak point analysis,
- conducting safety and performance analyses,
- designing system architectures.

Skill profile

- Knowledge and experience in the field "Requirements Engineering" (preparation and management of requirements) and "Planning Procurement",
- experience in the handling of requirements engineering tools,
- capability to proceed systematically,
- abstraction capability,
- capability to moderate,
- communication capability,
- knowledge of application and function of the system,
- capability to recognize dependencies,
- experience in the assessment of architectures,
- capability to communicate with the acquirer/user and the project staff.

Responsible for

Overall System Specification

Participating in

User Tasks Analysis, Logistic Support Specification, Offer

2.24 RFP-Manager

Description

The RFP Manager is responsible for the preparation of the »Request for Proposal and the selection of a suitable supplier based on the received »Offers and previously defined decision criteria.

Tasks and Responsibilities

- Planning the order in close cooperation with the »Project Leader (harmonization of contents, quality requirements, budget and schedule),
- specifying requirements to be observed by the supplier during the adminstration of the order,
- executing the request for proposal correctly from the selection of the suitable RFP concept to the acceptance of an offer,
- observing the correct schedule and the compliance with all laws and regulations during the request for proposal,
- coordinating the selection of potential suppliers with the »Purchaser if a »Distribution List must be prepared,
- preparing and maintaining RFP concepts and selection criteria for the organization.

Skill profile

- Thorough knowledge of the legal basis and the regulations in the RFP system (in case of public invitations for bids particularly the guidelines for preparing the tender specifications and the contract award law, e.g., »VgV, »GWB, »VOL, »VOF, »VOB, »UfAB III, »WiBe 21),
- experience in the preparation of invitations for bids,
- experience in the assessment of offers.

Role Allocation

It is useful to appoint one or more RFP managers within an organization as service providers for projects.

Responsible for

Offer Assessment, Request for Proposal, RFP Concept, Criteria Catalog for Assessment of Offers

Participating in

Statement of Acceptance, Project Manual, QA Manual

2.25 Safety Manager

Description

The Safety Manager is responsible for the compliance with and the implementation of the »Safety requirements of a system to be developed or to be used.

Tasks and Responsibilities

- Specifying the functional safety requirements on the part of the acquirer,
- analyzing and tracking the functional safety requirements on the part of the supplier,
- integrating the functional safety requirements into the supplier's system elements,
- interpreting and selecting standards, directives, guidelines and regulations regarding functional safety,
- monitoring the compliance with functional safety regulations,
- integrating functional safety aspects into the implementation, integration and evaluation concepts and the evaluation specification,
- integrating personal experience and showing technical risks and chances in the field of functional safety,
- executing the Hazard and Risk Analysis - Functional Safety,
- determining, assessing and implementing risk reduction measures.

Skill profile

- Capability to recognize weak points, hazards and the resulting risks,
- knowledge of the application and use of the system,
- knowledge of the methods and tools used for the Hazard and Risk Analysis - Functional Safety,
- knowledge of the applicable functional safety standards, assertiveness.

Role Allocation

The Safety Manager is only required in projects which must take into account functional safety requirements. In a project, the roles of Safety Manager and Security Manager can be assumed by one person.

Responsible for

Safety and Security Analysis

Participating in

Requirements Specification, External Hardware Module Specification, Hardware Specification, Hardware Implementation, Integration and Evaluation Concept, Requirements Specification Overall Project, Project Manual, External Software Module Specification, Software Implementation, Integration and Evaluation Concept, Software Specification, External Unit Specification, Overall System Specification, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept, System Specification

2.26 Security Manager

Description

The Security Manager is responsible for the compliance with and the implementation of »Security aspects in IT projects and projects with IT elements. Within the scope of the project, he is mainly tasked with the preparation and updating of the project-related security concept. In addition, the Security Manager is basically responsible for monitoring the implementation of the security concept.

Tasks and Responsibilities

- Preparing the project-related security concept,
- reviewing the acceptance of security measures in accordance with the information security concept,
- advising the Project Manager in technical questions regarding the project's security.

Skill profile

- Capability to recognize weak points, hazards and the resulting risks,
- knowledge of the application and use of the system,
- knowledge of the methods and tools used for the Hazard and Risk Analysis - Information Security,
- knowledge of the applicable information security standards/regulations/directives,
- assertiveness.

Role Allocation

The Security Manager is only required in projects which must take into account information security requirements. Security aspects shall always be considered in IT projects and projects with IT elements. In a project, the roles of Security Manager and »Safety Manager can be assumed by one person.

Responsible for

Information Security Concept

Participating in

Requirements Specification, Requirements Specification Overall Project, Project Manual, Overall System Specification, Data Protection Concept

2.27 Software Architect

Description

The »Software Architect is responsible for designing and developing all »Software Unit s and products of the type External Software Module of a »System.

Tasks and Responsibilities

- Designing the »Software Architecture,
- implementing the requirements posed on the software units,
- defining the requirements posed on the products of the type External Software Module,
- assuming responsibility for the software implementation, integration and evaluation concept,
- assuming responsibility for the External Software Module Specification,
- cooperating in the integration into the sgement and - possibly - system,
- cooperating in the development of the »System Architecture and the »Enabling System Architecture,
- cooperating in the preparation of the »System Specification or »External Unit Specification.

Skill profile

- Knowledge of application, environment and use of the system,
- knowledge of the system's interfaces,
- knowledge of architectural principles and different software architectures,
- knowledge of the system's software interfaces,
- knowledge of the standard software,
- knowledge of methods and tools,
- capability to recognize weak points and risks,
- capability to analyse problems with due consideration of the software/hardware and to develop appropriate solutions,
- capability to abstract and simplify,
- capability to recognize dependencies,
- capability to communicate with hardware developers, logistic experts and users.

Responsible for

Database Design, External Software Module Specification, Software Implementation, Integration and Evaluation Concept, Software Architecture, Software Specification

Participating in

Maintenance Documentation, Repair Documentation, Logistic Calculations and Analyses, Change

Decision, Problem/Change Evaluation, Training Documentation, External Unit Specification, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept, Make-or-Buy Decision, In-Service Documentation, Evaluation Specification System Element, System Architecture, Enabling System Architecture

2.28 Software Developer

Description

The »Software Developer is responsible for realizing the software elements in accordance with the »Software Specification.

Tasks and Responsibilities

- Realizing »Software Modules,
- integrating »Software Modules into »Software Components and »Software Units,
- integrating »Software Units into the »System,
- executing developer tests,
- supporting the »Inspector in the test of software elements.

Skill profile

- knowledge of the development environment,
- knowledge of the development standards,
- knowledge of programming and programming concepts,
- knowledge of standard software, programming languages, data definition languages and data manipulation languages,
- knowledge of the software/hardware interfaces,
- capability to provide structured programming,
- capability to recognize dependencies,
- capability to communicate with hardware developers, logistic experts and users.

Responsible for

External Software Module, Software Unit, Software Component, Software Module

Participating in

Maintenance Documentation, Repair Documentation, Logistic Calculations and Analyses, Database Design, External Software Module Specification, Software Implementation, Integration and Evaluation Concept, Software Architecture, Software Specification, Training Documentation, In-Service Documentation, Evaluation Report System Element

2.29 Steering Committee

Description

The »Steering Committee is the highest decision-making body of the project organization, in which all stakeholders should be represented adequately.

Normally, the »Executive is responsible for the »Project Progress Decision ; however, far-reaching decisions - e.g. on the discontinuation of the project - shall be escalated to the Steering Committee.

From the beginning, it must be specified which decisions will be made by the Steering Committee. In addition, the »Project Progress Decisions in which the Steering Committee will participate must be determined. These decisions will be specified as »Decision Gates in the V-Modell.

Tasks and Responsibilities

- Making the specified »Project Progress Decisions,
- developing solutions for problems which cannot be solved at executive level (conflict management).

Role Allocation

At minimum, the Steering Committee shall comprise the »Project Leaders and the »Executives of acquirer and supplier.

Participating in

Project Progress Decision

2.30 System Architect

Description

The »System Architect has the central role in system design and specification. Based on the »Overall System Specification, he designs the »System Architecture and »Enabling System Architecture. Simultaneously, he defines the system elements based on the »System Specification or »External Unit Specification and the respective »System Implementation, Integration and Evaluation Concept or »Enabling System Implementation, Integration, and Evaluation Concept. In addition, the System Architect is responsible for the »Legacy System Analysis and the »Migration Concept.

Tasks and Responsibilities

- Developing the system and enabling system architecture,
- designing the system elements in accordance with the system element specifications,
- indicating technical risks and chances, using his experience,
- defining system element specifications,
- cooperating in logistic concepts,

- specifying technical system design,
- examining feasibility,
- allocating requirements,
- describing non-functional requirements,
- describing the interface,
- checking infrastructure,
- specifying system integration,
- testing the system,
- defining requirements for the common use of hardware/software units,
- assessing legacy systems,
- designing migration concepts.

Skill profile

- Knowledge of application, framework conditions and function of the system,
- knowledge of the system's software and hardware interfaces,
- knowledge of architectural principles and different software and hardware architectures,
- knowledge of standard software and standard hardware,
- knowledge of development methods and tools,
- capability to recognize weak points and risks,
- capability to analyse problems,
- capability to abstract and simplify,
- capability to recognize dependencies,
- knowledge of system integration,
- capability to communicate with hardware developers, logistic experts and users,
- knowledge of system demonstration.

Responsible for

External Unit Specification, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept, System Architecture, System Specification, Enabling System Architecture, Legacy System Analysis, Migration Concept

Participating in

Market Survey for Off-the-Shelf Products, Hardware Architecture, Maintenance Documentation, Repair Documentation, Logistic Calculations and Analyses, Logistic Support Concept, Change Decision, Problem/Change Evaluation, Project Manual, Project Plan, Software Architecture, Training Documentation, Overall System Specification, Make-or-Buy Decision, In-Service Documentation, Evaluation Specification System Element

2.31 System Integrator

Description

The »System Integrator has the central role in the system realization phase. Based on the »System Implementation, Integration and Evaluation Concept, he integrates system elements into »Segments and into the »System. Analogously, he uses the »Enabling System Implementation, Integration, and Evaluation Concept to integrate the »Enabling System. In both integration cases, »External Units must possibly be taken into account.

Tasks and Responsibilities

- Installing, integrating and supporting a system or enabling system,
- recognizing faults arising during the integration,
- coordinating the interfaces between segments,
- preparing segment tests during the development phase and system tests to be demonstrated to the acquirer,
- supporting and accepting external units,
- supporting the preparation of training documents and user documentation,
- supporting logistic activities,
- supporting the construction of laboratory models and prototypes between the development and production phases,
- providing the evaluation environment.

Skill profile

- Knowledge of the system's structure and principle of operation,
- knowledge of development, integration and installation measures,
- comprehensive knowledge of the application of the system,
- capability to build up on existing concepts and to familiarize himself with new ways of thinking,
- capability to give constructive criticism,
- capability to communicate with developers and users,
- technical support of sub-suppliers.

Responsible for

External Unit, Segment, System, Enabling System

Participating in

Market Survey for Off-the-Shelf Products, Hardware Architecture, Evaluation Report Delivery, Delivery, Software Architecture, External Unit Specification, Overall System Specification, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept, Make-or-Buy Decision, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, System Specification, Migration Concept

2.32 Technical Author

Description

The Technical Author (Technical Writer) develops and prepares the (technical) documentation and the »Training Documentation and conducts acquirer instructions within the scope of the »V-Modell Project.

Tasks and Responsibilities

- Developing acquirer documentation and preparing the documentation concept,
- recording technical information and data, which are required for future use, operation and maintenance, from the logistic databases and technical archives,
- preparing technical manuals or electronic documentation in accordance with the specified documentation concept,
- cooperating in the specification and review of the acquirer instruction requirements included in offers and contracts,
- preparing training documents and CAT (computer-aided training),
- preparing (including the preparation of training documents) and conducting acquirer instructions,
- editing information and data, allocating them to various target groups.

Skill profile

- Technical understanding,
- capability to convert technical facts and connections into target group-oriented descriptions and programs of instruction,
- capability to express himself clearly in text and graphics,
- didactic/rhetoric capabilities,
- foreign language skills as required by the project,
- capability to identify and stress essential statements,
- knowledge and mastery of the processes, procedures, methods and tools required for the task,
- qualification as trainer/instructor,
- knowledge of the legal regulations and standards.

Role Allocation

The role of the Technical Author should be staffed as soon as documentation or training documents must be prepared or acquirer instructions must be conducted within the scope of the project.

Responsible for

Spare Parts Catalog, Maintenance Documentation, Repair Documentation, Training Documentation, Logistic Support Documentation, In-Service Documentation

Participating in

User Tasks Analysis

2.33 User

Description

After delivery, the user uses the system for fulfilling his tasks. Based on his experience with system operation and maintenance, he derives requirements for the overall system and introduces appropriate change proposals.

Tasks and Responsibilities

- Participating in the preparation of the »Requirements Specification,
- cooperating in the preparation of the user task analysis,
- cooperating in the identification of functions to be realized,
- describing problems, taking into account the technical and organizational integration of the system,
- specifying safety and security requirements from point of view of the user,
- describing framework conditions for the system maintenance and modification concept from point of view of the user,
- supporting the specification of organizational regulations for the use of the system,
- supporting the provisioning of infrastructure for operators and acceptance personnel,
- supporting the assessment of requirements and their economic efficiency,
- cooperating in tests and acceptance procedures,
- preparing change requests for extending and improving the functions of the delivered system.

Skill profile

- Knowledge of function and use of the system,
- communication capability.

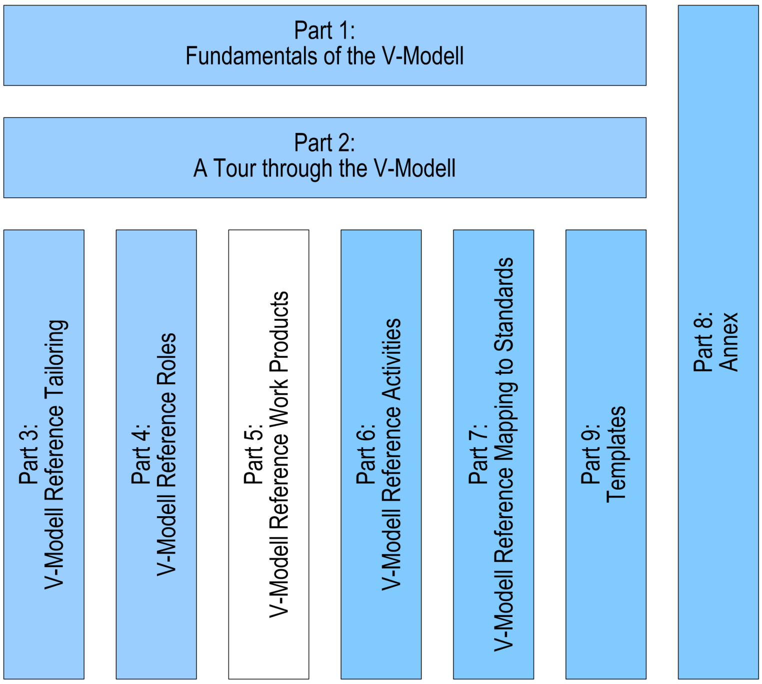
Participating in

Requirements Specification, Requirements Evaluation, User Tasks Analysis, Evaluation Report Delivery, Evaluation of the Overall Project Requirements Specification, Requirements Specification Overall Project

3 Role Index

Part 5: V-Modell Reference Work Products

V-Modell® XT



This document was created based on:

Export templates	Version 1.3 English
Export environment	Version 2.1.3
V-Modell XT	V-Modell® XT Version 1.3

Table of Contents

1 Introduction

1.1 Objectives of the V-Modell Reference

The »V-Modell Reference Work Products includes all »Disciplines, »Work Products and subjects, which will be described in accordance with the hierarchical product model of the V-Modell. The connections between the individual products will be described explicitly by product dependencies.

1.2 Audience

This V-Modell Reference is intended particularly for all project members which coorperate in or are responsible for the processing or testing of V-Modell products.

1.3 Contents and Structure of the V-Modell Reference

This V-Modell Reference includes the following chapters:

»Overview of the Product Model of the V-Modell

This chapter provides a survey of the V-Modell products, based on the »Discipline. In the following sections, the structure of a system established in accordance with the V-Modell will be described by means of the structural »Product Dependency. The generative product dependencies show the connections established for product generation.

»Products

This chapter describes the »Discipline and the products contained therein in detail. The responsible and cooperative »Roles will be specified. The respective generative product dependencies and the content-related product dependencies will be listed for each product.

»Generative Product Dependencies and »Content-Related Product Dependencies

These chapters describe all product dependencies in detail. For each product dependency, the products connected with each other within the scope of the product dependency will be listed.

»Product Index (According to Disciplines)

This chapter includes a complete hierarchical list of all components of the product model contained in the V-Modell, comprising disciplines, products and subjects.

»Product Index (alphabetically)

This chapter includes a complete alphabetical list of all V-Modell products.

»List of Figures

This chapter provides a survey of all illustrations contained in the »V-Modell Reference Work Products.

1.4 Notes Concerning the Display in the V-Modell Reference

The following paragraphs will explain the display concepts relevant for the V-Modell Reference Work Products in detail. This is particularly important for understanding the chapter »Overview of the Product Model of the V-Modell; this chapter provides a graphical presentation of the assignment of products to disciplines and the connection between the products as established by structural and generative product dependencies.

The assignment to disciplines is displayed analogously to the presentation in the »V-Modell Reference Tailoring .

Structural product dependencies structure products and relate them to each other. This leads basically to the three possibilities shown in Figure Abbildung 1.

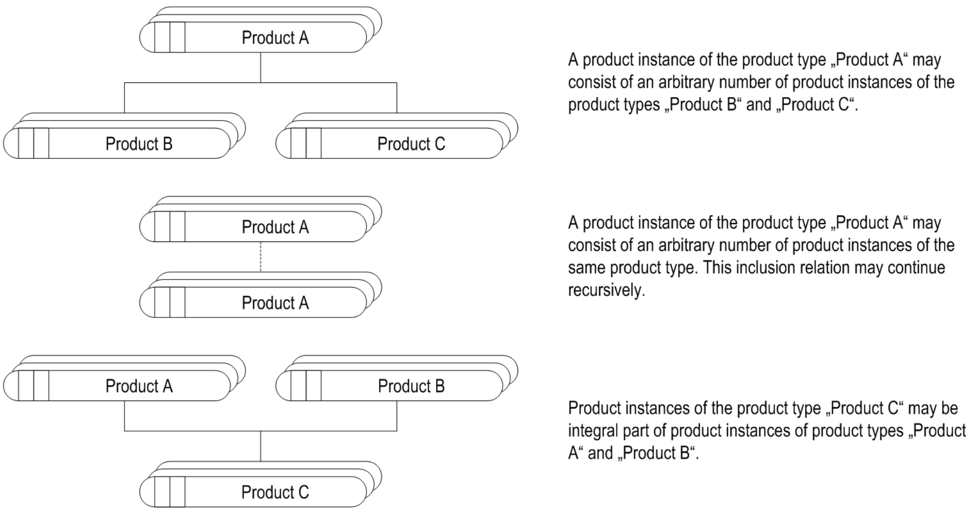


Abbildung 1: Legend for the Display of Structural Product Dependencies

Based on an initial product, a generative product dependency describes a condition; when this condition occurs, a target product must or can be be generated. Depending on the situation, this V-Modell Reference describes two different display types for generative product dependencies, which however are completely equivalent.

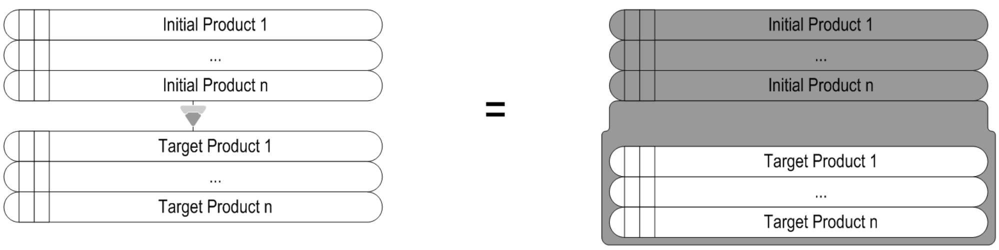


Abbildung 2: Legend for the Display of Generative Product Dependencies

2 Overview of the Product Model of the V-Modell

The graphical notation which will be used for products and disciplines in the following chapters is explained in the section »Fundamentals of the V-Modell in chapter »Process Modules.

2.1 Disciplines

Products are structured hierarchically in the V-Modell. The disciplines are the highest level of the product model. They categorize products in accordance with their contents and are useful for providing a survey of the V-Modell products. The V-Modell defines various disciplines, which can be subdivided into three categories - project (management), development, and organization. This classification is only used for the presentation within this chapter.

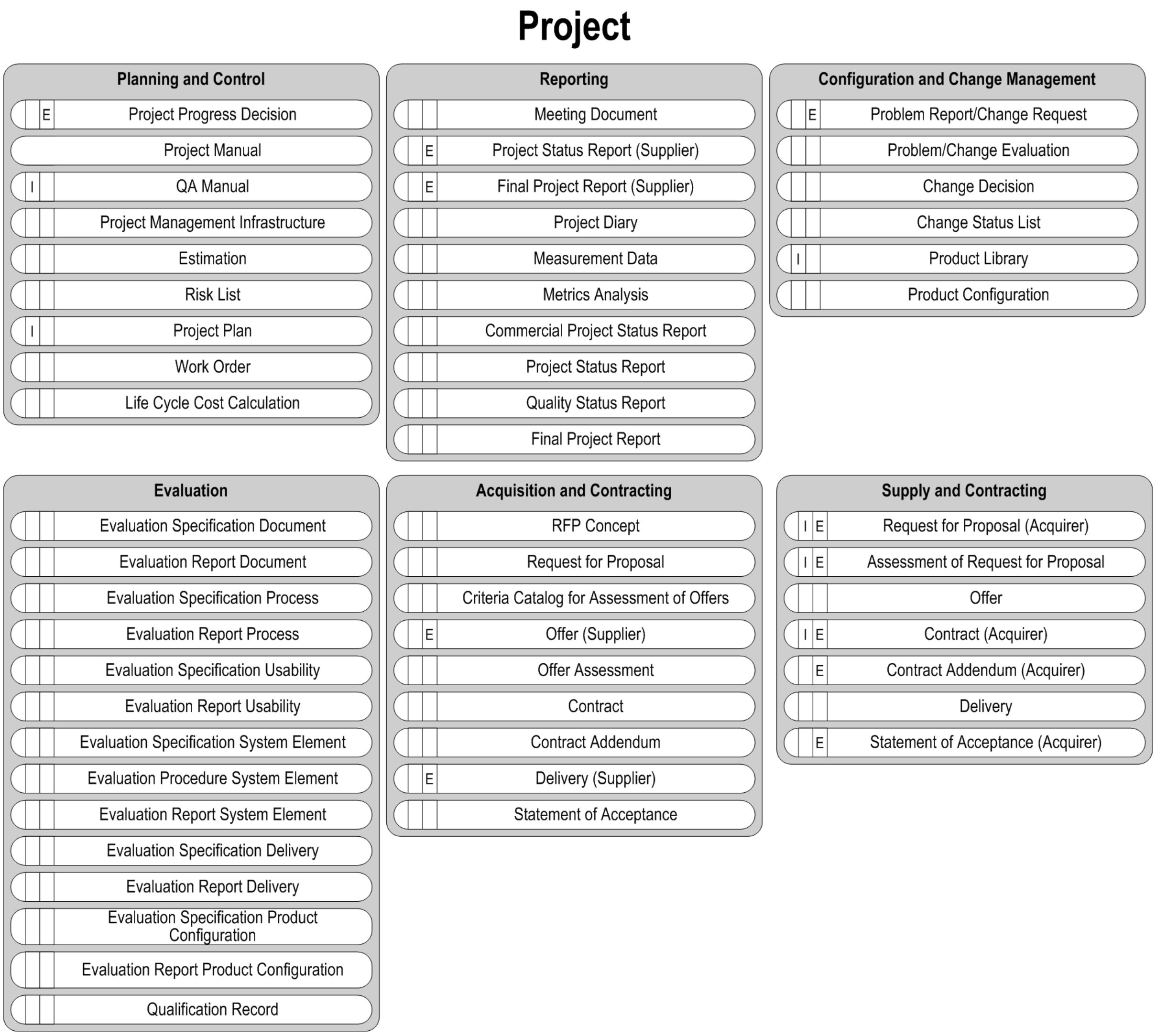


Figure 3: Project Disciplines

Figure 3 shows the project disciplines. The discipline »Planning and Control includes the central »Project Management products, like »Project Manual, »QA Manual and »Project Plan. Project reports and similar products supporting the project management are summarized in the discipline »Reporting. The products of the management disciplines Configuration and Change Management and Quality Assurance are summarized in the disciplines »Configuration and Change Management and »Evaluation. Specific products for the execution of acquirer projects are included in the discipline » Acquisition and Contracting, specific products for the supplier in the discipline »Supply and Contracting. Frequently, acquirer products have counterparts on the side of the supplier, and vice versa. An acquirer/supplier interface, which is modeled explicitly in the V-Modell (see »Generative Product Dependencies), is based primarily on products of these two disciplines.

Figure 4: Development Disciplines

Figure 4 shows the development disciplines. Products describing the functional requirements and analyses for specific development disciplines are summarized in the discipline »Requirements and Analyses. The discipline »System Specifications includes the technical requirements and specifications for the system and its components. Products describing the implementation of specifications in technical solutions and concepts - like the different architecture documents - are summarized in the discipline »System Design. The realized system components and the system itself are included in the discipline »System Elements. Products for the logistic support of the developed system are listed in the discipline »Logistic Conception for the concept documents and in the discipline »Logistic Elements for the realized logistic elements.

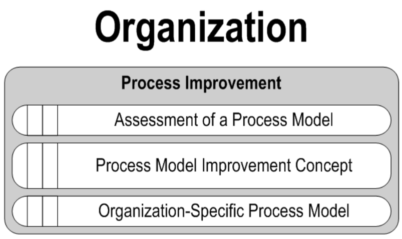


Figure 5: Organization Disciplines

Figure 5 shows the organization disciplines. The discipline »Process Improvement includes products used for the introduction and maintenance of an organization-specific process model.

The products of the various disciplines and the disciplines themselves will be described in detail in the chapter »Products. The following paragraphs provide a survey of the different connections between the products. In the V-Modell, these connections are modeled explicitly as product dependencies.

2.2 Structural Product Dependencies

»System Architecture and »Enabling System Architecture describe the hierarchical structure of the »System and the »Enabling Systems. This hierarchical structure provides a logical structuring of the system and the corresponding enabling systems. However, it does not reflect the complete composition structure and the layout plan of the system. Accordingly, it does not show the complete communcation and interface structure. It is a logical, hierarchical structuring of the system. In the V-Modell, the rules governing the layout of this hierarchical structure are described by means of structural product dependencies.

Figure 6 shows these dependencies. A system may comprise any number of interleaved »Segments. Segments which are not subdivided into further segments consist of »Software Units, »Hardware Units and »External Units. External units are not subdivided further. Software and hardware units consist of any number of interleaved software or »Hardware Components. Software and hardware components which are not subdivided further consist of products of the type »Software Module or »Hardware Module. At hardware and software level, there are also products of the type »External Hardware Module or »External Software Module, which are not subdivided further.

The segment and component levels may be omitted, i.e., the software/hardware unit level may be directly below the system level, and the software/hardware module level may be directly below the software/hardware unit level.

In addition to a system, a »V-Modell Project can develop a number of »Enabling Systems. Every enabling system will be structured like a system. Any number of logistic support documentations may be prepared for the system and the enabling systems. A logistic support documentation is a set of documents which belong together with regard to contents, i.e., »In-Service Documentation and »Training Documentation, and - depending on the necessary logistic effort - additional »Maintenance Documentation, »Repair Documentation and »Spare Parts Catalog s .

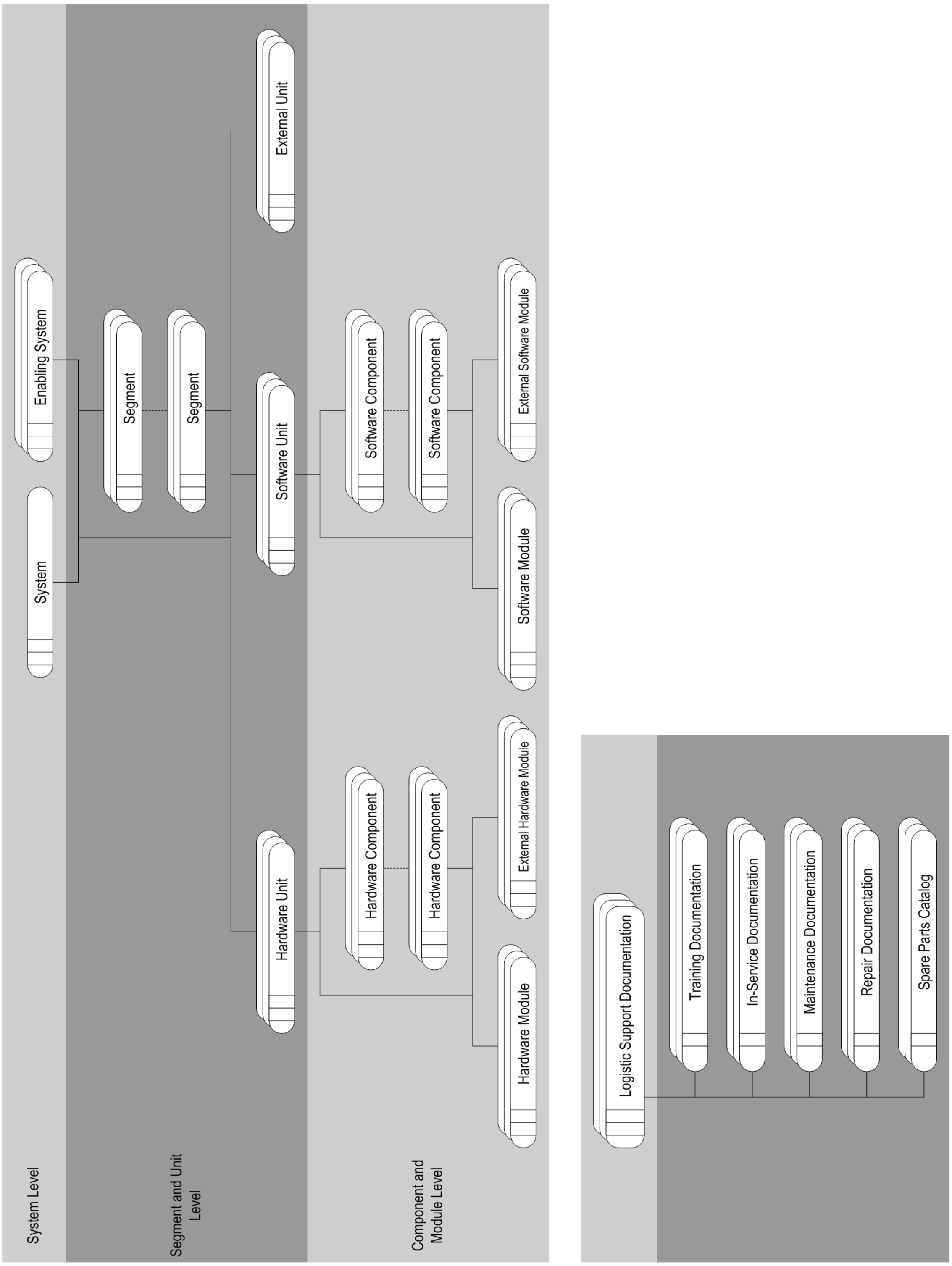


Figure 6: Overview of Structural Product Dependencies

2.3 Generative Product Dependencies

»Product Dependency, Generative describes which models of the initial products will specify the conditions for developing the models of the target products. Thus, the generative product dependencies are a set of important rules which provide appropriate support for the planning and development of a V-Modell project. The following figures depict these generative product dependencies as arrows directed from the generating products to the generated products.

As shown in Figure 7, project management products will be developed in accordance with the specifications of the »Project Manual and the »Project Plan. The quality assurance products will be developed in accordance with the specifications of the »QA Manual and the »Project Plan.

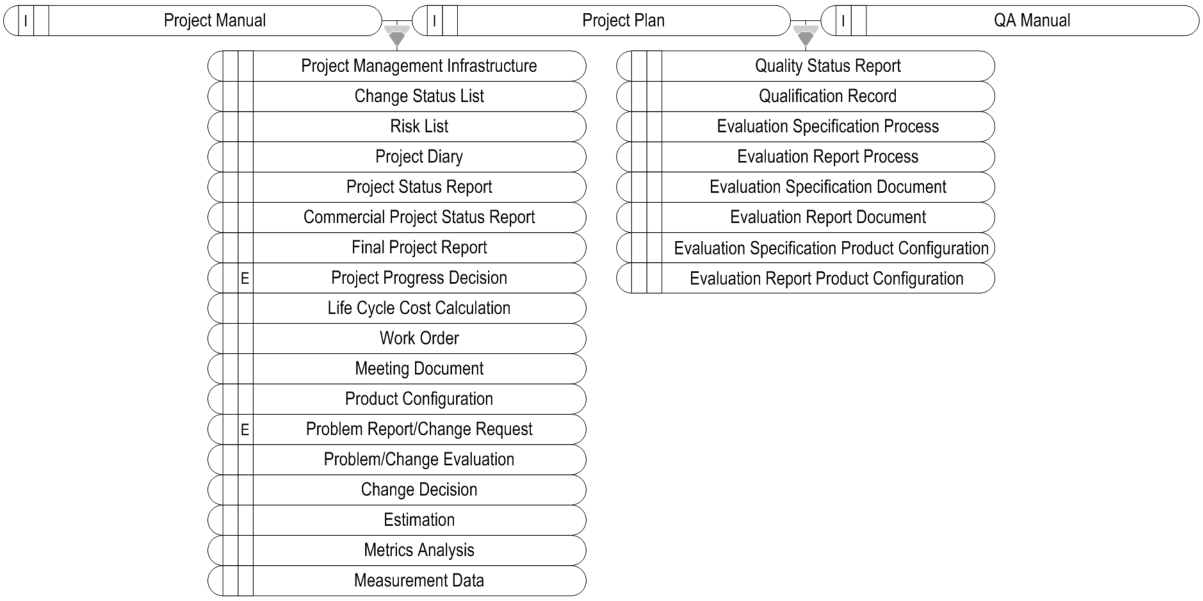


Figure 7: Overview of the Generative »Product Dependency of Management Products

»RFP Concept, »Criteria Catalog for Assessment of Offers and »Request for Proposal will be prepared in accordance with the specifications described in the »Project Manual of the acquirer. When subcontracts will be awarded, the »Make-or-Buy Decision shall also be taken into account as initital point for the preparation of these »Product Instance s.

The acquirer's request for proposal will be forwarded via the »Acquirer/Supplier Interface shown in Figure 8 . On the side of the supplier, this product will be designated as »Request for Proposal (Acquirer). Together with a positive »Assessment of Request for Proposal, this product will be used for the preparation of an »Offer. On the side of the acquirer, this product will be designated as »Offer (Supplier).

Based on these products and the specifications contained in the »Project Manual and - possibly - the corresponding »Make-or-Buy Decision, an »Offer Assessment will be prepared. On the basis of the »Contract and any »Contract Addendum, which will be developed within the scope of a »Change Decision, the »Statement of Acceptance, »Evaluation Specification Delivery and »Evaluation Report Delivery will be prepared.

Based on the »Contract (Acquirer) and any »Contract Addendum (Acquirer), the supplier will prepare the »Delivery (Supplier), »Project Status Reports and the »Final Project Report, which in turn will be forwarded to the acquirer via the »Acquirer/Supplier Interface.

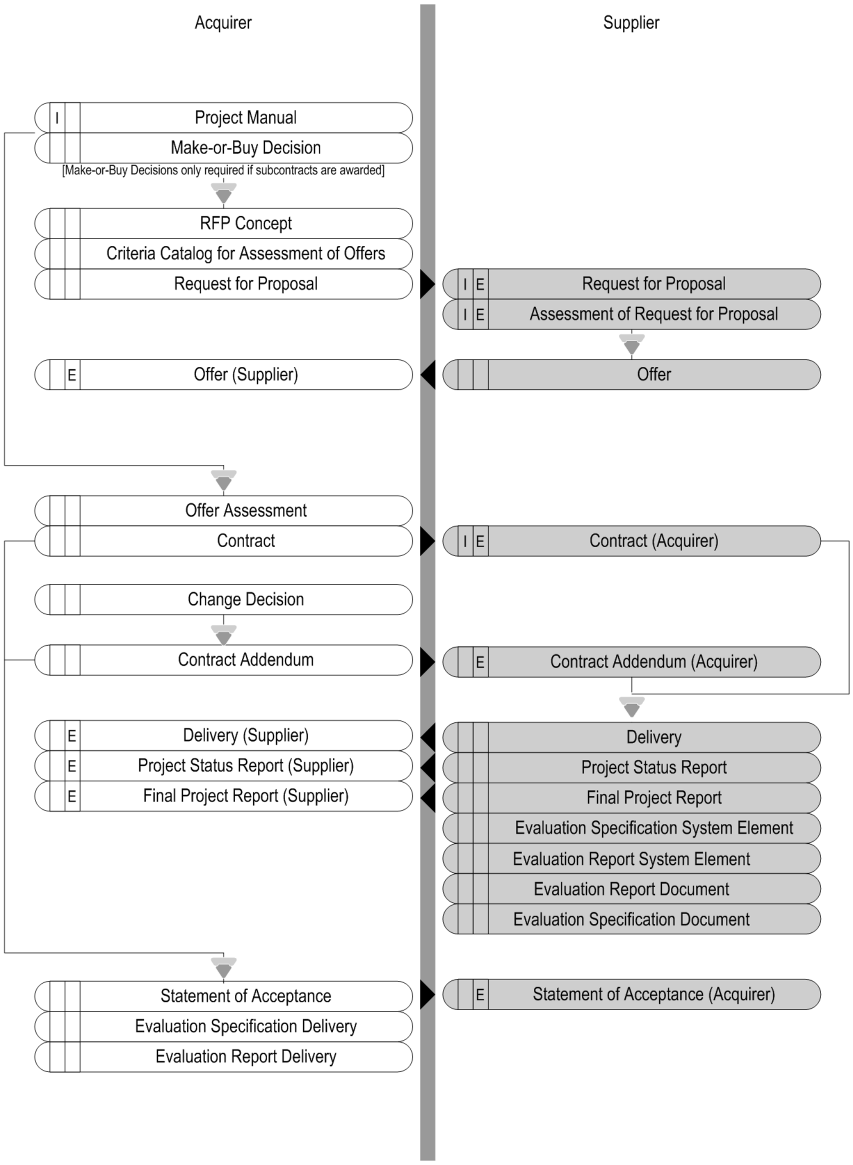


Figure 8: Overview of the Generative Product Dependencies at the Acquirer/Supplier Interface

The system development in the »Project Type »System Development Project (Acquirer/Supplier) is not provided with the »Acquirer/Supplier Interface described above. As shown in Figure Figure 9,the »Delivery (Supplier), the »Statement of Acceptance and the corresponding Evaluation Specifications and Evaluation Records will be generated by the Project Manual.

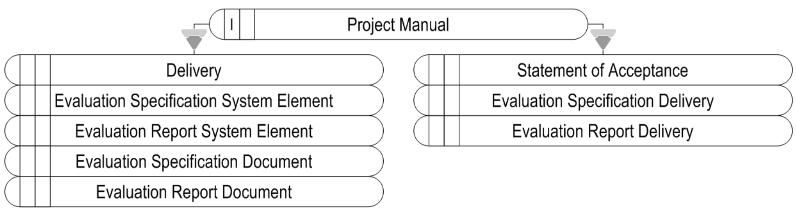


Figure 9: Generating Product Dependencies for the Delivery/Acceptance in »System Development Project (Acquirer/Supplier)

Figure 10 shows the creation of the »Work Product within the scope of the system development. Architectures, evaluation and integration concepts and the Overall System Specification are marked grey. They include specifications for existence and contents of all products which are listed in the equally colored boxes below.

The »Overall System Specification specifies if and how many enabling systems and logistic support documentations shall be prepared for the system and enabling system. The scope of the required documentation will be specified for every »System, »Enabling System and »Logistic Support Documentation, i.e., it will be specified in accordance with Figure 10 whether a »System Specification, an »User Tasks Analysis and a »Database Design must be prepared for the enabling system.

The products »Evaluation Report System Element , »Evaluation Procedure System Element, »Evaluation Specification System Element, »Evaluation Report Usability, »Evaluation Specification Usability and »Safety and Security Analysis can be prepared for each system element and are only indicated by "..." in order to improve clarity.

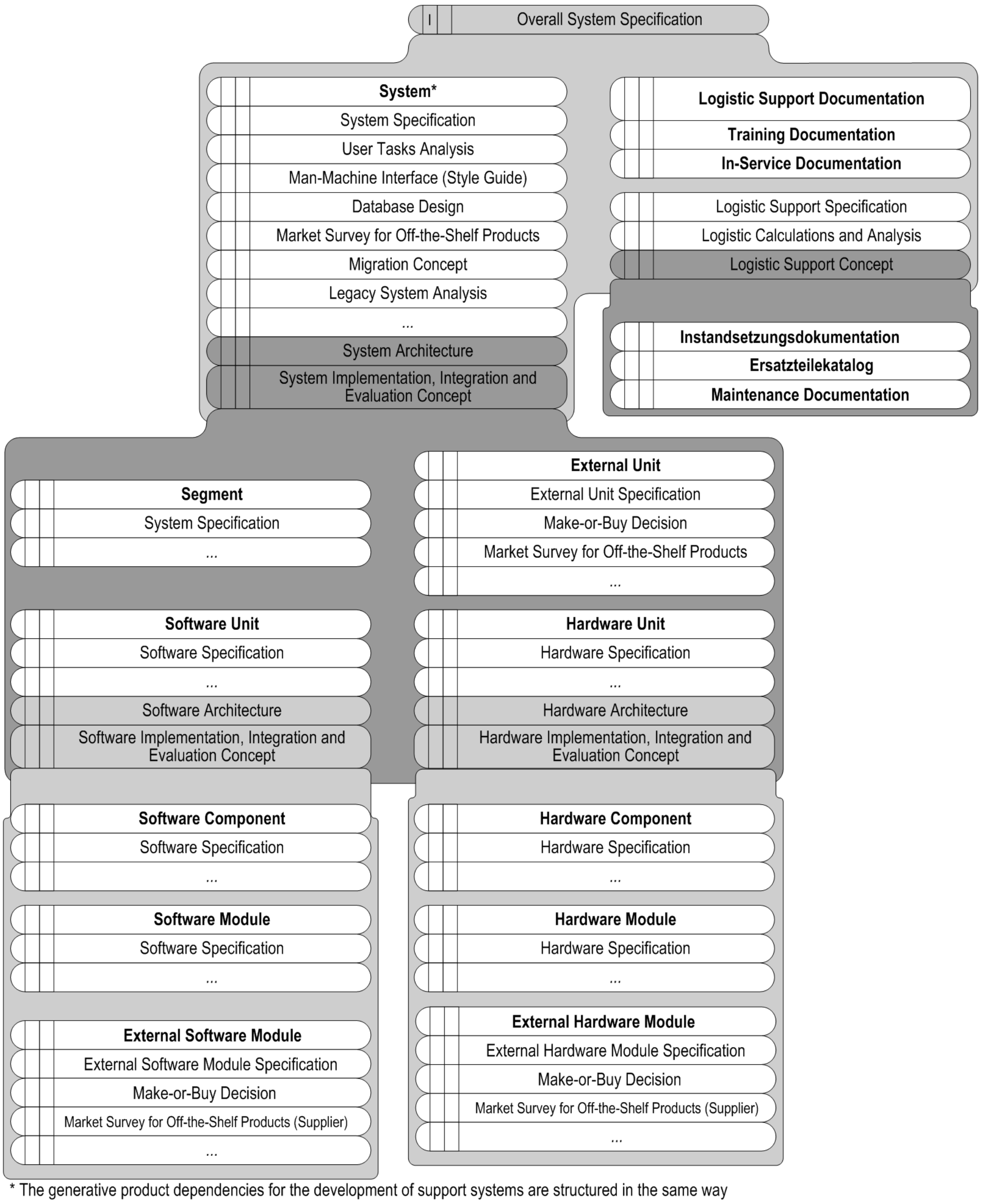


Figure 10: Overview of the System Development Product Dependencies

The system to be prepared is based on a »System Architecture, which describes the »System Decomposition down to unit level, i.e., it identifies »Segments, software and »Hardware Units and decides on the possibilities of using external units. Together with the »System Implementation, Integration and Evaluation Concept, it provides specifications for the appropriate documents to be prepared for segments, external units, »Hardware Units and »Software Units. The same applies analogously to the »Enabling System Architecture and the corresponding »Enabling System Implementation, Integration, and Evaluation Concept.

Software and hardware units, in turn, have an architecture and an implementation, integration and evaluation concept of their own, which have the same function as their counterparts at system level. Analogously to the »External Units at system level, there are the system elements »External Hardware Module and »External Software Module at hardware and software level, which can be procured as off-the-shelf products or by a sub-order. The scope of the work product »Logistic Support Documentation is regulated in the »Overall System Specification, which incudes the work product »Logistic Support Concept. The latter specifies the product scope of the Logistic Elements.

Figure 11 shows the generation of the »Market Survey for Off-the-Shelf Products. A market survey of this type can already be conducted during the specification of requirements if the necessary information can be derived from the »Project Proposal or the »Requirements Specification.

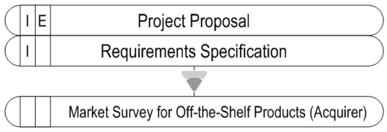


Figure 11: Generative Product Dependencies for the Specification of Requirements

As shown in Figure 12, the product maturity of an organization will be evaluated before an »Organization-Specific Process Model can be introduced or maintained. Based on the resulting »Assessment of a Process Model , an »Process Model Improvement Concept and finally the new process model itself will be developed.

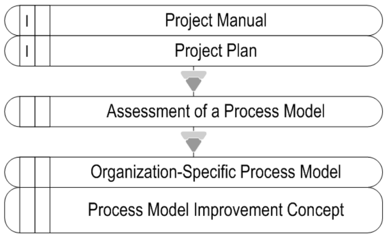


Figure 12: Overview of the Generative Product Dependencies of the Organization-Specific Process Model

3 Products

3.1 Supply and Contracting

The »Discipline Supply and Contracting includes the work products and activities from the »Request for Proposal (Acquirer) to »Offer, »Contract (Acquirer), »Delivery and »Statement of Acceptance (Acquirer) . Supplier products frequently have counterparts on the side of the acquirer and vice versa. Thus the work products »Request for Proposal (Acquirer), Contract (Acquirer), »Contract Addendum (Acquirer) and »Statement of Acceptance (Acquirer) are duplicates of the acquirer's originals. Conversely, this applies to the offer which is provided to the acquirer as duplicate of the supplier's original.

The »Assessment of Request for Proposal is unique since it is conducted by the respective organization before the V-Modell is applied and since it is used as basis for the decision to submitt a proposal in the »Decision Gate »Project Approved.

3.1.1 Request for Proposal (Acquirer)

Process module: Drafting and Conclusion of Contract (Supplier)

Responsible: Account Manager (when using process module Drafting and Conclusion of Contract (Supplier))

Work Product Attributes: external, initial

Source Work Product: Request for Proposal

Purpose

The »Request for Proposal of the Acquirer is the basis for the Supplier's »Offer (for a description, refer to »Delivery and Acceptance (Acquirer)).

Generates

Offer (see product dependency 4.31)

Depends on

Offer (see product dependency 5.56)

3.1.1.1 General Remarks on the Request for Proposal

See General Remarks on the Request for Proposal in product Request for Proposal.

3.1.1.2 Annex 1: Requirements Regarding the (Sub-)System

See Annex 1: Requirements Regarding the (Sub-)System in product Request for Proposal.

3.1.1.3 Annex 2: Directives for the Project Manual (Supplier)

See Annex 2: Directives for the Project Manual (Supplier) in product Request for Proposal.

3.1.1.4 Annex 3: Directives for the QA Manual (Supplier)

See Annex 3: Directives for the QA Manual (Supplier) in product Request for Proposal.

3.1.2 Assessment of Request for Proposal

Process module: Drafting and Conclusion of Contract (Supplier)

Responsible: Executive (when using process module Drafting and Conclusion of Contract (Supplier))

Work Product Attributes: external, initial

Purpose

The evaluation of the request for proposal is the basis for the decision as to whether an »Offer shall be prepared or not. For this purpose a rough technical solution proposal will be prepared based on the »Requirements Specification defined in the »Request for Proposal, a strategy for success will be developed, the economic profitability will be calculated, the significant specifications for the preparation of an offer will be made and the result of the evaluation will be processed systematically with respect to a decision to submit an offer.

Generates

Offer (see product dependency 4.31)

3.1.2.1 Requirements Analysis

The provider checks and evaluates the »Requirements Specification contained in the RFP documents with respect to their economic and technological feasibility, effort and importance.

3.1.2.2 Suggested Technical Solution

Based on the requirements analysis, the suggested technical solution describes the preliminary design of the overall system to be prepared. The overall system should be decomposed to a level which permits a reliable estimate of the effort required for the preparation of the offer.

3.1.2.3 Consideration of Economic Efficiency

The consideration of economic efficiency first checks the rentability of the project (also designated as business case), i.e., the question as to whether the project is profitable for the supplier. Based on a first Life Cycle Cost Calculation, the probable »Project Costs and »Manufacturing Costs shall be estimated and a Consideration of Economic Efficiency shall be executed.

In addition, it is possible to conduct considerations of economic efficiency which exceed the profit achieved directly, e.g., if additional chances on the market are possible, a product family is complemented, the development team will be qualified, the supplier's image will be improved or the system to be developed may be reused.

3.1.2.4 Success Strategy

This subject specifies the success factors of the »Offer which - in the opinion of the supplier - make a contract award probable. It should take into account the organization's strategy, the competitive situation, the market/acquirer situation, the own technological competence, possible recognizable legal and political influences, possible partners, the availability of resources, recognizable risks and chances and possible pricing variants.

3.1.2.5 Offer Preparation - Organization and Guidelines

This subject specifies standards for the preparation of an offer, the furtherance of which will depend on the probable effort required for the project. Normally, an »Offer does not require the preparation of the necessary project management documents. Only in exceptional cases, i.e. in case of very large projects, will - for example - the »Project Manual, the »Project Plan and the »QA Manual be prepared for the offer.

The standards for the preparation of an offer include milestones, deadlines, budgets of the offer, responsibilities (e.g., bidding manager, tasks of the bidding team, establishment and tasks of an editorial team (specialists not participating in the offer who are intended to improve the quality of the offer) or the establishment of the quality assurance required for the offer), the structure of the offer and the layout.

3.1.2.6 Evaluation Result

The results of the »Assessment of Request for Proposal will be summarized and prepared for the Steering Committee in such a way that they can be used as a basis for making an unambiguous decision on the preparation of an offer.

3.1.3 Offer

Process module: Drafting and Conclusion of Contract (Supplier)

Responsible: Account Manager (when using process module Drafting and Conclusion of Contract (Supplier))

Activity: Submitting an Offer

Participating: Project Leader, Controller, Executive, Requirements Engineer (Supplier)

Purpose

This product is intended to provide a competitive »Offer, which meets the informal expectations of the acquirer and fulfills the requirements of the »request for proposal.

The offer will be based on the »Request for Proposal (Acquirer) and the assessment thereof. In addition to the general clauses and conditions with notes on the organization's profile and qualification, it includes legal and commercial clauses and conditions, technical specifications and offer-relevant portions of the Project Manual and the QA Manual (Supplier). The latter need not be prepared as separate documents unless this is required by the request for proposal.

The offer shall comply with the applicable laws and directives in accordance with the request for proposal and the general statutory regulations (e.g. product safety, environmental protection regulations).

Is generated by

Request for Proposal (Acquirer), Assessment of Request for Proposal (see product dependency 4.31)

Depends on

Request for Proposal (Acquirer) (see product dependency 5.56)

3.1.3.1 General Clauses and Conditions

The general clauses and conditions include an introduction and all relevant data required by the acquirer, e.g., references to annexes like oraganization profile with references and qualification of employees, a description of the quality management system, organization brochures, applicable data sheets and certificates. Frequently, this subject also includes a summary for the management.

3.1.3.2 Offer - Legal and Commercial Clauses and Conditions

The legal and commercial clauses and conditions of the offer include - on the one hand - the legal conditions, e.g., general terms and conditions or - in case of a public acquirers - »EVB-IT, »BVB and »VOL, warranty terms, license agreements, provisions for the transfer of ownership, warnings and cautions, provisions of price legislation and place of jurisdiction.

On the other hand, they include commercial conditions, e.g., data on price type and price level, payment conditions and date of payment. Depending on the technical approach, they will frequently include a cost estimate, which - e.g. in case of competitive bidding - may be based on a detailed review of the expenditure.

3.1.3.3 Annex 1: Specification of Services

Annex 1 describes structure and functionality of the overall system to be prepared in accordance with the technical solution defined in the »Assessment of Request for Proposal, taking into account the »Requirements Specification. The required degree of detail is specified in the request for proposal. Interfaces and connections to the environment will be summarized.

This is a first pencil draft of the »Overall System Specification.

3.1.3.4 Annex 2: Offer-Relevant Parts of the Project Manual (Supplier)

Annex 2 describes the subjects of the »Project Manual which are requested in the Request for Proposal.

3.1.3.5 Annex 3: Offer-Relevant Parts of the QA Manual (Supplier)

Annex 3 describes the subjects of the »QA Manual which are requested in the Request for Proposal.

3.1.4 Contract (Acquirer)

Process module: Drafting and Conclusion of Contract (Supplier)

Responsible: Executive (when using process module Drafting and Conclusion of Contract (Supplier))

Activity: Concluding a Contract (Supplier)

Work Product Attributes: external, initial

Source Work Product: Contract

Purpose

The Contract (Acquirer) is a copy of the »Contract in the project of the Acquirer.

Generates

Delivery, Final Project Report, Project Status Report, Evaluation Report Document, Evaluation Specification Document, Evaluation Report System Element, Evaluation Specification System Element (see product dependency 4.32)

Depends on

Project Manual, QA Manual, Contract Addendum (Acquirer) (see product dependency 5.57)

Overall System Specification, Contract Addendum (Acquirer) (see product dependency 5.58)

3.1.4.1 Contract - Legal and Commercial Clauses and Conditions

See Contract - Legal and Commercial Clauses and Conditions in product Contract.

3.1.4.2 Annex 1: Requirements Regarding (Sub-)System

See Annex 1: Requirements Regarding (Sub-)System in product Contract.

3.1.4.3 Annex 2: Contract-Relevant Parts of the Project Manual (Supplier)

See Annex 2: Contract-Relevant Parts of the Project Manual (Supplier) in product Contract.

3.1.4.4 Annex 3: Contract-Relevant Parts of the QA Manual (Supplier)

See Annex 3: Contract-Relevant Parts of the QA Manual (Supplier) in product Contract.

3.1.5 Contract Addendum (Acquirer)

Process module: Drafting and Conclusion of Contract (Supplier)

Responsible: Executive (when using process module Drafting and Conclusion of Contract (Supplier))

Activity: Concluding a Contract Addendum (Supplier)

Work Product Attributes: external

Source Work Product: Contract Addendum

Purpose

The Contract Addendum (Acquirer) is a copy of the »Contract Addendum in the project of the acquirer.

Generates

Delivery, Final Project Report, Project Status Report, Evaluation Report Document, Evaluation Specification Document, Evaluation Report System Element, Evaluation Specification System Element (see product dependency 4.32)

Depends on

Project Manual, QA Manual, Contract (Acquirer) (see product dependency 5.57)

Overall System Specification, Contract (Acquirer) (see product dependency 5.58)

3.1.6 Delivery

Process module: Delivery and Acceptance (Supplier)

Responsible: Project Leader (when using process module Delivery and Acceptance (Supplier))

Activity: Preparing and Making a Delivery

Participating: System Integrator

Purpose

The delivery comprises the delivery items specified in the »Contract (Acquirer). These may include system elements like software and hardware or documents. The delivery items must be transported in a suitable packaging, which ensures that they arrive undamaged at the acquirer. It should be noted that it may be necessary to develop the packaging as well. The applicable documents, like freight/shipping documents, customs papers/export documents, delivery notes or sales documents, are part of the delivery. They must specify the configuration of the delivery items in order to enable the Acquirer to acknowledge receipt.

Is generated by

Project Manual (see product dependency 4.10)

Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 4.32)

3.1.7 Statement of Acceptance (Acquirer)

Process module: Drafting and Conclusion of Contract (Supplier)

Responsible: Executive (when using process module Drafting and Conclusion of Contract (Supplier))

Activity: Obtaining the Statement of Acceptance (Supplier)

Work Product Attributes: external

Source Work Product: Statement of Acceptance

Purpose

For a description, refer to »Statement of Acceptance and »Delivery and Acceptance (Acquirer).

3.1.7.1 Evaluation of Delivery

See Evaluation of Delivery in product Statement of Acceptance.

3.1.7.2 Annex: Evaluation Report Delivery

See Annex: Evaluation Report Delivery in product Statement of Acceptance.

3.2 Planning and Control

The »Work Products and »Activityies of the »Discipline »Planning and Control provide the fundament for an ordered and repeatable project management. The discipline includes products for the development of a project concept and for the project definition, like »Project Manual and »QA Manual, products for project planning, like »Project Plan and »Estimation, and products and activities for controlling the project, like »Project Progress Decision and »Meeting Document .

3.2.1 Project Progress Decision

Process module: Project Management

Responsible: Executive (when using process module Project Management)

Activity: Coming to a Project Progress Decision

Participating: Steering Committee, Project Leader

Work Product Attributes: external

Purpose

The Project Execution Strategies define the framework for project execution. They specify the sequence of the »Decision Gates to be achieved during the project. Based on the »Product Instances, it will be decided at each decision gate whether the respective »Project Progress Stage has been fulfilled; the result will be recorded in the »Project Progress Decision.

This decision includes the evaluation of the project progress, the coordination of the planned contents and schedule for the next planning section, the release of the required resources and the determination of specifications and framework conditions for the next planning section. The planning section must include at least the following »Project Section.

The project project decision will be made by the »Steering Committee, so that all decision makers can participate adequately. However, the »Executive is responsible for the decision. He alone can decide on the release of planning and resources.

A project progress decision will be made for every decision gate of the project. The first project project decision at the decision gate »Project Approved represents the authorization of the project by the higher management.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Project Proposal (see product dependency 5.3)

Proposal for the Introduction and Maintenance of an Organization-Specific Process Model (see product dependency 5.9)

Project Status Report (see product dependency 5.26)

Project Manual, Project Plan (see product dependency 5.30)

Example Work Products

»InfoMaPa:Project Progress Decision Project Approved

»InfoMaPa:Project Progress Decision Project Defined

3.2.1.1 Project Evaluation

The assessment is intended to determine if the project has »Finished all required results in order to fulfill the tasks of the next »Project Section successfully. The assessment is based on the products submitted at the »Decision Gate.

3.2.1.2 Decision Submittal

If a formal decision must be made based on organization-specific specifications and information or project management organization and specifications, this subject summarizes all data required for the decision. Thus it describes

- prioritized criteria for the evaluation of alternative solutions,
- alternative solutions,
- selected evaluation methods,
- the evaluation of alternative solutions,
- the recommended solution,

- the decision documentation.

3.2.1.3 Planning and Scheduling

The »Project Progress Decision documents the framework for the next planning section, as it has been coordinated wit »Executive and »Steering Committee. The planning section must include at least the next »Project Section. In this connection the agreed contents planning and scheduling for this planning section will be recorded. This includes a summary presentation of the - possibly adapted - key figures of the project proposal, Project Manual, »QA Manual and project plan with regard to the planned state of completion and the planned schedule, quality, effort and cost targets.

3.2.1.4 Resource Planning

The resource planning includes the provisioning of resources - e.g. qualified personnel, materiel and funds - for the next planning section as it has been agreed and guaranteed by the »Executive and the »Steering Committee.

3.2.1.5 Directives and General Conditions

This subject provides a summary of the specifications and framework conditions agreed by the »Executive and the »Steering Committee. They include the key figures of contents planning and scheduling, which may have been changed during the »Project Progress Decision, and the resource planning. Moreover, additional specifications and framework conditions which were agreed by the Executive and the Steering Committee - e.g. standards and guidelines to be observed and necessary cooperations with facilities and persons outside the project - will be recorded.

3.2.2 Project Manual

Process module: Project Management

Responsible: Project Leader (when using process module Project Management)

Activity: Preparing the Project Manual

Participating: Executive, Controller, CM Manager, System Architect, Safety Manager, RFP-Manager, Security Manager, Data Protection Manager

Work Product Attributes: initial

Purpose

The V-Modell is a generic process standard which must be adapted and concretized for an acutal project. The Project Manual determines the adaptations and specifications required for management and development. Thus it documents how and to what extent the V-Modell is applied to the project, and it is a source of information and guideline for all particpants.

The Project Manual includes a brief description of the project, the description of the tailoring result, the basic project execution plan, the required and agreed supplier support and organization and specifications for planning and executing the project as well as the corresponding development tasks. The »Project Leader shall develop this central product in coordination with the key personnel of the project.

The Project Manual determines frequency and necessity of generating follow-on products which are necessary for the planning and execution of the project, bids and contracts and process improvement, e.g. »Project Status Reports, »Risk List, contracts and assessment of process models.

Generates

Assessment of a Process Model (see product dependency 4.1)

Statement of Acceptance, Evaluation Report Delivery, Evaluation Specification Delivery (see product dependency 4.9)

Delivery, Evaluation Report Document, Evaluation Specification Document, Evaluation Report System Element, Evaluation Specification System Element (see product dependency 4.10)

Life Cycle Cost Calculation, Commercial Project Status Report, Product Configuration, Measurement Data, Metrics Analysis, Change Decision, Change Status List, Problem/Change Evaluation, Problem Report / Change Request, Work Order, Meeting Document, Final Project Report, Project Progress Decision, Project Management Infrastructure, Project Status Report, Project Diary, Risk List, Estimation (see product dependency 4.13)

Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept, Safety and Security Analysis (see product dependency 4.27)

Offer Assessment, Request for Proposal, RFP Concept, Criteria Catalog for Assessment of Offers, Contract (see product dependency 4.29)

Depends on

Project Proposal, Project Plan (see product dependency 5.1)

Proposal for the Introduction and Maintenance of an Organization-Specific Process Model, Project Plan (see product dependency 5.8)

Evaluation Specification Product Configuration (see product dependency 5.19)

Project Progress Decision, Project Plan (see product dependency 5.30)

Project Plan, Project Status Report, Risk List (see product dependency 5.32)

Quality Status Report (see product dependency 5.33)

QA Manual (see product dependency 5.37)

Requirements Specification, Overall System Specification (see product dependency 5.45)

Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 5.46)

Overall System Specification, Data Protection Concept, Information Security Concept (see product dependency 5.47)

Request for Proposal (see product dependency 5.48)

QA Manual, Request for Proposal (see product dependency 5.55)

QA Manual, Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 5.57)

Example Work Products

»InfoMaPa:Project Manual

»WiBe:Project Manual

»ToSA:Project Manual

3.2.2.1 Project Overview, Project Targets and Success Factors

The Project Manual is an indispensable source of information and guideline for all participants. This subject presents the common project model in a brief, concise and clear manner.

Exemplary Product Content

It is intended to describe

- the problem situation leading to the project,
- the initial situation including the results already achieved,
- the targets of the project,
- the product type (e.g. company information system, tracked vehicle, etc.),
- a summary of the significant requirements regarding
  - functionality,
  - quality,
  - maintainability and
  - safety and security,
- the rough system architecture as far as it is already known,
- the project type and size, as well as
- the decisive success factors for the project.

3.2.2.2 Sub-Projects

The sub-projects are specified based on an outline of the life cycle and the overall system architecture, the functional requirements and the non-functional requirements of the overall project. The specification of the sub-projects includes the number of sub-projects, a brief description and the most important decision gates of the sub-projects, the assignment of functional and non-functional requirements to the sub-projects and the coverage of the overall system architecture elements by the sub-projects.

In this connection the sub-project Integration, which integrates the results of the other sub-projects into the overall project, will also be specified.

The sub-project Integration describes the sequence of the sub-projects to be integrated, the particular procedures or methods for integrating the sub-project results, the schedules, efforts, responsibilities and resources.

3.2.2.3 Project-Specific V-Modell

The V-Modell is a generic process model. The project-specific adaptation - the so-called »Tailoring - is documented in this subject which determines the »Application Profile to be developed, the resulting project type, the »Process Modules to be used, the process modules selected in addition, and the selected Project Execution Strategies. This subject may also specify conditions and consequences of foreseeable dynamic tailoring. These specifications must be justified in accordance with the standards of the V-Modell (compare »Tailoring in Section 1: »Fundamentals of the V-Modell).

3.2.2.4 Deviations from the V-Modell

Every deviation from the standard of the V-Modell - e.g. deletion of individual products and activities, deviations from the tailoring procedure - must be documented, giving the reasons for this decision. The modifications shall be listed in this subject.

3.2.2.5 Project Execution Plan

The V-Modell specifies the rough structure of the project by determining appropriate »Decision Gates. This subject is intended to plan these decision gates by developing a project execution plan, which will include at least the beginning and end of the project and all important decision gates during the project.

Moreover, additional project-specific milestones may be specified if they are relevant for all stakeholders. Milestones which are only relevant within the project will be documented in the project plan.

3.2.2.6 Cooperation and Provisions of the Acquirer

The acquirer's cooperation within the scope of the contractually specified range of activities shall be specified in writing. It may include, e.g., the participation in project conferences and reviews - e.g. of the »Overall System Specification and the system architecture - and the cooperation in the »Change Control Board.

In addition, furnishings of the acquirer shall be specified unambiguously, stating particularly technical characteristics, like specifications and interfaces, but also deadlines and other conditions.

The Acquirer specifies his own cooperation and any possible provisions within the topic »Directives for the Project Manual of the Supplier.

3.2.2.7 Project Management - Organization and Directives

In this subject, the project management specifications will be adapted and concretized. The internal and external stakeholders will be listed, with the responsible points of contact being named. In addition the key roles of the V-Modell - like »Project Leader , »QA Manager and »System Architect - will be appointed, and their tasks and responsibilities will be determined in accordance with the V-Modell specifications.

The basic organization and execution of cooperation activities between all stakeholders will be defined. This includes e.g. meetings, harmonization procedures, conflict management and escalation strategies, which specify the conditions for the execution of a formal decision process. In addition, the subject defines threshold values, the exceeding of which leads to the initiation of control measures. An example for this is the exceedance of the planning target values by more than 15%. Organization-wide specifications must be taken into account.

For V-Modell products to be developed within the scope of project management - e.g. project plan, work order and »Project Diary - the subject specifies if and when these products shall be developed, on which methods, guidelines and standards they shall be based and with which tools or »Project Management Infrastructure components they shall be processed (compare section Generative Product Dependencies).

3.2.2.8 Risk Management - Organization and Directives

In order to ensure that the risks within the project are measured by the same standards, the risk management integrated in the V-Modell will be specified and concretized in this subject. This includes the general decision whether - in addition to the risks - also chances should be considered. Since the same procedure is applied to the assessment of chances and risks, the following paragraphs will not differentiate between them.

This subject specifies when and in accordance with which criteria the risks shall be documented in a »Risk List. In addition it must be defined on which methods, guidelines and standards the risk management shall be based and with which tools or »Project Management Infrastructure components it shall be processed.

The following items must be specified in detail:

- »Risk Classes for the classification of risks
- Risk acceptance criteria
- Escalation levels based on the defined risk classes in accordance with the specifications of the subject »Project Management - Organization and Directives
- Procedures for documenting the identified risks and the planned measures
- Schedule and procedures for risk identification
- Schedule for the re-evaluation of risks
- Schedule and procedures for planning and executing countermeasures

3.2.2.9 Problem and Change Management - Organization and Directives

In this subject, the problem and change management integrated in the V-Modell will be specified and concretized. It will be specified if, when and and which problem reports and change requests must be prepared, which methods, guidelines and standards will be used as basis for their preparation and with which tools or »Project Management Infrastructure components they will be processed.

This includes, but is not limited to, the definition of the planned state of problem reports and change requests (prepared, approved, rejected), the staffing of the »Change Control Board, the conflict management and escalation strategies. It may be necessary to appoint several persons in charge of changes and several Change Control Boards with different decision competences and different composition.

If there are different opinions within a Change Control Board, escalation levels will be definied. For example, a Change Control Board with greater decision competences or a »Steering Committee may be specified as escalation instance.

3.2.2.10 Configuration Management - Organization and Directives

In this subject, the configuration management integrated in the V-Modell will be specified and concretized. It will be specified which »Product Instance must be managed by the configuration management when and based on which methods, guidelines and standards and when and how often »Product Configuration and Releases must be prepared. The »Configuration Management specifications regarding number and scope of product configurations shall be observed.

All products created within the scope of a V-Modell Project will be entered and administered in the »Product Library in accordance with the specifications contained in the Project Manual. For this purpose, it must be specified which filing structure and naming conventions shall be used in the product library, how the products are named unambiguously in the configuration management, how versions and releases are updated and which product states are passed by the product model from point of view of the configuration management. The product states must include at least the states defined in the Chapter »Quality Assurance and Product State Model.

This subject must specify the administration of the product library and a concept for saving and archiving the models in the product library. It will specify responsibilities, schedules and procedures for data saving and concepts for archiving and storing data for extended periods of time.

The configuration management contributes to the »Project Status Report, which is intended to control the progress of product models and product configurations. It shall be specified when, in which form and to which persons the CM evaluation shall be forwarded.

Furthermore this chapter describes, how entries are inserted into the »History of Change and Review List. I.e., e.g. frequency of entries and which entries are edited under which circumstances.

3.2.2.11 Measurements and Analyses - Organization and Directives

In this subject, the measurement and analysis procedure integrated in the V-Modell will be specified and concretized. For this purpose, the project objectives which are to be achieved by the »Metrics, the metrics themselves and the »Measurement Data Types will be collated. The metrics will be allocated to the project objectives. This permits a quantiative or qualitative tracking of these objectives.

If the selected metrics and the corresponding measurement data are not defined in the organization-wide »Metrics Catalog, the required definitions must be made. These definitions correspond to the specifications in the Metrics Catalog. If the metrics and measurement data types adopted from the metrics catalog require project-specific adaptations, these must be documented here.

Finally, it must be specified if, when and by whom which »Measurement Data and »Metrics Analysis are to be collected or prepared. In addition, it must be specified which methods, guidelines and standards will be used as basis for their preparation and with which tools or »Project Management Infrastructure components they will be processed. Particularly the project-specific filing structure of the measurement data must be specified.

3.2.2.12 Controlling - Organization and Directives

In this subject, the commercial project management procedure integrated in the V-Modell will be specified and concretized. The economic specifications of the organization must be adapted to the project. It must be specified if and when which products are to be used for commercial project management, which methods, guidelines and standards will be used as basis for their preparation and with which tools or »Project Management Infrastructure components they will be processed.

This includes the specification of the organization and the allocation of commercial project management roles to persons or organizational units of the company. The organization will normally be developed based on the four-eye principle in order to ensure a balanced representation of technical and economical issues.

Escalation instances to be applied to in case of differences of opinion are normally specified within the organization structure of the company, however a »Steering Committee may be determined as escalation instance in great international projects.

3.2.2.13 Requirements Management - Organization and Directives

In this subject, the requirement management procedure integrated in the V-Modell will be specified and concretized. It must be specified if and when which products are to be used for requirement management, which methods, guidelines and standards will be used as basis for their preparation and with which tools or »Project Management Infrastructure components they will be processed.

This includes, but is not limited to, the appointment of all stakeholders of requirement management for the entire project life including their responsibilities, the definition of possible conditions, like the harmonization level of a requirement, the determination of a description template for requirements and possibly the specification of a tool for collecting and administering the requirements.

3.2.2.14 System Development - Organization and Directives

In this subject, the system development procedure integrated in the V-Modell will be specified and concretized. It must be specified if and when which products are to be used for system development, which methods, guidelines and standards will be used as basis for their preparation and with which tools or »Project Management Infrastructure components they will be processed.

This includes at least the specification of development methods to be applied, development environment, technologies, conflict management and escalation strategy.

3.2.2.15 Safety and Security - Organization and Directives

In this subject, the safety and security procedure integrated in the V-Modell will be specified and concretized. This includes functional safety and information security. Safety and security-relevant roles will be assigned to persons or organizational units. It must be specified if and when which »Work Product are to be used for safety and security, which methods, guidelines and standards will be used as basis for their preparation and with which tools or »Project Management Infrastructure components they will be processed.

This includes at least action concepts to be followed in case of inacceptable safety and security risks, the specification of general risk reduction measures to be applied, the information strategy in case of safety and security risks, conflict management and escalation strategies.

The general risk reduction measures will be specified in the safety and security level action matrix. This matrix includes suitable design and test measures depending on the safety and security level. These measures can be selected based on existing safety and security standards, e.g., »DIN EN IEC 61508. The measures suitable for the specific project shall be determined based on the measures proposed in the standards, or the existing standards shall be concretized for the specific project.

Exemplary Product Content

In detail the following measures may be specified:

- Actions to be followed in case of safety and security risks.
  - Methods for determining and selecting risk reduction measures.
  - Specifications for problem reports and change requests, based on the safety and security requirements of the specific system.
  - Description of the procedure for ensuring the obligation to inform the project management.
- Specification of responsibilities and decision-making authorities.
- Determination of the decision-making procedure.

3.2.2.16 Directives for the Project Manual of the Supplier

In this subject, the acquirer can provide the supplier with a variety of specifications for the planning and execution of the project. These specifications will be documented here, integrated into »Annex 2: Directives for the Project Manual (Supplier) of every »Request for Proposal and adapted as required. The specifications may include, e.g., the development process to be used, the »Tailoring and the infrastructure to be used and »Safety and Security procedures.

Exemplary Product Content

Possible specifications include, but are not limited to, the following:

- development process, e.g., development in accordance with the V-Modell
- tailoring of the V-Modell, e.g., process modules like safety and security or off-the-shelf products must be included
- milestones
- deadlines
- infrastructure to be used
- furnished items of the acquirer to be used
- type and frequency of reports
- risk acceptance matrix to be observed
- development of an as-built plan

3.2.2.17 Reporting and Communication Channels

The previous subjects determined the organization and specifications for various project planning and execution tasks. This subject provides a survey of the specifed reporting and communication channels. This includes, e.g., the specification as to who has to provide which information when and in which form.

Exemplary Product Content

It must be specified

- who receives
- which type and form of information (technical or administrative, written or oral)
- when (fixed date, periodically or depending on events)
- from whom or provides it
- to whom.

3.2.3 QA Manual

Process module:	Quality Assurance
Responsible:	QA Manager (when using process module Quality Assurance)
Activity:	Preparing the QA Manual
Participating:	Project Leader, Quality Manager, RFP-Manager
Work Product Attributes:	initial

Purpose

The V-Modell is a generic process standard which must be adapted to and concretized for an actual project. The QA Manual specifies the adaptations and features required for quality assurance. Thus it documents type and scope of the V-Modell application within the project and is information source and guideline for all stakeholders.

The »QA Manual includes a brief description of the project's quality targets, the specification of the products and processes to be tested, the organization and specifications for planning and executing quality assurance measures within the project and specifications for quality assurance measures to be executed by external suppliers. The QA Manager shall develop this central product in coordination with the key persons of the project.

In particular, the QA Manual specifies frequency and necessity of generating further products which are required for the quality assurance of the project, e.g. »Quality Status Report s, »Qualification Records and evaluation reports.

Generates

Evaluation Report Product Configuration, Evaluation Specification Product Configuration, Qualification Record, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Document, Evaluation Specification Process, Quality Status Report (see product dependency 4.14)

Depends on

Evaluation Specification System Element (see product dependency 5.16)

Project Manual (see product dependency 5.37)

Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept (see product dependency 5.43)

Request for Proposal (see product dependency 5.49)

Project Manual, Request for Proposal (see product dependency 5.55)

Project Manual, Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 5.57)

Example Work Products

»InfoMaPa:QA Manual

»WiBe:QA Manual

»ToSA:QA Manual

3.2.3.1 Quality Targets and Requirements

This subject defines the quality assurance requirements and the intended targets, e.g. a required test overlap or formal specification techniques. »Quality Targets and Requirements regarding the item to be developed will not be specified here since they have already been defined in the Requirements Specification. If an organization-specific quality management manual is available, the targets and requirements specified therein shall be adapted to the specific project.

3.2.3.2 Products to Be Evaluated

This subject specifies the products to be tested by an independent quality assurance activity. The selection must be justified. The appropriate evaluation specifications and evaluation reports for these products shall be prepared. The specification as to which system elements will be tested are documented in the corresponding implementation, integration and evaluation concepts.

3.2.3.3 Processes to Be Evaluated

This subject specifies the processes to be tested by an independent quality assurance activity. The selection must be justified, stating also the standards and guidelines on which the test is based. The appropriate evaluation specifications and evaluation reports for the processes to be tested shall be prepared.

In addition, the testing of further processes may be required due to current events in the project or its environment, e.g., an above-average deviation between estimated and actual planning.

3.2.3.4 Quality Assurance - Organization and Directives

In this subject, the V-Modell standards regarding product and process quality assurance will be concretized and adapted to the project. It will be specified if, when and and which QA products shall be used for project quality assurance, which methods, guidelines and standards will be used as basis for their preparation and with which tools or »Project Management Infrastructure components they will be processed.

Based on the quality targets, organization and authorities of project quality assurance will be specified. The constructional and analytical quality assurance measures will be presented.

Constructional measures include, but are not limited to, defensive programming, type-checking languages, standards, process models, checklists, guidelines. Analytical quality assurance measures include test measures for documents, e.g., reviews, tests of system elements and process tests.

In addition, procedures for output checks and input checks must be specified, e.g., tests of off-the-shelf products and furnished items.

Within the scope of quality control, it shall be described how arising »Quality Problems should be treated, tracked and solved by corrective actions. In addition, it shall be specified for which problem types an unscheduled »Quality Status Report must be prepared.

If contracts will be awarded to »Sub-Suppliers, the applicable quality standards shall be specified.

3.2.3.5 Quality Assurance of Delivery - Organization and Directives

This subject concretizes the standards for the quality assurance of the delivery. The acquirer conducts an acceptance test for every »Delivery.

Therefore, the supplier must ensure that his delivery fulfills the requirements of the acquirer. The requirements are replicable based on the »Evaluation Specification System Element. They include, but are not limited to, a list of acceptance evaluation cases proving the fulfillment of the requirements included in the Requirements Specification.

The results will be recorded in the »Evaluation Report System Element.

3.2.3.6 Directives for Evaluation Specification for Off-the-Shelf Products

Like all system elements, also off-the-shelf products can and should be tested. For this purpose, a »Evaluation Specification System Element will be prepared. In order to achieve a uniform quality assurance standard - particularly in case of off-the-shelf products - this subject specifies targets for the evaluation specification of off-the-shelf products. These targets shall be integrated into the corresponding system element evaluation specification. The targets may include requirements regarding scope and quality of the documentation, the manufacturer and the use test.

3.2.3.7 Directives for the QA Manual of the Supplier

The acquirer may specify a variety of quality assurance requirements for the supplier. They will be documented here, included into »Annex 3: Directives for the QA Manual (Supplier) of all »Request for Proposal and adapted as required. These specifications may include, e.g., scope of product and process testing and constructional quality assurance measures to be applied beyond the specifications in the V-Modell.

Exemplary Product Content

Possible specifications include, but are not limited to, the following:

- scope of documentation,
- development standards and methods to be used,
- specifications for internal tests of the supplier, and
- specifications for the planned configurations of the deliveries.

3.2.4 Project Management Infrastructure

Process module:	Project Management
Responsible:	Project Leader (when using process module Project Management)
Activity:	Establishing and Maintaining a Project Management Infrastructure
Participating:	CM Administrator

Purpose

The »Project Management Infrastructure is a conglomerate of tools and infrastructures used for planning and executing the project, e.g., configuration management tool, planning tool and the rooms of the project team. However, the project management infrastructure does not include the tools and infrastructure components developed as »Enabling System (compare »Structural Product Dependencies).

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

3.2.5 Estimation

Process module:	Project Management
Responsible:	Project Leader (when using process module Project Management)
Activity:	Performing an Estimation

Purpose

Reliable »Estimations are indispensable for a safe project planning and execution. An estimation ensures that the scope of the object to be estimated and the corresponding effort are replicable with a certain margin of error and that they are supported, estimated and documented methodically.

An estimation documents, e.g., the objects to be estimated, their description, the estimated values, the estimation assumptions and the estimation method used. In case of an »Estimation of the Scope, typical objects are specifications or system elements to be developed; in case of an »Estimation of Effort, typical objects include »Work Packages to be executed.

The »Project Leader is responsible for the estimation. He will be supported by the necessary stakeholders and additional experts as required.

The project planning will be prepared based on the estimations. During project execution, new facts will arise and estimated parameters will be concretized. Accordingly, new, more accurate estimations will be prepared. Number and frequency of the estimations to be prepared will be specified in the Project Manual.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Requirements Specification, Life Cycle Cost Calculation, Project Plan, Risk List, Overall System Specification (see product dependency 5.17)

3.2.5.1 Estimation of the Scope

In this subject, the scope of the object will be estimated. The scope to be estimated may be determined by the functionality of the system, e.g. type and number of use cases, function points or object points, or the results to be achieved, e.g. type and number of classes or lines of code. The estimation units used for an »Estimation must be defined unambiguously.

In addition, estimations provide important information for project control, error predictions an the projected design of target systems, e.g. computers, computer networks and bus structures.

3.2.5.2 Estimation of Effort

The »Estimation of Effort estimates a value for the effort - expressed e.g. in man months or man days - based on the estimated scope. It shall estimate the net effort without taking into account holidays, illness days and other efforts which are not relevant for the project. The effort for crossover project work - e.g. configuration management and project management - must also be estimated.

The estimate shall not only consider the sope but also influencing factors - like experience of the stakeholders, stability of the requirements or reuse level of the object to be estimated - by adding or subtracting a certain effort.

3.2.6 Risk List

Process module:	Project Management
Responsible:	Project Leader (when using process module Project Management)
Activity:	Managing Risks

Purpose

The risk management is intended to recognize project risks as early as possible and respond proactively to these risks before they become a problem for the project. The »Risk List administers the identified risks and records the planned countermeasues.

The »Project Leader is reponsible for the list of risks. He will be supported by the necessary stakeholders and additional experts as required. The recognized risks and the corresponding countermeasures will be integrated into project planning.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Requirements Specification, Life Cycle Cost Calculation, Project Plan, Estimation, Overall System Specification (see product dependency 5.17)

Project Manual, Project Plan, Project Status Report (see product dependency 5.32)

3.2.6.1 Identified Risks

This subject lists all identified risks with the information required in accordance with the Project Manual, e.g. risk state and »Risk Class.

Exemplary Product Content

The following data - normally in tabular form - will be compiled for all identified risks:

- Identification number
- Designation of risk
- Description of risk
- Date: when was the risk identfied
- Author
- Impacts of the risk: this item describes the impacts of the risk - in most cases schedule slippage and - perhaps - the resulting missed market chances, budget exceedance, reduced quality, lack of acquirer satisfaction etc.
- Estimated value for the probability of risk occurrence
- Risk damage
- Risk measure
- Risk class
- Risk state: this item can differentiate e.g. between active, occurred and closed.

3.2.6.2 Risk Mitigation Measures

The identified risks are countered by actions which are planned as response to the risk. For every action, the list describes the information required in accordance with the Project Manual (e.g., type of action, event triggering the action and person responsible for executing the action).

Exemplary Product Content

The following information is relevant for planning and executing the actions:

- Type of action: normally a distinction is made between the following possibilities: risk prevention, risk reduction or minimization, risk transfer or distribution, and risk acceptance
- Designation of action
- Description of action: a rationale will be entered here if a risk, being no longer regarded as relevant, receives the state "closed"
- Trigger: if an action is not intended to be initiated immediately, the event triggering the action will be described.
- Person responsible for executing the action
- Planned deadline for completing the action
- Actual deadline: probable deadline as seen from today's point of view
- Planned effort
- Actual effort: probable effort as seen from today's point of view
- Action state: e.g. planned, active or completed
- Residual risk probability: estimated probability with which the risk will occur after the action has been completed
- Residual risk damage: estimated damage if the risk occurs after the action has been completed
- Residual risk measure
- Residual risk class

3.2.7 Project Plan

Process module: Project Management

Responsible: Project Leader (when using process module Project Management)

Activity: Planning Project

Participating: Executive, QA Manager, System Architect, Controller, CM Manager, Logistics Manager

Work Product Attributes: initial

Purpose

A sound project plan is indispensable for the safe and coordinated execution of a project. The project plan describes the selected project approach and specifies in detail what must be done, by whom and when. Thus the project plan is the basis for project control. The »Project Leader is responsible for the project plan, which will be prepared and processed in coordination with all stakeholders.

Generates

Assessment of a Process Model (see product dependency 4.1)

Life Cycle Cost Calculation, Commercial Project Status Report, Product Configuration, Measurement Data, Metrics Analysis, Change Decision, Change Status List, Problem/Change Evaluation, Problem Report / Change Request, Work Order, Meeting Document, Final Project Report, Project Progress Decision, Project Management Infrastructure, Project Status Report, Project Diary, Risk List, Estimation (see product dependency 4.13)

Evaluation Report Product Configuration, Evaluation Specification Product Configuration, Qualification Record, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Document, Evaluation Specification Process, Quality Status Report (see product dependency 4.14)

Depends on

Project Proposal, Project Manual (see product dependency 5.1)

Proposal for the Introduction and Maintenance of an Organization-Specific Process Model, Project Manual (see product dependency 5.8)

Organization-Specific Process Model, Process Model Improvement Concept (see product dependency 5.10)

Requirements Specification, Life Cycle Cost Calculation, Risk List, Estimation, Overall System Specification (see product dependency 5.17)

Change Decision, Change Status List, Problem/Change Evaluation, Problem Report / Change Request (see product dependency 5.29)

Project Progress Decision, Project Manual (see product dependency 5.30)

Work Order (see product dependency 5.31)

Project Manual, Project Status Report, Risk List (see product dependency 5.32)

Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, System Implementation, Integration and Evaluation Concept (see product dependency 5.39)

Contract (see product dependency 5.54)

Example Work Products

»InfoMaPa:Project Plan

»WiBe:Project Plan

3.2.7.1 Project Execution Plan

The V-Modell specifies the rough structure of the project by determining appropriate »Decision Gates. This subject is intended to plan these decision gates by developing a project execution plan, which will include at least the beginning and end of the project and all decision gates during the project.

Moreover, additional project-specific milestones may be specified if they are relevant for all stakeholders. Contrary to the »Project Execution Plan in the »Project Manual this plan shows all additional project-specific milestones. In contrast to the »Project Manual, it will not specify the V-Modell products (more exactly: »Product Types), but the project-specific »Product Instances for every decision gate and every project-specific milestone. Thus this project execution plan includes the planning of the »Product Configurations to be developed within the scope of configuration management.

3.2.7.2 Integrated Planning

The subject Integrated Planning includes the complete project planning process. The other subjects are only different views on Integrated Planning. They show special planning aspects, e.g., quality assurance planning or planning of »Decision Gates.

During project execution, new facts will arise and the planning parameters will become more concrete. The project planning will then be updated accordingly. Number and frequency of project plan updates will be specified in the Project Manual.

The Integrated Planning includes all planning data known at the respective planning time. Specific data as defined in the »Project Manual will be listed for every element to be planned. Planning data include at least deadlines, efforts, persons responsible and personnel and materiel resources.

The integrated planning comprises the planning of the

- »Product Structure, i.e., the »Product Instances and their connections, and the
- project structure or »Activity Structure in form of »Decision Gates, »Work Packages and »Activity Instance.

The V-Modell does not provide for a subdivision into a product structure plan and a project structure plan. In the course of the project, the entire integrated planning must be updated in order to achieve a consistent planning state. For example, a modification of the product structure normally leads to a change of activity models and, thus, of the project structure.

In the V-Modell, the integrated planning is structured as follows:

- The integrated planning includes the planning of all project-specific decision gates.

- The project-specific work packages are subordinate to the decision gates. They are integrated into a »Project Section, i.e., into the period between two decision gates.
- All activities to be executed within the scope of the project are subordinate to the work packages.
- All product models to be produced within the scope of the V-Modell, i.e., delivery items and project-internal product models, are allocated to the activities.

The integrated planning must include all activity models, product models and project-specific decision gates which are defined in the V-Modell and used in the project. Moreover, additional activity models not included in the V-Modell, e.g., training activities for the project staff, may be integrated.

However, deadlines, resources and efforts need not be planned specifically for all activity models. Instead, project-specific »Work Packages including several activity models can be defined, e.g., a configuration management work package. Deadlines, resources and efforts may be planned at the level of these work packages.

If the planning elements are to small, they may be administered in one action list in accordance with the specifications of the »Project Manual, as described in the product »Work Order.

It would be reasonable to use a computer-based project planning tool for the development of the integrated planning process. Various notations are conceivable for displaying the integrated planning, e.g., Gantt chart, network diagram, table, indented list, organizational chart, or MindMap.

3.2.7.3 Evaluation Plan Documents

The »Evaluation Plan Documents includes all appropriate document test activities including the corresponding data, e.g., »Preparing Evaluation Specification Document and »Evaluating Document.

The evaluation plan specifies tasks, responsibilities and required resources. It includes a detailed test schedule for every document.

3.2.7.4 Integration and Evaluation Plan System Elements

The »Integration and Evaluation Plan System Elements includes all appropriate system-element-specific integration and test activities with the corresponding data, e.g. Integrating System and »Evaluating System Element.

The integration and evaluation plan specifies tasks, responsibilities and required resources. It includes a detailed test schedule for every system element.

3.2.7.5 Evaluation Plan Processes

The »Evaluation Plan Processes includes all process test activities with the corresponding data, e.g., »Preparing Evaluation Specification Process and »Evaluating Process.

The evaluation plan specifies tasks, responsibilities and the required resources, e.g., personnel and tools. It includes the detailed test schedule for every process.

3.2.7.6 Training Plan

The »Training Plan includes role-specific and project-specific instructions and follow-on training for qualifying project members. The activities to be planned for this purpose are not included in the V-Modell. They must be planned specifically for the respective project.

3.2.8 Work Order

Process module:	Project Management
Responsible:	Project Leader (when using process module Project Management)
Activity:	Assigning a Work Order

Purpose

The work order is an instrument used by the »Project Leader for internal project control. The Project Leader can give the staff work orders. In accordance with the Project Manual, the necessary data, e.g., task description, person responsible and completion date, shall be specified appropriately for every work order. The Project Manual also specifies if and in which form work orders will be given, planned and tracked. It is possible to collect and administer work orders in an action list.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Project Plan (see product dependency 5.31)

Example Work Products

»InfoMaPa:Work Order

3.2.9 Life Cycle Cost Calculation

Process module:	Life Cycle Cost Management
Responsible:	Controller (when using process module Life Cycle Cost Management)
Activity:	Performing Life Cycle Cost Calculation
Participating:	Project Leader

Purpose

The Life Cycle Cost Calculation determines the life cycle costs, which are one of the important parameters. On this basis, the economic efficiency of a project will be determined by a Life Cycle Cost Calculation at the start of the project in the Project Proposal, then in the »Assessment of Request for Proposal and continuously in the »Project Status Report.

Already during the preparation of the Requirements Specification, the life cycle is considered in Outline of the Life Cycle and the Overall System Architecture. In this context, the planning costs shall be examined as first.

Based on the »Estimation, the Life Cycle Cost Calculation determines and documents the monetary values for all planned project costs (e.g. development costs) and the expected »Manufacturing Costs in a replicable way. The cost structure to be evaluated will be derived from the structure of the delivery item. For example, if a system is created, the structural elements of logistics, »Enabling Systems and the system itself will be included into the cost structure. In addition, risks and chances will be evaluated from a monetary point of view (see list of risks).

The costs of use will be calculated in dependence on the specifications in the product Overall System Specification for the Life Cycle Analysis and the Overall System Architecture.

Based on these data, a cost and »Account Structure will be developed, which allows the costs to be tracked. The project result can then be assessed from a monetary point of view, which allows target costs for individual elements to be derived. Thus, the Life Cycle Cost Calculation provides an important indicator for project control.

Since many of the above data may be confidential, the Life Cycle Cost Calculation will frequently be an internal presentation.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Requirements Specification, Project Plan, Risk List, Estimation, Overall System Specification (see product dependency 5.17)

Commercial Project Status Report, Final Project Report, Project Status Report, Project Diary (see product dependency 5.18)

3.2.9.1 Costs of Planning Stage

The costs of planning stage comprise the costs arising during the planning of the project from the idea to contract award. In case of large systems, they can be processed in a separate V-Modell project. Normally, the life cycle costs will be analyzed during this phase.

3.2.9.2 Project Costs

Based on the »Estimation and the »Project Plan, the expected costs for the project developmentphase will be determined by estimating the organization-specific cost parameters, e.g., for personnel, travels, etc., and the development-relevant expenditure on material, like costs for tool support.

3.2.9.3 Manufacturing Costs

The significant portion of the »Manufacturing Costs will already be determined during the development phase. Therefore, the optimization of manufacturing costs must be considered from the start of the development.

The manufacturing costs are defined as the manufacturing costs expected for the overall system in the production phase. They are relevant above-all for hardware-intensive systems. The manufacturing costs are estimated based on all system elements of the system and the »Enabling System. The calculation at the start of the project is built on analogies to known elements and technologies, implicitely taking into account the know-how of the company.

Particularly if systems are combined with hardware, omtimized manufacturing costs are one of the most important objectives of the project.

3.2.9.4 Costs of Use

The costs of use (costs for deployment, use, maintenance, repair and disposal) are the signficant additional life cycle costs. Together with their expected development during the entire service life, these costs are processed within the framework of logitic support.

3.2.9.5 Account Structure

The subject »Account Structure defines the accounts as based on the project costs and integrates them into the organization-specific processes. It is used for tracking the costs arising the course of the project.

In addition, the accounts will be based on economic variables. In this connection, e.g., deadlines like payment milestones, the dates selected for accounting sales in the fiscal year and the outflow of funds must be considered in the budget and coordinated with the »Project Plan.

3.2.9.6 Analysis of Cost-Effectiveness

The Analysis of Cost-Effectiveness estimates the possible result or the potential economic benefit and compares it with the previously life cycle costs. In this connection, additional aspects like product strategy or innovation effects can be integrated into the planned commercial result.

Since project costs, manufacturing costs and costs of use are determined by the system elements, it is possible to derive appropriate standards for the individual system elements of the overall system from the Analysis of Cost-Effectiveness.

3.3 Reporting

The »Discipline »Reporting includes all »Work Products and »Activityies which are distributed to the stakeholders in accordance with the project-accompanying reporting system specified in the Project Manual. This discipline includes all state reports, e.g., »Project Status Report , »Quality Status Report and »Final Project Report , and current internal project daybooks, e.g. »Project Diary and »Metrics Analysis.

3.3.1 Meeting Document

Process module:	Project Management
Responsible:	Project Leader (when using process module Project Management)
Activity:	Holding a Meeting

Purpose

The term »Meeting Document comprises a variety of conference documents (e.g., jour-fixe of the project, design workshops, or requirement specification workshops). An invitation will be distributed before the meeting, and the conference will be documented appropriately. The »Project Leader is responsible for this product. However, his responsibility does not only refer to the preparation of the product, but also to the requirement that written briefs be prepared for the conferences to be documented in accordance with the Project Manual.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

3.3.1.1 Invitation

The invitation includes all data required previously for the execution of the conference, e.g., date, location, objective and agenda of the conference.

Exemplary Product Content

The invitation for a project conference should include at least the following data:

- Inviting agency with address
- Conference date
- Conference location
- Type of conference, e.g., "weekly jour fixe"
- Agenda, i.e., the individual items and the planned duration per item (including breaks)
- Projected overall duration of the conference
- Projected circle of participants or individual participants by name
- Necessary tools and equipment to be provided by the participant
- Necessary tools and equipment provided by the inviting agency
- Necessary preparation with regard to the contents of the conference
- Regulations for affirmative replies and cancelations

3.3.1.2 Protocol

The protocol is a written documentation of the course and the results of a conference. It should include particularly participants, list of distribution and the agreed tasks, if required in form of work orders. The finished protocol shall be distributed to all participants and other persons concerned, who will check it for correctness.

Exemplary Product Content

The protocol shall include at least the following data

- Participants, chairman, location and date,
- list of distribution, and
- results of the conference.

3.3.2 Project Status Report (Supplier)

Process module: Drafting and Conclusion of Contract (Acquirer)

Responsible: Project Leader (when using process module Drafting and Conclusion of Contract (Acquirer))

Work Product Attributes: external

Source Work Product: Project Status Report

Purpose

The »Project Status Report (Supplier) is a copy of the supplier's »Project Status Report in the project of the user. Relevant data shall be integrated in the own »Project Status Report in the project of the user.

Depends on

Final Project Report, Project Status Report, Final Project Report (Supplier) (see product dependency 5.51)

3.3.2.1 Management Summary

See Management Summary in product Project Status Report.

3.3.2.2 Project Results

See Project Results in product Project Status Report.

3.3.2.3 Problem and Change Statistics

See Problem and Change Statistics in product Project Status Report.

3.3.2.4 Quality Assessment

See Quality Assessment in product Project Status Report.

3.3.2.5 Current Risks and Related Risk Mitigation Measures

See Current Risks and Related Risk Mitigation Measures in product Project Status Report.

3.3.2.6 Deviations from the Project Plan

See Deviations from the Project Plan in product Project Status Report.

3.3.2.7 Planning for the next Reporting Period

See Planning for the next Reporting Period in product Project Status Report.

3.3.2.8 Overall Project Progress

See Overall Project Progress in product Project Status Report.

3.3.3 Final Project Report (Supplier)

Process module: Drafting and Conclusion of Contract (Acquirer)

Responsible: Project Leader (when using process module Drafting and Conclusion of Contract (Acquirer))

Work Product Attributes: external

Source Work Product: Final Project Report

Purpose

The »Final Project Report (Supplier) is a copy of the supplier's »Final Project Report within the project of the user. Relevant information shall be integrated into the own »Final Project Report within the project of the user.

Depends on

Final Project Report, Project Status Report, Project Status Report (Supplier) (see product dependency 5.51)

3.3.3.1 Management Summary

See Management Summary in product Final Project Report.

3.3.3.2 Initial Situation and Objectives

See Initial Situation and Objectives in product Final Project Report.

3.3.3.3 Project Results

See Project Results in product Final Project Report.

3.3.3.4 Quality Assessment

See Quality Assessment in product Final Project Report.

3.3.3.5 Project Progress

See Project Progress in product Final Project Report.

3.3.4 Project Diary

Process module: Project Management

Responsible: Project Leader (when using process module Project Management)

Activity: Keeping a Project Diary

Participating: Controller

Purpose

The »Project Diary is used as project-internal information source for all important project events and project decisions. Thus, the »Project Leader can always provide information on the previous project history - also in detail. In addition, the stakeholders can use the positive and negative lessons learned for the remaining project time and for follow-on projects. The Project Diary will be updated continually.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Life Cycle Cost Calculation, Commercial Project Status Report, Final Project Report, Project Status Report (see product dependency 5.18)

Project Status Report, Quality Status Report (see product dependency 5.36)

3.3.4.1 Lessons Learned

This subject documents the lessons learned which have influenced the project in a positive or negative way, e.g., project equipment, project risks, compliance with agreements, form and efficiency of conferences. In addition, it provides an overview of all important project events and project decisions.

Exemplary Product Content

Possible aspects, the analysis of which may allow statements on the project progress, include, but are not limited to:

- Project resources,
- project risks,
- motivation and commitment of team members,
- cooperation with acquirer or supplier,
- cooperation and dealings with internal and external team members,
- form and efficiency of conferences,
- conflict management,
- compliance with agreements,
- adherence to schedule of all participants,
- quality awareness of all participants,
- quality, reliability and and user-friendlines off employed tools,
- clearness, understandability and timeliness of »Reporting documents,
- efficiency of employed processes and possibly executed process improvements,
- flexibility in case of changes,
- planning accuracy, and
- up-to-dateness of the collected actual data.

3.3.4.2 Experiences with the Acquirer

The positive and negative experiences made with the acquirer in the course of the project shall be documented as neutrally as possible. These records may refer to the experiences gained during bidding and contract award, payment behavior, reliability of providing items to be furnished and support, technical, procedural and management know-how of the acquirer staff, adherence to schedule, stability of requirements etc.

3.3.4.3 Experience with Suppliers

See Experiences with Off-the-Shelf Products in product Project Diary.

3.3.4.4 Experiences with Off-the-Shelf Products

This subject documents experiences with external providers, which may be used as basis for deciding on the future selection of providers. It should include a description of the order and an assessment of the provider based on different critiera, like cooperation, quality and on-time delivery.

These data are forwarded to the »Purchaser who will manage them and take them into account when selecting future providers.

3.3.5 Measurement Data

Process module: Measurement and Analysis

Responsible: Project Leader (when using process module Measurement and Analysis)

Activity: Collecting Measurement Data

Purpose

The »Measurement Data are the explicit numerical material required for calculating the corresponding »Metrics and for preparing the »Metrics Analysis. This product administers all data acquired during the project for the calculation of metrics.

The Project Manual specifies for all metrics which »Measurement Data Types, i.e., which description and which structure of the data to be acquired, are required for their calculation. The »Project Management Infrastructure provides a central or distributed structure for filing the measurement data in accordance with the specifications of the »Project Manual.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

3.3.6 Metrics Analysis

Process module: Measurement and Analysis

Responsible: Project Leader (when using process module Measurement and Analysis)

Activity: Calculating and Analyzing Metrics

Purpose

»Metrics Analysis provides quantitative and qualitative statements in order to answer questions in the project. A metrics analysis shows the result and possible interpretation of a »Metric calculation based on the available »Measurement Data.

This may also include first conclusions derived from the results, e.g, proposals for actions to be initiated. In addition, metrics analyses can be used for the planned/actual comparison within the scope of project control.

Examples for metrics analyses include, but are not limited to, number of faults per class, modification effort per document and adherence to schedule in the course of the project.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

3.3.7 Commercial Project Status Report

Process module:	Life Cycle Cost Management
Responsible:	Controller (when using process module Life Cycle Cost Management)
Activity:	Preparing Commercial Project Status Report

Purpose

The Commercial Project Status Report is used for tracking the life cycle costs planned in the »Life Cycle Cost Calculation and the monetary project result and, thus, for controlling the monetary project result. It informs at least the »Project Leader, the »Executive and the »Steering Committee on the commercial situation of the project. Number and frequency of the Commercial Project Satus Reports to be prepared are specified in the Project Manual.

The detailed cost analyses may partly be confidential. Therefore, they will be integrated in compressed form into the »Project Diary's analysis of plan deviations and into the cost section of the »Project Status Report.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Life Cycle Cost Calculation, Final Project Report, Project Status Report, Project Diary (see product dependency 5.18)

3.3.7.1 Deviation from Projected Costs of Planning Stage

The document Life Cylce Cost Calculation compares the costs at planning stage with the projected budgeted costs. Any deviation will be documented and analyzed.

These deviations may be the basis for change proposals intended to ensure that the projected costs of planning stage will not be exceeded.

3.3.7.2 Deviations of Project Costs

The actual project costs will be compared with the costs planned in the work product »Life Cycle Cost Calculation, taking into account additional cost factors, e.g., general expenses and interest charges. Any deviation will be documented and analyzed with regard to contents.

Depending on the state of manufacture, the expected costs to complete, e.g., personnel costs, material costs and travel expenses, will be determined. This includes additional costs, e.g., risk surcharges, interests and financing charges. The costs at completion can be derived from these data.

3.3.7.3 Deviations of Manufacturing Costs

The future »Manufacturing Costs will be recalculated based on the current data and compared to the costs planned in the »Life Cycle Cost Calculation. Any deviation will be documented and analyzed with regard to contents.

The manufacturing costs will be detailed to such a degree that the cost drivers of individual system elements can be recognized. Proposals for technical modifications may be derived from the deviations in order to prevent the manufacturing costs planned in the »Life Cycle Cost Calculation from being exceeded.

3.3.7.4 Deviations from Projected Costs of Use

The document Life Cylce Cost Calculation compares the projected costs of use with the planned budgeted costs. Any deviation will be documented and analyzed.

These deviations may be the basis for change proposals intended to ensure that the projected costs of use will not be exceeded.

3.3.7.5 Deviations from Projected Cost-Effectiveness

The expected result will be recalculated based on current information and compared with the result planned in the »Life Cycle Cost Calculation. Any deviations will be documented and analyzed with regard to contents

Positive and negative effects of deviations from the planned values must compensate each other. If the planned result cannot be achieved or cost-effectiveness cannot be ensured, control measures shall be proposed and initiated.

3.3.8 Project Status Report

Process module:	Project Management
Responsible:	Project Leader (when using process module Project Management)
Activity:	Preparing Project Status Report
Participating:	Controller, Change Request Manager, QA Manager, CM Manager

Purpose

The project progress must be verified regularly in order to intervene appropriately if required. The »Project Status Report is the central document for evaluating the project progress. It includes statements on the current production state, stability and quality of the project results, risk assessments, deviations from the original planning and a - possibly updated - new planning.

The »Project Leader is responsible for the Project Progress Report. He prepares it in cooperation with the other key roles of the project. Number, frequency and distribution of the Project Status Report are specified in the Project Manual. The Project Status Report is used for project-internal and external reporting.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 4.32)

Depends on

Life Cycle Cost Calculation, Commercial Project Status Report, Final Project Report, Project Diary (see product dependency 5.18)

Project Progress Decision (see product dependency 5.26)

Change Status List (see product dependency 5.28)

Project Manual, Project Plan, Risk List (see product dependency 5.32)

Project Diary, Quality Status Report (see product dependency 5.36)

Final Project Report, Final Project Report (Supplier), Project Status Report (Supplier) (see product dependency 5.51)

Example Work Products

»WiBe:Project Status Report - Project Defined

3.3.8.1 Management Summary

The Management Summary briefly and concisely describes the current project progress parameters and any measures required for project control.

3.3.8.2 Project Results

This subject provides a survey of the results achieved and the activities completed during the reporting period. It should also include any results which could not be achieved as planned. The CM evaluations specified in the Project Manual can provide an adequate information source.

3.3.8.3 Problem and Change Statistics

This subject presents the »Problem and Change Statistics, e.g., number and scope of problem reports and change requests and number of finished and remodified products, in accordance with the specifications of the Project Manual. The »Change Status List and the CM evaluations specified in the Project Manual may be used as information sources.

3.3.8.4 Quality Assessment

See Quality Assessment in product Final Project Report.

3.3.8.5 Current Risks and Related Risk Mitigation Measures

This subject provides a summary of the current risks and the necessary future and already initiated measures.

3.3.8.6 Deviations from the Project Plan

This subject shows the deviations between planned and actual values, e.g., for the state of production, schedule, quality and costs.

3.3.8.7 Planning for the next Reporting Period

This subject provides a summary of the planning for the next reporting period, particularly of the planning changes required due to »Deviations from the Project Plan. In addition, decision documentations for report addressees can be presented and agreed accordingly (e.g. a significant project control measure to be agreed and initiated within the scope of a »Project Progress Decision).

Exemplary Product Content

Planning changes within the area of responsibility of the Project Leader may include, but are not limited to, the following:

- Postponing planned deadlines for activities without endangering the project-specifically planned decision gates as a whole,
- supporting critical activities especially, e.g. by
  - concentrating resources or
  - initiating a special quality assurance or external review of products,
- changing the assignment of personnel to activities,
- changing the resource allocation,
- adapting the contract,
- augmenting or reducing personnel on short notice,
- outsourcing work packages or awarding external contracts, or
- buying off-the-shelf products.

3.3.8.8 Overall Project Progress

In the overall project progress, the most important project progress values of the individual sub-projects are concentrated for the overall project. The project progress values of the sub-projects include statements on the current production status, stability and quality of the project results, risk assessments and deviations from the original planning.

3.3.9 Quality Status Report

Process module:	Quality Assurance
Responsible:	QA Manager (when using process module Quality Assurance)
Activity:	Preparing Quality Status Report

Purpose

The quality of the results must be verified regularly in order to intervene appropriately if required. The »Quality Status Report is the central document for evaluating the product quality. It includes statements on the scope of the conducted tests, the arising »Quality Problems and measures for remedying these problems. The QA Manger is responsible for the »Quality Status Report. He prepares it in cooperation with the other key roles of the project. Number, frequency and distribution of the »Quality Status Report are specified in the »QA Manual. The »Quality Status Report is used for project-internal and external reporting.

Is generated by

Project Plan, QA Manual (see product dependency 4.14)

Depends on

Project Manual (see product dependency 5.33)

Evaluation Report Delivery, Evaluation Report Document, Evaluation Report Process, Evaluation Report System Element (see product dependency 5.34)

Project Status Report, Project Diary (see product dependency 5.36)

3.3.9.1 Scope of Evaluations

This subject provides a survey of the tests conducted during the previous reporting period and indicates which tests are planned for the next reporting period. Any modification of the original project planning must be documented and justified.

3.3.9.2 Status of Processes

This subject presents the status of the individual processes in a concise manner, reflects the practice on the expectations specified by the management or the organization-specific process model, identifies problems and proposes measures for solving these problems.

3.3.9.3 Quality Problems

This subject summarizes the results of the tests conducted during the previous reporting period, especially problems arising and their causes. Completed measures and solved problems will also be documented.

Exemplary Product Content

Typical problems influencing the quality include, but are not limited to, the following:

- Survey of conducted and still pending tests
- Evaluation results
- Trends and causes of recognized faults
- Unclear statements in contracts, specifications, task formulations
- Unsafe specifications in planning data
- Insufficient qualification, conflicts, insufficient availability, excessive stress within the project team
- Insufficient support, behaviour of acquirer
- Resources, internal/external support

3.3.9.4 Corrective Actions

This subject lists actions for solving the pending »Quality Problems. The effects of these actions - e.g. the effort required for the execution, resulting delays and possible risks - should also be presented.

3.3.10 Final Project Report

Process module:	Project Management
Responsible:	Project Leader (when using process module Project Management)
Activity:	Concluding Project
Participating:	QA Manager, Controller, CM Manager

Purpose

At the end of a project, the results achieved and the lessons learned should be documented in such a way that future projects can build up on them. Therefore, the »Final Project Report includes a brief survey of motivation and objectives of the project, a summary description of the project results and their quality, and a brief description of the project history and the lessons learned. The Final Project Report is used as information source for all stakeholders and - particularly - also for external persons.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 4.32)

Depends on

Life Cycle Cost Calculation, Commercial Project Status Report, Project Status Report, Project Diary (see product dependency 5.18)

Project Status Report, Final Project Report (Supplier), Project Status Report (Supplier) (see product dependency 5.51)

3.3.10.1 Management Summary

See Management Summary in product Project Status Report.

3.3.10.2 Initial Situation and Objectives

This subject provides a summary of the initial situation and the objectives of the project.

Exemplary Product Content

It shall include the following:
- the problem situation leading to the project,
- the economic, organizational, and legal rationale for the necessity of the project,
- the original project execution strategy,
- the first risk estimates,
- the significant requirements posed on the new system, and
- possibly, the expectations of the project sponsors.

The objectives of the project describe the state to be achieved at the end of the project. In addition to the description of the contents of the expected project result, the so-called object goal, the significant objectives include the following:
- the cost targets in form of budget or fund allocations at the start of the project and
- the intended deadlines, which include all interim dates for certain milestones as derived from the end date.

3.3.10.3 Project Results

See Project Results in product Project Status Report.

3.3.10.4 Quality Assessment

The quality assessment includes a summary of the »Quality Status Report.

3.3.10.5 Project Progress

This subject describes the project progress chronologically, presenting and assessing the significant results and decisions. Planning changes executed during the project shall be presented together with a description of their contents and cause. Particular emphasis shall be placed on the documentation of project experiences. A summarizing planned/actual comparison shows the project progress quantiatively.

3.4 Configuration and Change Management

The »Discipline »Configuration and Change Management includes the »Work Products and »Activityies »Product Library and »Product Configuration, which are the central products and activities of »Configuration Management. The »Problem and Change Management is also represented in this discipline by the respective products, from the product »Problem Report / Change Request to the product »Change Decision.

3.4.1 Product Library

Process module: Configuration Management

Responsible: CM Manager (when using process module Configuration Management)

Activity: Managing Product Library

Participating: CM Administrator, Project Leader

Work Product Attributes: initial

Purpose

The »Product Library comprises all »Product Instances and their »Product Versions, which are developed in the course of a project. This includes at least the product models specified by the product structure. Accordingly, the product library may be regarded as central project database. It is normally administered by a »CM Tool.

The product lirbrary administers all product models in accordance with the specifications of the Project Manual. A product model as defined by the V-Modell is, e.g., a document, an individual hardware or software element or a combination of these elements.

The »Project Manual specifies which »Product Instances are not administered physically in the product library, e.g. physical hardware elements. In this case, at least an identificator of the »Product Instance must be administered in the product library.

The identification system specified in the »Project Manual, e.g., filing structure and name conventions, initializes, identifies and references all products adminstered in the product library. The access rights specified in the »Project Manual shall be established, administered and monitored when the product library is established and the products are stored in the product library.

3.4.2 Product Configuration

Process module: Configuration Management

Responsible: CM Administrator (when using process module Configuration Management)

Activity: Managing Product Configuration

Purpose

A »Product Configuration is a quantity of »Product Versions, a so-called baseline, which is intended to define the configuration units and their structural connections.

Product configurations are developed in accordance with the specifications of the »Project Manual and the Project Plan. A product configuration must be developed at least for every »Decision Gate and every project-internal milestone. Like every »Product Instance, also the product configuration itself will be administered in the »Product Library.

A product configuration must include the products specified for the respective decision gate or project-internal milestone in the »Product Version planned in the »Project Manual and the project plan. In addition, at least all »Product Versions with product dependencies shall be recorded. Additional »Product Versions may be recorded as desired.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

3.4.3 Problem Report / Change Request

Process module: Problem and Change Management

Responsible: Change Request Manager (when using process module Problem and Change Management)

Activity: Preparing Problem Report/Change Request

Work Product Attributes: external

Purpose

Problem report and change request are the documented wish to solve a problem, execute a modification or introduce an improvement. They may be initiated by various factors, e.g. changes of requirements or faults within the system.

Problem reports or change requests may be prepared by each stakeholder, e.g. »Software Developer or »User, or introduced as »External Product from the outside of the project. The Project Manual specifies when problem reports and change requests must be prepared in order to initiate and implement a change.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Change Decision, Change Status List, Problem/Change Evaluation, Project Plan (see product dependency 5.29)

3.4.3.1 Identification and Classification

This subject describes the identified problem and change request in detail. It should document all information - e.g. unambiguous identification of the subject matter of the problem, requesting agency and urgency - which is required in order to reproduce the problem or replicate the change request. Every change request shall be categorized and classified, e.g., with respect to the type of change, change priority and completion.

Exemplary Product Content

The change request may include the following:
Identification

- Identificator of request
- Project identification
- Identification of the subject matter (configuration) to which the report or request refers
- Date of receipt
- Requesting agency (name, telephone, email)
- Related other requests

Classification

- Categorization of change (fault (in request, design, coding, process/procedure), problem, change of requirement, extension, improvement)

- Urgency as seen from point of view of the requesting agency (e.g., critical, very important, important, desirable)
- Desired date of completion

3.4.3.2 Opportunity/Problem Description

Based on the description of the actual state in the previous subject, the »Opportunity/Problem Description indicates the reason for the change, e.g., technical problems, scarcity of resources or organisational conflicts. The rationale may also decribe opportunities and benefits of the desired change and potential damage which may occur if the changes are not executed.

If the request refers to a deviation of the system behavior from the specified requirements or to the change of a requirement, this requirement must be indicated.

3.4.3.3 Suggested Solution

If the requesting agency has any concrete concepts for implementing the desired state, these should be presented here. The effects of the implementation should also be described.

3.4.4 Problem/Change Evaluation

Process module: Problem and Change Management

Responsible: Change Request Manager (when using process module Problem and Change Management)

Activity: Assessing Problem Report/Change Request

Participating: Hardware Architect, CM Manager, Logistics Manager, QA Manager, Software Architect, System Architect

Purpose

The »Problem/Change Evaluation includes the analysis of one or more problem reports and change requestes. The assessment must include all required information, e.g. problem analysis, suggested solution and effects, in order to provide the »Change Control Board with a basis for deciding on problem reports and change requests.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Change Decision, Change Status List, Problem Report / Change Request, Project Plan (see product dependency 5.29)

3.4.4.1 Opportunity/Problem Analysis

The problem analysis shall analyze and present the cause of the respective problems or change requests. The resulting opportunities should be presented and classified accordingly.

3.4.4.2 Suggested Solutions and Consequences

All sensible suggestions for solving the problems or implementing the changes shall be described including the required information, e.g., effort, effects, advantages and disadvantages.

3.4.4.3 Recommendation

The suggested solutions as presented above will be assessed; the most suitable solution with its possible variations will be specified as recommendation and justified.

3.4.5 Change Decision

Process module: Problem and Change Management

Responsible: Change Control Board (when using process module Problem and Change Management)

Activity: Deciding on Changes

Participating: Hardware Architect, CM Manager, Logistics Manager, Change Request Manager, QA Manager, Software Architect, System Architect

Purpose

The »Change Decision documents the decisions made by the »Change Control Board on one or more »Problem/Change Evaluations. It requires a clear rationale for the criteria on which the decision is based. The change decision also includes a resolution as to how the decision will be implemented.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Generates

Contract Addendum (see product dependency 4.28)

Depends on

Change Status List, Problem/Change Evaluation, Problem Report / Change Request, Project Plan (see product dependency 5.29)

3.4.5.1 Decision Criteria

Criteria, e.g., costs arising, time delay and suitability of solution, will be presented and justified.

Exemplary Product Content

Decision criteria may include, e.g., the following:

- Costs arising
- Availability of funds (e.g. on side of the acquirer)
- Availability of personnel and other resources required

- Time delay
- Technical suitability of the proposed solution

3.4.5.2 Decision and Rationale

The decisions regarding the current »Problem/Change Evaluations will be documented and justified. This includes a presentation of the possibilities for initiating and implementing the decision within the course of the project. The effects, e.g., regarding time, budget and resources, will be documented in such a way that they can be integrated into the future planning by the project management.

Exemplary Product Content

This subject may include the following:

- Description of the selected solution
- Rationale for the selection
- Affected system elements/products
- List of the activities and products to be repeated/to be modified
- Notes on the way as to how the change will be migrated into the current system

3.4.6 Change Status List

Process module: Problem and Change Management

Responsible: Change Request Manager (when using process module Problem and Change Management)

Activity: Maintaining Change Status List

Purpose

In accordance with the specifications of the Project Manual, the »Change Status List includes all information required for administering and tracking the received problem reports and change requests, e.g., identification and state of the problem reports and change requests, person in charge of changes and a reference to the »Problem/Change Evaluation and the »Change Decision.

Is generated by

Project Manual, Project Plan (see product dependency 4.13)

Depends on

Project Status Report (see product dependency 5.28)

Change Decision, Problem/Change Evaluation, Problem Report / Change Request, Project Plan (see product dependency 5.29)

3.5 Evaluation

This »Discipline includes all products and activities required for testing documents, system elements and processes. Evaluation specifications define the requirements posed on form and contents of the evaluation object. They shall be prepared, taking into account the specifications of the »QA

Manual. Evaluation procedures include information and specifications for the sequence of tests and evaluation cases for system elements. Evaluation reports document the results of a test and indicate problem areas. They are the basis for »Quality Status Report. The »Qualification Record provides a summary description of all qualifications.

3.5.1 Evaluation Specification Product Configuration

Process module:	Configuration Management
Responsible:	Inspector (when using process module Configuration Management)
Activity:	Preparing Evaluation Specification Product Configuration
Participating:	CM Manager

Purpose

The Evaluation Specification Product Configuration provides the »Inspector with specifications and guideliness for the execution of the evaluation defined by the project progress stage of the corresponding decision gate. In accordance with the subject »Configuration Management - Organization and Directives within the »Project Manual, a specific evaluation specification will be prepared for every product configuration. Examples for evaluation criteria are the integrity and completeness of the »Product Configuration.

Is generated by

Project Plan, QA Manual (see product dependency 4.14)

Depends on

Project Manual (see product dependency 5.19)

3.5.1.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.1.2 Evaluation Criteria

The evaluation criteria describe the evaluation method (e.g., review, inspection and interview), the degree of coverage (e.g., sample evaluation or complete evaluation) and the criteria regarding form and contents of the evaluation (e.g., correctness of contents, compliance with project standards, design, orthography). They also include the conditions for a successful or unseccussful completion of the evaluation.

3.5.2 Evaluation Report Product Configuration

Process module:	Configuration Management
Responsible:	Inspector (when using process module Configuration Management)
Activity:	Evaluating Product Configuration

Purpose

See Product Evaluation Report Usability.

Is generated by

Project Plan, QA Manual (see product dependency 4.14)

3.5.2.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.2.2 Evaluation Results

See Evaluation Results in product Evaluation Report Usability.

3.5.2.3 Analysis of Results and Proposals for Corrective Actions

See Analysis of Results and Proposals for Corrective Actions in product Evaluation Report Usability.

3.5.3 Evaluation Specification Document

Process module:	Quality Assurance
Responsible:	Inspector (when using process module Quality Assurance)
Activity:	Preparing Evaluation Specification Document

Purpose

An evaluation specification provides the »Inspector with specifications and instructions for conducting the test. In accordance with the specifications of the »QA Manual, a specific evaluation specification will normally be prepared for every product version and every process model to be tested. Thus, a specific evaluation specification will be prepared for every test.

Is generated by

Project Manual (see product dependency 4.10)

Project Plan, QA Manual (see product dependency 4.14)

Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 4.32)

Depends on

Evaluation Report Delivery, Evaluation Specification Delivery, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Process, Evaluation Report System Element, Evaluation Specification System Element (see product dependency 5.35)

Example Work Products

»WiBe:Prüfspezifikation für Requirements Specification

3.5.3.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.3.2 Evaluation Criteria

See Evaluation Criteria in product Evaluation Specification Product Configuration.

3.5.4 Evaluation Report Document

Process module:	Quality Assurance
Responsible:	Inspector (when using process module Quality Assurance)
Activity:	Evaluating Document

Purpose

See Product Evaluation Report Usability.

Is generated by

Project Manual (see product dependency 4.10)

Project Plan, QA Manual (see product dependency 4.14)

Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 4.32)

Depends on

Evaluation Report Delivery, Evaluation Report Process, Quality Status Report, Evaluation Report System Element (see product dependency 5.34)

Evaluation Report Delivery, Evaluation Specification Delivery, Evaluation Report Process, Evaluation Specification Document, Evaluation Specification Process, Evaluation Report System Element, Evaluation Specification System Element (see product dependency 5.35)

Example Work Products

»WiBe:Prüfprotokoll für Requirements Specification

3.5.4.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.4.2 Evaluation Results

See Evaluation Results in product Evaluation Report Usability.

3.5.4.3 Analysis of Results and Proposals for Corrective Actions

See Analysis of Results and Proposals for Corrective Actions in product Evaluation Report Usability.

3.5.5 Evaluation Specification Process

Process module: Quality Assurance

Responsible: Inspector (when using process module Quality Assurance)

Activity: Preparing Evaluation Specification Process

Purpose

See Product Evaluation Specification Document.

Is generated by

Project Plan, QA Manual (see product dependency 4.14)

Depends on

Evaluation Report Delivery, Evaluation Specification Delivery, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Document, Evaluation Report System Element, Evaluation Specification System Element (see product dependency 5.35)

3.5.5.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.5.2 Evaluation Criteria

See Evaluation Criteria in product Evaluation Specification Product Configuration.

3.5.6 Evaluation Report Process

Process module: Quality Assurance

Responsible: Inspector (when using process module Quality Assurance)

Activity: Evaluating Process

Purpose

See Product Evaluation Report Usability.

Is generated by

Project Plan, QA Manual (see product dependency 4.14)

Depends on

Evaluation Report Delivery, Evaluation Report Document, Quality Status Report, Evaluation Report System Element (see product dependency 5.34)

Evaluation Report Delivery, Evaluation Specification Delivery, Evaluation Report Document, Evaluation Specification Document, Evaluation Specification Process, Evaluation Report System Element, Evaluation Specification System Element (see product dependency 5.35)

3.5.6.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.6.2 Evaluation Results

See Evaluation Results in product Evaluation Report Usability.

3.5.6.3 Analysis of Results and Proposals for Corrective Actions

See Analysis of Results and Proposals for Corrective Actions in product Evaluation Report Usability.

3.5.7 Evaluation Specification Usability

Process module:	Usability and Ergonomics
Responsible:	Inspector (when using process module Usability and Ergonomics)
Activity:	Preparing Evaluation Specification Usability
Participating:	Ergonomics Manager

Purpose

The evaluation specification provides the »Inspector with specifications and instructions for conducting the test. It defines evaluation cases (and test cases as special form of evaluation cases) and the evaluation environment and allocates the evaluation cases to the requirements. A coverage matrix may be used to allocate the requirements to evaluation cases. In addition, the specification will describe protective measures to be observed during the test.

The evaluation specification is based on the corresponding implementation, integration and evaluation concept.

The evaluation specification shall enable the inspector to decide whether the test was successful or not.

Is generated by

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

Overall System Specification (see product dependency 4.26)

Overall System Specification (see product dependency 4.25)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

3.5.7.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.7.2 Evaluation Strategy

The evaluation strategy describes how the requirements posed on the evaluation object can be tested in the necessary and required test depth by a suitable evaluation case structure. It specifies the test methods - e.g. functional test and stress test - and verification methods, e.g. test, verification and demonstrator.

The evaluation strategy to be applied is derived from the corresponding implementation, integration and evaluation concept and will be refined as required.

3.5.7.3 Evaluation Cases

Based on the evaluation strategy concept, this subject describes the individual evaluation cases including the required information, e.g., start state of the system, evaluation sequence and expected end state of the system.

The degree of coverage of the evaluation cases and the end criteria shall be considered particularly. The degree of coverage specifies how detailed the evaluation should be. The end criteria state conditions for the successful completion of the evaluation.

3.5.7.4 Protective Measures

For every evaluation object with an inherent test hazard potential, which prevents a normal test, this subject describes which precautions and measures must be taken in order to exclude any danger during the test.

3.5.7.5 Evaluation Environment

The general evaluation environment has already been described in the corresponding implementation, integration and evaluation concepts. This subject describes the necessary shaping and extension of the general evaluation environment or special evaluation environments required for the actual evaluation object, e.g., a turntable with real-time image simulation for a missile or a car test route with an appropriate test track.

3.5.7.6 Allocation of Evaluation Cases

The evaluation cases derived from the requirements are allocated to the requirements. This can be achived by using a coverage matrix. This subject is intended to demonstrate whether the desired degree of coverage and evaluation quality are ensured, particularly with respect to the previously specified evaluation strategy.

3.5.8 Evaluation Report Usability

Process module:	Usability and Ergonomics
Responsible:	Inspector (when using process module Usability and Ergonomics)
Activity:	Evaluating Usability
Participating:	Ergonomics Manager

Purpose

The evaluation report includes the »Inspector 's recordings on the course of the test, the comparison between actual and planned results, the analysis of the identfied planned/actual deviations, and the appropriate suggested solutions. It should be ensured that the evaluation result is replicable.

Number and frequency of tests - and thus of the corresponding evaluation reports - depend on the specifications in the »QA Manual and the applicable implementation, integration and evaluation concepts.

Is generated by

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

Overall System Specification (see product dependency 4.26)

Overall System Specification (see product dependency 4.25)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

3.5.8.1 Evaluation Object

This subject specifies an unambiguously defined identifiable version of the evaluation object to which the evaluation specification or the evaluation report will be referred.

3.5.8.2 Evaluation Results

The results of the »Requirements Evaluation includes particularly the overall evaluation of user requirements, which evaluates inhowfar it is possible to fulfill specified restrictions, posed either by the budget or the schedule or the available resources, or if these restrictions will be exceeded. In addition all user requirements recorded will be reviewed, and their classification will be evaluated: The user requirements postponed and the rationale for their postponement will be reviewed (e.g. can the necessity not be demonstrated). The modified user requirements and the rationale for the modification will be reviewed (e.g. by the more economical use of off-the-shelf products). The necessity of additional user requirements will be reviewed (e.g. have important non-functional user requirements not been recorded). The evaluation results also include the results of the consideration of economic efficiency of user requirements, e.g., cost-benefit analyses, the identification of cost-driving user requirements and the affordability of user requirements.

3.5.8.3 Analysis of Results and Proposals for Corrective Actions

The analysis of results analyzes contents and cause of the observed deviations between actual results and planned results. If it is possible to identify the cause, any suggested correction which is recognizable should be documented as well. If the evaluation results show a certain tendency regarding the occurrence of similar deficiencies, this should be documented, and appropriate measures should be suggested. These data will be integrated into the »Quality Status Report.

In accordance with the specifications of the Project Manual, an evaluation result or suggested correction could lead to a problem report or change request.

3.5.9 Evaluation Specification System Element

Process module: System Development

Responsible: Inspector (when using process module System Development)

Activity: Preparing Evaluation Specification System Element

Participating: System Integrator, Hardware Architect, System Architect, Software Architect

Purpose

See Product Evaluation Specification Usability.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

Project Manual (see product dependency 4.10)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

Overall System Specification (see product dependency 4.25)

Overall System Specification (see product dependency 4.26)

Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 4.32)

Depends on

QA Manual (see product dependency 5.16)

Qualification Record, Evaluation Report System Element (see product dependency 5.41)

Evaluation Report Delivery, Evaluation Specification Delivery, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Document, Evaluation Specification Process, Evaluation Report System Element (see product dependency 5.35)

3.5.9.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.9.2 Evaluation Strategy

See Evaluation Strategy in product Evaluation Specification Usability.

3.5.9.3 Evaluation Cases

See Evaluation Cases in product Evaluation Specification Usability.

3.5.9.4 Protective Measures

See Protective Measures in product Evaluation Specification Usability.

3.5.9.5 Evaluation Environment

See Evaluation Environment in product Evaluation Specification Usability.

3.5.9.6 Allocation of Evaluation Cases

See Allocation of Evaluation Cases in product Evaluation Specification Usability.

3.5.10 Evaluation Procedure System Element

Process module:	System Development
Responsible:	Inspector (when using process module System Development)
Activity:	Realizing Evaluation Procedure System Element
Participating:	System Integrator

Purpose

The »Evaluation Procedure System Element is a regression-capable description of the execution of evaluation cases in accordance with the evaluation specification. It is a working instruction which includes accurate instructions for each evaluation case and defines individual test steps.

It may be a script which is elaborated manually or a machine-processable run chart which is executed automatically by an evaluation environment.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

Overall System Specification (see product dependency 4.25)

Overall System Specification (see product dependency 4.26)

Depends on

Evaluation Report System Element (see product dependency 5.40)

3.5.11 Evaluation Report System Element

Process module:	System Development
Responsible:	Inspector (when using process module System Development)
Activity:	Evaluating System Element
Participating:	Software Developer, Hardware Developer, System Integrator

Purpose

See Product Evaluation Report Usability.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

Project Manual (see product dependency 4.10)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

Overall System Specification (see product dependency 4.25)

Overall System Specification (see product dependency 4.26)

Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 4.32)

Depends on

Evaluation Procedure System Element (see product dependency 5.40)

Qualification Record, Evaluation Specification System Element (see product dependency 5.41)

Evaluation Report Delivery, Evaluation Report Document, Evaluation Report Process, Quality Status Report, (see product dependency 5.34)

Evaluation Report Delivery, Evaluation Specification Delivery, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Document, Evaluation Specification Process, Evaluation Specification System Element (see product dependency 5.35)

3.5.11.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.11.2 Evaluation Results

See Evaluation Results in product Evaluation Report Usability.

3.5.11.3 Analysis of Results and Proposals for Corrective Actions

See Analysis of Results and Proposals for Corrective Actions in product Evaluation Report Usability.

3.5.12 Evaluation Specification Delivery

Process module: Delivery and Acceptance (Acquirer)

Responsible: Inspector (when using process module Delivery and Acceptance (Acquirer))

Activity: Preparing Evaluation Specification Delivery

Purpose

Every »Delivery must be subjected to an acceptance test. This test is based on the »Evaluation Specification Delivery, which defines all evaluation cases required for acceptance and - if the delivery includes also documents - the required evaluation criteria.

It comprises the entry control specification including verification of the desired configuration. The desired configuration will either be specified by the acquirer or included in the delivery, e.g. in the release notes. In addition, the »Evaluation Specification Delivery includes all evaluation cases required for the acceptance test and the evaluation environment. It will be prepared based on the requirements specified in the »Contract and the contract addenda - and only on these requirements. It must be documented - e.g. by a coverage matrix - that the delivery requirements are covered by the evaluation cases and evaluation criteria.

Is generated by

Project Manual (see product dependency 4.9)

Contract, Contract Addendum (see product dependency 4.30)

Depends on

Evaluation Report Delivery, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Document, Evaluation Specification Process, Evaluation Report System Element, Evaluation Specification System Element (see product dependency 5.35)

3.5.12.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.12.2 Evaluation Strategy

See Evaluation Strategy in product Evaluation Specification Usability.

3.5.12.3 Evaluation Cases

See Evaluation Cases in product Evaluation Specification Usability.

3.5.12.4 Evaluation Criteria

See Evaluation Criteria in product Evaluation Specification Product Configuration.

3.5.12.5 Evaluation Environment

See Evaluation Environment in product Evaluation Specification Usability.

3.5.12.6 Allocation of Evaluation Cases

See Allocation of Evaluation Cases in product Evaluation Specification Usability.

3.5.12.7 Protective Measures

See Protective Measures in product Evaluation Specification Usability.

3.5.13 Evaluation Report Delivery

Process module: Delivery and Acceptance (Acquirer)

Responsible: Inspector (when using process module Delivery and Acceptance (Acquirer))

Activity: Evaluating Delivery

Participating: User, System Integrator

Purpose

See Product Evaluation Report Usability.

Is generated by

Project Manual (see product dependency 4.9)

Contract, Contract Addendum (see product dependency 4.30)

Depends on

Evaluation Specification Delivery, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Document, Evaluation Specification Process, Evaluation Report System Element, Evaluation Specification System Element (see product dependency 5.35)

, Evaluation Report Document, Evaluation Report Process, Quality Status Report, Evaluation Report System Element (see product dependency 5.34)

3.5.13.1 Evaluation Object

See Evaluation Object in product Evaluation Report Usability.

3.5.13.2 Evaluation Results

See Evaluation Results in product Evaluation Report Usability.

3.5.13.3 Analysis of Results and Proposals for Corrective Actions

See Analysis of Results and Proposals for Corrective Actions in product Evaluation Report Usability.

3.5.14 Qualification Record

Process module:	Quality Assurance
Responsible:	QA Manager (when using process module Quality Assurance)
Activity:	Keeping Qualification Record

Purpose

The »Qualification Record lists all qualifications to be made in the course of the project. It states how and that the qualifications were made.

Qualifications of this type include, but are not limited to, the following: system tests in accordance with a standard type, e.g., »DIN, »VDE and ES, qualifications of testing activities, e.g., TÜV and DEKRA, and qualifications of authorizing agencies, e.g., Federal Office of Civil Aeronautics and Federal Office for Motor Traffic. The qualification record will be prepared and updated in accordance with the specifications of the »QA Manual.

Is generated by

Project Plan, QA Manual (see product dependency 4.14)

Depends on

Evaluation Report System Element, Evaluation Specification System Element (see product dependency 5.41)

3.5.14.1 Necessity and Allocation of Qualifications

In this subject, the necessary qualifications are derived from the requirements. The qualifications to be made will be allocated to the qualifications in the »Qualification Record as far as possible.

3.5.14.2 Listing of Qualifications

This subject lists the qualifications made including the necessary information like identification, qualification method, qualification provider and deviations.

Exemplary Product Content

The following information may be compiled for every qualification required in the survey:

- Number of qualification
- Number and name of requirement (this information is used for tracking the requirements which change in the course of time and provides easy references to derived requirements)
- Reference document and section number of requirement (this information is used for finding the requirement in the reference document)
- Identification as to whether the requirement was made by the acquirer, the supplier or both

parties
- Qualification method (e.g. test, analysis, review, simulation, demonstration, inspection)
- Reference to qualification made (evaluation specification, protocol)
- Date of qualification/protocol
- If required: deviations from the required qualification, indicating the reason for the deviation

3.6 Acquisition and Contracting

This »Discipline summarizes all products and activities prepared during the request for proposal and contracting procedure. For the request for proposal, the following products must be prepared: »RFP Concept, »Request for Proposal, »Criteria Catalog for Assessment of Offers and »Offer Assessment. For contracting, the following products are necessary: »Contract and »Contract Addendum. The »Evaluation Specification Delivery, »Evaluation Report Delivery and »Statement of Acceptance are required for the acceptance. Finally, this discipline includes some »Interface Products, which will be prepared by the contracter and provided to the acquirer, e.g., »Offer (Supplier), »Delivery (Supplier), »Project Status Report (Supplier) and »Final Project Report (Supplier).

3.6.1 RFP Concept

Process module: Drafting and Conclusion of Contract (Acquirer)

Responsible: RFP-Manager (when using process module Drafting and Conclusion of Contract (Acquirer))

Activity: Determining RFP Concept

Participating: Purchaser, Controller

Purpose

Requests for proposals of public purchasers are subject to specific regulations, like »VgV, »GWB, »VOL, »VOF , »VOB, »UfAB III and »WiBe 21. These define when which form of contract award must be selected and which time plan is applied. The »RFP Concept specifies a legally correct and reasonable procedure for the request for proposal.

Under certain circumstances, also private purchasers may be regarded as public purchasers in accordance with the EU provisions on the award of public contracts (compare GWB, particularly § 98, and the VgV).

If a private user invites »Offers without conducting an request for proposal, this product may be deleted. In this case, the »Request for Proposal corresponds to a request for an offer and is not subject to any legally prescribed regimentations.

Is generated by

Project Manual, Make-or-Buy Decision (see product dependency 4.29)

3.6.1.1 Overview and Evaluation of Alternatives

There are several possibilities for conducting an »Request for Proposal. This subject lists the possibilities permitted by contract award law. Based on prespecified criteria, e.g., contract volume and type of contract, the applicability of the award procedures will be assessed, and the results will be documented.

3.6.1.2 Selection of a RFP Concept

In this subject, the results from the »Overview and Evaluation of Alternatives are summarized, and an RFP concept will be selected. The selection shall be justified and documented.

3.6.1.3 Request for Proposal - Organization and Guidelines

In this subject, the »Request for Proposal will be planned in detail in accordance with the selected RFP Concept. The central key figures, e.g. deadlines, blocking periods, and required documents, must be concretized and planned appropriately. In the public sector, the sequence is normally specified by the selected »RFP Concept. However, also private users must specify the sequence accurately in this subject.

3.6.1.4 Distribution List

This subject specifies the distribution of the »Request for Proposal. Depending on the RFP procedure, the request for proposal may be distributed by a participation application, which shall be documented here, the applicable publication channels or a list of potential suppliers. Data from the supplier database of the »Purchaser should be taken into account when the distribution list is prepared.

In case of a public request for proposal (national procedure) or an advertising for tender (EU-wide procedure), this listing of potential suppliers may be deleted.

3.6.2 Request for Proposal

Process module: Drafting and Conclusion of Contract (Acquirer)

Responsible: RFP-Manager (when using process module Drafting and Conclusion of Contract (Acquirer))

Activity: Preparing Request for Proposal

Participating: Project Leader, Purchaser, Requirements Engineer (Acquirer), Controller, Executive

Purpose

The »Request for Proposal includes all information required by the bidder for »Submitting an Offer. The request for proposal is intended to invite potential bidders to submit an »Offer. Public purchasers shall observe the applicable regulations for the preparation of RFP specifications, e.g., »VgV , »GWB, »VOL, »VOF, »VOB, »UfAB III and »WiBe 21, when preparing an request for proposal. If a private purchaser, who will only award one contract, wants to invite offers without without conducting an request for proposal, this »Request for Proposal corresponds to a request for an offer and is not subject to any legally prescribed regimentations.

Is generated by

Project Manual, Make-or-Buy Decision (see product dependency 4.29)

Depends on

Project Manual (see product dependency 5.48)

QA Manual (see product dependency 5.49)

Requirements Specification, Contract, Contract Addendum (see product dependency 5.50)

External Hardware Module Specification, External Software Module Specification, External Unit Specification, Contract, Contract Addendum (see product dependency 5.53)

Project Manual, QA Manual (see product dependency 5.55)

3.6.2.1 General Remarks on the Request for Proposal

The general remarks on the »Request for Proposal include all information to be provided to the bidder about organization and contract award law, e.g. pencil draft of »Contract, »Criteria Catalog for Assessment of Offers, contract award criteria, assessment methods, and time frame.

3.6.2.2 Annex 1: Requirements Regarding the (Sub-)System

See Annex 1: Requirements Regarding (Sub-)System in product Contract.

3.6.2.3 Annex 2: Directives for the Project Manual (Supplier)

In this annex the acquirer lists mandatory specifications for the Project Manual of the supplier, e.g., tailoring specifications and risk management specifications. The guideline for this annex is included in the Project Manual of the acquirer in the subject »Directives for the Project Manual of the Supplier. This specification will be adopted. Any required changes shall be made in the Project Manual of the Acquirer.

3.6.2.4 Annex 3: Directives for the QA Manual (Supplier)

In this annex the acquirer lists mandatory specifications for the »QA Manual of the supplier, e.g., quality assurance measures to be conducted and standards to be used. The guideline for this annex is included in the Project Manual of the acquirer in the subject »Directives for the QA Manual of the Supplier. This specification will be adopted. Any required changes shall be made in the QA Manual of the Acquirer.

3.6.3 Criteria Catalog for Assessment of Offers

Process module:	Drafting and Conclusion of Contract (Acquirer)
Responsible:	RFP-Manager (when using process module Drafting and Conclusion of Contract (Acquirer))
Activity:	Peparing Criteria Catalog for Assessment of Offers
Participating:	Project Leader, Requirements Engineer (Acquirer), Controller, Executive, Purchaser

Purpose

The offers must be assessed in order to select the best »Offer. The »Criteria Catalog for Assessment of Offers lists the required criteria which may also include exclusion criteria. These criteria and the corresponding weighting factors must be specified by public purchasers before the »Request for Proposal is published. During the »Offer Assessment, the previously defined criteria shall only be applied and must not be changed. Private purchasers have more freedom in this respect; they may incorporate the information collected during the evaluation of offers into the assessment process.

Is generated by

Project Manual, Make-or-Buy Decision (see product dependency 4.29)

3.6.4 Offer (Supplier)

Process module: Drafting and Conclusion of Contract (Acquirer)

Responsible: Purchaser (when using process module Drafting and Conclusion of Contract (Acquirer))

Work Product Attributes: external

Source Work Product: Offer

Purpose

The »Offer (Supplier) is a copy of the supplier's »Offer in the project of the acquirer. The received »Offers will be assessed by the acquirer in the »Offer Assessment.

Depends on

Offer Assessment (see product dependency 5.52)

3.6.4.1 General Clauses and Conditions

See General Clauses and Conditions in product Offer.

3.6.4.2 Offer - Legal and Commercial Clauses and Conditions

See Offer - Legal and Commercial Clauses and Conditions in product Offer.

3.6.4.3 Annex 1: Specification of Services

See Annex 1: Specification of Services in product Offer.

3.6.4.4 Annex 2: Offer-Relevant Parts of the Project Manual (Supplier)

See Annex 2: Offer-Relevant Parts of the Project Manual (Supplier) in product Offer.

3.6.4.5 Annex 3: Offer-Relevant Parts of the QA Manual (Supplier)

See Annex 3: Offer-Relevant Parts of the QA Manual (Supplier) in product Offer.

3.6.5 Offer Assessment

Process module: Drafting and Conclusion of Contract (Acquirer)

Responsible: RFP-Manager (when using process module Drafting and Conclusion of Contract (Acquirer))

Activity: Assessing and Selecting Offers

Participating: Purchaser, Project Leader, Requirements Engineer (Acquirer), Controller, Executive

Purpose

The »Offer Assessment is the basis for the selection of a supplier. It includes a list of all »Offers received. The result of the offer assessment is the selection of a provider to whom the contract will be awarded. It is based on the assessment of offers which will document the evaluation of all offers in accordance with the »Criteria Catalog for Assessment of Offers.

Since there are numerous different contract award procedures, we have decided not to consider specific aspects of individual procedures.

Is generated by

Project Manual, Make-or-Buy Decision (see product dependency 4.29)

Depends on

Offer (Supplier) (see product dependency 5.52)

3.6.5.1 Offers Received

Together with the appropriate bidder, the »Offers received will be listed in tabular form. In addition, the table may comprise a column for every evaluation level, which will include the result of the assessment.

3.6.5.2 Assessment of Offers

The »Offers will be assessed in stages. For each offer, it must be clear which assessment result was achieved at every stage. If an offer is eliminated, it must also be clear at which stage it was eliminated.

The »Criteria Catalog for Assessment of Offers with the corresponding assessment matrix may be regarded as evaluation specification, and the subject Assessment of Offers may be regarded as the corresponding evaluation report.

3.6.5.3 Acceptance of an Offer

This subject is intended to document the contract award decision. The reasons for the contract award decision and the reason for the elimination of the other offers must be justified and documented in detail.

3.6.6 Contract

Process module: Drafting and Conclusion of Contract (Acquirer)

Responsible: Executive (when using process module Drafting and Conclusion of Contract (Acquirer))

Activity: Awarding Contract (Acquirer)

Participating: Project Leader, Purchaser, Controller, Requirements Engineer (Acquirer)

Purpose

The »Contract is the legal basis for the performance of services on the side of acquirer and supplier and regulates their cooperation. For public acquirers, there are prespecified contract terms, e.g., »EVB-IT and »BVB, which must be used and developed as required. In case of a public »Request for Proposal, is is sufficient to use the request for proposal and the selected »Offer as contract.

Is generated by

Project Manual, Make-or-Buy Decision (see product dependency 4.29)

Generates

Statement of Acceptance, Evaluation Report Delivery, Evaluation Specification Delivery (see product dependency 4.30)

Depends on

Requirements Specification, Request for Proposal, Contract Addendum (see product dependency 5.50)

External Hardware Module Specification, External Software Module Specification, External Unit Specification, Request for Proposal, Contract Addendum (see product dependency 5.53)

Project Plan (see product dependency 5.54)

3.6.6.1 Contract - Legal and Commercial Clauses and Conditions

The legal and commercial contract portion includes the legal conditions, e.g., general terms and conditions of business or - in case of a public acquirer - regulations as »EVB-IT, »BVB and »VOL, terms of guarantee and warranty, licensing agreements, provisions for the passing of ownership, warnings, cautions and notes, regulations in accordance with the law supervising prices and place of jurisdiction.

In addition, this contract portion includes commercial provisions, e.g., specifications on the type and level of prices, terms and dates of payment, and a price calculation.

3.6.6.2 Annex 1: Requirements Regarding (Sub-)System

This annex includes the requirements regarding the (sub-)system to be developed and the acceptance criteria. If the contract for the overall system is to be awarded, the »Annex includes the »Requirements Specification; if a subcontract is to be awarded, the annex comprises the »External Unit Specification, the External Hardware Module Specification or the External Software Module Specification.

3.6.6.3 Annex 2: Contract-Relevant Parts of the Project Manual (Supplier)

The supplier contributes parts of his Project Manual to the »Contract. These parts shall include at least the implementation of the specifications in accordance with »Annex 2: Directives for the Project Manual (Supplier), which were required of the supplier in the »Request for Proposal.

3.6.6.4 Annex 3: Contract-Relevant Parts of the QA Manual (Supplier)

The supplier contributes parts of his »QA Manual to the »Contract. These parts shall include at least the implementation of the specifications in accordance with »Annex 3: Directives for the QA Manual (Supplier), which were required of the supplier in the »Request for Proposal.

3.6.7 Contract Addendum

Process module:	Drafting and Conclusion of Contract (Acquirer)
Responsible:	Executive (when using process module Drafting and Conclusion of Contract (Acquirer))
Activity:	Awarding Contract Addendum (Acquirer)
Participating:	Project Leader, Purchaser, Controller

Purpose

A »Contract Addendum is a contractually agreed change of the »Contract, e.g., regarding scope of work, costs, deadlines. Contract addenda may be initiated by the supplier and the acquirer, e.g., by using the »Problem and Change Management.

Is generated by

Change Decision (see product dependency 4.28)

Generates

Statement of Acceptance, Evaluation Report Delivery, Evaluation Specification Delivery (see product dependency 4.30)

Depends on

Requirements Specification, Request for Proposal, Contract (see product dependency 5.50)

External Hardware Module Specification, External Software Module Specification, External Unit Specification, Request for Proposal, Contract (see product dependency 5.53)

3.6.8 Delivery (Supplier)

Process module: Drafting and Conclusion of Contract (Acquirer)

Responsible: Project Leader (when using process module Drafting and Conclusion of Contract (Acquirer))

Work Product Attributes: external

Source Work Product: Delivery

Purpose

The »Delivery (Supplier) is the physical »Delivery or partial delivery shipped by the supplier to the acquirer's project. Scope and number of (partial) deliveries are specified in the »Contract. Unless agreed otherwise, the acquirer shall prepare an »Statement of Acceptance for every delivery (supplier).

3.6.9 Statement of Acceptance

Process module: Delivery and Acceptance (Acquirer)

Responsible: Executive (when using process module Delivery and Acceptance (Acquirer))

Activity: Issuing Statement of Acceptance (Acquirer)

Participating: Purchaser, Project Leader, QA Manager, RFP-Manager

Purpose

In the »Statement of Acceptance, the acquirer states his acceptance or rejection of the (partial) »Delivery (supplier). If a delivery requires an acceptance in accordance with the »Contract, the supplier has a right to be issued a statement of acceptance. The statement of acceptance may entail legal consequences, e.g., agreed payments may become due.

If the acceptance is rejected, the supplier is obliged to prove that the delivery item is in conformity with the contract, or he must remove the determined defect within a specified period. The rejection of acceptance may entail considerable consequences for both parties, e.g., contractual penalties.

Is generated by

Project Manual (see product dependency 4.9)

Contract, Contract Addendum (see product dependency 4.30)

3.6.9.1 Evaluation of Delivery

Type and scope of the delivery item shall be described. The results of the acceptance test will be summarized and evaluated. Based on the evaluation results, it shall be decided whether the acceptance is granted, granted with reservations or rejected. If the acceptance is granted with reservations, the list of defects including the time limit for their removal will also be documented here.

3.6.9.2 Annex: Evaluation Report Delivery

The »Annex includes a copy of the »Evaluation Report Delivery, which is intended to document the test to the supplier.

3.7 Requirements and Analyses

The »Discipline Requirements and Analyses comprises all »Work Products and »Activityies which specifiy the user requirements based on a project proposal (prestudy) and the contract.

In addition, this discipline includes analyses of specific system aspects, e.g., a »Legacy System Analysis as basis for the migration of a system, a market survey for the use of off-the-shelf products, or an »User Tasks Analysis for describing ergonomic aspects. The documentation of the contract award decision (make-or-buy) for a system element and the market survey as basis for decision-making are also included in this discipline.

3.7.1 Proposal for the Introduction and Maintenance of an Organization-Specific Process Model

Process module: Introduction and Maintenance of an Organization-Specific Process Model

Responsible: Executive (when using process module Introduction and Maintenance of an Organization-Specific Process Model)

Work Product Attributes: external, initial

Purpose

This product provides the management with a basis for making a decision on the approval of a project within the scope of a »Project Progress Decision (project order). It is not prepared within the framework of the V-Modell.

The product is intended to provide a systematic presentation of the information and data which show that the execution of a project for introducing and maintaining an organization-specific process model is necessary, profitable and useful.

Based on a project idea, the acquirer systematically describes the necessity of a project, taking into account feasibility, affordability, market and economic criteria.

Depends on

Project Manual, Project Plan (see product dependency 5.8)

Project Progress Decision (see product dependency 5.9)

Assessment of a Process Model, Process Model Improvement Concept (see product dependency 5.11)

3.7.1.1 Initial Situation

The initial situation presents the assessment of the actual process situation of an organizational unit or the entire organization of an agency or company. Thus, a need for action, which may lead to a project idea, becomes recognizable.

The demonstration of capability gaps (i.e. the difference between the necessary planned capabilities and the actually existing capabilities) in a company or agency may clearly show an urgent need for action in order to increase the efficiency or reduce costs. This need for action is presented as project idea, leading frequently to a concrete project proposal.

3.7.1.2 General Conditions and Constraints

This subject describes the framework conditions to be observed by all stakeholders during the implementation of the project idea. Framework conditions, e.g., budget situation, existing know-how, legal provisions, co-operations, commitment to partners and deadlines, may be turned into specifications for project execution.

Technical framework conditions, e.g., applicable standards and regulations, shall also be taken into account.

3.7.1.3 Project Objectives, Opportunities and Risks

Project objectives and the resulting chances and risks of the new project are described on a high abstraction level. Project objectives may include, e.g., the introduction of new processes, the improvement of the process or product quality, the development of a joint communication basis within the organization, the implementation of standards or the achievement of a certain process maturity level.

3.7.1.4 Planning

The planning describes the organizational and commercial project execution aspects. The project organization, e.g., matrix organization and steering committees, and the responsibilities for the decision-making processes within the project will be specified.

The »Project Leader will be appointed, his tasks will be defined. Available resources, funds and specialist personnel will be determined. Start and end date for the project will be specified. The planning may be based on the statements developed in the project objectives, which make additional statements on feasibility, funding and schedule.

3.7.1.5 Economic Efficiency

The subject Economic Efficiency includes parameters which indicate the profitability of the new project. At an early stage, the »Estimations are still rather uncertain. The profitability can be indicated by parameters like return on investment, increases in efficiency or cost savings by early fault detection.

3.7.2 Project Proposal

Process module: Specification of Requirements

Responsible: Executive (when using process module Specification of Requirements)

Work Product Attributes: external, initial

Purpose

The management bases the decision to approve a project within the scope of a »Project Progress Decision of the »Decision Gate »Project Approved on the project proposal, which is not prepared within the framework of the V-Modell.

The project proposal is intended to systematically present information and data which show that the execution of a project is necessary, profitable and useful.

Based on a project or system idea, the acquirer systematically describes the necessity of a project based on feasibility, affordability, market, and economic efficiency criteria.

The project proposal processes subjects like the initial situation, existing framework conditions, project objectives and system concepts, chances and risks, and the economic efficiency.

Generates

Market Survey for Off-the-Shelf Products (see product dependency 4.3)

Depends on

Project Manual, Project Plan (see product dependency 5.1)

Project Progress Decision (see product dependency 5.3)

Requirements Specification, Requirements Specification Overall Project (see product dependency 5.4)

Requirements Specification, Requirements Specification Overall Project (see product dependency 5.27)

3.7.2.1 Initial Situation

The initial situation presents the assessment of the actual situation of an organizational unit or the entire organization of an agency or company. Thus a need for action, which may lead to a product or system vision, is recognizable. The vision may be developed into a project idea. The need for action may be initiated by several project or system ideas.

The demonstration of capability gaps (i.e. the difference between the necessary planned capabilities and the actually existing capabilities) in a company or agency may clearly show an urgent need for action in order to increase the efficiency or reduce costs. This need for action is presented as product or system idea, leading frequently to a concrete project proposal. Corresponsingly, the determination of the requirement to renew or improve a "technically obsolete" system (so-called "system regeneration") or the recognition of market chances for a new product or system may lead to a project idea. The applicable data must be developed for the project proposal.

Research programs or studies may also be the basis for project ideas; they will be concretized in a project proposal.

Exemplary Product Content

In the subject Initial Situation, e.g., the following information and data of the organizational unit to be examined will be described with a view to the project idea:

- The actual capabilities of the organization (what can we do?)
- The planned capabilities of the organization (what do we want to be able to do?)
- A planned/actual comparison (where are the deficiencies?)
- A capability comparison based on prespecified criteria
- An outline of the project idea

3.7.2.2 General Conditions and Constraints

This subject describes the framework conditions to be observed by all stakeholders when the project idea is implemented into concrete measures for realizing the system. Framework conditions, e.g., budget situation, existing know-how, legal provisions, cooperations, commitment to partners and deadlines, may be turned into specifications for project execution.

Technical framework conditions, e.g., development environments and platforms, IT infrastructure, applicable standards and regulations, or specifications of off-the-shelf products, lead to additional (non-functional) requirements for system development.

3.7.2.3 Project Objectives and System Concepts

In the Subject Project Objectives and System Concepts, the acquirer describes his vision of a new project or system on a high abstraction level. Project objectives and system concepts may concern several aspects, e.g., the introduction of innovations, the definition of objectives (quality, deadline and cost objectives), the operation of the system in its operating environment and the use of new, improved functionalities.

3.7.2.4 Opportunities and Risks

The Subject Opportunities and Risks comprises data which are normally prepared in industrial business plans. Frequently, an anonymous market with potential acquirers, which could be interested in the new product or system idea, will be analyzed at first. Therefore, the contents of this subject is characterized by a certain uncertainty or fuzziness. The subjects examines the chances of achieving profit on the market with a specific product or system. In addition to the chances, the risks of failing on the market or sustaining losses with a product or system should be analyzed.

Exemplary Product Content

Chances on the market include, but are not limited to, the following:

- the acquirer structure is homogeneous (i.e., the product or system needs only a few variants), the segmentation of the market is small,
- competitors do not have a comparable product,
- the market development is positive,
- the entrance into the market and opening up of new markets are easy,
- the company is holding a relatively dominant position on the market.

Product introduction risks include, but are not limited to, the following:

- the funding of the project is not ensured until market maturity is reached,
- the achievable prices are to low due to strong competition,

- the expected acquirer acceptance is small,
- there are well-established competitive products,
- the development of the product or system may lead to technical problems.

3.7.2.5 Planning

The planning specifies the organizational and commercial project execution and system development aspects. The project organization, e.g., matrix organization and steering committees, and the responsibilities for the decision-making processes within project will be specified.

The »Project Leader will be appointed, his tasks will be defined. Available resources, funds and specialist personnel will be determined. Start and end date for the project will be specified. The planning can be based on the statements developed in the subject Project Objectives and System Concepts, which makes additional statements on feasibility, funding and schedules.

3.7.2.6 Economic Efficiency

The Subject Economic Effiency includes figures which indicate the profitability of the new project or system. At an early stage, the »Estimations are still rather uncertain. The profitability can be indicated by parameters like capital value, return on investment, sales estimates, cost savings or increase in efficiency.

3.7.3 Requirements Specification Overall Project

Process module: Management of Multiple Projects

Responsible: Requirements Engineer (Acquirer) (when using process module Management of Multiple Projects)

Activity: Determining Requirements Overall Project

Participating: User, Executive, Project Leader, Data Protection Manager, Security Manager, Safety Manager

Work Product Attributes: initial

Purpose

The Product Requirements Specification Overall Project includes all mandatory requirements posed on the system to be developed, which describe the overall project in a complete and consistent manner. It is basis for the subdivision into sub-projects.

All relevant system requirements will be determined and documented by the supplier. The core of the Requirements Specification Overall Project comprises the functional and non-functional system requirements and an outline of the overall system design. The design considers the future environment and infrastructure for the system and provides guidelines for technological decisions. The outline of the overall system architecture is the decisive basis for subdividing the overall project into sub-projects.

In addition, the system life cycle phases to be supported will be identified and incorporated as logistic requirements. The delivery terms and acceptance criteria are also part of the requirements.

The functional and non-functional requirements are not only intended as development specifications, but also as basis for the tracing of requirements and the change management. The requirements should be prepared in such a way that traceability and a suitable change management are possible for the entire system life cycle.

The acquirer alone is responsible for the preparation and quality of the Requirements Specification. If required, he may task a third party with the preparation. Generally, the Requirements Specification should not specify technical solutions in order to ensure that architects and developers are not restricted in their search for optimum technical solutions.

Depends on

Requirements Specification, Project Proposal (see product dependency 5.4)

Requirements Specification (see product dependency 5.5)

Evaluation of the Overall Project Requirements Specification (see product dependency 5.25)

Requirements Specification, Project Proposal (see product dependency 5.27)

3.7.3.1 Initial Situation and Objectives

See Initial Situation and Objectives in product Requirements Specification.

3.7.3.2 Functional Requirements

See Functional Requirements in product Requirements Specification.

3.7.3.3 Non-Functional Requirements

See Non-Functional Requirements in product Requirements Specification.

3.7.3.4 Outline of the Life Cycle and the Overall System Architecture

See Outline of the Life Cycle and the Overall System Architecture in product Requirements Specification.

3.7.3.5 Safety and Security Relevant Requirements, Risk Acceptance and Safety and Security Levels

See Safety and Security Relevant Requirements, Risk Acceptance and Safety and Security Levels in product Requirements Specification.

3.7.3.6 Scope of Delivery Overall Project

See Scope of Delivery in product Requirements Specification.

3.7.3.7 Acceptance Criteria

See Acceptance Criteria in product Requirements Specification.

3.7.4 Evaluation of the Overall Project Requirements Specification

Process module: Management of Multiple Projects

Responsible: Requirements Engineer (Acquirer) (when using process module Management of Multiple Projects)

Activity: Preparing Overall Project Requirements Evaluation

Participating: Executive, Project Leader, User

Purpose

The »Evaluation of the Overall Project Requirements Specification is intended to evaluate the collection and preparation of user requirements and make the supplier's realization risk as transparent and controllable as possible. Thus, the acquirer has - based on his evaluation capabilities - already determined whether he regards the user requirements as technically feasible, affordable, economical and important.

If the requirements are economically doubtful or expensive or cannot be assessed adequately, the acquirer may take recourse to an optioning of capabilities, i.e., the requesting of capabilities or capability packages to be offered optionally, in order to base his assessment on real cost data.

The product Evaluation of the Overall Project Requirements Specification documents the evaluation results for the user requirements collected until that time. The evaluation is hardly possible unless the »Outline of the Life Cycle and the Overall System Architecture or a concrete system architecture have been prepared, i.e., there are already possible approaches. An evaluation of off-the-shelf products may make valuable contributions to this.

The Evaluation of the Overall Project Requirements Specification is based on prespecified evaluation criteria. The results of the Evaluation of the Overall Project Requirements Specification are integrated into the product Requirements Specification Overall Project.

Depends on

Requirements Specification Overall Project (see product dependency 5.25)

3.7.4.1 Evaluation Criteria Overall Project

See Evaluation Criteria in product Requirements Evaluation.

3.7.4.2 Evaluation Results Overall Project

See Evaluation Results in product Requirements Evaluation.

3.7.5 Requirements Specification

Process module: Specification of Requirements

Responsible: Requirements Engineer (Acquirer) (when using process module Specification of Requirements)

Activity: Determining Requirements

Participating: Executive, Project Leader, User, Safety Manager, Security Manager, Data Protection Manager

Work Product Attributes: initial

Purpose

The Product Requirements Specification includes all mandatory requirements posed on the system to be developed. It is basis for the »Request for Proposal and contracting and thus the most important specification for the preparation of an offer. The Requirements Specification is part of the »Contract between acquirer and supplier. The Requirements specify the framework conditions for the development, which will then be detailed by the supplier in the »Overall System Specification .

All relevant system requirements will be determined and documented by the supplier. They include the information required by the supplier for the development of the required system. The core of the Requirements Specification comprises the functional and non-functional system requirements and an outline of the overall system design. The design considers the future environment and infrastructure for the system and provides guidelines for technological decisions. In addition, the system life cycle phases to be supported will be identified and incorporated as logistic requirements. The delivery terms and acceptance criteria are also part of the requirements.

The functional and non-functional requirements are not only intended as development specifications, but also as basis for the tracing of requirements and the change management. The requirements should be prepared in such a way that traceability and a suitable change management are possible for the entire system life cycle.

The acquirer alone is responsible for the preparation and quality of the Requirements Specification. If required, he may task a third party with the preparation. Generally, the Requirements Specification should not specify technical solutions in order to ensure that architects and developers are not restricted in their search for optimum technical solutions.

Generates

Market Survey for Off-the-Shelf Products (see product dependency 4.3)

Depends on

Requirements Evaluation, Market Survey for Off-the-Shelf Products (see product dependency 5.2)

Project Proposal, Requirements Specification Overall Project (see product dependency 5.4)

Requirements Specification Overall Project (see product dependency 5.5)

Life Cycle Cost Calculation, Project Plan, Risk List, Estimation, Overall System Specification (see product dependency 5.17)

Project Proposal, Requirements Specification Overall Project (see product dependency 5.27)

Overall System Specification (see product dependency 5.44)

Project Manual, Overall System Specification (see product dependency 5.45)

Request for Proposal, Contract, Contract Addendum (see product dependency 5.50)

3.7.5.1 Initial Situation and Objectives

This subject illustrates the initial situation and the reasons for executing the project. It describes which deficiencies or problems of existing systems or the current situation have lead to the decision to execute the project and which advantages are expected from the use of the new system.

In addition, all relevant stakeholders of the projects will be appointed and the technical and professional integration of the system to be developed will be outlined. Moreover, the first framework conditions for the development will be identified and decribed. Framework conditions may include, e.g., technical specifications or safety and security specifications.

3.7.5.2 Functional Requirements

Functional requirements describe the system capabilities required by a user for solving a functional problem. The requirements will be derived from the supported business processes and the flow description for using the system.

The functional requirements are defined, e.g., by use cases. A use case describes a concrete, functionally self-contained sub-process. The entirety of the use cases defines the system behavior. A use case may be described in a simple text format. However, organization-specific patterns for the description are frequently available. In order to determine the functional requirements of data-centered systems, a first functional »Data Model will be developed, which is the basis for the later »Database Design. The functional data model of the system will be derived from the entities of the domain model.

The functional requirements are the central system development specifications. They will be integrated into the »Overall System Specification and concretized as required.

3.7.5.3 Non-Functional Requirements

Non-functional requirements are system requirements which are not of a functional nature, but contribute decisively to the applicability of the system. They define, e.g., quality requirements, safety and security requirements or performance requirements. If the project is critical related to security (see Project characteristic »Security (Acquirer) or »Security (Supplier)) the requirements related to security will be specified in a seperate Topic.

Non-functional requirements define fundamental characteristics of a system which must be taken into account in the architecture design. They may be used for estimating the development costs and should be described as measurably as possible.

In order to structurize the requirements as simply as possible, requirements which are not clearly defined as functional requirements will be assigned to the non-functional requirements.

3.7.5.4 Outline of the Life Cycle and the Overall System Architecture

The specification of user requirements without consideration of possible solutions entails the great risk of defining unrealistic user requirements. It is useful to specify a coordination frame for the integration, systematization, categorization and prioritization of user requirements, in order to facilitate their visualization.

This may be achieved by an overall system architecture which represents the point of view of the user and not the technical point of view of the system analyst or »System Architect. This means a functional system architecture embedded in the functional flow of adjacent systems should be prepared. At this early stage, it is hardly possible to develop a technical system architecture.

In case of an »Evaluation of Off-the-Shelf Products, the future system components should be identified and specified in the overall system architecture when the »Requirements Specification are revised.

In addition, the particular characteristics of the operational environment of the new system shall be described in order to be able to consider primarily the »Safety and Security requirements. The developer of user requirements should prepare a concept showing which life cycle sections should be covered by the project.

3.7.5.5 Safety and Security Relevant Requirements, Risk Acceptance and Safety and Security Levels

For safety- and security-critical systems, this subject specifies technical standards for safety and security. With regard to functional safety and security, it shows which risks exist during system operation, which damage or which class of damage may occur with which probability and inhowfar the occurrence of damage may be tolerated or is no longer acceptable. With regard to information security, information security requirements intended to protect the confidentiality, integrity, authenticity, and availability of information and information security requirements intended to protect information processing and information transmission systems must be specified. With regard to data protection, data protection requirements for handling personal data must be identified.

Based on the requirements, including the safety and security requirements, and the outline of the life cycle and the overall system architecture, the safety and security levels for all requirements shall be specified.

3.7.5.6 Scope of Delivery

All items and services to be delivered by the supplier to the acquirer during the project or at its completion shall be listed. Every »Delivery requires an acceptance evaluation. The scope of delivery may include the system, system components, an »Enabling System, enabling system components, documents, and agreed services.

3.7.5.7 Acceptance Criteria

Acceptance criteria specify the criteria to be fulfilled by the »Delivery in order to meet the requirements. They should be specified in a measurable way. From a contractual point of view, the acceptance criteria describe the conditions for the decision as to whether the final product fulfills the requirements or not. Acceptance criteria refer to functional and non-functional requirements.

Until the contract is awarded, the acceptance criteria can only be indicated in a general form, e.g., as KO criteria. These criteria define, e.g., that at least 90 % of all evaluation cases must be completed successfully in order to achieve a successful acceptance. These general acceptance criteria should also include the requirement that the supplier must prepare acceptance criteria, the structure and number of which shall be outlined by the acquirer. The acceptance criteria should be structured in accordance with their three decisive components - initial situation, action(s) and expected result. In any case, the expected results of the acceptance must be specified for each acceptance criterion.

The acceptance test is based on the acceptance criteria which are included as requirements in the »Evaluation Specification Delivery.

3.7.6 Requirements Evaluation

Process module: Specification of Requirements

Responsible: Requirements Engineer (Acquirer) (when using process module Specification of Requirements)

Activity: Preparing Requirements Evaluation

Participating: User, Executive, Project Leader

Work Product Attributes: initial

Purpose

The »Requirements Evaluation is intended to evaluate the collection and preparation of user requirements and make the supplier's realization risk as transparent and controllable as possible. When the contract is awarded, the acquirer has - based on his evaluation capabilities - already determined whether he regards the user requirements as technically feasible, affordable, economical and important.

If the requirements are economically doubtful or expensive or cannot be assessed adequately, the acquirer may take recourse to an optioning of capabilities, i.e., the requesting of capabilities or capability packages to be offered optionally, in order to base his assessment on real cost data.

The product Requirements Evaluation documents the evaluation results for the user requirements collected until that time. The evaluation is hardly possible unless the »Outline of the Life Cycle and the Overall System Architecture or a concrete system architecture have been prepared, i.e., there are already possible approaches. An evaluation of off-the-shelf products may make valuable contributions to this.

The Requirements Evaluation is based on prespecified evaluation criteria. The results of the Requirements Evaluation are integrated into the product Requirements Specification.

Depends on

Requirements Specification, Market Survey for Off-the-Shelf Products (see product dependency 5.2)

3.7.6.1 Evaluation Criteria

This subject specifies the evaluation criteria to be applied during the »Requirements Evaluation or »Evaluation of the Overall Project Requirements Specification. The evaluation criteria include, but are not limtied to, the plausibility of the defined requirements, particularly the information security requirements, the possiblity of controlling the complexity and the evaulation of the possibility to employ off-the-shelf products. Additional criteria include the existing IT infrastructure and the cost estimate for the individual requirements.

3.7.6.2 Evaluation Results

The evaluation results of the »Requirements Evaluation include particularly an overall evaluation of user requirements. It will be evaluated how far prespecified restrictions, which are either due to the budget, the schedule or available resources, can be complied with or will be exceeded. In addition, all user requirements collected will be examined and classified as follows: The deferred user requirements and the rationale for deferring them will be examined (e.g., is the necessity not demonstrable). The modified user requirements and the rationale for the modification will be examined (e.g., by the more economical use of off-the-shelf products). The necessity of new user requirements will be examined (e.g., have important non-functional user requirements not been recorded). In addition, the evaluation results include results of the economic analysis, e.g. cost-benefit assessments, identification of cost-driving user requirements and affordability of user requirements.

3.7.7 User Tasks Analysis

Process module: Usability and Ergonomics

Responsible: Ergonomics Manager (when using process module Usability and Ergonomics)

Activity: Analyzing User Tasks

Participating: User, Logistics Developer, Technical Author, Requirements Engineer (Supplier)

Purpose

The »User Tasks Analysis is intended to develop the basis for the design of an adequate system. For this purpose the user tasks to be supported must be presented in their interaction with the working environment.

The analysis of user tasks identifies and describes user profiles, tasks to be supported and system and environmental conditions.

Is generated by

Overall System Specification (see product dependency 4.26)

Overall System Specification (see product dependency 4.25)

Depends on

Overall System Specification (see product dependency 5.6)

3.7.7.1 User Profiles

The user profile describes characteristics and prior skills of the future users of the system to be developed. For the preparation of an »Application Profile, personal characteristics of the users - e.g. age and gender - and their professional characteristics - e.g., experience, frequency and intensity of use - will be considered.

Exemplary Product Content

A user profile may include the following information:

- Personal characteristics of the user, e.g., age, gender, goggles, right-/left-handedness, color blindness,
- knowledge, skills and experiences of the user, e.g., computer skills, training, professional experience,
- professional and working skills, e.g., frequency of use, system training, mandatory/voluntary system use, professional category of user like manager, administrative or technical assistant, job fluctuation, use of other tools, importance and complexity of task.

3.7.7.2 Physical Operation Environment

The working environment of a user working with a dialog system will be recorded and documented. The results influence the design of the dialog system. Decisive factors include, but are not limited to, location of the system, e.g., office, hangar, public place, influences caused by noise, light, dirt, climatic conditions, vibrations or other external disturbances.

3.7.7.3 User Tasks

This subject describes the tasks to be performed by the users of the new system. All work processes and their characteristics which are important for designing the user interface of the system will be presented.

Exemplary Product Content

Sub-subjects of the user tasks include, but are not limited to, the following:

- Survey of the business and operational objectives of the new system,
- integration of the functional areas supported by the new system within the organizational unit,
- description of the work flows to be supported by the new system,
- task descriptions, responsibilities, dependencies and hierarchies of the supported functional area,
- any measures performed due to a workflow reengineering

3.7.8 Data Protection Concept

Process module: Safety and Security (Supplier)

Responsible: Data Protection Manager (when using process module Safety and Security (Supplier))

Activity: Preparing Data Protection Concept

Participating: Security Manager

Work Product Attributes: initial

Purpose

The data protection concept regulates the implementation of legal data protection standards for the handling of personal data.

It includes statements on the following:

- Legal foundations and their implementation.
- Purpose of processing personal data.
- Origin of personal data.
- System survey and protection requirements.
- Risks.
- Requirements and measures.

Is generated by

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Overall System Specification (see product dependency 4.25)

Overall System Specification (see product dependency 4.26)

Depends on

Project Manual, Information Security Concept, Safety and Security Analysis (see product dependency 5.46)

Project Manual, Overall System Specification, Information Security Concept (see product dependency 5.47)

3.7.8.1 Legal Foundations and Their Implementation

The legal data protection provisions and regulations required for the handling of personal data shall be identified.

3.7.8.2 Origin and Purpose of Processing Personal Data

Origin and purpose of processing personal data shall be presented.

3.7.8.3 System Survey and Protection Requirements

The system survey shall focus on system elements which process personal data. The protection requirements for personal data will be specified.

3.7.8.4 Risks

Possible risks incurred when processing personal data shall be identified.

3.7.8.5 Requirements and Measures

The data protection concept shall fulfill all legal data protection requirements, e.g., legal, technical, organizational, and material requirements. In addition, the requirements must be covered completely by appropriate measures. Aspects to be covered include, but are not limited to, the following:

- Administration and processing of personal data on data carriers and servers, e.g., storage time, safekeeping, marking, re-use, destruction and deletion of programs and data no longer required.
- Physical access control/user control, access control, transfer control, input control, request control.
- Obligation to notification/consultation of the Data Protection Specialist, e.g., in case of unexpected system behavior or extraordinary events which have effects on data loss or the loss of data protection.
- Release procedures, e.g., for modified/new system elements and the transfer or personal data.
- Processing of job data, e.g., in case of installation, maintenance, repair, software maintenance and deletion/destruction of data carriers.

3.7.9 Information Security Concept

Process module: Safety and Security (Supplier)

Responsible: Security Manager (when using process module Safety and Security (Supplier))

Activity: Preparing Information Security Concept

Work Product Attributes: initial

Purpose

The Information Security Concept shall be prepared for every IT project and every project with IT elements.

The project-related Information Security Concept includes all information security requirements mandatory for the system to be developed, the information security measures designed to protect the information against loss of integrity, authenticity, confidentiality and availability, and information security requirements and information security measures designed to protect technical information processing and information transmission systems.

During the preparation and updating process, the contents of the Information Security Concept shall be checked for correctness, consistency and completeness and adapted as required.

During service use, the Information Security Concept shall be updated in case of technical changes, changes of regulations, changes of the hazard situation, extension of the functionality and construction measures.

The »Security Manager of the respective project is responsible for the preparation of the Information Security Concept.

Is generated by

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Overall System Specification (see product dependency 4.25)

Overall System Specification (see product dependency 4.26)

Depends on

Project Manual, Data Protection Concept, Safety and Security Analysis (see product dependency 5.46)

Project Manual, Overall System Specification, Data Protection Concept (see product dependency 5.47)

3.7.9.1 Presentation of the Project and the Operational Environment

In addition to a general survey of the project, this subject shall roughly describe operational purpose and operational environment.

3.7.9.2 Protection Requirements

The information processed or transmitted - including their classification regarding confidentiality and their assessment with respect to integrity, authenticity and availability - shall be identified.

3.7.9.3 System Architecture from an IT Security Point of View

The system architecture shall be presented as seen from an information security point of view. The necessary infrastructure and general organizational and personal conditions shall be identified.

3.7.9.4 Information Security Requirements

The information security requirements shall be identified, subdivided into technical, organizational, personal and material information security requirements.

3.7.9.5 Information Security Measures

The necessary information security measures shall be described, subdivided into technical, organizational, personal and material information security measures. The products designed to implement the information security measures shall be listed.

3.7.9.6 Risks Remaining

If information security requirements cannot be covered completely by information security measures, the risks remaining shall be described.

3.7.9.7 Emergency Plan

The necessary emergency measures shall be developed. This includes particularly the detailed description of the approach for restoring system functionality after a partial or total failure of the system.

3.7.9.8 Standards for Verifying the Effectiveness of the Measures

Standards for verifying the effectiveness of the measures for maintaining information security shall be specified. This includes particularly also specifications for necessary training and sensitization measures.

3.7.10 Safety and Security Analysis

Process module: Safety and Security (Supplier)

Responsible: Safety Manager (when using process module Safety and Security (Supplier))

Activity: Performing and Evaluating Safety and Security Analysis

Participating: QA Manager

Purpose

The safety and security analysis (frequently also called risk analysis) is intended to determine the causes of hazards and to estimate the probability of ocurrence of this hazard with respect to functional safety.

The risks (probability of occurrence times damage level per hazard) will be determined, and risk minimization measures will be selected. The selection must be justified.

The safety and security analysis shall be executed for every system element regarded as critical for safety and security.

Is generated by

Project Manual, Overall System Specification (see product dependency 4.27)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Overall System Specification (see product dependency 4.25)

Overall System Specification (see product dependency 4.26)

Depends on

Project Manual, Data Protection Concept, Information Security Concept (see product dependency 5.46)

3.7.10.1 Hazard Identification and Damage Classification

The subject »Hazard Identification and Damage Classification describes hazards which may lead to the occurence of damage when the respective system is used. For every hazard, the potential damage level per damage category will be indicated. For every identified hazard, the respective damage class per damage category will be indicated.

Depending on the system type, the occurrence of damage may lead to different damage categories, e.g., loss of life, injuries, illness, loss or damage of equipment or property and/or environmental damage. It may also lead to purely economic losses, e.g., by production shortfalls or nonavailability of an urgently needed system.

Possibly, an intangible damage may occur, e.g., in case of an infringement of legal regulations/parameters, a reduced image which may impair sales or if a recall action is initiated. Every occurrence of damage, which may be caused by a hazard, has consequences of a different level. In order to facilitate the processing, the occurrence of damage will be subdivided into appropriate damage classes.

3.7.10.2 Post analysis and determination of relevance

For every hazard recognized during the hazard identification, the following results will be collected:

- cause of hazard,
- probability of occurence of hazard,
- risk determination (probability of occurrence of damage times damage level),
- assessment if the determined risk lies within the risk level accepted by the acquirer. If the risk is above the acceptance value, risk-reduction measures shall be selected in the next step. In case of the hazard "component failure", the probability of occurrence can be indicated based on the component's lifetime or operating hours.

3.7.10.3 Safety and Security Measures

Risk-reduction measures will be determined for all risks regarded as inacceptable in the system safety and security analysis. The proposals for risk-reduction measures are described in the Project Manual under the subject »Safety and Security - Organization and Directives.

Risk-reduction measures are required if a hazard occurs which is outside the prespecified tolerance range or above the prespecified threshold value, thus becoming inacceptable. Therefore, suitable measures must be determined, and it must be checked whether the present risk is reduced to an acceptable level if these measures are taken.

»Safety and Security Measures may include constructional procedures (regarding system development and realization), analytical measures (test measures), additional functional or non-functional system requirements and additional safety and security systems or organizational requirements.

Risk-reduction measures are intended to reduce the damage level (damage class) and/or the probability of occurrence of a hazard.

The effects of the measures - e.g. degree of reduction, effort required for implementation, effects on initialization, operation, deactivation of the system or on the operating personnel - will be assessed with respect to their technical and economical suitability.

The decision for the selection of the optimum measure will be justified.

If it is impossible to find a suitable measure, the safety and security specifications in the Project Manual shall be followed. In cooperation with the acquirer, a solution shall be searched and introduced by a problem report/change request. The approach shall be documented.

3.7.11 Legacy System Analysis

Process module: Enhancement and Migration of Legacy Systems

Responsible: System Architect (when using process module Enhancement and Migration of Legacy Systems)

Activity: Analyzing Legacy System

Purpose

The »Legacy System Analysis is intended to describe the actual state of a system, to provide an understanding for the legacy system and to lay the basis for the further development or migration of system components. The analysis describes functionality, objectives and rough architecture of the legacy system and identifies interactions between the system and its environment. The current »Data Model of the legacy system shall be determined and the data quality shall be assessed in order to provide a basis for the migration.

The »System Architect is responsible for the execution of the legacy system analysis. He should be supported by experts of the legacy system and persons responsible for adjacent systems.

Is generated by

Overall System Specification (see product dependency 4.26)

Overall System Specification (see product dependency 4.25)

Depends on

Overall System Specification, System Architecture (see product dependency 5.59)

3.7.11.1 System Outline

The »System Outline describes the rough architecture of the legacy system and its integration into the environment. It indicates objectives and tasks of the system and the context in which the system is used. The system components are described roughly, and the technologies employed are identified.

In addition, the outline indicates databases on which the system operates, platform and programming language. Adjacent systems with which the system exchanges data and messages are identified, and the interfaces to the legacy system are analyzed and defined.

For a better understanding, the system outline may be complemented by a graphical presentation showing the system in its environment and the system interfaces. The system summary is the basis for the data and interface analysis.

3.7.11.2 Functional Overview

The summary of functions describes functionality and business processes supported by the legacy system. If the legacy system is intended to be replaced, the summary of functions provides additional information for specifying the requirements. This ensures that the requirements posed on the new system include all essential functionalities of the legacy system.

3.7.11.3 Interface and Dependency Analysis

Legacy systems, particularly legacy information systems, frequently communicate in many ways with a great number of adjacent systems. In the most simple case, the communication is file-based, i.e., a file including data in a specified formart is transferred from the transmitting system to a specified location, where it is read by the receiving system.

An additional communication possibility is the asynchronous transmission and reception of messages by means of messaging systems. In case of a very close coupling of systems, data will be exchanged between the systems within the scope of synchronous calls.

For the above communication forms, a protocol shall be prepared which specifies in detail according to which rules the communication shall be conducted. The protocols will be negotiated and documented with the person responsible for the respective adjacent system

The flow within the system determines the sequence in which the interfaces shall be served. Thus, there are inherent dependencies between the interfaces. These dependencies shall also be identified and documented.

3.7.11.4 Data Model

The »Data Model of the legacy system describes how data maintenance was realized in the legacy system. It identifies the affected databases, determines the respective database schemes and documents the results within the scope of their environment. The documentation is prepared analogous to the physical data model of the »Database Design for a new system.

In addition to the data structure, the data quality shall be determined. Based on samples and data copies, it will be determined how many invalid data records exist in the databases of the legacy system and how far these data records impair the workflow.

3.7.12 Market Survey for Off-the-Shelf Products

Process module: Evaluation of Off-the-Shelf Products

Responsible: Project Leader (when using process module Evaluation of Off-the-Shelf Products)

Activity: Performing Market Survey for Off-the-Shelf Products

Participating: Purchaser, Logistics Manager, System Integrator, Requirements Engineer (Acquirer), System Architect

Purpose

If a »Segment, a Software/Hardware Unit, a Software/Hardware Module or a Software/Hardware Component of the system to be developed is intended to be realized by using an off-the-shelf product, a suitable off-the-shelf product must be found based on the specifications available at the respective time. In order to get an overview over the off-the-shelf product candidates available on the market, a »Market Survey for Off-the-Shelf Products will be prepared. The result of the market survey is a list of possible off-the-shelf product candidates, which includes additional information on every candidate, e.g., product sheets, product specifications, performance characteristics and prices.

Acquirer and Supplier may conduct market surveys at different times in the course of the project.

If the »Project Proposal shows or even prescribes that off-the-shelf products should be used wherever possible, the acquirer can conduct a rough market survey based on the »Project Proposal before the »Requirements Specification is formally specified. The assessed results will then be integrated into the »Requirements Specification.

The market survey can also (possibly again) be conducted at a later time based on the »Requirements Specification in order to examine if and to which extent developments are required or if the system can be realized completely or partly by using off-the-shelf products. The results of the market survey are important inputs for the »Offer Assessment, thus providing the basis for a decision on the use of off-the-shelf products.

At an early stage of the system development process, the supplier prepares the »Overall System Specification, which may give an impetus for a systematic market survey of suitable off-the-shelf products. If »External Units have already been identified in the system architecture, the »External Unit Specification provides the necessary information. If external elements at hardware or software level have been identified as products of the type External Hardware Module or External Software Module, they are identified in the External Hardware Module Specification or External Software Module Specification. The examination and assessment of off-the-shelf products is based on the »Overall System Specification, the »External Unit Specification, the External Hardware Module Specification or the External Software Module Specification. The market survey is basis and decision-making aid for the »Make-or-Buy Decision. The results of the market survey are integrated directly into the decision-making process.

Is generated by

Requirements Specification, Project Proposal (see product dependency 4.3)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Overall System Specification (see product dependency 4.26)

Overall System Specification (see product dependency 4.25)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

Depends on

Make-or-Buy Decision (see product dependency 5.12)

Requirements Specification, Requirements Evaluation, (see product dependency 5.2)

3.7.13 Make-or-Buy Decision

Process module:	System Development
Responsible:	Project Leader (when using process module System Development)

Activity: Performing Make-or-Buy Decision

Participating: System Architect, Controller, Purchaser, System Integrator, Hardware Architect, Software Architect

Purpose

A »Make-or-Buy Decision documents the way to the decision as to whether an external unit, an external hardware module or an external software module will be bought as off-the-shelf product, developed by the supplier himself or awarded as sub-contract. Depending on the strategic specifications, a priority study as to whether the reuse of a self-developed component or the use of an open-source component is possible, may be required.

Strategic and economic aspects will be examined. Potential off-the-shelf products may be evaluated. The results of the analyses and the evaluation support the final decision. The result of the decision will be documented in the system architecture or »Enabling System Architecture.

Is generated by

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

Generates

Offer Assessment, Request for Proposal, RFP Concept, Criteria Catalog for Assessment of Offers, Contract (see product dependency 4.29)

Depends on

Market Survey for Off-the-Shelf Products (see product dependency 5.12)

External Unit Specification (see product dependency 5.13)

External Hardware Module Specification (see product dependency 5.14)

External Software Module Specification (see product dependency 5.15)

Overall System Specification (see product dependency 5.42)

3.7.13.1 Strategic Analysis

When determining the strategic orientation of his organization, the supplier shall examine if it is possible to exploit the potential advantages of using off-the-shelf products, reusing self-developed components, using open-source components or awarding a contract for his project. In this connection he must consider particularly whether availability and maturity of prefabricated components are sufficient and suitable for the required functionalities.

For any type of procurement, it should be examined if - as compared to an in-house development - costs can be saved during the procurement, utilization and maintenance phase and if the delivery times between specification of requirements and implementation are expected to be reduced significantly.

In case of open-source components, it should be noted that some open-source communities prescribe regulations for the use of the respective component.

The strategic analysis must take into account any specification to be observed in the entire company. Applicable specifications may include, e.g., the following:

- Contracts which require the revealing of core competences must not be awarded.
- The use of specified off-the-shelf products is mandatory. In-house developments shall be justified particularly. Reasons may include an increase of the economic or technical risks if off-the-shelf products are used.
- The use of off-the-shelf products is approved. The most economic solution shall be striven for.
- Components of the own company shall be re-used, e.g., in connection with product line engineering.

3.7.13.2 Economic Analysis

If possible, the economic efficiency of using work products of the type external unit, external hardware module or external software module shall be demonstrated by a cost-benefit analysis in quantitative form (monetary units). This is independent of the fact whether the analysis deals with the use of a prefabricated product or with the result of a development order. If the benefits exceed the costs, the use of an external unit can clearly be regarded as economical. Perhaps an additional cost saving can be achieved by reducing the requirements posed on the »External Unit (e.g., with 20% of the costs, 80% of the requirements may be fulfilled).

The measurable benefit of using a prefabricated product may lie, e.g., in its immediate availability. In addition, the expected test and integration effort may be small since the products normally have already undergone market or in-house tests.

However, the cost disadvantages must be considered as well as the cost advantages. For example, the cost advantages may be neutralized if off-the-shelf products or open-source components require extensive adaptations, or implementation faults, interface incompatibilities or platform incompatibilities must be remedied.

If the benefit cannot be expressed in monetary units, qualitative benefits may also be considered (in the public sector, the recommendation on the implementation of economic reviews regarding the use of IT in the Federal Administration (IT-WiBe) may be used for this purpose). For example, the benefit of using standard components lies in a higher flexibility and easier extendability. Products which have already been tested on the market or in the company are expected to have a lower failure probability and, thus, a higher availability.

If the use of off-the-shelf products, open-source components or re-usable components is out of question, a decision shall be made between out-of-house and in-house development. In this case, aspects like time to market, availability of own resources and the cost factor are of importance.

3.7.13.3 Evaluation of Off-the-Shelf Products

The subject »Evaluation of Off-the-Shelf Products documents the evaluation of possible off-the-shelf product candidates for products of the type »External Unit, »External Hardware Module or »External Software Module. Thus, it provides the basis for a decision for or against an off-the-shelf product in general or a specific off-the-shelf product. If strategic considerations allow open-source components to be used, these will also be considered.

A criteria list will be prepared based on the interfaces and non-functional requirements of the »External Unit Specification, the »External Hardware Module Specification or the »External Software Module Specification. This list is intended to examine the suitablility of the off-the-shelf product candidates. Frequently, decisions are made due to the failure to comply with marginal KO criteria, which have not always been considered in the beginning. Therefore, it is necessary to assess the degree of fulfillment of concrete and weighted requirements, i.e., to conduct a classical utility analysis including KO criteria. An evaluation of off-the-shelf products, e.g. by means of rigid function catalogs, is useless and leads to wrong results. The individual off-the-shelf products will be evaluated based on this criteria list.

It should be noted that off-the-shelf products frequently do not fulfill the special (e.g. military) requirements reulting from environmental influences and special operating conditions. Therefore, it will be necessary to adapt the off-the-shelf products to the specified operating conditions (by hardening or wrapping technologies), i.e., if off-the-shelf products are used, the possible effort, costs and integration risks for newly to be developed adaptation software and hardware must be considered. The evaluation result is a priority list of off-the-shelf product candidates.

3.7.13.4 Assessment and Result

If the various analyses - and, if required, the evaluation of off-the-shelf products - have been completed, the results shall be used as a basis for making a decision on self-development, purchase, re-use or outsourcing.

Additional assessment criteria for potential suppliers of off-the-shelf products or »Sub-Suppliers will also be integrated into the decision, e.g., credit ratings, performance criteria and contract criteria. Criteria like market position of a company, special experience, participation in standardizations, contract policy, price policy and available maintenance, support and training offers are also relevant for a make-or-buy decision.

If an evaluation of off-the-shelf products was conducted, the prioritized candidate list shall also be used as basis for decision-making. In addition possible risks, e.g., integration risks, controllability of new technologies or adaptability and modularity of the off-the-shelf product, shall be assessed.

Based on the above criteria and risks, the alternatives will be prioritized, the decision made, and the result documented.

Exemplary Product Content

For the final decision on the relization of external units, at least the following aspects should be taken into account:

- How high are the costs,
- time to market
- degree of fulfillment of requirements,
- how is the maturity of the product assessed,
- how good is the conformity to standards,
- how reliable is the product,
- which performance parameters are supported by the product,
- how expressive and complete is the documentation,
- how reliable is the support?

3.8 System Elements

The discipline System Elements comprises all elements to be realized during system development. These include the target systems (system and enabling systems), segments used as units for structuring sub-systems and hardware and software development elements (units, components and modules). In addition, »External Units or products of the type »External Hardware Module or »External Software Module are available for the integration of elements which were not developed within the scope of the project.

The system elements represent the hierarchical structure of a system or »Enabling System Figure 13. For system development, the system elements, beginning with hardware and »Software Modules, will be integrated in accordance with the hierarchical structure.

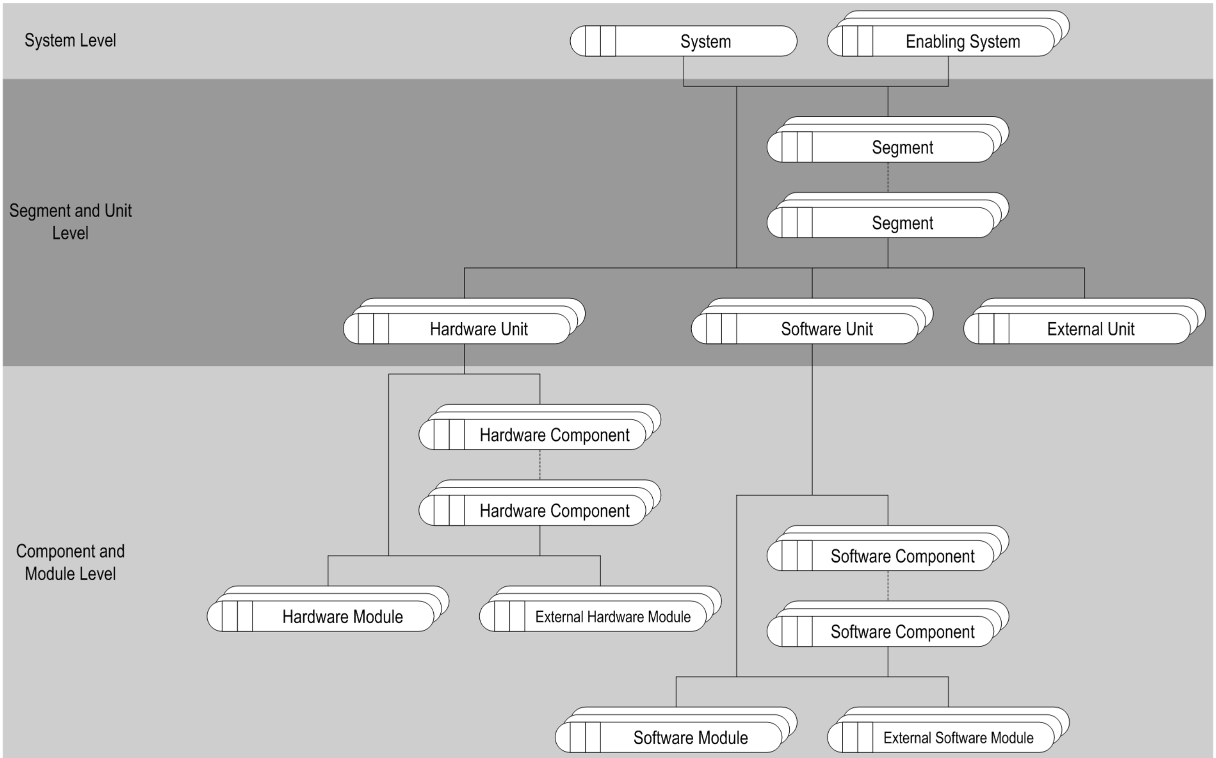


Figure 13: System Architecture Hierarchy

3.8.1 System

Process module: System Development

Responsible: System Integrator (when using process module System Development)

Activity: Integrating into System

Purpose

The system is the product to be realized within the scope of a system development project. It implements the functional and non-functional requirements of the Overall System Specification. A system may be composed of software and hardware elements (e.g. aircraft, ship, automobile, computer). However, there are also pure software systems (e.g. information system), pure hardware systems comprising electronic/electrical and mechanical elements (e.g. housing, power supply unit) or embedded systems (e.g. free programmable gatter array (FPGA)).

Depending on the system type, the lowest system level is composed of »Hardware Units and/or »Software Units. Embedded systems comprise hardware and software units. The units will be integrated into »Segments and finally into the »System Integrated. Depending on the scope of delivery and the acceptance criteria specified in the Overall System Specification, the system will be deliverd to the acquirer together with the appropriate »Enabling Systems and »Delivery documentation.

Is generated by

Overall System Specification (see product dependency 4.26)

Depends on

Logistic Support Documentation, Enabling System (see product dependency 5.20)

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment (see product dependency 5.38)

3.8.2 Enabling System

Process module: System Development

Responsible: System Integrator (when using process module System Development)

Activity: Integrating into Enabling System

Purpose

A »Enabling System is an autonomous system required for supporting the system itself or another enabling system. For every system, any number of enabling systems may be developed.

A enabling system is always a piece of hardware and/or software supporting the development or use of the system, but not belonging to the system itself. Documents like user documentation or operating documentation are not regarded as enabling systems. They will be prepared within the scope of the logistic concept. Normally, enabling systems will be developed in parallel to the system itself.

Like the system itself, a enabling system is structured hierarchically based on system elements and will be developed by realizing and integrating the system elements. Depending on the requirements, a enabling system may be part of the »Delivery.

Is generated by

Overall System Specification (see product dependency 4.25)

Depends on

Logistic Support Documentation, System (see product dependency 5.20)

3.8.3 Segment

Process module:	System Development
Responsible:	System Integrator (when using process module System Development)
Activity:	Integrating into Segment

Purpose

A »Segment is an important part of a system, presenting a hierarchy level below the system itself. It is the realization of a part of the system. Segments may be subdivided hierarchically into additional segments. In addition, segments may include hardware and/or software and/or »External Units. Normally, a segment comprises hardware and »Software Units. However, pure software segments, pure hardware segments, or segments comprising exclusively external units are also conceivable.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, System (see product dependency 5.38)

3.8.4 External Unit

Process module:	System Development
Responsible:	System Integrator (when using process module System Development)
Activity:	Taking over External Unit
Participating:	Purchaser

Work Product Attributes: external

Purpose

The Product »External Unit comprises system elements which are not developed within the scope of the project. An external unit may be an off-the-shelf product, a unit furnished by the user, a re-usable system or segment developed in advance, an adjacent system or the result of a sub-contract. An external unit may comprise hardware and software portions.

In case of a system integration project, the system will be integrated exclusively from external units. Examples for external units include middleware technologies, database servers or bought processors.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

3.8.5 Hardware Unit

Process module: Hardware Development

Responsible: Hardware Developer (when using process module Hardware Development)

Activity: Integrating into Hardware Unit

Purpose

A »Hardware Unit is the top system element in the hierarchy which includes exclusively electric or mechanic parts. Hardware units are composed hierarchically of »Hardware Components. Examples for hardware units include multiprocessor systems, processor printed wiring boards or motors. The »Hardware Developer is responsible for integrating the hardware components into a hardware unit.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Depends on

External Hardware Module, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

3.8.6 Software Unit

Process module: Software Development

Responsible: Software Developer (when using process module Software Development)

Activity: Integrating into Software Unit

Purpose

A »Software Unit is the top system element in the hierarchy which includes exclusively software. Software units are composed hierarchically of »Software Components. Examples for software units include the acquirer administration of an information system or the control process module of a roboter. The »Software Developer is responsible for integrating the software components into a software unit.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

3.8.7 Hardware Component

Process module: Hardware Development

Responsible: Hardware Developer (when using process module Hardware Development)

Activity: Integrating into Hardware Component

Purpose

A »Hardware Component is part of a »Hardware Unit. Hardware components may be subdivided hierarchically into additional hardware components. »Hardware Modules are on the lowest level of the component hierarchy. An example for a hardware component is the printed board assembly of the unit processor printed wiring board. The »Hardware Developer is responsible for integrating the hardware process modules into a hardware component and for integrating hardware components into additional hardware components.

Is generated by

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

Depends on

External Hardware Module, Hardware Unit, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

3.8.8 Software Component

Process module: Software Development

Responsible: Software Developer (when using process module Software Development)

Activity: Integrating into Software Component

Purpose

A »Software Component is part of a »Software Unit. Software components may be subdivided hierarchically into additional software components. »Software Modules are on the lowest level of the component hierarchy. An example for a software component is the private acquirer administration of the unit acquirer management system. The »Software Developer is responsible for integrating the software process modules into a software component and for integrating software components into additional software components.

Is generated by

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

3.8.9 External Hardware Module

Process module: Hardware Development

Responsible: Hardware Developer (when using process module Hardware Development)

Activity: Taking over External Hardware Module

Participating: Purchaser

Work Product Attributes: external

Purpose

The product External Hardware Module comprises system elements (hardware modules, hardware components) which are not developed within the scope of the project. An external hardware module is a functional element which can be described autonomously. An external hardware module may be an off-the-shelf product, a unit furnished by the supplier, a re-usable system or segment developed in advance, an adjacent system or the result of a sub-contract.

Is generated by

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Depends on

Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

3.8.10 Hardware Module

Process module: Hardware Development

Responsible: Hardware Developer (when using process module Hardware Development)

Activity: Realizing Hardware Module

Purpose

A »Hardware Module is on the lowest level of the system element hierarchy. In contrast to other hardware elements, it is realized concretely. A hardware module is part of a »Hardware Component. It is not subidivided further in a hierarchical manner. Examples for a hardware process include A/D conversion functions, processing elements or interface elements of a component, e.g. of an unprogrammed printed board assembly. The »Hardware Developer is responsible for realizing a hardware module.

Is generated by

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

3.8.11 External Software Module

Process module:	Software Development
Responsible:	Software Developer (when using process module Software Development)
Activity:	Preparing External Software Module Specification, Taking over External Software Module
Participating:	Purchaser
Work Product Attributes:	external

Purpose

The product External Software Module comprises system elements (software modules, software components) which are not developed within the scope of the project. An external software module is a functional element which can be described autonomously. An external software module may be an off-the-shelf product, a unit furnished by the supplier, a re-usable system or segment developed in advance, an adjacent system or the result of a sub-contract.

Is generated by

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

3.8.12 Software Module

Process module: Software Development

Responsible: Software Developer (when using process module Software Development)

Activity: Realizing Software Module

Purpose

A »Software Module is on the lowest level of the system element hierarchy. In contrast to other software elements, it is realized concretely as a piece of program code without further understructures. A software module is part of a »Software Component. It is not subdivided further. An example for a software module is the class "private acquirer" of the component "acquirer adminstration". The »Software Developer is responsible for realizing a software module.

Is generated by

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

3.9 System Specifications

The »Discipline »System Specification comprises »Work Products and »Activityies supporting the entire specification process from the overall system to individual software and »Hardware Elements.

In addition to the central product »Overall System Specification, the product group includes four specification types: the »System Specification for System Elements, the »External Unit Specification which specifies units which were not developed within the scope of the project and a Hardware and »Software Specification as well as an »External Hardware Module Specification and an »External Software Module Specification for each system element.

The specifications are closely connected with regard to contents. Proceeding from the Overall System Specification, functional and non-functional requirements of the acquirer will be described and refined in the system specifications and finally, as interfaces, in the specifications of hardware and »Software Element s. In this way, a continuous and repeatable development process and a suitable tracking of requirements can be realized.

3.9.1 Overall System Specification

Process module: System Development

Responsible: Requirements Engineer (Supplier) (when using process module System Development)

Activity: Preparing Overall System Specification

Participating: System Architect, Ergonomics Manager, Logistics Manager, Inspector, QA Manager, System Integrator, Safety Manager, Data Protection Manager, Security Manager

Work Product Attributes: initial

Purpose

The »Overall System Specification ist the counterpart to the acquirer product Requirements Specification on side of the supplier. It will be prepared by the supplier in cooperation with the acquirer and is the basis for the system development process.

The Overall System Specification includes the functional and non-functional requirements posed on the system to be developed, which will be derived from the Requirements Specification and prepared adequately. A first preliminary architecture of the system will be developed and described in a summary of interfaces. The system to be developed and additional »Enabling Systems to be developed will be identified and allocated to the requirements. Additional logistic requirements will be prepared in cooperation with the Logistic Manager. Acceptance criteria and scope of delivery for the finished overall system will be adopted from the Requirements Specification and concretized. In order to ensure that all requirements are taken into account, the requirements will be tracked to the Requirements Specification, the system and the enabling systems.

The preparation of the Overall System Specification requires knowledge of various disciplines, like system development, safety and security, ergonomics and logistics, which normally cannot be provided by one person. Since the requirements are the central core of the specification, the »Requirements Engineer (Supplier) has the responsible role for preparing the Overall System Specification. However, he needs the intensive support by experts of various specialities for the preparation of its contents.

The required products, like specification and architecture, will be prepared for every system, enabling system and »Segment identified in the Overall System Specification. Logistic requirements will be integrated into the »Logistic Support Specification.

Generates

Logistic Calculations and Analyses, Logistic Support Concept, Logistic Support Specification (see product dependency 4.12)

Training Documentation, In-Service Documentation (see product dependency 4.22)

User Tasks Analysis, Man-Machine Interface (Style Guide), Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, Database Design, Enabling System Implementation, Integration, and Evaluation Concept, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, System Specification, Enabling System, Enabling System Architecture, Data Protection Concept, Information Security Concept, Safety and Security Analysis, Legacy System Analysis, Migration Concept (see product dependency 4.25)

User Tasks Analysis, Man-Machine Interface (Style Guide), Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, Database Design, System Implementation, Integration and Evaluation Concept, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, System, System Architecture, System Specification, Data Protection Concept, Information Security Concept, Safety and Security Analysis, Legacy System Analysis, Migration Concept (see product dependency 4.26)

Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept, Safety and Security Analysis (see product dependency 4.27)

Depends on

User Tasks Analysis (see product dependency 5.6)

Requirements Specification, Life Cycle Cost Calculation, Project Plan, Risk List, Estimation (see product dependency 5.17)

Make-or-Buy Decision (see product dependency 5.42)

Requirements Specification (see product dependency 5.44)

Requirements Specification, Project Manual (see product dependency 5.45)

Project Manual, Data Protection Concept, Information Security Concept (see product dependency 5.47)

Contract (Acquirer), Contract Addendum (Acquirer) (see product dependency 5.58)

System Architecture, Legacy System Analysis (see product dependency 5.59)

Example Work Products

»FWD:Overall System Specification

3.9.1.1 Initial Situation and Objectives

See Initial Situation and Objectives in product Requirements Specification.

3.9.1.2 Functional Requirements

See Functional Requirements in product Requirements Specification.

3.9.1.3 Non-Functional Requirements

See Non-Functional Requirements in product Requirements Specification.

3.9.1.4 Safety and Security Relevant Requirements, Risk Acceptance and Safety and Security Levels

See Safety and Security Relevant Requirements, Risk Acceptance and Safety and Security Levels in product Requirements Specification.

3.9.1.5 Life Cycle Analysis and Overall System Architecture

Based on the requirements, a preliminary design of the overall system will be prepared and the life cycle phases to be supported (development, maintenance, deactivation) will be identified.

The overall system architecture identifies the core system and its »Enabling System and specifies the systems for which a »Logistic Support Concept shall be prepared. This concept will be based on the functional and non-functional requirements and the outline of the overall system architecture described in the requirements. Furnishings of the user will be taken into account.

A »Market Survey for Off-the-Shelf Products will possibly already be executed based on the »Overall System Specification in order to be able to estimate the influence exerted by possible off-the-shelf product candidates on the requirements and the »System Architecture.

3.9.1.6 Interface Overview

A Interface Overview will be prepared in order to describe the connections between the system and its environment. The interfaces between the system and the user, »Enabling Systems, logistic systems and adjacent systems will be identified and documented in suitable form.

The interfaces will be described concretely in the specifications of system elements and the »Logistic Support Specification.

3.9.1.7 Scope of Delivery

See Scope of Delivery in product Requirements Specification.

3.9.1.8 Acceptance Criteria

Acceptance criteria specify the criteria to be fulfilled by the »Delivery in order to meet the requirements. The description of the acceptance criteria will be derived from the Requirements Specification.

The acquirer checks the fulfillment of the acceptance criteria by means of a receipt inspection.

In order to ensure that the delivery fulfills the acceptance criteria, the criteria will be included as requirements into the »Evaluation Specification System Element of the system or »Enabling System. The acquirer may conduct an internal acceptance test based on the evaluation specification.

3.9.1.9 Requirements Tracing to Requirements Specification

The Requirements Tracing with Regard to the Requirements Specification presents the allocation of the functional and non-functional requirements described in the Requirements Specification to the requirements specified in the Requirements Specification. The bi-directional trackability must be ensured. The data may be presented, e.g., in form of a matrix.

3.9.1.10 Requirements Tracing

The requirements tracing in the Requirements Specification summarizes the allocation of functional and non-functional requirements to elements of the overall system architecture (system, »Enabling System, »Segment or logistics). The bi-directional trackability must be ensured. The data may be presented, e.g., in form of a matrix.

3.9.2 System Specification

Process module: System Development

Responsible: System Architect (when using process module System Development)

Activity: Preparing System Specification

Participating: Logistics Developer, System Integrator, Safety Manager, Ergonomics Manager, Logistics Manager, Inspector

Purpose

The »System Specification describes the functional and non-functional requirements posed on a system element (system, »Enabling System or segment). In order to prepare the System Specification, the requirements will be derived from the specifications of higher system elements or from the Overall System Specification. The specification provides standards and tools for designing and decomposing the architecture. If changes are required in the course of the development of the system element, the System Specification shall be adapted at first. The »Evaluation Specification System Element defines the evaluation cases required for demonstrating the requirements of interfaces and specifications.

The System Specification mainly describes the requirements posed on the system element and specifies the connected interfaces. In addition, requirements and interfaces will be refined and allocated to lower system elements.

The requirements tracing ensures that all requirements posed on the respective elements will be taken into account when the next hierarchy level is refined. The System Specification will be prepared together with the architecture design of the system or a sub-system. The »System Architect is responsible for the preparation of these products, thus ensuring the consistency between specification and architecture.

Requirements of the System Specification may influence the Logistic Support Specification, just as logistic requirements may influence the System Specification.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.23)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.24)

Overall System Specification (see product dependency 4.25)

Overall System Specification (see product dependency 4.26)

Depends on

Man-Machine Interface (Style Guide), Hardware Specification, Software Specification (see product dependency 5.7)

External Hardware Module Specification, Hardware Specification, Logistic Support Specification, External Software Module Specification, Software Specification, External Unit Specification (see product dependency 5.23)

3.9.2.1 System Element Overview

The summary of system elements provides a brief survey of the system element to be realized. It describes tasks and objectives of the system element and its role within the system or »Enabling System.

3.9.2.2 Interface Specification

An interface represents the boundary between a system element and its environment. It describes the data exchanged at the system boundary and their logic dependencies. Thus, the interface defines the services to be provided by the system element. One system element can support several interfaces.

The interface description collects all functional requirements posed on the system element, specifies all interfaces and presents them in their environment. Together with the non-functional requirements, the interface description defines the information required for developing the system element. The interface description describes the interfaces to other system elements and the interfaces to the environment, e.g. the man-machine interface or interfaces to »Enabling Systems.

The description of the functional interface is subdivided into the description of the static and dynamic behavior. The static behavior specifies the structure of the interface, through which the functionalities of the system element can be used. The dynamic behavior determines the sequence of use and the logic dependencies of the transmitted data and signals.

Contents and description of the interfaces may vary, depending on the fact as to whether the interface belongs to hardware or software components of the system element. Hardware components will be specified by electrical and mechanical data, while software components will be specified by the description of methods, parameters and information on the behavior.

Static elements of a hardware interface include, e.g., information on electrical performance parameters (power, voltage, current, frequency, polarity), information on the mechanical design (type of connector, connector assignment, type of cable), or information on the technical design (function call and parameter list, transmission device, layout of a user interface). The description of the dynamic behavior includes, e.g., the determination of communication protocols and their specification, the description of synchronization mechanisms and references to the use and operation of the interface.

The static behavior of a software interface determines the structure of the calls through which the services of the software elements can be used. The description is mainly based on method signatures and definitions of data types. The dynamic behavior determines the possible sequence of the calls. The description of the dynamic behavior is frequently based on flowcharts (sequence charts, message sequence charts) or state transition diagrams.

The interface description is based on the summary of interfaces in the architecture and on the interface realizations of the »System Specifications of higher system elements.

The interface description should consider if a re-use of already existing system elements is possible. In addtion, it should be ensured that the interface is stable, thus allowing a long use of the system element.

3.9.2.3 Non-Functional Requirements

In addition to the functional requirements, a system element must fulfill several non-functional requirements. Frequently demanded non-functional requirements include quality characteristics like performance, safety and security, availability and maintainability.

The non-functional requirements will be described in detail and specified by the actually required values. The non-functional requirements relevant for the system element will be derived from the specifications of higher system elements or the Overall System Specification.

3.9.2.4 Interface Realization

The interface realization refines the functional requirements of the interface description. Requirements and interfaces will be concretized, refined and allocated to the system elements of the lower hierarchy levels.

The interface realization is based on the system architecture or a »Enabling System Architecture of the higher system. The hierarchical structure will be identified in the architectures with in the scope of the decomposition process.

3.9.2.5 Refining Non-Functional Requirements

Non-functional requirements are refined in parallel to functional requirements in the interface realization. The non-functional requirements will be concretized, refined and allocated to the system elements of the lower hierarchy level.

The refined requirements remain in existence as autonomous requirements or will be integrated into the interface realization.

3.9.2.6 Requirements Tracing

The requirements tracing summarizes the allocation of functional and non-functional requirements posed on the system element to the refined requirements and lower system elements. It is based on the results of the interface realization and the refinement of non-functional requirements. The bi-directional trackability (i.e. from higher to lower system elements and vice versa) must be ensured. The data may be presented, e.g., in form of a matrix.

3.9.3 External Unit Specification

Process module: System Development

Responsible: System Architect (when using process module System Development)

Activity: Preparing External Unit Specification

Participating: System Integrator, Hardware Architect, Logistics Manager, Inspector, Software Architect, Safety Manager, Ergonomics Manager, Logistics Developer

Purpose

An »External Unit Specification will be prepared for every potential »External Unit identified within the scope of the architectural design. The specification is basis for the selection of an off-the-shelf product, a system element available for re-use, or a furnished item. In case of a sub-contract, the External Unit Specification is used as requirements document. In addition is is used as basis for the test.

The External Unit Specification defines all functional and non-functional requirements posed on the external unit. If the use of a off-the-shelf product may be possible, the specification will be used for conducting a market survey and evaluating off-the-shelf products. If a sub-contract is awarded, the specification will be the basis for the »Contract with the »Sub-Supplier.

The »System Architect is responsible for preparing the External Unit Specification. He will be supported by the »System Integrator, who ensures that the finally selected external unit fulfills all requirements regarding the integration into the system.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.20)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.21)

Depends on

Make-or-Buy Decision (see product dependency 5.13)

External Hardware Module Specification, Hardware Specification, Logistic Support Specification, External Software Module Specification, Software Specification, System Specification (see product dependency 5.23)

External Hardware Module Specification, External Software Module Specification, Request for Proposal, Contract, Contract Addendum (see product dependency 5.53)

3.9.3.1 System Element Overview

The summary of system elements provides a brief survey of the »External Unit. It briefly describes tasks and objectives and the role within the system or »Enabling System.

3.9.3.2 Interface Specification

An interface represents the boundary between an external unit and its environment. It describes the data exchanged at the system boundary and their logic dependencies. Thus, the interface defines the services to be provided by the external unit. One »External Unit can support several interfaces.

The interface description collects all functional requirements posed on the external unit, specifies all interfaces and presents them in their environment. Together with the non-functional requirements, the interface description defines the information required for selecting the external unit. The interface description describes the interfaces to other system elements and the interfaces to the environment, e.g. the man-machine interface or interfaces to »Enabling Systems.

The description of the functional interface is subdivided into the description of the static and dynamic behavior. The static behavior specifies the structure of the interface, through which the functionalities of the external unit can be used. The dynamic behavior determines the sequence of use. Contents and description of the interfaces may vary, depending on the fact as to whether the interface belongs to hardware or software components of the external unit. Hardware components will be specified by electrical and mechanical data, while software components will be specified by the description of methods, parameters and information on the behavior.

Static elements of a hardware interface include, e.g., information on electrical performance parameters (power, voltage, current, frequency, polarity), information on the mechanical design (type of connector, connector assignment, type of cable), or information on the technical design (function call and parameter list, transmission device, layout of a user interface). The description of the dynamic behavior includes, e.g., the determination of communication protols and their specification, the description of synchronization mechanisms and references to the use and operation of the interface.

The static behavior of a software interface determines the structure of the calls, through which the services of the software elements can be used. The description is mainly based on method signatures and definitions of data types. The dynamic behavior determines the possible sequence of the calls. The description of the dynamic behavior is frequently based on flowcharts (sequence charts, message sequence charts) or state transition diagrams.

The interface description is based on the summary of interfaces in the architecture and on the interface realizations of the »System Specifications of higher system elements.

3.9.3.3 Non-Functional Requirements

In addition to the functional requirements, an »External Unit must fulfill several non-functional requirements. The non-functional requirements posed on an external unit are similary to the non-functional requirements posed on a system element.

The non-functional requirements will be described in detail and specified by the actually required values. The non-functional requirements relevant for the external unit will be derived from the specifications of higher system elements or the Overall System Specification.

3.9.3.4 Acceptance Criteria and Receiving Evaluation Criteria

Acceptance criteria specify the criteria to be fulfilled by the »External Unit in order to meet the requirements of the »External Unit Specification. They should be presented in measurable form. From the contractual point of view, the acceptance criteria describe the conditions for the decision as to whether the external unit fulfills the requirements or not. The acceptance criteria apply to functional and non-functional requirements.

Layout and number of acceptance criteria shall be outlined by the acquirer. The acceptance criteria should be structured in accordance with the three main elements - initial situation, action(s) and expected result. In any case, the expected results shall be specified for each acceptance criterion.

The on-receipt test determines whether the acceptance criteria are fulfilled. The acceptance criteria are included as requirements into the »Evaluation Specification Delivery.

3.9.4 Hardware Specification

Process module: Hardware Development

Responsible: Hardware Architect (when using process module Hardware Development)

Activity: Preparing Hardware Specification

Participating: Hardware Developer, Logistics Developer, Ergonomics Manager, Safety Manager

Purpose

The »Hardware Specification describes all functional and non-functional requirements posed on a hardware element (hardware unit, »Hardware Components or hardware process module). In order to prepare the Hardware Specification, the requirements will be derived from the specifications of higher system elements or hardware elements. The specification provides standards and tools for designing and decomposing the »Hardware Architecture. If changes are required in the course of the development of the hardware element, the Hardware Specification shall be adapted at first. The »Evaluation Specification System Element defines the evaluation cases required for demonstrating the requirements of interfaces and specifications.

The Hardware Specification mainly describes the requirements posed on the hardware element and specifies the connected interfaces. In addition, requirements and interfaces will be refined and allocated to lower hardware elements.

The requirements tracing ensures that all requirements posed on the respective elements will be taken into account when the next hierarchy level will be refined. The Hardware Specification will be prepared together with the architecture design of the »Hardware Units. The »Hardware Architect is responsible for the preparation of these products, thus ensuring the consistency between specification and architecture.

Requirements of the Hardware Specification may influence the Logistic Support Specification, just as logistic requirements may influence the Hardware Specification.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.6)

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.8)

Depends on

Man-Machine Interface (Style Guide), Software Specification, System Specification (see product dependency 5.7)

External Hardware Module Specification, Logistic Support Specification, External Software Module Specification, Software Specification, External Unit Specification, System Specification (see product dependency 5.23)

3.9.4.1 Hardware Element Overview

The »Hardware Element Overview provides a brief survey of the hardware element to be realized. It outlines tasks and objectives of the hardware element, e.g., by means of a block diagram with explanatory notes. For a better understanding, the role of the element within the system, a »Enabling System or a »Hardware Unit will be described.

3.9.4.2 Interface Specification

An interface represents the boundary between a hardware element and its environment. It describes the data exchanged at the system boundary and their logic dependencies. Thus, the interface defines the services to be provided by the hardware element. One hardware element can support several interfaces.

The interface description collects all functional requirements posed on the hardware element, specifies all interfaces and presents them in their environment. Together with the non-functional requirements, the interface description defines the information required for developing the hardware element. The interface description describes the interfaces to other hardware elements and the interfaces to the environment, e.g. the man-machine interface or interfaces to »Enabling Systems.

The description of the functional interface is subdivided into the description of the static elements and the description of the dynamic behavior. The static behavior specifies the structure of the interface, through which the functionalities of the hardware element can be used. The dynamic behavior determines the sequence of use and the logic dependencies of the transmitted data and signals.

Static elements of a hardware interface include, e.g., information on electrical performance parameters (power, voltage, current, frequency, polarity), information on the mechanical design (type of connector, connector assignment, type of cable), or information on the technical design (function call and parameter list, transmission device, layout of user interface). The description of the dynamic behavior includes, e.g., the determination of communication protocols and their specification, the description of synchronization mechanisms and references for the use and operation of the interface. The description of functional sequences and data flows in normal, borderline and exceptional cases is also part of the dynamic behavior. Frequent interfaces of hardware elements include the following:

- External communication interfaces for operations
- Test and diagnosis interfaces (e.g., JTAG, switches, LED's)
- Electrical, mechanical, hydraulic or pneumatic interfaces

Ideally, the description of the communication interfaces will be based on the layers of the OSI reference model.

The interface description is based on the summary of interfaces in the architecture and on the interface realizations of the »System Specifications of higher system elements. The interface description should consider if a re-use of already existing system elements is possible. In addtion, it should be ensured that the interface is stable, thus allowing a long use of the hardware element.

3.9.4.3 Non-Functional Requirements

In addition to the functional requirements, a hardware element must fulfill several non-functional requirements. Non-functional requirements are particularly important for hardware elements. They include at least the following requirements:

- Computational capability as referred to computer architecture,
- memory requirements (VM, NVM),
- reliability (operation and storage, e.g. avoidance of metastability of programmable logic or data retention time in case of PROMS),
- safety and security,
- »Logistic Requirements (reliability, availability, maintainability, replaceability, repairability, usability, operability, disposal),
- efficiency (power consumption, voltages, power supply units),
- EMC (electromagnetic compatibility),
- CE, »VDE,
- environmental conditions,
- legal requirements (safety and security, hazardous substances, etc.)
- technologies to be used,
- specifications for component selection,
- materials, screening, marking, interfaces, heat management,
- confidentiality and security (e.g., no user interface, encryption for ensuring the confidentiality of fixedly coded secret system parameters).

The non-functional requirements will be described in detail and specified by the actually required values. The non-functional requirements relevant for the hardware element will be derived from the specifications of higher system elements or hardware elements.

3.9.4.4 Interface Realization

The interface realization refines the functional requirements of the interface description. Requirements and interfaces will be concretized, refined and allocated to the hardware elements of the lower hierarchy levels.

The interface realization is based on the »Hardware Architecture of the higher »Hardware Unit. »Hardware Components and »Hardware Modules of the different hierarchy levels will be identified within the scope of the decomposition process.

3.9.4.5 Refinement of Non-Functional Requirements

Non-functional requirements are refined in parallel to functional requirements during the interface realization. The non-functional requirements will be concretized, refined and allocated to the hardware elements of the lower hierarchy level. For example, a testability requirement may be reflected in a a JTAG test interface and the definition of a precise requirement posed on the boundary scan test coverage. The refined requirements remain in existence as autonomous requirements or will be integrated into the interface realization.

3.9.4.6 Requirements Tracing

The requirements tracing summarizes the allocation of functional and non-functional requirements posed on the hardware element to the refined requirements and lower hardware elements. It is based on the results of the interface realization and the refinement of non-functional requirements. The bidirectional trackability (i.e. from higher to lower hardware elements and vice versa) must be ensured. The data may be presented, e.g., in form of a matrix.

3.9.5 Software Specification

Process module: Software Development

Responsible: Software Architect (when using process module Software Development)

Activity: Preparing Software Specification

Participating: Software Developer, Logistics Developer, Ergonomics Manager, Inspector, Safety Manager

Purpose

The »Software Specification describes all functional and non-functional requirements posed on a software element (software unit, »Software Component or software process module). In order to prepare the Software Specification, the requirements will be derived from the specifications of higher system elements or software elements. The specification provides standards and tools for designing and decomposing the »Software Architecture. If changes are required in the course of the development of the software element, the Software Specification shall be adapted at first. The »Evaluation Specification System Element defines the evaluation cases required for demonstrating the requirements of interfaces and specifications.

The Software Specification mainly describes the requirements posed on the software element and specifies the connected interfaces. In addition, requirements and interfaces will be refined and allocated to lower software elements.

The requirements tracing ensures that all requirements posed on the respective elements will be taken into account when the next hierarchy level will be refined. The Software Specification will be prepared together with the architecture design of the »Software Unit. The »Software Architect is responsible for the preparation of these products, thus ensuring the consistency between specification and architecture.

Requirements of the Software Specification may influence the Logistic Support Specification, just as logistic requirements may influence the Software Specification.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.17)

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.19)

Depends on

Man-Machine Interface (Style Guide), Hardware Specification, System Specification (see product dependency 5.7)

External Hardware Module Specification, Hardware Specification, Logistic Support Specification, External Software Module Specification, External Unit Specification, System Specification (see product dependency 5.23)

3.9.5.1 Software Element Overview

The »Software Element Overview provides a brief survey of the software element to be realized. It outlines tasks and objectives of the software element. For a better understanding, the role of the element within the system, a »Enabling System or a »Software Unit will be described.

3.9.5.2 Interface Specification

An interface represents the boundary between a software element and its environment. It describes the data exchanged at the element boundary and their logic dependencies. Thus, the interface defines the services to be provided by the software element. One software element can have several interfaces.

The interface description collects all functional requirements posed on the software element, specifies all interfaces and presents them in their environment. Together with the non-functional requirements, the interface description defines the information required for developing the software element. The interface description describes the interfaces to other software elements and the interfaces to the environment, e.g. the graphical user interface or interfaces to »Enabling Systems.

The description of the functional interface is subdivided into the description of the static and dynamic behavior. The static behavior determines the structure of the calls, through which the services of the software elements can be used. The description is mainly based on method signatures and definitions of data types. The dynamic behavior determines the sequence of calls and the logic dependencies of the transmitted data. The description of the dynamic behavior is frequently based on flowcharts (sequence charts, message sequence charts) or state transition diagrams.

The interface description is based on the summary of interfaces in the architecture and on the interface realizations of the »System Specifications of higher system elements. The interface description should consider if a re-use of already existing software elements is possible. In addtion, it should be ensured that the interface is stable, thus allowing a long use of the software element.

3.9.5.3 Non-Functional Requirements

In addition to the functional requirements, a software element must fulfill several non-functional requirements. Frequently demanded non-functional requirements - especially for software elements - include, e.g., usability, response time, transaction rate, confidentiality, or data integrity.

The non-functional requirements will be described in detail and specified by the actually required values. The non-functional requirements relevant for the software element will be derived from the specifications of higher system elements or software elements.

3.9.5.4 Interface Realization

The interface realization refines the functional requirements of the interface description. Requirements and interfaces will be concretized, refined and allocated to the software elements of the lower hierarchy levels.

The interface realization is based on the »Hardware Architecture of the higher »Hardware Unit. »Hardware Components and »Hardware Modules of the different hierarchy levels will be identified within the scope of the decomposition process.

The interface realization is based on the »Software Architecture of the higher »Software Unit. »Software Components and »Software Modules of the different hierarchy levels will be identified within the scope of the decompositoin process.

3.9.5.5 Refinement of Non-Functional Requirements

Non-functional requirements are refined in parallel to functional requirements during the interface realization. The non-functional requirements will be concretized, refined and allocated to the software elements of the lower hierarchy level.

For example, a maximum rsponse time of 0.5 seconds, which was required in the interface description, may be refined by dividing it onto two software elements, each with a required maximum response time of 0.25 seconds.

The refined requirements remain in existence as autonomous requirements or will be integrated into the interface realization.

3.9.5.6 Requirements Tracing

The requirements tracing summarizes the allocation of functional and non-functional requirements posed on the software element to the refined requirements and lower software elements. It is based on the results of the interface realization and the refinement of non-functional requirements. The bidirectional trackability (i.e. from higher to lower software elements and vice versa) must be ensured. The data may be presented, e.g., in form of a matrix.

3.9.6 External Hardware Module Specification

Process module: Hardware Development

Responsible: Hardware Architect (when using process module Hardware Development)

Activity: Preparing External Hardware Module Specification

Participating: Hardware Developer, Logistics Developer, Ergonomics Manager, Inspector, Safety Manager

Purpose

The »External Hardware Module Specification describes all functional and non-functional requirements posed on an »External Hardware Module. In order to prepare the specification, the requirements will be derived from the specifications of higher system elements. If changes are required in the course of the following development, the applicable specification shall be adapted at first. The »Evaluation Specification System Element defines the evaluation cases required for demonstrating the requirements of interfaces and specifications.

The External Hardware Module Specification mainly describes the requirements posed on the work product External Hardware Module and specifies the connected interfaces.

The requirements tracing ensures that all requirements posed on the respective elements will be taken into account. The External Hardware Module Specification will be prepared together with the architecture design of the »Hardware Units. The »Hardware Architect is responsible for the preparation of these products, thus ensuring the consistency between specification and architecture.

Requirements of the External Hardware Module Specification may influence the Logistic Support Specification, just as logistic requirements may influence the External Hardware Module Specification.

Is generated by

Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept (see product dependency 4.7)

Depends on

Make-or-Buy Decision (see product dependency 5.14)

Hardware Specification, Logistic Support Specification, External Software Module Specification, Software Specification, External Unit Specification, System Specification (see product dependency 5.23)

External Software Module Specification, External Unit Specification, Request for Proposal, Contract, Contract Addendum (see product dependency 5.53)

3.9.6.1 External Hardware Module Overview

The »External Hardware Module Overview provides a brief survey of the work product External Hardware Module, which is to be realized. It outlines tasks and objectives of the work product External Hardware Module, e.g., by means of a block diagram with explanatory notes. For a better understanding, the role of the element within a »Hardware Unit will be described.

3.9.6.2 Interface Specification

An interface represents the boundary between a a work product of the type External Hardware Module and its environment. It describes the data exchanged at the system boundary and their logic dependencies. Thus, the interface defines the services to be provided by the work product External Hardware Module. One External Hardware Module can support several interfaces.

The interface description collects all functional requirements posed on the work product External Hardware Module, specifies all interfaces and presents them in their environment. Together with the non-functional requirements, the interface description defines the information required for developing the work product External Hardware Module. The interface description describes the interfaces to other hardware elements and the interfaces to the environment, e.g. the man-machine interface or interfaces to »Enabling Systems.

The description of the functional interface is subdivided into the description of the static elements and the description of the dynamic behavior. The static behavior specifies the structure of the interface, through which the functionalities of the work product External Hardware Module can be used. The dynamic behavior determines the sequence of use and the logic dependencies of the transmitted data and signals.

Static elements of a hardware interface include, e.g., information on electrical performance parameters (power, voltage, current, frequency, polarity), information on the mechanical design (type of connector, connector assignment, type of cable), or information on the technical design (function call and parameter list, transmission device, layout of user interface). The description of the dynamic behavior includes, e.g., the determination of communication protocols and their specification, the description of synchronization mechanisms and references for the use and operation of the interface. The description of functional sequences and data flows in normal, borderline and exceptional cases is also part of the dynamic behavior. Frequent interfaces of hardware elements include the following:

- External communication interfaces for operations
- Test and diagnosis interfaces (e.g., JTAG, switches, LED's)
- Electrical, mechanical, hydraulic or pneumatic interfaces

Ideally, the description of the communication interfaces will be based on the layers of the OSI reference model.

The interface description is based on the summary of interfaces in the architecture and on the interface realizations of the »System Specifications of higher system elements.

The interface description should consider if a re-use of already existing system elements is possible. In addtion, it should be ensured that the interface is stable, thus allowing a long use of the hardware element.

3.9.6.3 Non-Functional Requirements

In addition to the functional requirements, an external hardware module must fulfill several non-functional requirements. Non-functional requirements are particularly important for hardware elements. They include at least the following requirements:

- Computational capability as referred to computer architecture,
- memory requirements (VM, NVM),
- reliability (operation and storage, e.g. avoidance of metastability of programmable logic or data retention time in case of PROMS),
- safety and security,
- »Logistic Requirements (reliability, availability, maintainability, replaceability, repairability, usability, operability, disposal),
- efficiency (power consumption, voltages, power supply units),
- EMC (electromagnetic compatibility),
- CE, »VDE,
- environmental conditions,
- legal requirements (safety and security, hazardous substances, etc.)
- technologies to be used,
- specifications for component selection,
- materials, screening, marking, interfaces, heat management,
- confidentiality and security (e.g., no user interface, encryption for ensuring the confidentiality of fixedly coded secret system parameters).

The non-functional requirements will be described in detail and specified by the actually required values. The non-functional requirements relevant for the work product External Hardware Module will be derived from the specifications of higher system elements or hardware elements.

3.9.6.4 Acceptance Criteria and Receiving Evaluation Criteria

Acceptance criteria specify which criteria must be fulfilled in order to ensure that the delivered work product of the type External Hardware Module fulfills the requirements of the External Hardware Module Specification. The acceptance criteria shall be presented in a measurable way. From a contractual point of view, the acceptance criteria describe the conditions for the decision as to whether the work product of the type External Hardware Module fulfills the applicable requirements or not. Acceptance criteria refer to functional and non-functional requirements.

The acquirer shall outline structure and number of acceptance criteria. The acceptance criteria should be structured in accordance with their significant components: initial situation, action(s) and expected result. In any case, the expected acceptance results must be specified for each acceptance criterion.

The receiving evaluation determines if the acceptance criteria are fulfilled. Thus the acceptance criteria are included as requirements into the Evaluation Specification Delivery.

3.9.7 External Software Module Specification

Process module: Software Development

Responsible: Software Architect (when using process module Software Development)

Participating: Software Developer, Logistics Developer, Ergonomics Manager, Safety Manager, Inspector

Purpose

The »External Software Module Specification describes all functional and non-functional requirements posed on an »External Software Module. In order to prepare the Software Specification, the requirements will be derived from the specifications of higher system elements. If changes are required in the course of the following development, the applicable specification shall be adapted at first. The »Evaluation Specification System Element defines the evaluation cases required for demonstrating the requirements of interfaces and specifications.

The External Software Module Specification mainly describes the requirements posed on the external software and specifies the connected interfaces.

The requirements tracing ensures that all requirements posed on the respective elements will be taken into account. The External Software Module Specification will be prepared together with the architecture design of the »Software Units. The »Software Architect is responsible for the preparation of these products, thus ensuring the consistency between specification and architecture.

Requirements of the External Software Module Specification may influence the Logistic Support Specification, just as logistic requirements may influence the External Software Module Specification.

Is generated by

Software Implementation, Integration and Evaluation Concept, Software Architecture (see product dependency 4.18)

Depends on

Make-or-Buy Decision (see product dependency 5.15)

External Hardware Module Specification, Hardware Specification, Logistic Support Specification, Software Specification, External Unit Specification, System Specification (see product dependency 5.23)

External Hardware Module Specification, External Unit Specification, Request for Proposal, Contract, Contract Addendum (see product dependency 5.53)

3.9.7.1 External Software Module Overview

The »External Software Module Overview provides a brief survey of the work product External Software Module, which is to be realized. It outlines tasks and objectives of the work product External Software Module. For a better understanding, the role of the element within a »Software Unit will be described.

3.9.7.2 Interface Specification

An interface represents the boundary between an external software module and its environment. It describes the data exchanged at the element boundary and their logic dependencies. Thus, the interface defines the services to be provided by the external software module. One software module can have several interfaces.

The interface description collects all functional requirements posed on the work product External Software Module, specifies all interfaces and presents them in their environment. Together with the non-functional requirements, the interface description defines the information required for developing the work product External Software Module. The interface description describes the interfaces to other software elements and the interfaces to the environment, e.g. the graphical user interface or interfaces to »Enabling Systems.

The description of the functional interface is subdivided into the description of the static and dynamic behavior. The static behavior determines the structure of the calls, through which the services of the work product External Software Module can be used. The description is mainly based on method signatures and definitions of data types. The dynamic behavior determines the sequence of calls and the logic dependencies of the transmitted data. The description of the dynamic behavior is frequently based on flowcharts (sequence charts, message sequence charts) or state transition diagrams.

The interface description is based on the summary of interfaces in the architecture and on the interface realizations of the »System Specifications of higher system elements. The interface description should consider if a re-use of already existing software elements is possible. In addtion, it should be ensured that the interface is stable, thus allowing a long use of the work product External Software Module.

3.9.7.3 Non-Functional Requirements

In addition to the functional requirements, an external software module must fulfill several non-functional requirements. Frequently demanded non-functional requirements - especially for software elements - include, e.g., usability, response time, transaction rate, confidentiality, or data integrity.

The non-functional requirements will be described in detail and specified by the actually required values. The non-functional requirements relevant for the work product of the type External Software Module will be derived from the specifications of higher system elements or software elements.

3.9.7.4 Acceptance Criteria and Receiving Evaluation Criteria

Acceptance criteria specify which criteria must be fulfilled in order to ensure that the delivered work product of the type External Software Module fulfills the requirements of the External Software Module Specification. The acceptance criteria shall be presented in a measurable way. From a contractual point of view, the acceptance criteria describe the conditions for the decision as to whether the work product of the type External Software Module fulfills the applicable requirements or not. Acceptance criteria refer to functional and non-functional requirements.

The acquirer shall outline structure and number of acceptance criteria. The acceptance criteria should be structured in accordance with their significant components: initial situation, action(s) and expected result. In any case, the expected acceptance results must be specified for each acceptance criterion.

The receiving evaluation determines if the acceptance criteria are fulfilled. Thus the acceptance criteria are included as requirements into the Evaluation Specification Delivery.

3.10 System Design

The »Discipline System Design includes »Work Products and »Activityies supporting the architectural design and defining a suitable development process.

In the V-Modell, the architectural design is developed at two hierarchy levels - the level of the system or »Enabling System and the unit level. The preliminary design and the design decisions are documented in specific architectural documents. The development process and the integration and evaluation process are specified in the appropriate implementation, integration and evaluation concepts.

Architectural documents and implementation, integration and evaluation concepts are closely connected. It must be possible to develop all system, hardware and »Software Elements identified in the architecture by using the respective implementation, integration and evaluation concept. In addition, system architecture and integration architecture must be consistent in order to ensure the correct implementation of architectural decisions.

The discipline System Design includes an additional product especially for migration projects - the so-called »Migration Concept. This concept specifies the mapping of the legacy system and the new system and the execution of the migration.

3.10.1 System Architecture

Process module:	System Development
Responsible:	System Architect (when using process module System Development)
Activity:	Preparing System Architecture
Participating:	Software Architect, Hardware Architect, Logistics Manager

Purpose

The System Architect is tasked with designing a suitable system architecture based on the functional and non-functional system requirements. The architectural products will be used as guideline and for documenting the design decisions.

In the first step, significant architectural principles will be specified, and possible design alternatives will be examined. In accordance with the selected design alternative, the system will be decomposed into »Segments, hardware, software, and »External Unit. Relations and interfaces between the elements and to the environment will be identified and summarized. In addition, joint system charactistics like safety and security concept, transaction concept and logging concept, will be specified.

The suitability of the selected architecture for the system to be developed will be assessed. Open questions may be answered, e.g., within the scope of a prototype development.

The main responsibility for the architectural design is vested in the »System Architect, who will be supported by various specialists, e.g. for hardware development, software development, logistics, safety and security or ergonomics.

The architecture is the central document for the preparation of additional products. It specifies all segements, hardware, software and external units for the system. Based on the overall architecture, an architecture will be developed for every hardware or »Software Unit, and specifications will be prepared for the respective elements.

Is generated by

Overall System Specification (see product dependency 4.26)

Generates

Evaluation Report Usability, Evaluation Specification Usability, Evaluation Report Usability, Evaluation Specification Usability, Hardware Architecture, Hardware Unit, Hardware Specification, Hardware Implementation, Integration and Evaluation Concept, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.4)

Evaluation Report Usability, Evaluation Specification Usability, Software Implementation, Integration and Evaluation Concept, Software Architecture, Software Unit, Software Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.15)

Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Unit, External Unit Specification, Make-or-Buy Decision, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.20)

Evaluation Report Usability, Evaluation Specification Usability, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Segment, System Specification, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.23)

Depends on

Logistic Calculations and Analyses, Enabling System Architecture (see product dependency 5.22)

Overall System Specification, Legacy System Analysis (see product dependency 5.59)

Example Work Products

»FWD:System Architecture

3.10.1.1 Architectural Principles and Design Alternatives

Normally, there are several architectural solutions for every system or »Enabling System, each of which has advantages and disadvantages. The description of the underlying architectural principles and possible design alternatives document the decision process for the finally selected architecture and provide the basis for its assessment.

Architectural principles are standards which are decisive for the the architectural design, e.g., due to the system type or other system characteristics. At system level, these principles may include, e.g., the application domain (embedded system, information system) or the decision for a distributed system.

Design alternatives describe the different possibilities for the »System Decomposition into »Segments, hardware, software and »External Units. For every alternative, the advantages and disadvantages will be identified, and the solution will be assessed based on a criteria list to be defined. At system level, e.g., model architectures may be used for searching possible design alternatives.

Conditions for architectural principles and restrictions for possible design alternatives are particularly due to the requirements of the »System Specification or the Overall System Specification.

3.10.1.2 System Decomposition

The decomposition specifies the static structure of the system or »Enabling System. The static structure describes the dissection into »Segments and units. The design result will be documented as graph depicting the segment types and unit types to be realized and their interrelations.

Every unit identified during the decomposition will be defined as hardware, software or »External Unit.

The decomposition is based on the requirements posed in the »System Specification. The framework conditions for the decomposition will be specified by the architectural principles defined in the system architecture or »Enabling System Architecture and the design decisions.

3.10.1.3 Overall System Characteristics

The characteristics of a system or »Enabling System may be subdivided into specific system element characteristics and common system characteristics. Solutions for specific system element characteristics will be described in the specification for the respective system element. Solutions for common system characteristics will be described in this subject.

Typical common characteristics of software systems include, e.g., transaction requirements, persistence of data or logging and tracing requirements. For hardware systems, joint characteristics may include, e.g., uniform connector assignments or common safety and security requirements. The overall system characteristics to be taken into account will be determined in this subject.

3.10.1.4 Interface Overview

The summary of interfaces of the system architecture or »Enabling System Architecture provides a survey of the system interfaces and the interfaces of the system elements. For the summary of interfaces, only the communication at one level will be described :

- At the level of the system or »Enabling System, the interfaces between the systems and the interfaces to the environment will be described.
- At »Segment level, the interfaces between the segments within the system or enabling system will be described.
- At unit level, the interfaces between the units within a segment will be described.

Interfaces to the environment may exist between a system or enabling system and the user (user interface), logistic systems (documentation) or various enabling systems (measuring and test equipment, spare parts). The interfaces are described in detail in the specification of the respective system element.

3.10.1.5 Overall Data Catalog

Systems and system elements communicate by exchanging data. At hardware level, data are exchanged as signals, at software level, they are exchanged as serializable data transport objects. The Joint »Data Catalog of a system or »Enabling System describes all data structures and signals exchanged at the interfaces and any possibly assigned values.

Data and signals of the system are used as preset values for the data catalog for »Software Units and for the »Data and Signal Catalog of the »Hardware Units.

3.10.1.6 Design Evaluation

If an architectural design has been selected and developed down to unit level, it must be ensured that the selected design implements the requirements in a suitable manner. This will be tested and documented by a design verification.

The Subject Design Evaluation specifies the methods to be used for design verification and the critieria for testing whether the design fulfills the requirements. The development of prototypes is a method which is frequently used for verifying the design. If this method is employed in a preliminary project, the user can also use the prototype in order to check the requirements for completeness.

The design verification will be based on the functional and non-functional requirements of the »System Specification and the identfied architectural principles. Execution and results of the verification will be documented. They may lead to a re-evaluation of the design decisions and a review of the architecture.

3.10.1.7 System Elements to be Specified

The preparation of a specification for a system element is expensive and not always required. In order to adapt the specification effort to the requirements of individual projects, the »System Architect can - based on the specifications in the Project Manual and the requirements - determine which system elements need a »System Specification.

Critiera for the necessity of a specification may include the following: safety and security of the system elment, complexity of the requirements posed on the system element, test requirements specified in the »QA Manual and the respective implementation, integration and evaluation concept. In any case, a system specification shall be prepared for system elements to be tested since this specification will be the basis for the »Evaluation Specification System Element .

If system elements are classified as not to be specified, a rationale shall be included.

3.10.2 Enabling System Architecture

Process module:	System Development
Responsible:	System Architect (when using process module System Development)
Activity:	Preparing Enabling System Architecture
Participating:	Software Architect, Hardware Architect, Logistics Manager

Purpose

The System Architect is tasked with designing a suitable »Enabling System Architecture based on the functional and non-functional »Enabling System requirements. The architectural products will be used as guideline and for documenting the design decisions.

In the first step, significant architectural principles will be specified, and possible design alternatives will be examined. In accordance with the selected design alternative, the system will be decomposed into »Segments, hardware, software, and »External Units. Relations and interfaces between the elements and to the environment will be identified and summarized. In addition, joint system charactistics like safety and security concept, transaction concept and logging concept, will be specified. The suitability of the selected architecture for the system to be developed will be assessed. Open questions may be answered, e.g., within the scope of a prototype development.

The main responsibility for the architectural design is vested in the »System Architect, who will be supported by various specialists, e.g. for hardware development, software development, logistics, safety and security or ergonomics.

The architecture is the central document for the preparation of additional products. It specifies all segements, hardware, software and external units for the enabling system. Based on the overall architecture, an architecture will be developed for every hardware or »Software Unit, and specifications will be prepared for the respective elements.

Is generated by

Overall System Specification (see product dependency 4.25)

Generates

Evaluation Report Usability, Evaluation Specification Usability, Hardware Architecture, Hardware Unit, Hardware Specification, Hardware Implementation, Integration and Evaluation Concept, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.5)

Evaluation Report Usability, Evaluation Specification Usability, Software Implementation, Integration and Evaluation Concept, Software Architecture, Software Unit, Software Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.16)

Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Unit, External Unit Specification, Make-or-Buy Decision, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.21)

Evaluation Report Usability, Evaluation Specification Usability, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Segment, System Specification, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.24)

Depends on

Logistic Calculations and Analyses, System Architecture (see product dependency 5.22)

3.10.2.1 Architectural Principles and Design Alternatives

See Architectural Principles and Design Alternatives in product System Architecture.

3.10.2.2 Enabling System Decomposition

See System Decomposition in product System Architecture.

3.10.2.3 Overall System Characteristics

See Overall System Characteristics in product System Architecture.

3.10.2.4 Interface Overview

See Interface Overview in product System Architecture.

3.10.2.5 Overall Data Catalog

See Overall Data Catalog in product System Architecture.

3.10.2.6 Design Evaluation

See Design Evaluation in product System Architecture.

3.10.2.7 System Elements to be Specified

See System Elements to be Specified in product System Architecture.

3.10.3 Man-Machine Interface (Style Guide)

Process module: Usability and Ergonomics

Responsible: Ergonomics Manager (when using process module Usability and Ergonomics)

Activity: Preparing Style Guide for Man-Machine Interface

Purpose

Mandatory specifications are necessary in order to ensure a uniform design of a (graphical) user interface or to hamonize the interface with a prespecified layout. The Product Man-Machine Interface, frequently also referred to as styleguide if used within the scope of software development, defines regulations and criteria for the design of the man-machine interface.

The regulations include, e.g., design rules for interface elements - e.g. haptic and optical characteristics - design rules for the graphical user interface and design rules for the hardware interface.

The »Ergonomics Manager is responsible for the styleguide. He is tasked with deriving the rules from the requirements and the »User Tasks Analysis or with developing them in cooperation with the acquirer. All designs developed within the scope of the system, hardware and »Software Specification shall implement the specifications of the styleguide.

Is generated by

Overall System Specification (see product dependency 4.26)

Overall System Specification (see product dependency 4.25)

Depends on

Hardware Specification, Software Specification, System Specification (see product dependency 5.7)

3.10.3.1 Design Principles and Alternatives

Design principles specify general guidelines for designing the man-machine interface. They will be derived from the »User Tasks Analysis and identfied based on generally acknowledged standards.

Mandatory principles for the design of ergonomic user interfaces are defined by standard EN ISO 9241 as follows:

- Task adequacy
- Self-descriptiveness
- Controllabilty
- Expectation conformity
- Fault tolerance
- Individualisability
- Learning suitability.

3.10.3.2 Identification and Structure of Operation Elements

The identification of all operation elements integrated into the structure of the interface is the first step for determining the design regulations for a user interface.

The list of operation elements will be derived from the requirements and complemented and completed when the user interface is designed. The structure of compound operation elements will be described.

3.10.3.3 Design Rules for Operation Elements

Design regulations define the "Look and Feel" of operation elements. They are allocated to each identified modular or compound operation element. For a graphical user interface, e.g., the look of a text field, the design of a table or the color of the background may be determined. These requirements shall be implemented in the specifications of system elements.

3.10.4 Hardware Architecture

Process module: Hardware Development

Responsible: Hardware Architect (when using process module Hardware Development)

Activity: Preparing Hardware Architecture

Participating: Hardware Developer, System Architect, System Integrator

Purpose

Based on the functional and non-functional requirements posed on a »Hardware Unit, the »Hardware Architect is tasked with designing a suitable »Hardware Architecture. The Product Hardware Architecture will be used as design guide and for documenting the design decisions.

As in the system architecture development, significant architectural principles will be specified, and possible design alternatives will be examined. In accordance with the selected design alternative, the hardware unit will be decomposed into »Hardware Component, »Hardware Modules and External Hardware Modules. Relations and interfaces between the elements and to the environment will be identified and summarized. A »Data and Signal Catalog of the signals exchanged at the interfaces will be prepared. The suitability of the selected architecture for the system to be developed will be assessed. Open questions may be answered, e.g., within the scope of a prototype development.

The result of the architectural design will be documented in a set of drawings for the hardware unit, which includes all documents required for production, e.g., outline of structure, drawings, assembly instructions, list of parts, circuit and connection diagrams, layout and delivery instructions.

The hardware architecture design may lead to changes in the system architecture. Depending on the specifications in the Project Manual, the »System Architect will examine the change and integrate it immediately, if required. In individual cases, an explicit change request may be necessary.

The main responsibility for the design of the hardware architecture will be vested in the Hardware Architect who will be supported by the »Hardware Developer and various specialists for individual subjects, e.g., logistics, safety and security, and ergonomics.

The hardware architecture is the central document for the preparation of additional products. It specifies all hardware components and hardware modules of the hardware unit. The individual elements and their specifications will be devleoped in accordance with these architectural requirements.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Generates

Evaluation Report Usability, Evaluation Specification Usability, Hardware Component, Hardware Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.6)

Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Hardware Module, External Hardware Module Specification, Make-or-Buy Decision, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.7)

Evaluation Report Usability, Evaluation Specification Usability, Hardware Module, Hardware Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.8)

3.10.4.1 Architectural Principles and Design Alternatives

The description of the Subject Architectural Principles and Design Alternatives is similar to the Subject Architectural Principles and Design Alternatives of the system architecture. The architectural principles at hardware level include, e.g., specifications for standards and guidelines which must be observed. Design alternatives at hardware level describe various possibilities for the »Hardware Unit Decomposition into »Hardware Components and »Hardware Modules.

3.10.4.2 Hardware Unit Decomposition

The decomposition specifies the static structure of the »Hardware Unit. The static structure describes the dissection of the hardware unit into »Hardware Components and »Hardware Modules. The design result will be documented as graph depicting the hardware elements to be realized and their interrelations. All hardware components and hardware process modules will be listed with their identificators and a long name.

The decomposition is based on the requirements posed in the »Hardware Specification for the hardware unit or a higher system element. The framework conditions will be specified by the architectural principles defined in the »Hardware Architecture and the design decisions.

The results of the final decomposition step are the production data, e.g., drawings, circuit diagrams, lists of parts and connection diagrams. This includes a detailed description of programmable logic with function, call, parameter list, transmission device and resources employed.

3.10.4.3 Interface Overview

The summary of interfaces of the »Hardware Architecture provides a survey of the interfaces of the »Hardware Unit and the interfaces of the corresponding elements. For the summary of interfaces, only the communication at one level will be described :

- At the level of the hardware unit, the interfaces to other units and to the environment will be described.
- At the level ot the »Hardware Components, the interfaces between the component within the unit will be described.
- At the level of the »Hardware Modules, the interfaces between the process modules within the component will be described.

Interfaces to the environment may exist between a hardware element and the user, logistic systems or various »Enabling Systems. The interfaces are described in detail in the specification of the respective hardware element.

3.10.4.4 Data and Signal Catalog

The Data and Signal Catalog of the »Hardware Architecture describes all signals and variables exchanged at the interfaces of and within the »Hardware Unit, including designator, data type, data format, function and allocation of values.

3.10.4.5 Design Evaluation

If an architectural design for the »Hardware Unit has been selected and developed down to unit level, it must be ensured that the selected design implements the requirements in a suitable manner. The design security of the »Hardware Architecture specifies the analysis and assessment methods to be employed for the selected design. Frequently used procedures include, but are not limited to, the following:

- Reliability analyses for operation and storage based on prespecified standards
- Tolerance analyses, taking into account production tolerances
- Vibration and thermal analyses
- Board level simulation for ensuring the integrity of the signal
- Simulation and assessment of the emitted and received electromagnetic waves
- Analysis of the fulfillment of the confidentiality requirements
- Rapid prototyping of critical portions of programmable logic in order to ensure the feasibility for a prespecified number of gates and tractates.

Execution and results of the verification will be documented. They may lead to a re-evaluation of the design decisions and a review of the architecture.

3.10.4.6 Hardware Elements to be Specified

The preparation of a specification for a hardware element is expensive and not always required. In order to adapt the specification effort to the requirements of individual projects, the »Hardware Architect can - based on the specifications in the Project Manual and the requirements - determine which hardware elements need a »Hardware Specification.

Critiera for the necessity of a specification may include the following: criticality of the hardware elment, complexity of the requirements posed on the hardware element, test requirements specified in the »Hardware Implementation, Integration and Evaluation Concept. In any case, a hardware specification shall be prepared for hardware elements to be tested, since this specification will be the basis for the »Evaluation Specification System Element. If hardware elements are classified as not to be specified, a rationale shall be included.

3.10.5 Software Architecture

Process module: Software Development

Responsible: Software Architect (when using process module Software Development)

Activity: Preparing Software Architecture

Participating: Software Developer, System Architect, System Integrator

Purpose

For every software unit identified in the system architecture, a »Software Architecture will be developed. Based on the functional and non-functional requirements posed on a »Software Unit, the »Software Architect is tasked with designing a suitable »Software Architecture. The Product Software Architecture will be used as design guide and for documenting the design decisions.

As in the system architecture development, significant architectural principles will be specified, and possible design alternatives will be examined. In accordance with the selected design alternative, the software unit will be decomposed into »Software Component, »Software Modules and products of the type External Software Module. Relations and interfaces between the elements and to the environment will be identified and summarized. A »Data Catalog of the data structures exchanged at the interfaces will be prepared.

The suitability of the selected architecture for the system to be developed will be assessed. Open questions may be answered, e.g., within the scope of a prototype development.

The software architecture design may lead to changes in the system architecture. Depending on the specifications in the Project Manual, the »System Architect will examine the change and integrate it immediately, if required. In individual cases, an explicit change request may be necessary.

The main responsibility for the design of the software architecture will be vested in the Software Architect who will be supported by the »Software Developer and various specialists for individual subjects, e.g., logistics, safety and security, and ergonomics.

The software architecture is the central document for the preparation of additional products. It specifies all software components and software modules of the software unit. The individual elements and their specifications will be developed in accordance with these architectural requirements.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Generates

Evaluation Report Usability, Evaluation Specification Usability, Software Component, Software Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.17)

Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Software Module, External Software Module Specification, Make-or-Buy Decision, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.18)

Evaluation Report Usability, Evaluation Specification Usability, Software Module, Software Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.19)

Example Work Products

»FWD:Software Architecture ECU-SW

3.10.5.1 Architectural Principles and Design Alternatives

The description of the Subject Architectural Principles and Design Alternatives is similar to the Subject Architectural Principles and Design Alternatives of the system architecture.

The architectural principles at software level include, e.g., the decision for a programming paradigm (object-oriented, procedureal), the decision fo a technology (CORBA, EJB) or specifications for a special system type (distributed internet application, desktop application). Design alternatives for software development are supported, e.g., by design patterns, sample designs and design heuristics.

3.10.5.2 Software Unit Decomposition

The decomposition specifies the static structure of the »Software Unit. The static structure describes the dissection of the software unit into »Software Components and »Software Modules. The design result will be documented as graph depicting the software elements to be realized and their interrelations. It may also be presented by component and/or class diagrams.

The decomposition is based on the requirements posed in the »Software Specification for the software unit or a higher system element. The framework conditions will be specified by the architectural principles defined in the »Software Architecture and the design decisions.

3.10.5.3 Interface Overview

The summary of interfaces of the »Software Architecture provides a survey of the interfaces of the »Software Unit and the interfaces of the corresponding elements. For the summary of interfaces, only the communication at one level will be described :

- At the level of the software unit, the interfaces to other units and to the environment will be described.
- At the level ot the»Software Components, the interfaces between the component within the unit will be described.
- At the level of the»Software Modules, the interfaces between the process modules within the component will be described.

Interfaces to the environment may exist between a software element and the user, logistic systems or various »Enabling Systems. The interfaces are described in detail in the specification of the respective software element.

3.10.5.4 Data Catalog

The »Data Catalog of the »Software Architecture decribes the data structures exchanged at the interfaces of the »Software Unit, including attributes, data types and range of values. Every programming language and platform has its own solutions which must be taken into account during the definition phase.

3.10.5.5 Design Evaluation

If an architectural design for the »Software Unit has been selected and developed down to unit level, it must be ensured that the selected design implements the requirements in a suitable manner. Various methods are available for securing the design of the »Software Architecture. Two frequently used methods are the architecture evaluation by scenario-based methods and the prototype development of system parts. Execution and results of the design securing process will be documented. They may lead to a re-evaluation of the design decisions and a review of the architecture.

3.10.5.6 Software Elements to be Specified

The preparation of a specification for a software element is expensive and not always required. In order to adapt the specification effort to the requirements of individual projects, the »Software Architect can - based on the specifications in the Project Manual and the requirements - determine which software elements need a »Software Specification.

Critiera for the necessity of a specification may include the following: criticality of the software element, complexity of the requirements posed on the software element, test requirements specified in the software implementation, integration and evaluation concept. In any case, a software specification shall be prepared for software elements to be tested, since this specification will be the basis for the »Evaluation Specification System Element. If software elements are classified as not to be specified, a rationale shall be included.

3.10.6 Database Design

Process module: Software Development

Responsible: Software Architect (when using process module Software Development)

Activity: Preparing Database Design

Participating: Software Developer

Purpose

Data-centered software systems, e.g. information systems, need a persistent memory for data maintenance. Normally, one or more databases are used for this purpose. In this case, the system design must include an additional »Database Design. The database design supports the »Software Architect when he derives the technical »Data Model from the requirements and designs a physical database scheme.

The database design is based on the system entities to be saved in a persistent manner. The entities (relational data model) or classes (object-oriented data model) in their entirety represent the functional data model of the system. For the database design, all entities or classes of the system will be identified and summarized in the logical data model. Technical and physical data models are refinements and concretizations of the functional data model on the way to the database scheme. The Software Architect is responsible for the database design.

Is generated by

Overall System Specification (see product dependency 4.26)

Overall System Specification (see product dependency 4.25)

3.10.6.1 Logical Data Model

The logical »Data Model describes the entities or classes of the business model in their context. The relevant characteristics (attributes) and the interrelations of the entities or classes will be identified and described.

The logical data model can be presented as entity relationship diagram, class diagram or table. It is the basis for the design of the physical data model.

3.10.6.2 Physical Data Model

The physical »Data Model describes the concrete »Database Design. It is derived from the logical data model and will be used as specification for the database scheme in the database.

The physical data model allocates concrete data types to the attributes of the entities or classes. Primary and external keys will be specified, and relations will be defined. The model defines consistency conditions for changing the data. In case of relational databases, entities and attributes will be allocated to concrete tables and fields within the scheme.

Normaly, physical data models are designed by means of entity relationship diagrams or class diagrams. If suitable tools are used, the database scheme can be generated directly from the diagram.

3.10.7 System Implementation, Integration and Evaluation Concept

Process module: System Development

Responsible: System Architect (when using process module System Development)

Activity: Preparing System Implementation, Integration and Evaluation Concept

Participating: System Integrator, Hardware Developer, Software Architect, Safety Manager

Purpose

The »System Implementation, Integration and Evaluation Concept defines the realization and completion process for a system. It provides particularly the »System Integrator and the »Inspector with guidelines for their tasks.

The concept describes procedures, tools and environment for installation, integration and tests of system elements and systems in detail. At system level, the integration is based on the units developed within the scope of hardware and software development and the implementation of external units identified in the architecture. Depending on the complexity of the realization process or the heterogenity of the system to be developed, the concept may cover the entire system development or deal exclusively with the higher hierarchy levels down to unit level. In the latter case, an individual concept will be prepared for the development of Hardware and »Software Units.

The contents of the system implementation, integration and evaluation concept shall be consistent with the corresponding architecture. The design decisions made shall be implemented in a suitable manner. With respect to organization and framework conditions, the concept is determined by specifications in the Project Manual. For the scheduling of the integration and test process, the concept shall be coordinated with the »Integration and Evaluation Plan System Elements in the »Project Plan.

The »System Architect is responsible for the preparation of the concept. He will be supported by the System Integrator, who is finally reponsible for the completed system.

Integration and testing require a balanced strategy with regard to acquirer specifications, available integration and demonstration assets and the minimization of redundancies regarding the necessary compliance demonstration activities.

Normally, the environment to be used will be described in this concept. However, if an environment is required for the long-term support of the system life cycle, the environment shall be realized as independent »Enabling System.

Depending on the evaluation specifications, the test products for the individual system elements will be prepared.

Is generated by

Overall System Specification (see product dependency 4.26)

Project Manual, Overall System Specification (see product dependency 4.27)

Generates

Evaluation Report Usability, Evaluation Specification Usability, Evaluation Report Usability, Evaluation Specification Usability, Hardware Architecture, Hardware Unit, Hardware Specification, Hardware Implementation, Integration and Evaluation Concept, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.4)

Evaluation Report Usability, Evaluation Specification Usability, Software Implementation, Integration and Evaluation Concept, Software Architecture, Software Unit, Software Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.15)

Evaluation Report Usability, Evaluation Specification Usability, Software Implementation, Integration and Evaluation Concept, Software Architecture, Software Unit, Software Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.16)

Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Unit, External Unit Specification, Make-or-Buy Decision, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.20)

Evaluation Report Usability, Evaluation Specification Usability, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Segment, System Specification, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.23)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, External Unit, Segment, System (see product dependency 5.38)

Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, Project Plan (see product dependency 5.39)

Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, QA Manual, Enabling System Implementation, Integration, and Evaluation Concept (see product dependency 5.43)

3.10.7.1 Realization Procedures and Environment

A system element should be realized within the scope of a suitable environment and a defined realization process. At system level, however, this aspect is of subordinate importance. Realization procedures are mainly executed at hardware and software level.

3.10.7.2 Integration Procedures and Integration Plan

Integration procedures specify the integration environment and the integration tools. The integration plan defines the integration architecture and the sequence of the integration steps. It specifies the system element instances to be realized for the system element types defined in the architectures and determines the integration sequence.

For every Hardware or »Software Unit specified in the integration architecture, it will be determined if an independent implementation, integration and evaluation concept must be prepared or if the concept of the higher system specifies the development process down to process module level.

3.10.7.3 Installation Procedures and Target Environment

The development process also includes the identification of the required target environment and the description of the installation process. All target environments which may be used by the system in the different development phases shall be identified, and the installation procedures shall be specified. The Project Manual specifies conditions for the target environments to be supported. Frequently specified target environments include, but are not limited to, the development environment, a separate evaluation environment and an integration environment for simulating the final target platform.

The installation procedure and the required tools will be described for every identified target environment. The description of the procedure for installing the system on the target platform is based on the contents of this subject. It will be prepared within the scope of the logisitc »In-Service Documentation and delivered to the acquirer.

3.10.7.4 Evaluation Procedures and Strategy

A general evaluation strategy and a concrete test process shall be specified for all system elements. In this connection, economic efficiency, availability of evaluation environments, testability or test duration are important factors.

The test process specifies algorithms, test tools and test methods to be used for executing the tests. The concrete test procesure will be developed in the respective system element evaluation specifications.

The evaluation strategy will be derived from the specifications in the Project Manual and the »QA Manual. It specifies general rules and criteria for the execution of system element tests. Particularly the demonstrations and framework conditions required by the acquirer shall be taken into account for the evaluation strategy.

The evaluation strategy should be examined especially with regard to redundancy and risk reduction and with regard to the availability of existing tools.

3.10.7.5 System Elements to be Evaluated

The test of a system element is expensive and not always required. In order to adapt the effort to the requirements of individual projects, the »System Architect shall - based on the specifications in the Project Manual and the specified evaluation strategy - determine which system elements are to be tested.

Critiera for the necessity of a test may include the following: safety and security issues and complexity of the system element and its central role within the system. If system elements are classified as not to be tested, a rationale shall be included.

3.10.7.6 Safety and Security Relevant System Elements and Safety and Security Measures

See Safety and Security Relevant System Elements and Safety and Security Measures in product Enabling System Implementation, Integration, and Evaluation Concept.

3.10.8 Enabling System Implementation, Integration, and Evaluation Concept

Process module: System Development

Responsible: System Architect (when using process module System Development)

Activity: Preparing Enabling System Implementation, Integration and Evaluation Concept

Participating: System Integrator, Hardware Developer, Logistics Manager, Software Architect, Safety Manager

Purpose

The »Enabling System Implementation, Integration, and Evaluation Concept defines the realization and completion process for an enabling system. It provides particularly the »System Integrator and the »Inspector with guidelines for their tasks.

The concept describes procedures, tools and environments for installation, integration and tests of system elements and enabling systems in detail. At system level, the integration is based on the units developed within the scope of hardware and software development and the implementation of external units identified in the architecture. Depending on the complexity of the realization process or the heterogenity of the enabling system to be developed, the concept may cover the entire system development or deal exclusively with the higher hierarchy levels down to unit level. In the latter case, an individual concept will be prepared for the development of Hardware and »Software Units.

The contents of the enabling system implementation, integration and evaluation concept shall be consistent with the corresponding architecture. The design decisions made shall be implemented in a suitable manner. With respect to organization and framework conditions, the concept is determined by specifications in the Project Manual. For the scheduling of the integration and evaluation process, the concept shall be coordinated with the »Integration and Evaluation Plan System Elements in the »Project Plan.

The »System Architect is responsible for the preparation of the concept. He will be supported by the system integrator, who is finally reponsible for the completed system.

Integration and evaluation require a balanced strategy with regard to acquirer specifications, available integration and demonstration assets and the minimization of redundancies regarding the necessary compliance demonstration activities.

Normally, the environment to be used will be described in this concept. However, if an environment is required for the long-term support of the system life cycle, the environment shall be realized as independent »Enabling System.

Depending on the evaluation specifications, the test products for the individual system elements will be prepared.

Is generated by

Overall System Specification (see product dependency 4.25)

Project Manual, Overall System Specification (see product dependency 4.27)

Generates

Evaluation Report Usability, Evaluation Specification Usability, Hardware Architecture, Hardware Unit, Hardware Specification, Hardware Implementation, Integration and Evaluation Concept, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.5)

Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Unit, External Unit Specification, Make-or-Buy Decision, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.21)

Evaluation Report Usability, Evaluation Specification Usability, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Segment, System Specification, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.24)

Depends on

Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, QA Manual, System Implementation, Integration and Evaluation Concept (see product dependency 5.43)

3.10.8.1 Realization Procedures and Environment

See Realization Procedures and Environment in product System Implementation, Integration and Evaluation Concept.

3.10.8.2 Integration Procedures and Integration Plan

See Integration Procedures and Integration Plan in product System Implementation, Integration and Evaluation Concept.

3.10.8.3 Installation Procedures and Target Environments

See Installation Procedures and Target Environment in product System Implementation, Integration and Evaluation Concept.

3.10.8.4 Evaluation Procedures and Strategy

See Evaluation Procedures and Strategy in product System Implementation, Integration and Evaluation Concept.

3.10.8.5 System Elements to be Evaluated

See System Elements to be Evaluated in product System Implementation, Integration and Evaluation Concept.

3.10.8.6 Safety and Security Relevant System Elements and Safety and Security Measures

For every system element (the system itself or the system elements that will emerge during the decomposition), it shall be determined if it has a risk potential, how high is this risk potenital with regard to functional safety and security, to which safety and security level (sometimes also called criticality level, assurance level or evaluation assessment level) it belongs and whether the execution of a »Safety and Security Analysis is required. The safety and security requirements to be fulfilled will be derived from the specification of the system element.

System elements critical for system safety and security are elements which are of critical importance for fulfilling the safety and security requirements, i.e., the risk assessment/danger potential of which exceeds a prespecified threshold level.

3.10.9 Hardware Implementation, Integration and Evaluation Concept

Process module: Hardware Development

Responsible: Hardware Architect (when using process module Hardware Development)

Activity: Preparing Hardware Implementation, Integration and Evaluation Concept

Participating: Hardware Developer, Safety Manager

Purpose

The »Hardware Implementation, Integration and Evaluation Concept defines the developoment and completion process for the »Hardware Unit of the system. It provides particularly the »Hardware Developer and the »Inspector with guidelines for their tasks.

The concept describes design guidelines, documentation specifications, procedures, tools and environments for the implementation, installation, integration and testing of hardware elements in detail. This includes the description of the generation and compilaiton of source files (e.g. VHDL Code) and loading and installation procedures for programmable logic.

The contents of the hardware implementation, integration and evaluation concept shall be consistent with the »Hardware Architecture. The design decisions made shall be implemented in a suitable manner. With respect to organization and framework conditions, the concept is determined by specifications in the Project Manual.

The »Hardware Architect is responsible for the preparation of the system. He will be supported by the Hardware Developer who is finally responsible for the completed system. Depending on the quality assurance specifications, the test products for the individual hardware elements will be prepared.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.4)

Enabling System Implementation, Integration, and Evaluation Concept, Enabling System Architecture (see product dependency 4.5)

Project Manual, Overall System Specification (see product dependency 4.27)

Generates

Evaluation Report Usability, Evaluation Specification Usability, Hardware Component, Hardware Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.6)

Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Hardware Module, External Hardware Module Specification, Make-or-Buy Decision, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.7)

Evaluation Report Usability, Evaluation Specification Usability, Hardware Module, Hardware Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.8)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, External Software Module, Software Implementation, Integration and Evaluation Concept, Software Unit, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

, Software Implementation, Integration and Evaluation Concept, Project Plan, System Implementation, Integration and Evaluation Concept (see product dependency 5.39)

, Software Implementation, Integration and Evaluation Concept, QA Manual, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept (see product dependency 5.43)

3.10.9.1 Realization Procedures and Environments

The programmable logic of a »Hardware Unit should be realized in a suitable environment within the scope of a defined development process.

Tools, like cutting machines or CAE synthesis tools, and command procedures for compiling and binding programmable logic shall be defined.

The realization process and realization environment do not describe the production of »Hardware Modules.

3.10.9.2 Integration Procedures and Integration Plan

The architecture of a »Hardware Unit specifies the required hardware element types and the structure of the hardware unit. For integration planning, the concrete hardware elements to be developed and the integration sequence shall be derived from the »Hardware Architecture, and a suitable integration process shall be defined.

Integration procedures specify the integration environment and the integration tools. This includes, but is not limited to, the description of the soldering process, assembly and activation. In addition informal, functional, environmental and EMC tests will be described, and test tools will be specified.

The integration plan defines the integration architecture and the sequence of the integration steps. It specifies the hardware elements to be realized for the hardware element types defined in the hardware architecture and determines the integration sequence.

3.10.9.3 Installation Procedures and Target Environments

The development process also includes the identification of the required target environment and the description of the installation process. All target environments for the programmable logic of a »Hardware Unit shall be identified, and the installation procedures shall be specified. The Project Manual specifies conditions for the target environments to be supported.

In hardware development, target environments are hardware elements, like storage or logic process modules. Target environments may include the development environment, a separate evaluation environment and an integration environment for simulating the final target platform. The installation procedure and the required tools will be described for every identified target environment. The description of the procedure for installing the system on the target platform is based on the contents of this subject. It will be prepared within the scope of the logisitc »In-Service Documentation and delivered to the acquirer.

3.10.9.4 Evaluation Procedures and Strategy

A general evaluation strategy and a concrete test process shall be specified for all hardware elements. In this connection, economic efficiency, availability of test facilities, testability or test duration are important factors.

The test process specifies algorithms, test tools and test methods to be used for executing the tests. The concrete evaluation procedure will be developed in the respective hardware element evaluation specifications.

The evaluation strategy will be derived from the evaluation strategy in the higher implementation, integration and evaluation concept and the specifications in the Project Manual and the »QA Manual. It specifies general rules and criteria for the execution of hardware element tests. Particularly the demonstrations and framework conditions required explicitly by the acquirer shall be taken into account in the evaluation strategy.

The evaluation strategy should be examined especially with regard to redundancy and risk reduction and with regard to the availability of existing tools.

3.10.9.5 Hardware Elements to be Evaluated

The evaluation of a hardware element is expensive and not always required. In order to adapt the effort to the requirements of individual projects, the »Hardware Architect has - based on the specifications in the Project Manual and the specified evaluation strategy - the possibility to determine which hardware elements of the »Hardware Unit shall be evaluated. Critiera for the necessity of an evaluation may include the following: criticality and complexity of the hardware element and its central role within the hardware unit. If hardware elements are classified as not to be evaluated, a rationale shall be included.

3.10.9.6 Safety and Security Relevant Hardware Elements and Safety and Security Measures

For every hardware element, it shall be determined if it has a risk potential, how high is this risk potenital, to which safety and security level it belongs and whether the execution of a hazard and safety analysis is required. The safety and security requirements to be fulfilled will be derived from the »Hardware Specification of the hardware element.

Hardware elements critical for safety and security are elements which are of critical importance for fulfilling the safety and security requirements, i.e., the risk assessment/danger potential of which exceeds a prespecified threshold level.

3.10.10 Software Implementation, Integration and Evaluation Concept

Process module: Software Development

Responsible: Software Architect (when using process module Software Development)

Activity: Preparing Software Implementation, Integration and Evaluation Concept

Participating: Software Developer, Safety Manager

Purpose

The »Software Implementation, Integration and Evaluation Concept defines the developoment and completion process for the »Software Unit of the system. It provides particularly the »Software Developer and the »Inspector with guidelines for their tasks.

The concept describes programming conventions, documentation specifications, procedures, tools and environments for the implementation, installation, integration and testing of software elements in detail. This includes the description of the developoment environment, tools (compiler, linker) and programming language.

The contents of the software implementation, integration and evaluation concept shall be consistent with the »Software Architecture. The design decisions made shall be implemented in a suitable manner. With respect to organization and framework conditions, the concept is determined by specifications in the Project Manual.

The »Software Architect is responsible for the preparation of the concept. He will be supported by the Software Developer who is finally responsible for the completed system. Depending on the quality assurance specifications, the test products for the individual software elements will be prepared.

Is generated by

System Implementation, Integration and Evaluation Concept, System Architecture (see product dependency 4.15)

System Implementation, Integration and Evaluation Concept, Enabling System Architecture (see product dependency 4.16)

Project Manual, Overall System Specification (see product dependency 4.27)

Generates

Evaluation Report Usability, Evaluation Specification Usability, Software Component, Software Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.17)

Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Software Module, External Software Module Specification, Make-or-Buy Decision, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.18)

Evaluation Report Usability, Evaluation Specification Usability, Software Module, Software Specification, Evaluation Report System Element, Evaluation Procedure System Element, Evaluation Specification System Element, Data Protection Concept, Information Security Concept, Safety and Security Analysis (see product dependency 4.19)

Depends on

External Hardware Module, Hardware Unit, Hardware Component, Hardware Module, Hardware Implementation, Integration and Evaluation Concept, External Software Module, Software Unit, Software Component, Software Module, External Unit, System Implementation, Integration and Evaluation Concept, Segment, System (see product dependency 5.38)

Hardware Implementation, Integration and Evaluation Concept, , Project Plan, System Implementation, Integration and Evaluation Concept (see product dependency 5.39)

Hardware Implementation, Integration and Evaluation Concept, , QA Manual, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept (see product dependency 5.43)

3.10.10.1 Realization Procedures and Environments

A »Software Unit should be realized in a suitable environment within the scope of a defined development process. Development environment and tools like compiler or linker shall be specified. The realization procedure will be defined by means of compiler procedures, link procedures and compilation orders. The data will be made automatizable and thus repeatable by tools like Make or Ant. All code references relevant for compiling and link procedures will be identified.

If a development environment is required in the long term for supporting the system in its life cycle phases, an independent »Enabling System will be developed.

3.10.10.2 Integration Procedures and Integration Plan

The architecture of a»Software Unit specifies the required software element types and the structure of the software unit. For integration planning, the concrete software elements to be developed and the integration sequence shall be derived from the »Software Architecture, and a suitable integration process shall be defined.

Integration procedures specify the integration environment and the integration tools. In this connection, it must be ensured that the tools of the realization and integration environment harmonize with each other and complement each other properly. The integration plan defines the integration architecture and the sequence of the integration steps. It specifies the software elements to be realized for the software element types defined in the software architecture and determines the integration sequence.

3.10.10.3 Installation Procedures and Target Environments

The development process also includes the identification of the required target environment and the description of the installation process. All target environments to be used by the system in various development phases shall be identified, and the installation procedures shall be specified. The Project Manual specifies conditions for the target environments to be supported. In addition to the development environment, an evaluation environment and an integration environment for simulating the final target platform will frequently be specified as target environments.

The installation procedure and the required tools will be described for every identified target environment. The description of the procedure for installing the system on the target platform is based on the contents of this subject. It will be prepared within the scope of the logisitc »In-Service Documentation and delivered to the acquirer.

3.10.10.4 Evaluation Procedures and Strategy

A general evaluation strategy and a concrete test process shall be specified for all software elements. In this connection, economic efficiency, availability of evaluation environments, testability or test duration are important factors.

The test process specifies algorithms, test tools and test methods to be used for executing the tests. The concrete evaluation procedure will be developed in the respective software element evaluation specifications.

The evaluation strategy will be derived from the evaluation strategy in the higher implementation, integration and evaluation concept and the specifications in the Project Manual and the »QA Manual. It specifies general rules and criteria for the execution of software element tests. Particularly the demonstrations and framework conditions required explicitly by the acquirer shall be taken into account for the evaluation strategy.

The evaluation strategy should be examined especially with regard to redundancy and risk reduction and with regard to the availability of existing tools.

3.10.10.5 Software Elements to be Evaluated

The evaluation of a software element is expensive and not always required. In order to adapt the effort to the requirements of individual projects, the »Software Architect has - based on the specifications in the Project Manual and the specified evaluation strategy - the possibility to determine which software elements of the »Software Unit are to be evaluated. Critiera for the necessity of an evaluation may include the following: criticality and complexity of the software element and its central role within the software unit. If software elements are classified as not to be evaluated, a rationale shall be included.

3.10.10.6 Safety and Security Relevant Software Elements and Safety and Security Measures

For every software element, it shall be determined if it has a risk potential, how high is this risk potenital, to which safety and security level it belongs and whether the execution of a hazard and safety analysis is required. The safety and security requirements to be fulfilled will be derived from the »Software Specification of the software element.

Software elements critical for safety and security are elements which are of critical importance for fulfilling the safety and security requirements, i.e., the risk assessment/danger potential of which exceeds a prespecified threshold level.

3.10.11 Migration Concept

Process module: Enhancement and Migration of Legacy Systems

Responsible: System Architect (when using process module Enhancement and Migration of Legacy Systems)

Activity: Developing Migration Concept

Participating: System Integrator

Purpose

The »Migration Concept is basis and procedural manual for migrating system divisions from a legacy system to a new system. It describes tasks, responsibilities and procedures for transferring relevant system divisions of the legacy system to the new target environment.

The migration concept describes in detail which divisions of the legacy system are concerned, which changes shall be executed for the migration and where the migrated system divisions are to be integrated into the new system. Depending on safety and security aspects of the legacy system, a migration and a »Rollback Strategy will be selected for business processes, and a detailed migration plan will be specified.

The »System Architect, as person in charge for the design of the new system, is also responsible for the migration concept. This ensures that the system divisions to be migrated are considered properly in the architectural design. The System Architect will be supported by the »System Integrator, who is responsible for the new system to be developed

Data on the legacy system, which are relevant for the new system, will be derived from the »Legacy System Analysis. Information on the new system will be derived from the Overall System Specification, the system architecture and the »Database Design.

Is generated by

Overall System Specification (see product dependency 4.26)

Overall System Specification (see product dependency 4.25)

3.10.11.1 Migration Overview

The »Migration Overview supports the »System Architect during migration planning and preparation. It describes which systems are included in the migration, which targets are intended to be achieved by the migration and which framework conditions must be observed.

A typical framework condition for a migration is the temporal restriction to a specified period. Frequently, applications to be migrated are subject to high availability requirements, which must be fulfilled.

3.10.11.2 Migration Strategy

The »Migration Strategy specifies the strategy for executing the migration. Basically, there are two strategies for replacing a legacy system: the step-by-step introduction of a new system or the big-bang strategy, i.e., the introduction in one step. It must be examined and determined in detail which strategy is suitable for the individual case.

If the big-bang strategy is applied, the legacy system will be switched off, the new system will be installed, and system divisions and data will be migrated during a specified period - frequently during one weekend.

In case of a step-by-step migration, the legacy system will be migrated in several steps. Generally, this step-by-step migration is less critical than the big-bang strategy. The users can familiarize themselves more slowly with the new functionalities. If the new system is not yet stable, it is possible to take recourse to the legacy system in case of emergency. The step-by-step migration may be subdivided in two types:

- The new system provides the complete functionality, but is only available to a limited user group. New and legacy systems run in parallel. With each step, the user circle will be extended. However, the parallel use of legacy and new system, and thus particularly the maintenance of data consistency, pose a problem.

- In another type of step-by-step introduction, a partial functionality will be provided for all users. The users work in parallel on new and legacy systems. With each step, the functionality of the new system will be extended until the legacy system is replaced completely.

3.10.11.3 Rollback Strategy

A »Rollback Strategy shall be determined for every level specified in the migration planning. This strategy describes all activities to be executed in order to reset modifications in time if the migration fails. For each migration level, it will be specified individually

- according to which criteria the decision for a reset of the modifications, and thus for an abort of the migration, will be made,
- which tasks must be executed in order to prepare the abort,
- which activities must be executed to conduct the abort, particularly how the original data stock can be reconstructed and
- which activities are necessary after the execution of the abort. Particularly an evaluation strategy ensuring that the legacy system will again be available with its complete functionality shall be developed.

3.10.11.4 Data Migration

Data are the central element of the migration. Perhaps, data from the legacy system must be transformed into a new format and loaded into the database(s) of the new system. The »Data Migration shall be planned in detail. The data flow from the source databases to the target databases will be specified. In addition all necessary data transformations will be defined.

The degree of detailing goes down to the fields in a database table. The planning of the data migration is based on the »Data Model of the »Legacy System Analysis as source of the data flow and on the »Database Design of the new system as target.

3.10.11.5 Migration Plan

Depending on the selected »Migration Strategy, the schedule for the execution of the migration will be planned. Within the defined migration levels, additional levels - each provided with a »Rollback Strategy - will be specified. The activities to be executed will be planned and the responsibilities assigned. For each level and for the entire migration planning, the point of no return, i.e., the point when an abort or rollback is impossible, will be specified.

3.11 Logistic Elements

This discipline summarizes all »Work Product s and »Activityies prepared for implementing the logistic support of a system. It includes primarily the system documentation, which consists of »Training Documentation and »In-Service Documentation . These two logistic elements are mandatory for every system and thus included in the »System Development. The additional »Logistic Elements - »Maintenance Documentation, »Repair Documentation and »Spare Parts Catalog - complement the work products of the type »Logistic Support Documentation if the process module »Integrated Logistic Support was selected (see »Structural Product Dependencies).

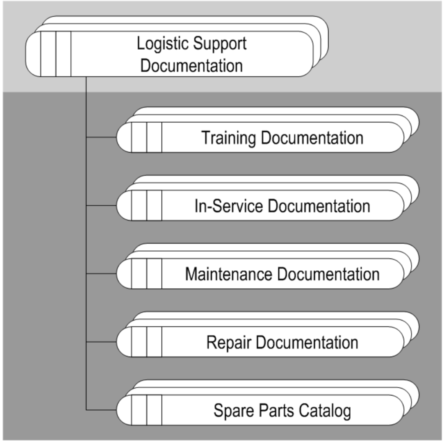


Figure 14: Logistic Support Hierarchy

3.11.1 Training Documentation

Process module: System Development

Responsible: Technical Author (when using process module System Development)

Activity: Preparing Training Documentation

Participating: Hardware Architect, Hardware Developer, QA Manager, Software Architect, Software Developer, System Architect

Purpose

The training for a system is subdivided into different training activities, which require a variety of documents, e.g., »Curriculum and »Participants Dokumentation. The training may be based on different media, e.g, print media or computer-aided training (CAT).

Normally, the training is oriented toward specified job profiles, e.g., operator, maintenance, repair and servicing training. A special safety and security training will be provided for safety- and security-critical systems.

Is generated by

Overall System Specification (see product dependency 4.22)

Depends on

Logistic Support Concept, In-Service Documentation (see product dependency 5.24)

3.11.1.1 Curriculum

The »Curriculum provides a survey of contents, objectives and shaping of the training. It includes the necessary information, e.g, timetable, minimum and maximum number of students and educational background of the students, which is required for executing the training.

Exemplary Product Content

The curriculum may include, e.g., the following information:
- Number (serial number) of training activity
- Designation of training activity
- Duration of training activity
- Minimum and maximum number of students
- Training documents, equipment and tools
- Objective of training activity
- Necessary educational background of the students
- Planning of the training activity (timetable)

3.11.1.2 Instructor Documentation

The »Instructor Documentation provides the instructor with guidelines and material for the training. It includes all tools, comments and notes required for teaching as well as the didactic explanations to the documents. The instructor documents can be provided in different forms, e.g., as presentations, information charts, video and audio material or computer-aided training (CAT).

Exemplary Product Content

Instructor documents may include the following:
- Presentations (slides and in electronic form)
- Diagrams, maps
- Video and audio material
- Computer-aided training (CAT)
- Instructions for exercises and private studies
- Examination documents (test sheets, correction notes)

3.11.1.3 Participants Dokumentation

The »Participants Dokumentation is the documentation for the students. It is used for the individual preparation and reinforcement of training activities. It describes the complete subject material and provides additional tasks for self-tests. The Participants Documentation can be provided in different forms, e.g., presentations, training manual, video and audio material or computer-aided training (CAT).

Exemplary Product Content

Documents for participants may include, e.g., the following:
- Presentation (slides and in electronic form) from the instructor documents
- Training manual with additional presentation contents
- Video material, audio material, computer- aided training and tasks for self tests
- Tools (templates, gages, pocket cards)
- Specialized literature

3.11.1.4 Execution Record

There are two types of »Execution Records. One type certifies, e.g. by a certificate of training, that the student has participated in a training activity with a certain success. The other justifies the payment for the instructor by certifying that the training has been completed successfully and to the agreed extent, e.g., by an attendance list with the signatures of all participants.

Exemplary Product Content

The following documents may be used as execution records:

- Certificates of attendance
- Certificates of training
- Attendance list, perhaps with signatures
- Certificate on the conduct of training for the instructor

3.11.2 In-Service Documentation

Process module: System Development

Responsible: Technical Author (when using process module System Development)

Activity: Defining In-Service Documentation

Participating: Hardware Architect, Hardware Developer, QA Manager, Software Architect, Software Developer, System Architect, Ergonomics Manager

Purpose

The »In-Service Documentation includes all data required by a user in order to operate the system properly and to respond adequately to problems. Type and number of in-service documents to be prepared correspond to the specifications of the Overall System Specification.

Is generated by

Overall System Specification (see product dependency 4.22)

Depends on

Logistic Support Concept, Training Documentation (see product dependency 5.24)

3.11.2.1 Warning Statements and Notes of Caution

The »Warning Statements and Notes of Caution describe the system features relevant for the safety of the user. They must be observed during the entire system life cycle from the activation to the »Disposal of the system. Warning statements and notes of caution shall be positioned at a prominent place - if possible at the beginning of the documentation - where they cannot be overlooked.

Exemplary Product Content

Warning statements and notes of caution may include, e.g., the following:

- (in-) admissible environmental conditions,
- (in-) admissible operating parameters,

- (in-) admissible in-service variants,
- protective measures before activation/shutdown/deactivation,
- behavior in case of system malfunctions,
- medical advice in case of personal injuries.

3.11.2.2 System Scope and Functionality

This subject describes the user-relevant features of the system. The user learns the relevant components and functions of the system by reading the description. The description includes, but is not limited to, the overall view of the system, a technical description and the technical data.

Exemplary Product Content

The description of scope and function of the system includes, e.g., the following:

- Overall view
- Designations, markings
- Survey, architecture of the system
- Technical description of system and system elements (purpose, principles of operation)
- Technical data of system and system elements
- Equipment, auxiliary equipment and interfaces

3.11.2.3 Installation and Operation

The instruction manual describes the proper use of the system. It describes the operations to be executed by the user.

Depending on the type of use, the instruction manual may include various aspects, like activation, administration, operation and error control. Depth and detailling of the description of operations depend on the knowledge of the expected user.

Exemplary Product Content

Depending on the type of use, the instruction manual may include the following subjects:

- Installation, initial activation and reactivation
- Hardware and software configuration
- Administration and operation
- Error control
- Deactivation, preservation, packaging, transport and storage

3.11.2.4 Preventive Maintenance Instructions

Servicing includes all simple maintenance procedures which can be executed by the user without auxiliary tools, e.g., cleaning of the system, replacement of wear-and-tear parts and operating fluids, and monitoring of operational parameters.

3.11.3 Maintenance Documentation

Process module: Integrated Logistic Support

Responsible: Technical Author (when using process module Integrated Logistic Support)

Activity: Preparing Maintenance Documentation

Participating: Hardware Architect, Hardware Developer, QA Manager, Software Architect, Software Developer, System Architect

Purpose

The »Maintenance Documentation describes all measures required in order to ensure and maintain the functional capability of the system. Maintenance is scheduled and executed at certain intervals, in case of a vehicle, for example, annually or every 15,000 km. The maintenance documentation is intended for persons planning and executing the maintenance procedures.

Is generated by

Logistic Support Concept (see product dependency 4.11)

3.11.3.1 Maintenance Plan

The »Maintenance Plan describes the individual maintenance measures and their schedule. The maintenance measures may be summarized in maintenance levels. Maintenance procedures may be executed during operation or if the operation is interrupted.

The maintenance plan may also include the equipment maintenance record if an individual maintenance plan exists for every system. If this is not the case, the equipment maintenance record shall be conducted in suitable form, e.g., as service manual, maintenance manual or material history report.

Exemplary Product Content

A maintenance plan may include the following:

- Warning statements and notes of caution
- Serial number
- System element or test location of the measure, possibly with item number of the spare parts catalog
- Standard/special tools, measuring and test equipment
- Procedure to be executed
- Statement on admissible wear-and-tear parts, operating fluids and tolerances
- Work schedule, depending on operating parameters (e.g., hours, time, number and type of use)

3.11.3.2 Maintenance Instructions

The »Maintenance Instructions describes the execution of the different maintenance measures in repeatable procedural steps. The maintenance instruction will only be prepared for measures which require additional explanations not included in the »Maintenance Plan. The disposal of wear-and-tear parts and operating fluids must be considered. The use of measuring and test equipment and necessary tools will be explained.

Exemplary Product Content

The maintenance instruction may include, but not be limited to, the following:

- Warning statements and notes of caution

- Cleaning of the system
- Standard/special tools, measuring and test equipment
- Replacement of wear-and-tear parts and operating fluids
- Monitoring of operating parameters

3.11.4 Repair Documentation

Process module: Integrated Logistic Support

Responsible: Technical Author (when using process module Integrated Logistic Support)

Activity: Preparing Repair Documentation

Participating: Hardware Architect, Hardware Developer, QA Manager, Software Architect, Software Developer, System Architect

Purpose

The »Repair Documentation describes all measures required for re-establishing the functional capability of the system. The repair documentation specifies how the cause for a system failure can be discovered and how the discovered malfunction can be repaired afterwards.

Is generated by

Logistic Support Concept (see product dependency 4.11)

3.11.4.1 Diagnosis Instructions

The »Diagnosis Instructions describes how the reasons for a system failure can be determined and analyzed. The use of the measuring and test equipment required for the diagnosis will be explained. In the most simple case, the diagnosis instruction is a list with error messages and the corresponding potential reasons. For complex systems, a diagnosis instruction can be supported by fault trees, decision trees and expert systems.

Exemplary Product Content

The diagnosis instruction may include, e.g., the following:

- Warning statements and notes of caution
- Diagnostic routines
- Standard/special tools to be used, measuring and test equipment

3.11.4.2 Repair Instructions

The »Repair Instructions describes the execution of individual repair procedures in repeatable steps. The use of the measuring and test equipment and required tools will be explained

Exemplary Product Content

The repair instruction may include, e.g., the following:

- Warning statements and notes of caution
- Standard/special tools to be used, measuring and test equipment

- Diagnostic procedures which were not described in the diagnosis instruction
- Repair procedures, i.e., replacement of defect parts or correction of damage
- Check as to whether the repair was successful (e.g. by a test run).

3.11.5 Spare Parts Catalog

Process module: Integrated Logistic Support

Responsible: Technical Author (when using process module Integrated Logistic Support)

Activity: Defining Spare Parts Catalog

Purpose

The Spare Parts Catalog is the basis for identifying and ordering a spare part required for maintenance and repair. It consists of a »List Section and an »Illustrated Section. The structure of Spare Parts Catalogs may by specified by applicable standards, e.g., »B007, »ASD Spec 2000M and »ASD Spec 1000D.

Spare Parts Catalogues may be availably as hardcopy, as database, on microfiches or as interactive electronic technical publication.

Is generated by

Logistic Support Concept (see product dependency 4.11)

3.11.5.1 List Section

The »List Section includes a list of all spare parts with the required data. These shall include at least the designation of the spare part and its part number (identification number, ordering number), in order to identify the part for the manufacturer.

Exemplary Product Content

Data on a spare part may include, e.g., the following:

- Part number to identify the spare part for the manufacturer,
- item number of spare part in figures,
- price,
- minimum order quantity of spare parts,
- dimensions and weight or storage requirements.

3.11.5.2 Illustrated Section

The »Illustrated Section shows the spare parts specified in the »List Section illustrated in figures. The spare parts shall be depicted in sufficient size and provided with an item number. The illustrated section may include two- and three-dimensional drawings and three-dimensional exploded views.

3.11.6 Logistic Support Documentation

Process module: System Development

Responsible: Technical Author (when using process module System Development)

Activity: Integrating into Logistic Support Documentation

Purpose

The logistic support documentation comprises a set of necessary system documentation elements, which belong together with regard to contents (see »Structural Product Dependencies). It includes »In-Service Documentation,»Training Documentation and - depending on the required logistic effort - »Maintenance Documentation, »Repair Documentation and »Spare Parts Catalogs.

For reasons of product liability, all documentations shall include complete and binding statements on the proper use of the system. An improper use which may be foreseen shall also be taken into account. The documentation should include the appropriate warnings, cautions and notes, indicating the hazards and risks. Notes on use, maintenance, repair and disposal shall be prepared with consideration to the probable user.

Operating instructions and a hardcopy of safety- and security-relevant information shall be attached to every item of equipment. Exclusively electronic operating instructions are insufficient even if the product has a display capability.

Depends on

System, Enabling System (see product dependency 5.20)

3.12 Logistic Conception

Up to 80 percent of the system life cycle costs may be influenced by the logistic concept, which is a significant basis for optimizing life cycle costs, thus being decisive for acceptance and success of the in-service use.

The discipline Logistic Concept comprises products and activities required for planning and developing the logistic support. It includes the »Logistic Support Specification, a »Logistic Support Concept and »Logistic Calculations and Analyses.

3.12.1 Logistic Support Specification

Process module: Integrated Logistic Support

Responsible: Logistics Manager (when using process module Integrated Logistic Support)

Activity: Preparing Logistic Support Specification

Participating: Requirements Engineer (Supplier)

Purpose

The »Logistic Support Specification describes and refines the requirements posed on logistic support. The requirements specified in the »Overall System Specification will be analyzed and refined from a logistic point of view. In addition, operational environment, maintenance and repair activities will be recorded and examined.

Is generated by

Overall System Specification (see product dependency 4.12)

Depends on

Logistic Calculations and Analyses, Logistic Support Concept (see product dependency 5.21)

External Hardware Module Specification, Hardware Specification, External Software Module Specification, Software Specification, External Unit Specification, System Specification (see product dependency 5.23)

3.12.1.1 Initial Situation

Proceeding from the »Overall System Specification, the actual logistic situation will be recorded and analyzed in the initial situation. This includes, e.g., the presentation of the integration of logistics into the organizational procedures, existing devices, equipment and tools, and weak points of the current logistic support.

The operational environment and the physical loads exerted on the system during use will be described, and the requirements posed on the logistic support to be developed will be derived.

3.12.1.2 Logistic Requirements

This subject documents the requirements posed on logistic support. The overall picture of the requirements can be derived from the logistic requirements specified in the »Overall System Specification and the requirements derived from the subject »Initial Situation.

The required availability of the system will be specified concretely. On this basis, parameters like reliability, repairability and testability will be specified at system, segment, hardware unit and software unit level.

Type and expected frequency of the required system maintenance activities and the resulting requirements will be described. The methods for determining the activities will be presented.

General requirements posed on logistic support, which are not specific for individual resources, will be indicated, e.g., warranty policy and quality provisions.

3.12.1.3 Refinement of the Logistic Requirements

The requirements of the »Overall System Specification shall be allocated to »Logistic Elements and other logistic resources (e.g., special tools, measuring and test equipment). In addition, the documentation required for maintenance, repair and other support measures and the corresponding responsibilities will be allocated to logistic elements. The logistically relevant requirements shall be refined.

Exemplary Product Content

Logistically relevant requirements include the following:

- Documentations required for operation, maintenance/repair and other support measures (description, presentation, identification, development documents)
- Responsibilities for operation, maintenance/repair and other support measures (personnel

strength and qualification/training requirements)
- Training infrastructure, systems, equipment and tools, e.g., defective components
- Special/standard tools, measuring and test equipment
- Spare/exchange parts, material and expendables
- Infrastructure and utilities
- Scope of storage and storage requirements (e.g., storage space, storage conditions, storage location)
- Scope of transport and transport requirements (e.g., transport volume, transport conditions)

3.12.1.4 Requirements Tracing

The requirements tracing allocates the logistic requirements to the refined logistic requirements, to the logistic elements and to the system and system support elements (see also Subject »Requirements Tracing in the »System Specification). The bidirectional trackability must be ensured. The allocation can be presented, e.g., by means of a matrix.

3.12.2 Logistic Support Concept

Process module:	Integrated Logistic Support
Responsible:	Logistics Manager (when using process module Integrated Logistic Support)
Activity:	Preparing Logistic Support Concept
Participating:	System Architect

Purpose

The work product Logistic Support Concept describes the scheme for logistic support, which is derived from the »Logistic Support Specification. The concept is the basis for planning and executing the logistic support as well as for activation, use, maintenance/repair and »Disposal of the system. It describes the required logistic resources.

Is generated by

Overall System Specification (see product dependency 4.12)

Generates

Spare Parts Catalog, Maintenance Documentation, Repair Documentation (see product dependency 4.11)

Depends on

Logistic Calculations and Analyses, Logistic Support Specification (see product dependency 5.21)

Training Documentation, In-Service Documentation (see product dependency 5.24)

3.12.2.1 Directives and General Conditions

This subject presents a summary of the standards and framework conditions derived from the »Logistic Support Specification.

It describes the general logistic outline concept to be applied to the system. This includes, e.g., work-sharing logistics, operator model, leasing model or cooperative logistics. The specific conditions and configurations of the selected logistic outline concept, e.g. duration of contract, warranty conditions, guaranteed support, legal or other restrictions, will be described.

3.12.2.2 System Architecture

This subject provides a summary of the system architecture as seen from a logistic point of view. It specifies the designation and part number (identification number), the number of elements within the system and the planned total number for every element of the »System Architecture. Indicators, like reliability (Mean Time Between Failure) and maintainability (Mean Time To Repair) shall be provided (see also »Logistic Calculations and Analyses). It should be ensured that the presented system architecture corresponds to the system architecture presented in the work product »System Architecture.

Exemplary Product Content

The following data elements should be provided for every element of the system architecture:

- Designation
- Part number (unambiguous identification number, not serial number)
- Manufacturer/supplier or person in charge of logistic support
- Number of the respective element per system or per higher component
- Total number of systems, segments, hardware/software units to be delivered
- Reliability (MTBF)
- Maintainability (MTTR)

3.12.2.3 Logistic Support Alternatives and Comparative Evaluation

This subject develops and evaluates several logistic support alternatives. The required logistic resources, organizational provisions, infrastructure measures and logistic indicators, like availability, will be described for every alternative. The decisive results of the alternatives - fulfillment of the requirements with maximum availability and minimum life cycle costs - shall be compared.

Exemplary Product Content

In order to fulfill the requirements, particularly with regard to availability, logistic support alternatives shall be developed. For every alternative, the following characteristics shall be presented in detail:

- Maintenance (definition of easily replaceable units, servicing, maintenance, repair)
- Technical availability (reliability, maintainability, repairability, testability)
- Logistic resources (standard/special tools, measuring and test equipment, alternate equipment and spare parts, documentation, training, personnel and qualification, service organization, transport logistics and storage, disposal and waste management)
- Infrastructure measures
- Organizational provisions

- External logistic support interfaces (integration of logistic resources into the system, e.g., IETD into system software, interfaces to logistic information systems)

3.12.2.4 Logistic Support Design

One of the developed alternatives will be selected, and the selection will be justified. This subject develops and describes the selected solution in detail.

This subject specifies particularly type, number and structuring of the required logistic support documentation. In case of complex systems, the structuring depends on the »System Decomposition. Elements of the logistic support documentation will be allocated to system elements.

This subject also lists additional support to be provided by the supplier, e.g., delivery of spare parts, instructions, local support or technical logistic support.

Exemplary Product Content

In case of complex systems, the structuring of resources depends on the decomposition (structure) of the system. The additional structuring of logistic support may be based on the following elements :

- Documentation
- Training
- Standard/special tools, measuring and test equipment
- Spare parts

Depending on the use of the system during its life cycle and the employed personnel, the elements may be structured further as follows:

- Control,
- administration,
- operation,
- maintenance,
- repair and
- supply.

The logistic support for selected resources could - for example - be structured as follows:

In-service use, maintenance and repair documentation:

1. level: "manual series" (e.g. description, operation and diagnosis)
2. level: "manual" (e.g. diagnostic manual)
3. level: "volume" (e.g. service level I or service level II)
4. level: "chapter" or "data process module" (e.g. fault finding or corrective action)

Training documents:

1. level: training document, "system training" (e.g. communication system)
2. level: training document, "equipment training" (e.g. communication equipment)
3. level: training document, "training activity" (e.g. operation)
4. level: training document, "training hour or training day" (e.g. activation)

Standard/special tools, measuring and test equipment:

1. level: "test bench" (e.g. radar system)
2. level: "test function" (e.g. check for emission control)
3. level: "test equipment" (e.g. protective clothing, measuring device)
4. level: "test unit" (e.g. antenna, sensor)

Infrastructure:

1. level: "site" (e.g. consumer goods)

2. level: "hangar" (e.g. production hangar)
3. level: "hangar area or room" (e.g. production of product A)
4. level: furnishings (e.g. furniture or utility connections)

The allocation of logistic resources to different life cycle phases shall be indicated, with individual resources possibly being allocated to several phases.

3.12.2.5 Logistic Resources Cooperation

This subject describes the cooperation of system, »Enabling Systems and logistic elements. It presents, e.g, the deployment of resources, process chains, sequences of operations and procedures (Supply Chain Management).

The subject also describes organizational features, e.g., points of contact, liaison, responsibilities and integration into existing or newly to be developed organizational and IT structures.

It must be possible to implement the logistic support by using this description.

3.12.2.6 Establishment of Logistic Supportability and Introduction into Service

The establishment of logistic supportability and introduction into service shall be described in detail. The establishment of logistic supportability includes all measures required for providing and integrating the logistic support for the system. Logistic supportability is ensured when all necessary »Enabling Systems, spare parts and additional logistic resources are available.

The introduction into service includes the installation and activation of the system. Test or parallel operations shall be provided as required. For this purpose, the required logistic support and the training of the acquirer shall be ensured.

Exemplary Product Content

The logistic supportability of a system is ensured when

- all facilities, standard and special tools for in-service use, maintenance and repair are available,
- spare parts requirements are fulfilled,
- the follow-on spare parts supply is ensured,
- the personnel required for operation, maintenance and repair, and spare parts supply is available and trained adequately,
- the documentation for in-service use, maintenance and repair has been delivered to the acquirer, and
- in-service support, maintenance and repair are ensured.

These subjects shall be taken into account for the establishment of logistic supportability.

3.12.2.7 Disposal

This subject describes all measures required for the »Disposal of a system. The disposal comprises the deactivation and waste management.

The deactivation is a temporary storage of a system. It is intended to remove a system which is no longer in use from its operational environment. Depending on the further use, the system will be preserved and maintained before or during the deactivation in order to permit a reactivation at a later date.

Waste management deals with the final removal of a system, which can no longer be reactivated. Waste management is intended to recycle the system in an eco-friendly manner. System elements which cannot be recycled shall be transferred in an eco-friendly manner to a waste treatment plant or - in the worst case - to a final storage.

Exemplary Product Content

The deactivation shall take into account the following technical conditions which must be described in the Subject Disposal:

- Condition of the system
- Packaging
- Preservation
- Archiving of data
- Scheduled maintenance
- Reactivation

The description of waste management shall take into account the following issues:

- Condition of the system
- Company neutralization (demilitarization)
- Dismantling (including deletion of sensitive data)
- Rendering safe
- Disposal possibilities (scrappage, sale)
- Recycling
- Special waste
- Final storage

3.12.3 Logistic Calculations and Analyses

Process module: Integrated Logistic Support

Responsible: Logistics Developer (when using process module Integrated Logistic Support)

Activity: Performing Logistic Calculations and Analyses

Participating: Logistics Manager, Hardware Architect, Hardware Developer, Software Architect, Software Developer, Ergonomics Manager, System Architect

Purpose

The logistic calculations and analyses are basis and prerequisite for the development of the logistic support concept and, thus, for the »Logistic Support Design. Within the scope of this product, the characteristics of the system and its environment will be evaluated and analyzed with regard to the logistic objective - maximum availability with minimum life cycle costs. The execution of logistic analyses and calculation is intended to provide logistic parameters, which will be used to properly develop and optimize the logistic concept.

Examples for calculations and analyses include reliability analyses and calculations, testability analyses, maintainability and repairability analyses, spare parts definition and spare parts calculations, availability calculations and analyses, and analyses of the life cycle costs.

The availability of the system is determined by the avialability calculation/analysis; it is directly connected with the reliability (mean time between failure) and the period required for reactivating the system after a failure (mean down time).

The mean time between failure is determined by the quality of the system elements and the applied design measures. The mean down time is determined by the type of the fault (fault analysis), testability (mean time to test), maintainability (mean time to repair), availability of spare parts (calculation of spare parts) and the repair personnel.

The costs incurred during the service life of a system are designated as life cycle costs (through-life costs). Particularly the operating costs, which are included in the life cycle costs, shall be optimized. The operating costs include, but are not limited to, the following: personnel costs for operation, maintenance and repair, and costs for spare parts and their storage. Thus, the reliability determines the life cycle costs: the lower the reliability of spare parts, the higher the costs for spare parts and repair measures. In addition, the costs for the »Disposal (deactivation and waste management) including the costs for the separation of components must be taken into account.

Is generated by

Overall System Specification (see product dependency 4.12)

Depends on

Logistic Support Concept, Logistic Support Specification (see product dependency 5.21)

System Architecture, Enabling System Architecture (see product dependency 5.22)

3.13 Process Improvement

The discipline »Process Improvement includes all products and activities prepared and maintained within the scope of the introduction and maintenance of an organization-specific process model. This includes the »Assessment of a Process Model, the development of an »Process Model Improvement Concept and finally the description of an improved organization-specific process model.

3.13.1 Assessment of a Process Model

Process module:	Introduction and Maintenance of an Organization-Specific Process Model
Responsible:	Assessor (when using process module Introduction and Maintenance of an Organization-Specific Process Model)
Activity:	Performing a Process Model Assessment

Purpose

The »Assessment of a Process Model documents the current proccess maturity of an organization or organizational unit. It will be executed by an independent »Assessor. In addition to the »Strengths and Weaknesses Profile of the processes, it includes proposals for measures to ensure a continuous process improvement and the corresponding action plans, e.g. prioritized action foci and a matrix showing the need for action.

The proposed measures are the basis for the »Process Model Improvement Concept. If an external report on process maturity has already been submitted, it may be used as initial evaluation of a process model.

Is generated by

Project Manual, Project Plan (see product dependency 4.1)

Generates

Organization-Specific Process Model, Process Model Improvement Concept (see product dependency 4.2)

Depends on

Process Model Improvement Concept, Proposal for the Introduction and Maintenance of an Organization-Specific Process Model (see product dependency 5.11)

3.13.1.1 Objectives and Management Support

The »Assessment of a Process Model is the initial point and the basis for process improvement. The Subject Objectives and Management Support is intende to document the goals of the evaluation, the management support and the selection of the projects to be evaluated.

For example, the evaluation may be intended to recognize weak points of the processes, to demonstrate a specific process maturity or to provide a certification in accordance with a specified standard. Goal planning and management support influence the selection of the projects to be evaluated. The management supports demonstrates the priority of the evaluation for the projects to be examined, and thus influences the execution of the projects significantly.

3.13.1.2 Strengths and Weaknesses Profile

»Strengths and Weaknesses Profile list the strengths and weaknesses of all examined processes of a process model. This documents the process maturity and identifies improvement potential.

3.13.1.3 Improvement Measures

The activity plan lists the measures recommended by the »Assessor in order to remedy the weaknesses of the process model and increase the process maturity. The Assessor shall prioritize the proposed activities. Thus, the activity plan provides the basis for determining the requirements posed on the improvment of the organization-specific process model.

3.13.2 Process Model Improvement Concept

Process module: Introduction and Maintenance of an Organization-Specific Process Model

Responsible: Process Engineer (when using process module Introduction and Maintenance of an Organization-Specific Process Model)

Activity: Specifying Process Improvement

Participating: Quality Manager

Purpose

The »Process Model Improvement Concept specifies the framework conditions for process improvement. It describes which activities specified in the work product »Assessment of a Process Model are intended to be implemented. In addition, it includes concepts for the piloting and large-scale introduction of an organization-specific process model, thus providing the basis for the introduction and maintenance of the model.

Is generated by

Assessment of a Process Model (see product dependency 4.2)

Depends on

Organization-Specific Process Model, Project Plan (see product dependency 5.10)

Assessment of a Process Model, Proposal for the Introduction and Maintenance of an Organization-Specific Process Model (see product dependency 5.11)

3.13.2.1 Objectives and Management Support

This subject documents the goal planning for the intended improvement and the management support to be provided during the development and implementation of the improvement. The goal planning is derived from the »Assessment of a Process Model. It may include, e.g., the introduction of new processes, the development of a basis for the understanding between all stakeholders, the implementation of standards and the achievement of a specified process maturity.

The management support must always be recognizable by all stakeholders and at all levels. This includes not least a public affirmation of the management that the improvement project will be executed, a presentation of the commercial relevance of the process measures and the provisioning of the resources required for executing the improvement.

Exemplary Product Content

Examples for the description of management support include the following:

- Presentation of the commercial relevance of the process measures
- Integration of the process measures into the business strategy of the organization
- Which business goals are intended to be achieved or supported by the improvement
- Open discussion of the results of a process measurement
- Active tracking of the process definition, implementation and improvement as seen from point of view of the management (e.g. participation in execution decisions)
- Open affirmation to process definition, maintenance and improvement in front of all stakeholders and active tracking of the established priorities
- Provisioning of sufficient resources for the execution of the activities, e.g., budget, personnel, training, infrastructure (offices, tools, mail etc.).
- Selection, support and promotion of pilot projects which implement the process improvement for the first time
- Implementation of the standard process

The following activities, among others, can provide additional support:

- Transparency of management reporting (e.g. balanced score cards and metrics)
- Provisioning of incentives
- Goal agreements at all hierarchy levels.

3.13.2.2 Requirements

The requirements list the prioritized activities actually to be implemented in the respective process improvement project.

These activities are a subset of the measures listed in the »Assessment of a Process Model. This subset will be determined by the priorization made in the »Assessment of a Process Model and by higher business goals.

3.13.2.3 Realization Concept

The »Realization Concept describes the procedure for implementing the measures specified in the Subject »Requirements in detail. It may describe, e.g., which parts of the process will be revised, how these process parts will be prepared and which interfaces and dependencies to other processes must be considered. The training requirements for the stakeholders are derived from the concept of realization. In addition, the realization concept describes the procedure for a large-scale introduction of the organization-specific process model.

3.13.2.4 Piloting Concept

The »Piloting Concept is a »Realization Concept adapted to one or more pilot pojects. Perhaps, a pilot project will implement the realization concept only partially. The parts to be implemented will be developed in more detail in the piloting concept. The piloting concept will be coordinated with the management. It includes all information required to test improvements within the scope of the pilot project, e.g., designation of coaches for accompanying the pilot project, specification of the communication between pilot project and process improvement project and planning of measures required additionally in the pilot project, e.g. instructions and reporting.

3.13.3 Organization-Specific Process Model

Process module:	Introduction and Maintenance of an Organization-Specific Process Model
Responsible:	Process Engineer (when using process module Introduction and Maintenance of an Organization-Specific Process Model)
Activity:	Preparing, Introducing and Maintaining an Organization-Specific Process Model
Participating:	Quality Manager, Coach

Purpose

The Product »Organization-Specific Process Model is the information source for all process-relevant aspects. It includes, e.g., process descriptions and »Training Documentation, supporting the use of processes within an organization. The Product »Organization-Specific Process Model may already be filled with contents by previous process improvements. After a revision, it will again be available for subsequent improvement projects.

The contents must be easily and simply accessible for all current and future projects. This can be realized, e.g., by an information turntable in the organization's intranet. This offers additional possibilities of providing further information, e.g. sample documents of projects or tips and tricks, to every process user and to establish discussion fora.

Is generated by

Assessment of a Process Model (see product dependency 4.2)

Depends on

Process Model Improvement Concept, Project Plan (see product dependency 5.10)

3.13.3.1 Process Descriptions

The »Process Descriptions include the information required for applying the necessary processes in the project. The layout of a process description shall be designed in accordance with the V-Modell. For a detailed description, refer to Section 1 »Fundamentals of the V-Modell.

The process description shall take into account any relevant national, international or organization-specific product and process standards. In addition, a styleguide should ensure a uniform terminology for all process descriptions. For additional specifications regarding process descriptions, refer to the »Realization Concept.

Exemplary Product Content

A process description may include the following elements:

- Participating roles
- Applied standards
- Initial and end criteria
- Initial and end products
- Decision Gates
- Products to be submitted to quality control measures
- Process interfaces, e.g. between process elements and with external processes

3.13.3.2 Metrics Catalog

The metrics catalog is intended to provide an organization-specific basis for the uniform use of »Metric, thus allowing a cross-project use of the results. It provides support in order to answer repeated project questions by tested and useful metrics.

Thus, the »Metrics Catalog provides a pool of metrics which could or should be used in all projects of an organization. A metrics describes a quantitative measure for a characteristic to be determined, e.g., time, cost and quality aspects of projects, products and processes.

For each metrics, the metrics catalog includes all data required for »Calculating and Analyzing Metrics. This comprises particularly the following:

- Measurement targets and the derived questions,
- definition of the metrics contributing to answering the questions and, thus, to achieving the measurement objectives,
- »Measurement Data Types and the required filing structures and procedures which provide the basis for calculating the metrics.

Exemplary Product Content

A metrics catalog may be structured and presented as follows:

List of Measurement Objectives and Derived Questions

The definition of objectives ensures that the metrics are defined in a target and target group oriented manner. The targets covered by metrics in the metric plan and the derived questions will be documented.

Metrics Description

The metrics are subdivided into chapters in accordance with their targets and aspects. A possible breakdown is shown in the following:

- Project metrics
  - Effort/cost metrics, e.g.
    - Cost trend plan as compared to actual state
    - Distribution of effort to each phase
  - Time metrics
    - Milestone trend PLAN as compared to ACTUAL state
- Product metrics
  - Quality metrics
    - Fault finding
    - Fault cycle time
    - Requirements stability
    - Review efficiency
    - Evaluation efficiency
    - Fault statistics
    - Code metrics
  - Performance
  - Acquirer satisfaction
- Process metrics
  - Review culture
  - Requirements stability
  - Review efficiency
  - Evaluation efficiency

Every metrics may be described, e.g., as follows:

- Title/name of metrics as identifier
- Target/aspect: which project target or aspect is covered by the metrics, which question is answered
- Explanation (if required): e.g., orientation (project, project phase, comparison between different projects, etc.), statements which may be derived from the metrics.
- Target group: recipients and users of the metrics.

   - This group comprises persons using the metrics for decision making. The users request the metrics evaluations or receive them within the scope of reports.
- Definition: calculation formula and textual description as to how the metrics will be generated from the measurement data types.
- Masurement data types: listing of the measurement data types which are used as basis for calculating the metrics.
- Evaluation: how often will the metrics be updated/prepared (e.g., monthly, every quarter, after every system test)
- Persons in charge:
   - of preparing the metrics: this person is responsible for preparing the metrics based on the defined data and on the specified date, e.g., for reporting purposes.
   - of providing data: this person is responsible for filing the measurement data in the specified filing structure
- Use: type of report or conference indicated in the metrics evaluation
- Presentation: Data on the presentation of the metrics in the metrics evaluation, e.g., diagram, table
- Experiences (optional): Remarks on suitability and limits of the metrics; how simple can the required data be provided/determined, what cannot be answered by the metrics

Description of Measurement DataTypes

Measurement data types are the input data required for calculating the metrics. They will be defined separately since there is an n:m relation between metrics and measurement data. The data measured actually are designated as measurement data, while the definition is designated as measurement data type.

The description of measurement data types includes, e.g., the following aspects:

- Title/name
- Textual description
- Measurement times
- Data source, e.g., evaluation reports, time recording tools, etc.
- Filing structure for measurement data, e.g., EXCEL table, fault database, time recording system
- Person in charge of recording and filing

3.13.3.3 Experience Base

The lessons learned reports of pilot projects, broadly introduced projects and all other projects will be prepared within the scope of a »Project Diary and collected in the »Experience Base. For reasons of data protection, it must be ensured that project data collected in the experience base are protected against unauthorized access.

The experience database shall include, but not be limited to, project and product data, design experiences, problems, faults, interactions, training state of the employees, feedback and proposals for improving processes and instructions as well as results and evaluations of the »Metric.

3.13.3.4 Training Concept

The Training Concept is intended to specify which training measures will be conducted in the entire organiization, and which training measures will be provided within the framework of individual projects. It is based on the training requirements of the individual projects. Organization-wide training measures meet the common demands of all projects. Additional training requirements are due to the strategic business objectives and activities within the framework of the introduction and maintenance of an organization-specific process model.

The »Training Concept describes the training requirements and the resulting training contents. In addition to the training contents, the required capability profiles of the instructors are defined. Moreover, the training concept specifies training methods, quality standards for training material and evaluation sheets for the courses, a training plan and the required resources, roles and responsibilities, taking into account the »Experience Base collected during the last process improvement cycle. The result is coordinated with all persons responsible for the implementation of the plan. Afterwards the training measures offered will be published in the organization. This applies to the training of the process team and to instructions within the scope of pilot projects and large-scale introduction.

3.13.3.5 Training Documentation

»Training Documentation are intended to provide the stakeholders during instructions with the necessary knowledge on the process employed in the project.

The training documents should be structured in such a way that they can first be used for instructing the stakeholders in a project for introducing and maintaining an organization-specific process model and inthe respective pilot project and can afterwards be integrated as standard training into the organization-wide training program.

The training documents are based on the stakholders' profiles describing the necessary knowledge of process subjects. The training requirements for individual subjects may be derived from these profiles. The »Training Concept will be developed accordingly. Process-relevant subjects for stakeholders participating in a project for introducing and maintaining an organization-specific process model include the following:

- Profound knowledge of the respective prozess areas, e.g., CM, QA, and of the project management for IT projects
- Profound knowledge of the basic process model
- Contents and structure of references and standards, e.g., CMMI®, ISO 900x
- Planning and control of development processes
- Development of a tailorable standard process
- Process management techniques, e.g., cause-effect diagrams and Pareto diagrams
- Development of instructions and training documents
- Execution of process instructions
- Definition, collection and evaluation of metrics
- Psychology of communicating the contents of processes
- Establishment of Process Teams
- Technology change within the organization
- Process modification procedures in the organization
- Coaching and knowledge of operational projects

- Moderator training.

The training activities are either prepared and executed internally or conducted by means of external instructors and courses.

3.13.3.6 Organization-specific Directives and Informations

»Organization-specific Directives and Informations include organization-wide specifications and requirements which shall be observed accordingly. Examples include joint quality management requirements, requirements posed on methods and standards to be applied, guidelines for the execution of formal decisions and specifications of the tools and technologies to be used.

3.13.3.7 Product Templates

Detailed product templates and sample products, e.g. document and programming templates, must be provided for all products to be developed within the scope of the process defined in the »Process Descriptions.

4 Generative Product Dependencies

4.1 Assessment of a Process Model

Generative Work Products:	Project Manual, Project Plan
Generated Products	Assessment of a Process Model

The »Project Manual and the »Project Plan will be starting point and basis as regards content for the improvement project that will start with process evaluation (»Assessment of a Process Model). In the project manual the object and the framework conditions of the improvement project will be defined. In the project plan (including its sub-plans) the activities and resources of the improvement project will be planned, directed and controlled. The evaluation of the organization-specific process model will be the starting point for the improvement project, because there measures and thus the basis for future process improvement requirements will be defined.

4.2 Product Set for the Improvement of an Organization-Specific Process Model

Generative Work Products:	Assessment of a Process Model
Generated Products	Process Model Improvement Concept, Organization-Specific Process Model

The »Assessment of a Process Model will be firstly the basis of the »Process Model Improvement Concept and secondly of the organization-specific process model itself.

Starting with the measures suggested in the process evaluation, the requirements that will be part of the process improvement concept will be determined. Subsequently the measures will be implemented in the process improvement project and prepared in the organization-specific process model.

4.3 Conducting a Market Survey for Off-the-Shelf Products

Generative Work Products:	Requirements Specification, Project Proposal
Generated Products	Market Survey for Off-the-Shelf Products

If the »Project Proposal or the »Requirements Specification show that it may be possible to procure or use off-the-shelf products, a »Market Survey for Off-the-Shelf Products will be conducted. The results of the »Market Survey for Off-the-Shelf Products will be integrated into the »Requirements Specification.

4.4 Product Set of a Hardware Unit within the System

Generative Work Products:	System Architecture, System Implementation, Integration and Evaluation Concept

Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Evaluation Report Usability, Evaluation Specification Usability, Hardware Specification, Hardware Unit, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept, Safety and Security Analysis, Data Protection Concept, Information Security Concept

This »Product Dependency will describe the transition from system development to hardware development.

For each »Hardware Unit identified in the system architecture a »Hardware Architecture and a »Hardware Specification will be required. Starting with the hardware unit, the decomposition of the hardware elements will be carried out when the »Hardware Architecture will be developed. The decomposition of the hardware elements will be accompanied by an assignment and refinement of the interfaces and the requirements of the hardware specification.

For each hardware unit an evaluation specification and an evaluation procedure will be prepared in accordance with the specifications of the hardware implementation, integration and evaluation concept. The evaluation specification will be derived from the hardware specification. The evaluation procedure will be a detailed translation of the evaluation specification into concrete work instructions for the testing process of each individual evaluation case. The evaluation results will be documented in the evaluation report.

The integration of the tested hardware unit into the system will be described in the »System Implementation, Integration and Evaluation Concept.

4.5 Product Set of a Hardware Unit within an Enabling System

Generative Work Products:	Enabling System Architecture, Enabling System Implementation, Integration, and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Hardware Specification, Hardware Unit, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept, Safety and Security Analysis, Data Protection Concept, Information Security Concept

This »Product Dependency describes the transition from the system development of the »Enabling System to the hardware development.

The description of this dependency corresponds to the product dependency »Product Set of a Hardware Unit within the System.

4.6 Product Set of a Hardware Component

Generative Work Products:	Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept

Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Hardware Specification, Hardware Component, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

This »Product Dependency will describe the transition from the hierarchy level »Hardware Unit to the level »Hardware Component of the hardware development.

For each hardware unit identified in the hardware architecture, a »Hardware Specification will be required.

Starting with the hardware component, the decomposition in further detailed hardware elements will be carried out when the »Hardware Architecture will be developed. The decomposition of these hardware elements will be accompanied by an assignment and refinement of the interfaces and requirements of the hardware specification similar to the product dependency »Product Set of a Hardware Unit within the System.

In accordance with the specifications of the hardware implementation, integration and evaluation concept, an evaluation specification and an evaluation procedure will be prepared for each hardware component. The evaluation specification will be derived from the hardware specification. The connection between hardware component, hardware implementation, integration and evaluation concept, evaluation procedure, evaluation specification and evaluation report may be obtained from the »Product Set of a Hardware Unit within the System.

The integration of the tested hardware component into the hardware unit or hardware component will be described in the »Hardware Implementation, Integration and Evaluation Concept.

4.7 Product Set of an External Hardware Module

Generative Work Products:	Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Hardware Module Specification, External Hardware Module, Make-or-Buy Decision, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

The »Hardware Architecture defines all »Products of the type »External Hardware Module . A »Make-or-Buy Decision documents the way to the decision as to whether an »External Hardware Module will be procured as off-the-shelf product or awarded as sub-contract. The product »External Hardware Module is described in detail in the »External Hardware Module Specification.

The »Hardware Implementation, Integration and Evaluation Concept describes the integration of products of the type »External Hardware Module into »Hardware Units or into the product »External Hardware Module . The evaluation outlined in the »Hardware Implementation, Integration and Evaluation Concept for every product »External Hardware Module will be specified in detail for every »External Hardware Module in an »Evaluation Specification System Element, which specifies evaluation cases. These cases will be conducted in accordance with an »Evaluation Procedure System Element and documented in an »Evaluation Report System Element.

4.8 Product Set of a Hardware Module

Generative Work Products:	Hardware Architecture, Hardware Implementation, Integration and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Hardware Specification, Hardware Module, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

This »Product Dependency will describe the transition from the hierarchy level »Hardware Component to the level »Hardware Module.

The description of this dependency corresponds to the product dependency »Product Set of a Hardware Component.

4.9 Product scope for the acceptance of a delivery (without contract)

Generative Work Products:	Project Manual
Generated Products	Statement of Acceptance, Evaluation Report Delivery, Evaluation Specification Delivery

The products Statement of Acceptance, Evaluation Specification Delivery and Evaluation Report Delivery shall be prepared for every development objective specified in the project definition, unless these products are already included in the contract.

The contents of the Evaluation Specificaiton Delivery will be derived from the requirements. The acceptance test will be executed based on the Evaluation Specification Delivery and documented in the Evaluation Report Delivery, which will be attached to the Statement of Acceptance as evidence for the completed acceptance test.

4.10 Product scope for the compilation of a delivery (without contract)

Generative Work Products:	Project Manual
Generated Products	Delivery, Evaluation Report System Element, Evaluation Specification System Element, Evaluation Report Document, Evaluation Specification Document

Every development objective specified in the project definition will be included in the delivery unless the composition of the delivery is specified in a contract between acquirer and supplier. This delivery may include several partial deliveries, with each partial delivery being regarded as separate delivery.

4.11 Product Set of Logistic Elements

Generative Work Products:	Logistic Support Concept
Generated Products	Spare Parts Catalog, Maintenance Documentation, Repair Documentation

The Overall System Specification specifies the »Training Documentation and the »In-Service Documentation in detail and determines the volume of the required documentation in form of Maintenance Documentation, Repair Documentation and Spare Parts Catalogs.

4.12 Product Set of Logistic Support Documentation

Generative Work Products:	Overall System Specification
Generated Products	Logistic Support Specification, Logistic Calculations and Analyses, Logistic Support Concept

In accordance with the requirements in the »Overall System Specification, the following products will be prepared for the system and the appropriate »Enabling Systems: specifications for the respective logistic support, the corresponding »Logistic Calculations and Analyses and for each system a »Logistic Support Concept.

4.13 Product Set for the Project Management

Generative Work Products:	Project Manual, Project Plan
Generated Products	Life Cycle Cost Calculation, Commercial Project Status Report, Product Configuration, Measurement Data, Metrics Analysis, Problem Report / Change Request, Problem/Change Evaluation, Change Decision, Change Status List, Meeting Document, Project Status Report, Final Project Report, Project Management Infrastructure, Risk List, Estimation, Project Diary, Project Progress Decision, Work Order

This »Product Dependency will regulate the generation of products from the area of project management of the V-Modell. Those products will be derived from the »Project Manual and the »Project Plan.

For example, the number of the »Project Status Reports to be prepared in the project will be derived from the subject »Reporting and Communication Channels of the »Project Manual and the subject »Project Execution Plan in the »Project Plan.

A project progress decision must be prepared for every decision gate achieved in the project. In case of important decisions, it may be necessary to make also unscheduled project progress decisions.

4.14 Product Set for Quality Assurance

Generative Work Products:	QA Manual, Project Plan
Generated Products	Evaluation Specification Product Configuration, Evaluation Report Product Configuration, Qualification Record, Evaluation Report Document, Evaluation Report Process, Evaluation Specification Document, Evaluation Specification Process, Quality Status Report

The QA Manual will define the processes that shall be subjected to process testing. In case of the occurrence of special events or problems in the project (for example if a measurable quantity deviates from a specified value or if there are deviations from planning) that will be recorded in the »Project Status Report, an unscheduled process test will be performed. The »QA Manual defines criteria from which the circumstances under which scheduled and unscheduled »Quality Status Report shall be prepared can be derived.

The planning included in the »Project Plan shall take into account the requirements from the »QA Manual »Evaluation Specification Document and the »Evaluation Report Document. Starting with the products planned in integrated planning and taking into account the requirements from the QA Manual, the documents to be tested will be selected.

For the evaluation, a (document/system element/process/delivery) evaluation specification and a (document/system element/process/delivery) evaluation report will be prepared. The »Qualification Record will determine which qualifications will be needed and will refer to the appropriate evaluation reports.

4.15 Product Set of one Software Unit in the System

Generative Work Products:	System Architecture, System Implementation, Integration and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Software Specification, Software Unit, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Software Architecture, Software Implementation, Integration and Evaluation Concept, Safety and Security Analysis, Data Protection Concept, Information Security Concept

The implementation of requirements by the »Software Unit is defined in the »System Architecture. The design of the »Software Unit is documented in each case in the »Software Architecture. The appropriate »Software Specification describes accurately the interface of the »Software Unit and its realization.

Starting with the »Software Specification, the contents of the »Evaluation Specification System Element are worked out. For each specified evaluation case a »Evaluation Procedure System Element is prepared. The results of the execution of this »Evaluation Procedure System Element, i. e. the realization of the evaluation cases, are documented in a »Evaluation Report System Element.

In the corresponding »Software Implementation, Integration and Evaluation Concept the required approaches for the preparation of the software unit are defined.

4.16 Product Set of one Software Unit in the Enabling System

Generative Work Products:	Enabling System Architecture, System Implementation, Integration and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Software Specification, Software Unit, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Software Architecture, Software Implementation, Integration and Evaluation Concept, Safety and Security Analysis, Data Protection Concept, Information Security Concept

The implementation of requirements by the »Software Unit is defined in the »Enabling System Architecture. The design of the each »Software Unit is documented in the »Software Architecture. The appropriate »Software Specification describes accurately the interface of the »Software Unit and its realization.

Starting with the software specification, the contents of the »Evaluation Specification System Element are worked out. For each specified evaluation case a »Evaluation Procedure System Element is prepared. The results of the execution of this »Evaluation Procedure System Element, i. e. the realization of the evaluation cases, are documented in a »Evaluation Report System Element.

In the corresponding »Software Implementation, Integration and Evaluation Concept the required approaches for the preparation of the software unit are defined.

4.17 Product Set of one Software Component

Generative Work Products:	Software Architecture, Software Implementation, Integration and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Software Specification, Software Component, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

The implementation of the requirements by a »Software Component will be defined in the »Software Architecture. The appropriate »Software Specification will describe accurately the interface of the »Software Component and its realization.

Starting with the software specification, the contents of the »Evaluation Specification System Element will be worked out. For each specified evaluation case a »Evaluation Procedure System Element will be prepared. The results of the execution of this »Evaluation Procedure System Element, i. e. the realization of the evaluation cases, will be documented in a »Evaluation Report System Element.

In the corresponding »Software Implementation, Integration and Evaluation Concept the required approaches for the preparation of the software component will be defined.

4.18 Product Set of one External Software Module

Generative Work Products:	Software Architecture, Software Implementation, Integration and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Software Module Specification, External Software Module, Make-or-Buy Decision, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

The »Software Architecture defines all »Products of the type »External Software Module . A »Make-or-Buy Decision documents the way to the decision as to whether an »External Software Module will be procured as off-the-shelf product or awarded as sub-contract. The product »External Software Module is described in detail in the »External Software Module Specification.

The »Software Implementation, Integration and Evaluation Concept describes the integration of products of the type »External Software Module into »Software Units or into the product »External Software Module . The evaluation outlined in the »Software Implementation, Integration and Evaluation Concept for every product »External Software Module will be specified in detail for every »External Software Module in an »Evaluation Specification System Element , which specifies evaluation cases. These cases will be conducted in accordance with an »Evaluation Procedure System Element and documented in an »Evaluation Report System Element.

4.19 Product Set of one Software Module

Generative Work Products:	Software Architecture, Software Implementation, Integration and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Software Specification, Software Module, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

In the »Software Architecture the implementation of the requirements is defined by a »Software Module. The appropriate »Software Specification describes accurately the interface of the »Software Module and its realization.

Starting with the software specification, the contents of the »Evaluation Specification System Element are worked out. For each specified evaluation case a »Evaluation Procedure System Element is prepared. The results of the execution of this »Evaluation Procedure System Element, i. e. the realization of the evaluation cases, are documented by a »Evaluation Report System Element.

In the corresponding »Software Implementation, Integration and Evaluation Concept the required approaches for the preparation of the software process module are defined.

4.20 Product Set of External Units in the System

Generative Work Products:	System Architecture, System Implementation, Integration and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Unit Specification, External Unit, Make-or-Buy Decision, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

All products of the type »External Units of the »System are defined in the »System Architecture. The path to the decision as to whether an »External Unit is purchased as an off-the-shelf product or subcontracted is documented in a »Make-or-Buy Decision. A detailed description of the »External Unit is included in the »External Unit Specification .

The »System Implementation, Integration and Evaluation Concept describes the assembly of the products of the type »External Unit to »Segments or to the »System. The tests of each »External Unit for which a rough outline is given in the »System Implementation, Integration and Evaluation Concept are specified in detail for each »External Unit with the help of evaluation cases described in an »Evaluation Specification System Element. These evaluation cases are conducted in accordance with an »Evaluation Procedure System Element and documented in a »Evaluation Report System Element.

4.21 Product Set of External Units in an Enabling System

Generative Work Products:	Enabling System Architecture, Enabling System Implementation, Integration, and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, External Unit Specification, External Unit, Make-or-Buy Decision, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

All »External Units of the »Enabling System are defined in the »Enabling System Architecture. The path to the decision as to whether an »External Unit is purchased as an off-the-shelf product or subcontracted is documented in a »Make-or-Buy Decision. A detailed description of the »External Unit is included in the »External Unit Specification .

The »Enabling System Implementation, Integration, and Evaluation Concept describes the assembly of the »External Units to »Segments or to the »Enabling System. The tests of each »External Unit for which a rough outline is given in the »Enabling System Implementation, Integration, and Evaluation Concept are specified in detail for each »External Unit with the help of evaluation cases described in an »Evaluation Specification System Element. These tests are conducted in accordance with an »Evaluation Procedure System Element and documented in an »Evaluation Report System Element.

4.22 Product Set of Logistic Elements

Generative Work Products:	Overall System Specification
Generated Products	Training Documentation, In-Service Documentation

The »Overall System Specification shall specify the scope of the required documentation in form of »Training Documentation and »In-Service Documentation. These »Logistic Elements will be integrated into the work product »Logistic Support Documentation and extended, as required, by additional work products and subjects in the module »Integrated Logistic Support.

4.23 Product Set of Segments in the System

Generative Work Products:	System Architecture, System Implementation, Integration and Evaluation Concept

Generated Products	Evaluation Report Usability, Evaluation Specification Usability, System Specification, Segment, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

In the »System Architecture all »Segments of the »System are defined. A detailed description of the segments is included in the »System Specification.In the »System Implementation, Integration and Evaluation Concept the assembly of the »Segments, respectively of the »System consisting of »Hardware Units, »Software Units, »External Units or »Segments, is described.

The tests of each »Segment of which a rough outline is given in the »System Implementation, Integration and Evaluation Concept are specified in detail for each »Segment with the help of evaluation cases in a »Evaluation Specification System Element. Those tests are performed by a »Evaluation Procedure System Element and documented in a »Evaluation Report System Element.

4.24 Product Set of Segments in an Enabling System

Generative Work Products:	Enabling System Architecture, Enabling System Implementation, Integration, and Evaluation Concept
Generated Products	Evaluation Report Usability, Evaluation Specification Usability, System Specification, Segment, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Safety and Security Analysis, Data Protection Concept, Information Security Concept

All »Segments of the »Enabling System are defined in the »Enabling System Architecture. They are described in detail in the »System Specification.

The »Enabling System Implementation, Integration, and Evaluation Concept describes the assembly of the »Segments or the »Enabling System from »Hardware Units, »Software Units, »External Units or »Segments.

The tests of each »Segment of which a rough outline is given in the »Enabling System Implementation, Integration, and Evaluation Concept are specified in detail for each »Segment with the help of evaluation cases in a »Evaluation Specification System Element. Those tests are performed by a »Evaluation Procedure System Element and documented in a »Evaluation Report System Element.

4.25 Product Set of Enabling Systems

Generative Work Products:	Overall System Specification

Generated Products	User Tasks Analysis, Man-Machine Interface (Style Guide), Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, Database Design, System Specification, Enabling System, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, Enabling System Architecture, Enabling System Implementation, Integration, and Evaluation Concept, Safety and Security Analysis, Data Protection Concept, Information Security Concept, Legacy System Analysis, Migration Concept

In the »Overall System Specification the implementation of the requirements by the »System and the »Enabling Systems is defined. The design of the »System and the »Enabling Systems is documented in the »System Architecture or the »Enabling System Architecture. An appropriate »System Specification accurately describes the interface of the »System and the »Enabling Systems and its realization.

Starting with the »System Specification, the contents of the »Evaluation Specification System Element are worked out. For each specified evaluation case a »Evaluation Procedure System Element is prepared. The results of the execution of this»Evaluation Procedure System Element, i. e. the realization of the evaluation cases, are documented in a »Evaluation Report System Element.

The necessary approaches to the preparation of the »System or »Enabling System are defined in the corresponding »System Implementation, Integration and Evaluation Concept or »Enabling System Implementation, Integration, and Evaluation Concept.

4.26 Product Set of the System

Generative Work Products:	Overall System Specification
Generated Products	User Tasks Analysis, Man-Machine Interface (Style Guide), Evaluation Report Usability, Evaluation Specification Usability, Market Survey for Off-the-Shelf Products, Database Design, System Specification, System, Evaluation Specification System Element, Evaluation Procedure System Element, Evaluation Report System Element, System Architecture, System Implementation, Integration and Evaluation Concept, Safety and Security Analysis, Data Protection Concept, Information Security Concept, Legacy System Analysis, Migration Concept

In the »Overall System Specification the implementation of the requirements by the »System and the »Enabling Systems is defined. The design of the»System and the »Enabling Systems is documented in the »System Architecture and the »Enabling System Architecture. An appropriate »System Specification accurately describes the interface of the »System and the »Enabling Systems and its realization.

Starting with the »System Specification, the contents of the »Evaluation Specification System Element are worked out. For each specified evaluation case a »Evaluation Procedure System Element is prepared. The results of the execution of this »Evaluation Procedure System Element, i. e. the realization of the evaluation cases, are documented in a »Evaluation Report System Element.

The necessary approaches to the preparation of the »System or »Enabling System are defined in the corresponding »System Implementation, Integration and Evaluation Concept or »Enabling System Implementation, Integration, and Evaluation Concept.

4.27 Product Scope for Safety

Generative Work Products:	Project Manual, Overall System Specification
Generated Products	System Implementation, Integration and Evaluation Concept, Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept, Safety and Security Analysis

The Project Manual and the Overall System Specification show if functional safety aspects must be taken into account in the project. If this is a case, a safety and security analysis and the respective implementation, integration and evaluation concepts shall be prepared.

4.28 Preparation of a Contract Addendum

Generative Work Products:	Change Decision
Generated Products	Contract Addendum

If contractual provisions, such as scope of work, deadlines or costs, shall be changed due to a »Change Decision, a »Contract Addendum that includes the agreements that were changed will be prepared.

4.29 Product Set for Contract Award

Generative Work Products:	Make-or-Buy Decision, Project Manual
Generated Products	RFP Concept, Request for Proposal, Criteria Catalog for Assessment of Offers, Contract, Offer Assessment

If it will be decided in the »Make-or-Buy Decision to award a contract for the development of a whole system or a subsystem, »Product Instances for the products »RFP Concept, »Request for Proposal, »Criteria Catalog for Assessment of Offers, »Offer Assessment and »Contract shall be prepared.

The request for proposal will be prepared and sent off, respectively published, in accordance with the procedure selected in the RFP Concept. Incoming »Offers will be assessed on the basis of the criteria defined in the »Criteria Catalog for Assessment of Offers. The results of this assessment will be documented in the Offer Assessment. The contract will be negotiated with the supplier selected in the Offer Assessment.

4.30 Product Set for the Supplies and Services to be Received According to Contract

Generative Work Products:	Contract, Contract Addendum

Generated Products	Statement of Acceptance, Evaluation Report Delivery, Evaluation Specification Delivery

Unless agreed otherwise in the »Contract or a »Contract Addendum, product instances for the products »Statement of Acceptance, »Evaluation Specification Delivery and »Evaluation Report Delivery shall be prepared for each contractually agreed delivery unit.

Starting with the performance agreed in »Annex 1: Requirements Regarding (Sub-)System of the contract or the contract addenda (see »Contract Addendum), the contents of the »Evaluation Specification Delivery will be prepared. Acceptance testing will be performed on the basis of this »Evaluation Specification Delivery and documented in the »Evaluation Report Delivery. This will be attached to the statement of acceptance as proof of the completion of the acceptance test.

4.31 Preparing an Offer

Generative Work Products:	Request for Proposal (Acquirer), Assessment of Request for Proposal
Generated Products	Offer

If - based on the »Request for Proposal (Acquirer) and the resulting »Assessment of Request for Proposal - a decision is made that the preparation of an offer will make sense, then the product »Offer will be prepared.

4.32 Product Set to be Delivered According to Contract

Generative Work Products:	Contract (Acquirer), Contract Addendum (Acquirer)
Generated Products	Delivery, Project Status Report, Final Project Report, Evaluation Report System Element, Evaluation Specification System Element, Evaluation Specification Document, Evaluation Report Document

Based on the delivery items agreed in the »Contract or the »Contract Addendum, the »Delivery, which may consist of several partial deliveries, will be generated. Each partial delivery shall be considered a separate delivery and shall be described in the subject Project Results of the appropriate »Project Status Report.

The delivery also includes a final inspection. If the delivery consists of system elements, this inspection will be conducted based on the »Evaluation Specification System Element, and an »Evaluation Report System Element will be prepared. However, if the delivery consists of documents, the inspection will be conducted based on the »Evaluation Specification Document, and an »Evaluation Report Document will be prepared.

The delivery or the partial deliveries will be documented in the »Final Project Report.

5 Content-Related Product Dependencies

5.1 Consideration of the Project Proposal

Content-dependent Work Products: Project Proposal, Project Manual, Project Plan

The information about »Initial Situation, existing framework conditions, project targets, system conception and »Economic Efficiency contained in the »Project Proposal have to be considered in the »Project Manual and in the »Project Plan.

5.2 Requirements Evaluation

Content-dependent Work Products: Requirements Evaluation, Requirements Specification, Market Survey for Off-the-Shelf Products

The »Requirements Evaluation is performed on the basis of the requirements (see »Requirements Specification) and is reincorporated in an updated version of the requirements. During the evaluation of requirements all requirements are checked for their affordability, cost-effectiveness and also for their necessity.

5.3 Preparing the first Project Progress Decision

Content-dependent Work Products: Project Progress Decision, Project Proposal

The project ideas and realization proposals presented in the »Project Proposal have to be weighted in a decision process that is outside of the V-Modell. The decision that is made has to be laid down in a »Project Progress Decision.

5.4 Project Proposal and Requirements Specification

Content-dependent Work Products: Requirements Specification, Project Proposal, Requirements Specification Overall Project

In the product »Requirements Specification or Requirements Specification Overall Project, the information from the »Project Proposal concerning framework conditions, system idea and realization plan have to be taken into account.

5.5 Consistency between Sub-Project Requirements and the Requirements Specification Overall Project

Content-dependent Work Products: Requirements Specification, Requirements Specification Overall Project

The Requirements Specifications of sub-projects shall be consistent with the requirements of the Requirements Specification Overall Project.

5.6 Consistency of User Task Analysis and Overall System Specification

Content-dependent Work Products: Overall System Specification, User Tasks Analysis

The »User Tasks, user profiles and physical use environment identified »User Tasks Analysis have to be considered as input for the topic »Functional Requirements in the »Overall System Specification.

5.7 Directives for the User Interface

Content-dependent Work Products: Man-Machine Interface (Style Guide), System Specification, Software Specification, Hardware Specification

The design of the user interface described in the »System Specification, the »Software Specification and the »Hardware Specification has to be based on the requirements from the »Man-Machine Interface (Style Guide).

5.8 Consideration of the Proposal for Introducing and Maintaining an Organization-Specific Process Model

Content-dependent Work Products: Proposal for the Introduction and Maintenance of an Organization-Specific Process Model, Project Manual, Project Plan

The information contained in the »Proposal for the Introduction and Maintenance of an Organization-Specific Process Model must be considered in the »Project Manual and the »Project Plan.

5.9 Preparation of the First Project Progress Decision

Content-dependent Work Products: Proposal for the Introduction and Maintenance of an Organization-Specific Process Model, Project Progress Decision

The project ideas and realization proposals presented in the »Proposal for the Introduction and Maintenance of an Organization-Specific Process Model have to be weighted in a decision process that is outside of the V-Modell. The decision that is made has to be laid down in a »Project Progress Decision.

5.10 Consistency of the Products of the Organization-specific Process Model

Content-dependent Work Products: Process Model Improvement Concept, Project Plan, Organization-Specific Process Model

The »Process Model Improvement Concept, which describes, among other things, the »Requirements for the improvement project and the »Realization Concept, is the basis for the product »Organization-Specific Process Model that is used to support the improvement process. The implementation of the »Requirements is described in the »Realization Concept. The contents of the »Realization Concept are incorporated into the »Process Descriptions.

The »Process Model Improvement Concept provides also input for the »Training Plan in the »Project Plan. For the selected processes that are to be dealt with in the improvement project and that are described in the »Realization Concept, the necessary training courses are included in the »Training Plan of the »Project Plan.

5.11 Proposal for Introducing and Maintaining an Organization-Specific Process Model

Content-dependent Work Products:	Proposal for the Introduction and Maintenance of an Organization-Specific Process Model, Assessment of a Process Model, Process Model Improvement Concept

The framework conditions and plans specified in the products »Assessment of a Process Model and »Process Model Improvement Concept have to consider the information cointained in the »Proposal for the Introduction and Maintenance of an Organization-Specific Process Model.

5.12 Consideration of the Market Survey

Content-dependent Work Products:	Market Survey for Off-the-Shelf Products, Make-or-Buy Decision

In the »Market Survey for Off-the-Shelf Products candidates for off-the-shelf products for an »External Unit, an External Hardware Module or an External Software Module are identified. Within the framework of the »Make-or-Buy Decision these candidates have to be evaluated (see »Evaluation of Off-the-Shelf Products).

5.13 Influence of an Off-the-Shelf Product on the External Unit Specification

Content-dependent Work Products:	External Unit Specification, Make-or-Buy Decision

The »External Unit Specification provides the basis for the »Evaluation of Off-the-Shelf Products within the framework of the »Make-or-Buy Decision.

If the result of a Make-or-Buy Decision is that an off-the-shelf product is to be used, this usually has repercussions on the »External Unit Specification, because the off-the-shelf product usually meets only part of the requirements. The remainder will have to be met by other or new components of the system or the requirements will have to be adapted or reduced. This in turn may have repercussions on the »System Architecture, the »System Specification , the »Overall System Specification or even the »Requirements Specification.

Off-the-shelf products often do not meet the special requirements resulting from environmental influences and special operational environments (e. g. in the military). Therefore it will be necessary to adapt off-the-shelf products to the specified operational conditions (e. g. by hardening). When using off-the-shelf products, this has to be taken into consideration with regard to the costs and the integration risk.

The decision as to whether this additional work is possibly contracted is made within the framework of a further »Make-or-Buy Decision.

5.14 Influence of an Off-the-Shelf Product on the External Hardware Module Specification

Content-dependent Work Products:	External Hardware Module Specification, Make-or-Buy Decision

At hardware level, the »External Hardware Module Specification provides the basis for the »Evaluation of Off-the-Shelf Products within the framework of the »Make-or-Buy Decision.

If the result of a Make-or-Buy Decision is that an off-the-shelf product is to be used, this usually has repercussions on the »External Hardware Module Specification because the off-the-shelf product usually meets only part of the requirements. The remainder will have to be met by other or new components of the system, or the requirements will have to be adapted or reduced. This in turn may have repercussions on the hardware architecture and the hardware specification and - consequently - on the »System Architecture , the »System Specification , the »Overall System Specification or even the »Requirements Specification.

Off-the-shelf products often do not meet the special requirements resulting from environmental influences and special operational environments (e. g. in the military). Therefore it will be necessary to adapt off-the-shelf products to the specified operational conditions (e. g. by hardening). When using off-the-shelf products, this has to be taken into consideration with regard to the costs and the integration risk.

The decision as to whether this additional work is possibly contracted is made within the framework of a further »Make-or-Buy Decision.

5.15 Influence of an Off-the-Shelf Product on the External Software Module Specification

Content-dependent Work Products:	External Software Module Specification, Make-or-Buy Decision

At software level, the »External Software Module Specification provides the basis for the »Evaluation of Off-the-Shelf Products within the framework of the »Make-or-Buy Decision.

If the result of a Make-or-Buy Decision is that an off-the-shelf product is to be used, this usually has repercussions on the »External Software Module Specification, because the off-the-shelf product usually meets only part of the requirements. The remainder will have to be met by other or new components of the system, or the requirements will have to be adapted or reduced. This in turn may have repercussions on the software architecture and the software specification and - consequently - on the »System Architecture , the »System Specification , the »Overall System Specification or even the »Requirements Specification.

Off-the-shelf products often do not meet the special requirements resulting from environmental influences and special operational environments (e. g. in the military). Therefore it will be necessary to adapt off-the-shelf products to the specified operational conditions (e. g. by hardening). When using off-the-shelf products, this has to be taken into consideration with regard to the costs and the integration risk.

The decision as to whether this additional work is possibly contracted is made within the framework of a further »Make-or-Buy Decision.

5.16 Directives of the QA Manual Regarding Off-the-Shelf Products

Content-dependent Work Products: QA Manual, Evaluation Specification System Element

In each »Evaluation Specification System Element that refers to a system element which is realized by an off-the-shelf product, the »Directives for Evaluation Specification for Off-the-Shelf Products in the »QA Manual have to be taken into account.

5.17 Preparing the Life Cycle Cost Calculation

Content-dependent Work Products: Life Cycle Cost Calculation, Project Plan, Risk List, Estimation, Overall System Specification, Requirements Specification

The preparation of the product »Life Cycle Cost Calculation is based on the Requirements Specification, the Overall System Specification, the planned »Work Packages in the »Project Plan, the results of »Estimations and the risk considerations in the »Risk List.

The products Requirements Specification and Overall System Specification specify life cycle standards, which are integrated as target values into the Life Cycle Cost Calculation.

The »Account Structure usually provides a more sketchy outline of the planned work packages, respectively the planned preparation of system elements in the »Project Plan. If possible, the »Account Structure should be derived directly from the structure of the work packages in the »Project Plan so that consistency with the product »Life Cycle Cost Calculation can be easily restored when the planning is revised.

The estimated expenditure is the input variable for the calculation of the planned cost of the product »Life Cycle Cost Calculation, »Project Costs.

If risks are accepted and if deliberately no preventive measures are taken, it has to be checked whether it is necessary to set aside money reserves, for example for contractual penalties.

5.18 Preparing the Life Cycle Cost Calculation

Content-dependent Work Products: Life Cycle Cost Calculation, Commercial Project Status Report, Project Status Report, Final Project Report, Project Diary

Deviations of the planned costs from the actually accumulated costs (subjects Deviations of the Projected Costs of Planning Stage, »Deviations of Project Costs, »Deviations of Manufacturing Costs, and Deviations from the Projected Costs of Use) are included in the »Project Diary, »Project Status Report and »Final Project Report .

5.19 Consistency between CM Requirements specified in the Project Manual and the Evaluation Specification Product Configuration

Content-dependent Work Products: Evaluation Specification Product Configuration, Project Manual

In each »Evaluation Specification Product Configuration the subject »Configuration Management - Organization and Directives in the »Project Manual is to be taken into consideration.

5.20 Description of System and Enabling Systems by Logistic Elements

Content-dependent Work Products: Logistic Support Documentation, System, Enabling System

The »Logistic Support Documentation consists of the logistic elements. Depending on the requirements specified in the Overall System Specification, it describes the use, maintenance, repair and interaction of »Enabling System (e.g. special tooling, measuring and test equipment and training tools) and the »System for the users.

5.21 Logistic Calculations and Analyses as Prerequisites for the Logistic Conception

Content-dependent Work Products: Logistic Support Specification, Logistic Calculations and Analyses, Logistic Support Concept

The result of »Logistic Calculations and Analyses are logistics parameters, such as expected reliability and maintainability of the system and possibly suggestions concerning spare parts. Based on the analyses and calculations, the requirements are refined in the product »Logistic Support Specification. A »Logistic Support Concept is used to develop alternatives for logistic support. One of these alternatives is worked out in detail.

5.22 Logistic Calculations and Analyses based on (Enabling) System Architecture

Content-dependent Work Products: Logistic Calculations and Analyses, Enabling System Architecture, System Architecture

»Logistic Calculations and Analyses use information from the »System Architecture and the »Enabling System Architectures to determine logistics parameters such as reliability or maintainability.

5.23 Influence of Logistic Conception on Hardware and Software Specifications

Content-dependent Work Products: Logistic Support Specification, System Specification, Software Specification, Hardware Specification, External Unit Specification, External Hardware Module Specification, External Software Module Specification

»Logistic Requirements such as availability or maintainability are met by the interaction of »System, »Enabling System and logistic support. The removability of a »Hardware Module in the system, the functionality of the enabling system "measuring equipment" and the quality of the »Maintenance Instructions, for example, determine the time needed to repair the system and thus its availability. The logistic concept examines this interaction, which may lead to new requirements for hardware or software components and external elements, like External Units and work products of the type External Hardware Module and External Software Module.

5.24 Influence of Logistic Conception on In-Service and Training Documentation

Content-dependent Work Products: Logistic Support Concept, In-Service Documentation, Training Documentation

The »Training Documentation and »In-Service Documentation specified as standard in the »Overall System Specification will be augmented by additional subjects depending on the »Logistic Support Concept . These subjects ensure the consistency with »Maintenance Documentation, »Repair Documentation and »Spare Parts Catalog.

5.25 Evaulation of the Overall Project Requirements Specification

Content-dependent Work Products: Requirements Specification Overall Project, Evaluation of the Overall Project Requirements Specification

The Assessment of the Overall Project Requirements Specification will be based on the requirements (see Overall Project Requirements Specification). Its result will be integrated into an updated version of the requirements. The Assessment of the Overall Project Requirements Specification examines the affordability, economic efficiency and necessity of all requirements.

5.26 Aggregation of project status reports to the overall project

Content-dependent Work Products: Project Status Report, Project Progress Decision

The Project Status Reports of the overall project include relevant data of the Project Status Reports of sub-projects in condensed and aggregated form.

5.27 Project proposal and requirements

Content-dependent Work Products: Requirements Specification, Project Proposal, Requirements Specification Overall Project

The product Requirements Specification or Requirements Specification Overall Project shall take into account the information on general conditions, system idea and realization plan, which is included in the Project Proposal.

5.28 Change Status List within Project Status Report

Content-dependent Work Products: Change Status List, Project Status Report

»Project Status Reports include the relevant contents of the »Change Status List in condensed form.

5.29 Consistency of Problem and Change Management Products

Content-dependent Work Products: Problem Report / Change Request, Change Status List, Problem/Change Evaluation, Change Decision, Project Plan

Consistency with regard to evaluating, deciding, planning and tracing problem reports and change requests has to be maintained.

Each »Problem Report / Change Request is registered in the »Change Status List. For each »Problem Report / Change Request there is exactly one »Problem/Change Evaluation and one »Change Decision. Major »Change Decisions are schedulded in the »Project Plan.

5.30 Consideration of Project Progress Decisions

Content-dependent Work Products:	Project Manual, Project Plan, Project Progress Decision

Consistency of the »Project Manual and the »Project Plan with the requirements from the »Project Progress Decisions has to be maintained.

5.31 Consistency of Work Orders and Project Plan

Content-dependent Work Products:	Work Order, Project Plan

Task description, deadlines and funding for a »Work Order may be taken from the »Project Plan, i. e. work orders are also scheduled in the »Project Plan.

If during the basic ordering agreement the »Project Leader and the team members come to the conclusion that the deadlines, expenditures and resources contained in the »Project Plan cannot be realized, the »Project Plan has to be revised.

5.32 Planning of Risk Management Measures

Content-dependent Work Products:	Project Plan, Risk List, Project Manual, Project Status Report

The planned risk management measures (see the »Risk Mitigation Measures) are documented in the action plan of the »Risk List. The measures that are initiated are determined according to the specifications of the topic »Risk Management - Organization and Directives in the »Project Manual. All initiated measures have to be included in the project plan. In addition, the »Project Status Report includes a summary of the measures intended to reduce the identified risks

5.33 Preparing Regular Quality Status Reports

Content-dependent Work Products:	Quality Status Report, Project Manual

The reporting system for the project is defined in the topic »Reporting and Communication Channels in the »Project Manual. In this topic also the frequency of regular »Quality Status Reports is stipulated.

5.34 Evaluation Reports in the Quality Status Report

Content-dependent Work Products:	Evaluation Report Delivery, Quality Status Report, Evaluation Report Document, Evaluation Report Process, Evaluation Report System Element

The »Quality Status Report summarizes important results of the different test reports.

5.35 Evaluation Specification and Evaluation Report

Content-dependent Work Products:	Evaluation Report Delivery, Evaluation Specification Delivery, Evaluation Specification Document, Evaluation Report Document, Evaluation Specification Process, Evaluation Report Process, Evaluation Report System Element, Evaluation Specification System Element

The results of each test with regard to the evaluation specification and the object to be tested are described in a test report.

5.36 Quality Status Reports in Project Status Report and Project Diary

Content-dependent Work Products:	Project Status Report, Quality Status Report, Project Diary

»Project Status Reports and »Project Diary include relevant contents of the »Quality Status Reports in condensed form.

5.37 Directives Regarding Products to be Evaluated

Content-dependent Work Products:	Project Manual, QA Manual

In the »QA Manual, the products contained in the »Decision Gates have to be agreed as the products to be tested. At least those products have to be tested in the project.

5.38 Integration of the System Elements

Content-dependent Work Products:	Hardware Implementation, Integration and Evaluation Concept, Hardware Module, Hardware Unit, Hardware Component, External Hardware Module, Software Unit, Software Component, Software Module, Software Implementation, Integration and Evaluation Concept, External Software Module, System Implementation, Integration and Evaluation Concept, Segment, System, External Unit

The »System Elements have to be integrated in accordance with the implementation, test and integration concepts.

5.39 Planning of Evaluation and Integration

Content-dependent Work Products:	Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, System Implementation, Integration and Evaluation Concept, Project Plan

Deadlines and resources for the approach indicated in the »System Implementation, Integration and Evaluation Concept have to be planned in the »Integration and Evaluation Plan System Elements of the »Project Plan.

5.40 Evaluation Procedure and Evaluation Report

Content-dependent Work Products: Evaluation Report System Element, Evaluation Procedure System Element

The result of a test is documented in a »Evaluation Report System Element based on the steps that are specified in a »Evaluation Procedure System Element and that have to be performed during testing.

5.41 Evaluation Specifications and Reports in the Qualification Record

Content-dependent Work Products: Qualification Record, Evaluation Report System Element, Evaluation Specification System Element

The »Qualification Record contains references to system element evaluation specifications and protocols.

The »Evaluation Specification System Element indicates how a qualification is to be or was demonstrated. A qualification is documented by a positive »Evaluation Report System Element.

5.42 Directives in the Overall System Specification regarding Off-the-Shelf Products

Content-dependent Work Products: Make-or-Buy Decision, Overall System Specification

If concrete requirements for the use of off-the-shelf products are established in the »Overall System Specification , these requirements have to be taken into account in the »Make-or-Buy Decision.

This may include for example the following requirements:

- Use of a concrete product or a concrete product family
- Tasking of a clearly defined sub-supplier
- Realization criteria that admit only specific products or product families.

5.43 Directives Regarding Evaluation of System Elements

Content-dependent Work Products: Hardware Implementation, Integration and Evaluation Concept, Software Implementation, Integration and Evaluation Concept, QA Manual, System Implementation, Integration and Evaluation Concept, Enabling System Implementation, Integration, and Evaluation Concept

The »QA Manual contains System Element Testing Specifications that must be taken into account in the implementation, integration and evaluation concepts.

5.44 Consistency between the Requirements Specification and the Overall System Specification (without contract)

Content-dependent Work Products: Requirements Specification, Overall System Specification

If there is no contract, the specified requirements (Requirements Specification) shall be covered completely by the Overall System Specification. The System Developer shall ensure that all functional and non-functional requirements of the Overall System Specification will be fulfilled by the first preliminary architecture of the system (including interface overview). The requirements shall be refined as required.

5.45 Product Scope for Safety and Security

Content-dependent Work Products: Project Manual, Requirements Specification, Overall System Specification

The Project Manual indicates if information security and/or functional safety features must be considered in the project and how these features should be integrated in the requirements specified in the Requirements Specification and the Overall System Specification.

5.46 Directives Regarding Safety and Security in the Project Manual

Content-dependent Work Products: Project Manual, Safety and Security Analysis, Information Security Concept, Data Protection Concept

In the topic »Safety and Security - Organization and Directives in the »Project Manual, constructional and analytical specifications for safety and security are defined that will be applicable to the project.

Based on these specifications, risk reduction measures have to be determined for each system element that exceeds the accepted risk threshold. These risk-reduction measures lead to a reduction of the probability that a risk occurs or to a reduction of the damage level.

5.47 Information Security Specifications

Content-dependent Work Products: Project Manual, Overall System Specification, Information Security Concept, Data Protection Concept

The Project Manual and the Overall System Specification indicate if information security requirements must be considered in the respective project. If this is the case, an Information Security Concept and a Data Protection Concept shall be prepared. The system architecture data in the Information Security Concept must be consistent to the work product »System Architecture.

5.48 Acceptance of the Directives Specified for the Supplier in the Project Manual

Content-dependent Work Products: Request for Proposal, Project Manual

The request for proposal will take over the subject Directives for the Project Manual of the Supplier from the Project Manual.

5.49 Acceptance of the Directives Specified for the Supplier in the QA Manual

Content-dependent Work Products: Request for Proposal, QA Manual

The request for proposal will take over the subject Directives for the QA Manual of the Supplier from the QA Manual.

5.50 Requirements as Part of Request for Proposal and Contracts

Content-dependent Work Products:	Request for Proposal, Requirements Specification, Contract, Contract Addendum

When a complete system is put up for bidding, the state of the »Requirements Specification becomes a component of the »Request for Proposal.

Depending on the award procedure, it may be possible to renegotiate changes in the »Requirements Specification that emerged after the mailing of the »Request for Proposal. If this happens before the »Offers are submitted, public purchasers may have to grant an extension of the closing date and inform all possible »Sub-Suppliers.

The state of the »Requirements Specification that is valid at the time of the contract is part of the »Contract. After the conclusion of the contract the contract is no longer updated, i. e. possible future changes of the »Requirements Specification do not have any impact on the contract and are settled by way of contract addenda (see »Contract Addendum).

5.51 Supplier Reports

Content-dependent Work Products:	Project Status Report (Supplier), Final Project Report (Supplier), Final Project Report, Project Status Report

Important contents of the product »Project Status Report (Supplier), respectively the product »Final Project Report (Supplier), are included in the »Project Status Report, respectively the »Final Project Report, of the acquirer project.

5.52 Assessment of Offers

Content-dependent Work Products:	Offer (Supplier), Offer Assessment

The Assessment of Offers is based on the products »Offer (Supplier) of various potential suppliers. In the »Offer Assessment a statement, which is based on the product »Criteria Catalog for Assessment of Offers, must be made for each »Offer (Supplier).

5.53 External Unit Specification as Part of Request for Proposal and Contract

Content-dependent Work Products:	Request for Proposal, Contract, External Unit Specification, Contract Addendum, External Hardware Module Specification, External Software Module Specification

When a subsystem is awarded, the current state of the »External Unit Specification, »External Hardware Module Specification or »External Software Module Specification becomes part of the »Request for Proposal.

Depending on the award procedure, it may be possible to renegotiate changes in these specifications that emerged after the mailing of the »Request for Proposal. Between public purchasers and suppliers, contract negotiations are possible only with limitations. If this happens before the »Offers are submitted, public purchasers may have to grant an extension of the closing date and inform all possible »Sub-Suppliers.

The state of the »External Unit Specification , »External Hardware Module Specification or »External Software Module Specification that is valid at the time of the contract is part of the »Contract. After the conclusion of the contract, the contract is no longer updated, i. e. possible future changes of these specifications no longer have an impact on the contract and are settled by way of contract addenda (see »Contract Addendum).

5.54 Planning of the Cooperation in Activities of the Supplier

Content-dependent Work Products: Contract, Project Plan

The contractually agreed cooperation of the acquirer in supplier activities has to be defined in the »Project Plan.

5.55 Directives for the Supplier

Content-dependent Work Products: Project Manual, QA Manual, Request for Proposal

The »Project Manual and the »QA Manual of the acquirer include standards for the supplier. Those will be included in the »Request for Proposal (see »Annex 2: Directives for the Project Manual (Supplier) and »Annex 3: Directives for the QA Manual (Supplier)).

5.56 Consistency of Request for Proposal and Offer

Content-dependent Work Products: Offer, Request for Proposal (Acquirer)

In the »Offer, the contents of all requirements established in the »Request for Proposal shall be revised by the supplier.

5.57 Contract-Relevant Parts of Project and QA Manual in the Contract

Content-dependent Work Products: Contract (Acquirer), Contract Addendum (Acquirer), Project Manual, QA Manual

If the acquirer requires that a complete or partial »Project Manual or »QA Manual is prepared already when the »Contract (Acquirer) is concluded, the supplier has to prepare the required documentation already for this purpose.

5.58 Consistency of Requirements Specification and Overall System Specification

Content-dependent Work Products: Overall System Specification, Contract (Acquirer), Contract Addendum (Acquirer)

The requirements specification of the supplier has to cover completely the requirements defined in the »Contract (Acquirer) and »Contract Addendum (Acquirer). The supplier takes care that all functional and non-functional requirements of the Requirements Specification and the contract or contract addendum are met in the initial outline of the system architecture (including the interface list) prepared by him. The requirements may have to be refined by the supplier.

5.59 Influence of Legacy System Analysis on System Development

Content-dependent Work Products:	Legacy System Analysis, Overall System Specification, System Architecture

The functionality of the system to be replaced, which is determined in the »Legacy System Analysis, has to be taken into account in the further development and thus in the »Overall System Specification. In the »System Architecture the interfaces between the system to be replaced and neighboring systems, which are described in the »Legacy System Analysis, must be taken into account.

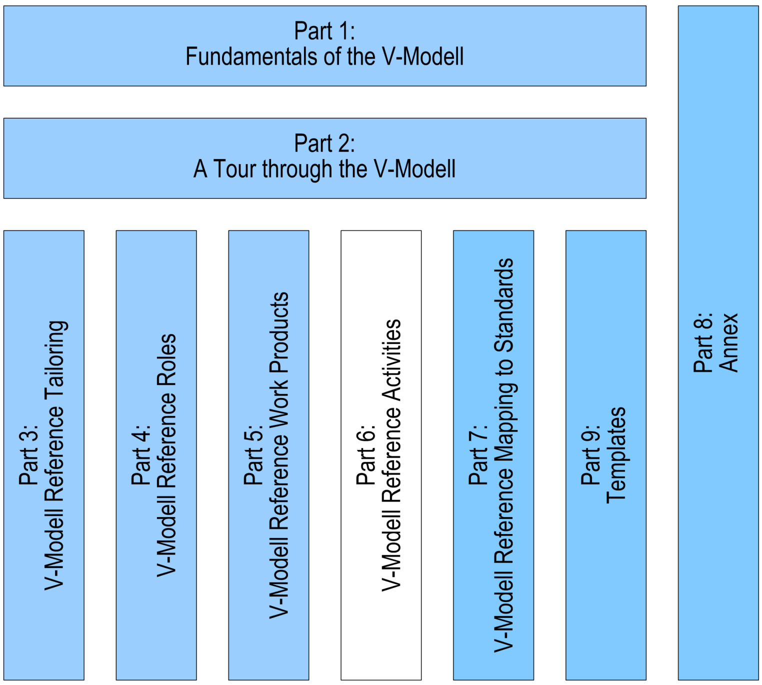
6 Product Index (According to Disciplines)

7 Product Index (alphabetically)

8 List of Figures

Part 6: V-Modell Reference Activities

V-Modell® XT



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Export environment	Version 2.1.3
V-Modell XT	V-Modell® XT Version 1.3

Table of Contents

1 Introduction

1.1 Objectives of the V-Modell Reference

The »V-Modell Reference Activities will include - corresponding to the hierarchical activity model - all activities and work steps of the »Discipline of the V-Modell. Within the framework of an activity, in particular the course of events of the individual work steps will be described. Thus, this V-Modell reference will contain a detailed instruction for the work on and preparation of the »Work Product that are to be generated.

1.2 Audience

This V-Modell reference is intended in particular for all project staff members who participate in or are responsible for the preparation of the V-Modell.

1.3 Contents and Structure of the V-Modell Reference

The V-Modell Reference will consist of the following chapters:

»Overview of the Activity Model of the V-Modell

This chapter will give a general account of the activities included in the V-Modell based on the »Discipline.

»Activities

In this chapter the »Discipline and the included activities with their work steps will be described in detail. The products on which work is done will be determined. For complex activities, finally, a graphic description of the sequence of their realisation by means of »Work Steps will be provided.

»Activity Index (According to Disciplines)

This chapter will include a complete hierarchical listing of all disciplines, activities and work steps.

»Activity Index (alphabetically)

This chapter will include a complete alphabetic listing of all activities in the V-Modell.

»List of Figures

Here once more a clearly arranged listing of all figures included in the »V-Modell Reference Activities will be provided.

1.4 Notes Concerning the Display in the V-Modell Reference

The course of events of activities will be depicted in a graphical display in the form of an activity diagram, if the execution of their work steps is connected in a more complex way or if it is not sequential. The structure of the activity diagrams will be shown in Figure 1. Work steps of activities whose sequence of events is not depicted are intended to be executed sequentially in the order of their definition..

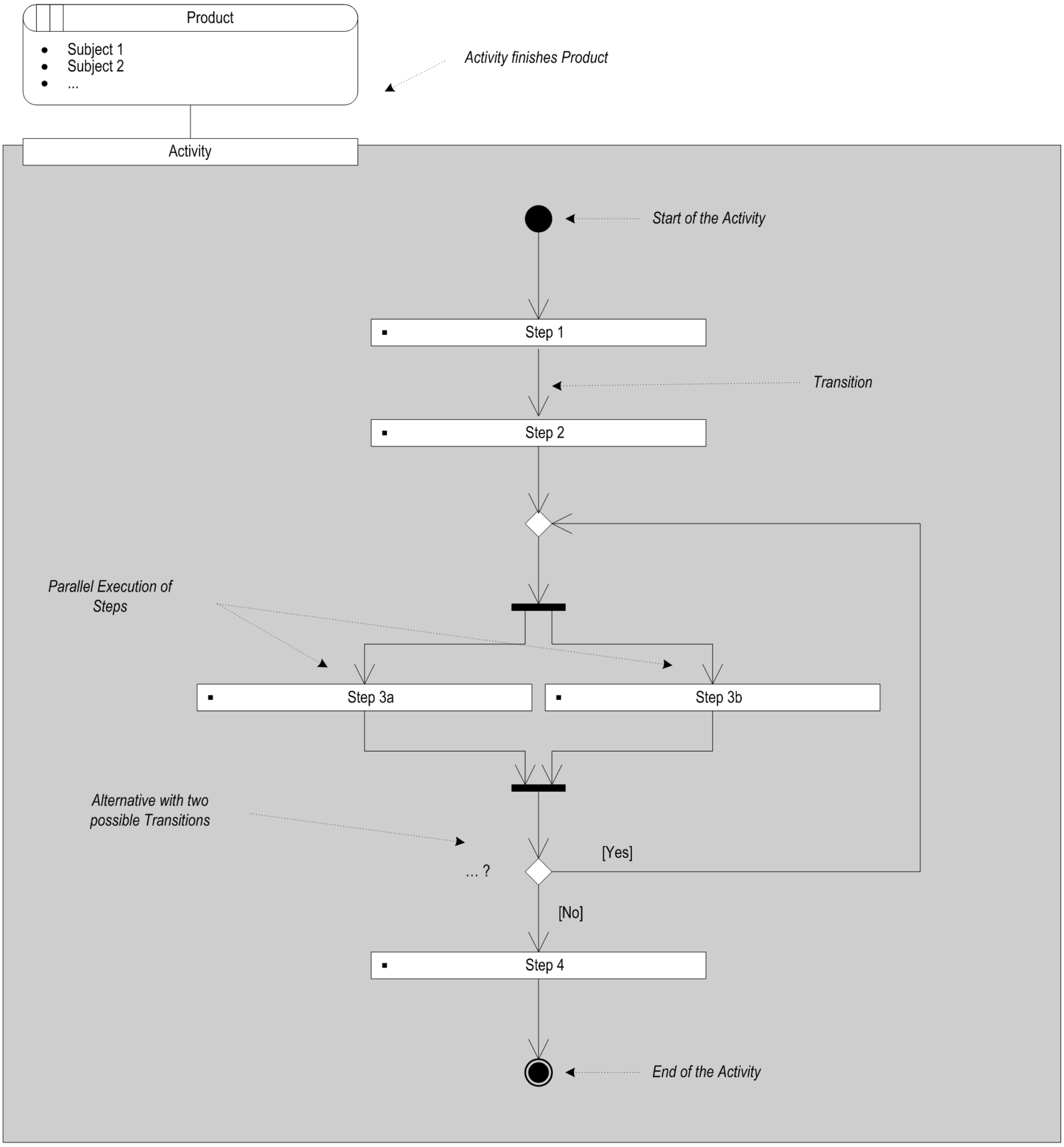

Figure 1: Representation of Activity Diagrams

2 Overview of the Activity Model of the V-Modell

In the V-Modell, activities will be hierarchically structured. The top level of the activity model will be formed by the »Disciplines. Disciplines will classify the activities by content aspects and will help to gain an overview of the activities of the V-Modell. In the V-Modell 13 disciplines will be defined. The disciplines may be subdivided into the three areas project (management), development and organisation. This classification is only used for the presentation within this chapter. The graphic notation for activities and disciplines used in the following figures will be explained in the part »Fundamentals of the V-Modell in the chapter »Process Modules.

In the V-Modell there will be a direct connection between activities and products, because each activity works on and finishes products. The grouping of products and activities, which is content-oriented, will be provided by disciplines, which include the products and the associated activities.

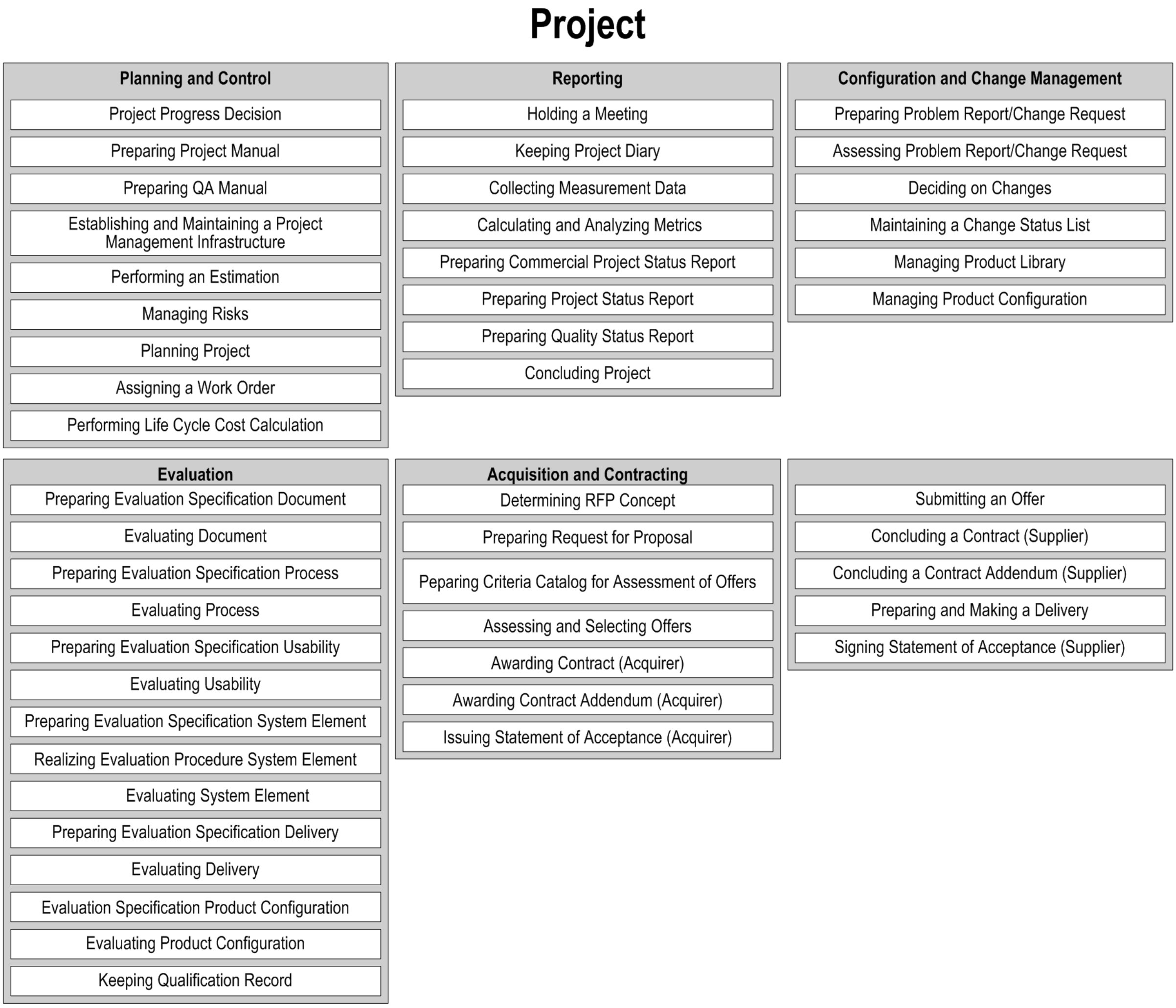

Figure 2: Project Disciplines

Figure 2 shows the disciplines from the area Project. The discipline »Planning and Control includes activities concerning the central project management functions. In this discipline, in particular the central project management control loop will be defined and described. Supporting activities for the generation of project reports and similar products will be combined in the discipline »Reporting. The functions belonging to the management disciplines configuration and change management and quality assurance will be described in the disciplines » Configuration and Change Management and » Evaluation. Activities concerning in particular the implementation of acquirer projects will be included in the discipline » Aquisition and Contracting. The same will be true for specific supplier activities in the discipline »Supply and Contracting.

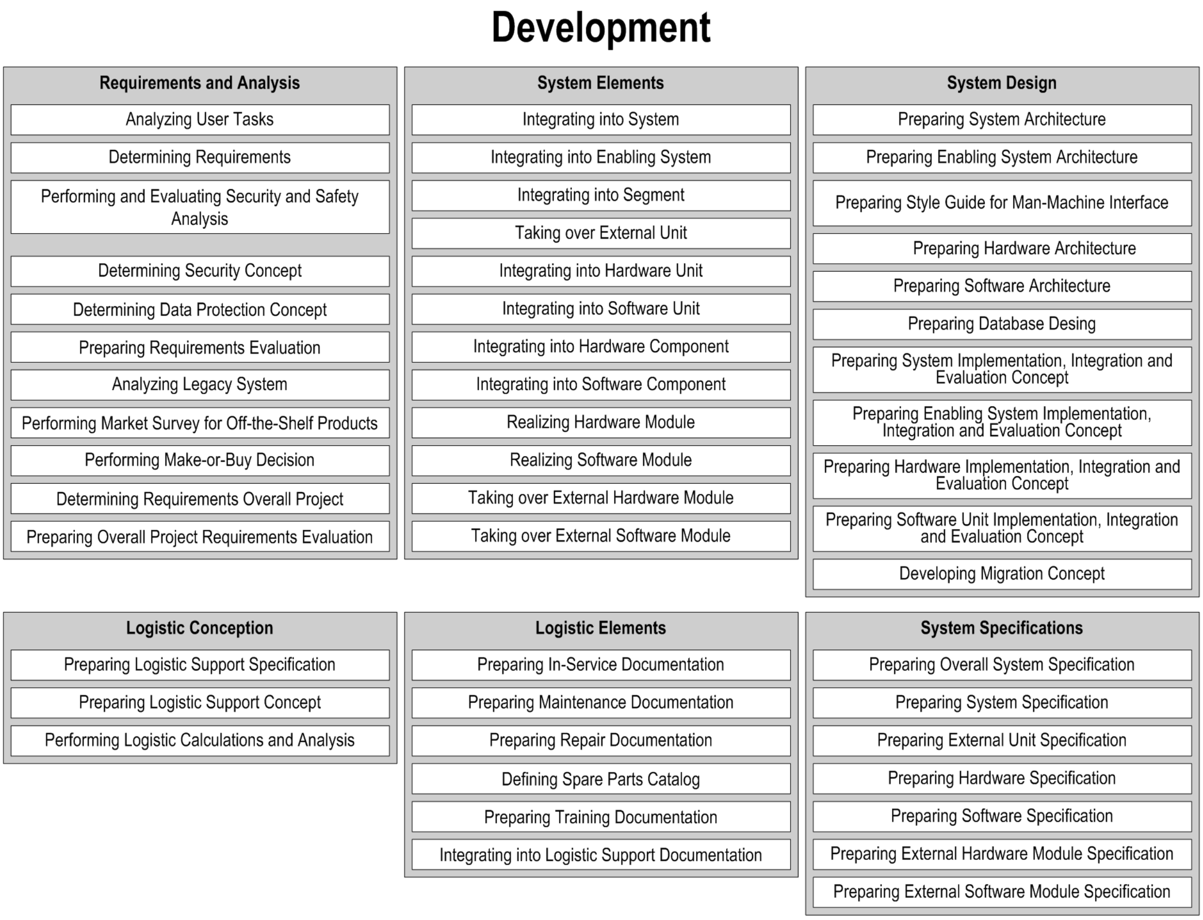

Figure 3: Development Disciplines

Figure 3 shows the developement disciplines. Activities used to define requirements and to analyse various aspects of specific development disciplines will be brought together in the discipline » Requirements and Analyses. The discipline »System Specifications includes the procedure for the development of the technical requirements for and specifications of the system and its components. Activities that describe the implementation of the specifications to technical solutions and concepts, such as the preparation of the various architecture documents, will be brought together in the discipline »System Design. The activities for the integration and realisation of the system components will be included in the discipline » System Elements. Logistic support activities for the system will be listed in the disciplines »Logistic Conception on the concept side and »Logistic Elements for the realization and integration of logistic elements.

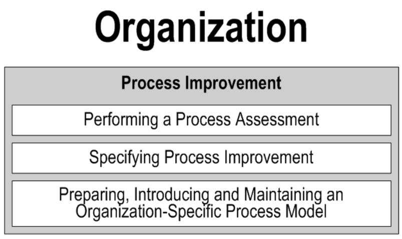

Figure 4: Organization Discipline

Figure 4 shows the organization discipline. The discipline »Process Improvement. The products of the various disciplines will be described in detail in chapter »Products . The following sections will provide a detailed summary of the activity structure of the V-Modell. In this context the activities will describe the methodical procedure for the generation of the products.

3 Activities

3.1 Supply and Contracting

The »Discipline Supply and Contracting includes the work products and activities from the »Request for Proposal (Acquirer) to »Offer, »Contract (Acquirer), »Delivery and »Statement of Acceptance (Acquirer) . Supplier products frequently have counterparts on the side of the acquirer and vice versa. Thus the work products »Request for Proposal (Acquirer), Contract (Acquirer), »Contract Addendum (Acquirer) and »Statement of Acceptance (Acquirer) are duplicates of the acquirer's originals. Conversely, this applies to the offer which is provided to the acquirer as duplicate of the supplier's original.

The »Assessment of Request for Proposal is unique since it is conducted by the respective organization before the V-Modell is applied and since it is used as basis for the decision to submitt a proposal in the »Decision Gate »Project Approved.

3.1.1 Submitting an Offer

Work Product:	Offer

Purpose

The aim of the activity »Submitting an Offer is to prepare the offer and to submit the »Offer to the acquirer.

When the offer will be prepared, the solicitor will charge the team that prepares the offer with the work required for the offer and track the performance of the work.

The topic »Suggested Technical Solution in the »Assessment of Request for Proposal will be applied to specify and evaluate the performance characteristics both technically and with regard to the expenditures, and to improve them in an iterative process. For this purpose, it may be necessary to prepare a first preliminary draft of the system architecture. If External Units, External Hardware Modules or External Software Modules are identified during this process, it may be necessary to consider a make-or-buy decision for the first time. The resulting technical solution will be used as a basis for the generation of the topics »Annex 1: Specification of Services and »Offer - Legal and Commercial Clauses and Conditions.

After defining the delivery units and services and the »Annex 2: Offer-Relevant Parts of the Project Manual (Supplier) and »Annex 3: Offer-Relevant Parts of the QA Manual (Supplier) a calculatory evaluation of the offer can be performed.

At the same time the documents for the topic »General Clauses and Conditions will be compiled.

3.1.2 Concluding a Contract (Supplier)

Work Product:	Contract (Acquirer)

Purpose

The aim of the activity »Concluding a Contract (Supplier) will be to obtain an attractive order when the contract negotiations are finished.

In the contract negotiations, the Requirements Specification will be coordinated in order to achieve a joint understanding, dissolve any discrepancies and proactively recognize gaps in the requirements. As a result, the contents of the »Offer may be modified. Therefore the »Contract (Acquirer) that is entered will be checked for consistency with the »Offer and, if required, staffed in accordance with the signature rules of the organization.

3.1.3 Concluding a Contract Addendum (Supplier)

Work Product: Contract Addendum (Acquirer)

Purpose

The aim of the activity »Concluding a Contract Addendum (Supplier) will be to adapt the »Contract (Acquirer) to changing conditions, e. g. additional or changed requirements or new technical knowledge emerging in the course of the project.

These will require a »Contract Addendum (Acquirer) that is negotiated between user and supplier. The procedure is analogous to the approach when »Concluding a Contract (Supplier).

3.1.4 Preparing and Making a Delivery

Work Product: Delivery

Purpose

The (partial) »Delivery will be compiled in accordance with the desired configuration of the delivery items determined in the »Contract (Acquirer).

Transportation will be planned. If necessary, a transportation insurance will be effected and required approvals are obtained. The relevant shipping documents will be prepared. It must be possible to gather the configuration of the delivery items from the shipping documents so that the acquirer can ascertain the completeness of the shipment. In addition a delivery or pickup date will be agreed with the acquirer.

After the packaging of the delivery items together with the shipping documents, the transport of the (partial) »Delivery will be arranged.

3.1.5 Obtaining the Statement of Acceptance (Supplier)

Work Product: Statement of Acceptance (Acquirer)

Purpose

When the acquirer has declared in the »Statement of Acceptance (Acquirer) that he approved the (partial) »Delivery made by the supplier, the supplier also obtains a signed copy of the »Statement of Acceptance (Acquirer).

If the acquirer rejects acceptance due to deficiencies, the supplier shall either prove the contractual creation of the delivery items or eliminate the detected deficiencies within a fixed period.

The rejection of the acceptance may entail considerable consequences for both sides, such as agreed contractual penalties.

3.2 Planning and Control

The »Work Products and »Activityies of the »Discipline »Planning and Control provide the fundament for an ordered and repeatable project management. The discipline includes products for the development of a project concept and for the project definition, like »Project Manual and »QA Manual, products for project planning, like »Project Plan and »Estimation, and products and activities for controlling the project, like »Project Progress Decision and »Meeting Document .

3.2.1 Coming to a Project Progress Decision

Work Product:	Project Progress Decision

Purpose

The project-specific decision gates agreed in the »Project Execution Plan in the »Project Manual will define quality gates where a decision has to be made on the further execution of the project based on the quality of the respective products that shall be submitted.

By submitting the respective products the project leader shall bring about a decision on the progress of the project. In the V-Modell the minimum number of the products that have to be submitted shall be explicitly defined by the number of decision gates. Deviations with regard to the products to be submitted shall be agreed in the »Project Execution Plan in the »Project Manual.

The responsibility for the decision on the progress of the project lies with the management above project level (»Executive or »Steering Committee) and should be made in coordination with the project. This is usually done in a meeting.

Prior to this meeting at first the products of the decision gate to be discussed shall be submitted to the decision-makers. For the meeting, an agenda shall be drawn up, and the decision-makers shall be invited. In the course of the meeting, the already achieved project results and - if required - decision submittals shall be presented, a decision on the progress of the project has to be made, and the project progress shall be recorded. In the follow-up to this meeting the recorded project decision shall be sent once again to the decision makers for reasons of documentation (see Figure 5)].

The decision shall be documented in the product »Project Progress Decision. At this point framework conditions for the project may be formulated that will be adopted at the next project stage. Should the project progress decision be negative, it shall be determined in the individual case, whether the product models of the decision gate have to be resubmitted or if the project has to be fundamentally re-established or even completely abandoned.

Activity Flow

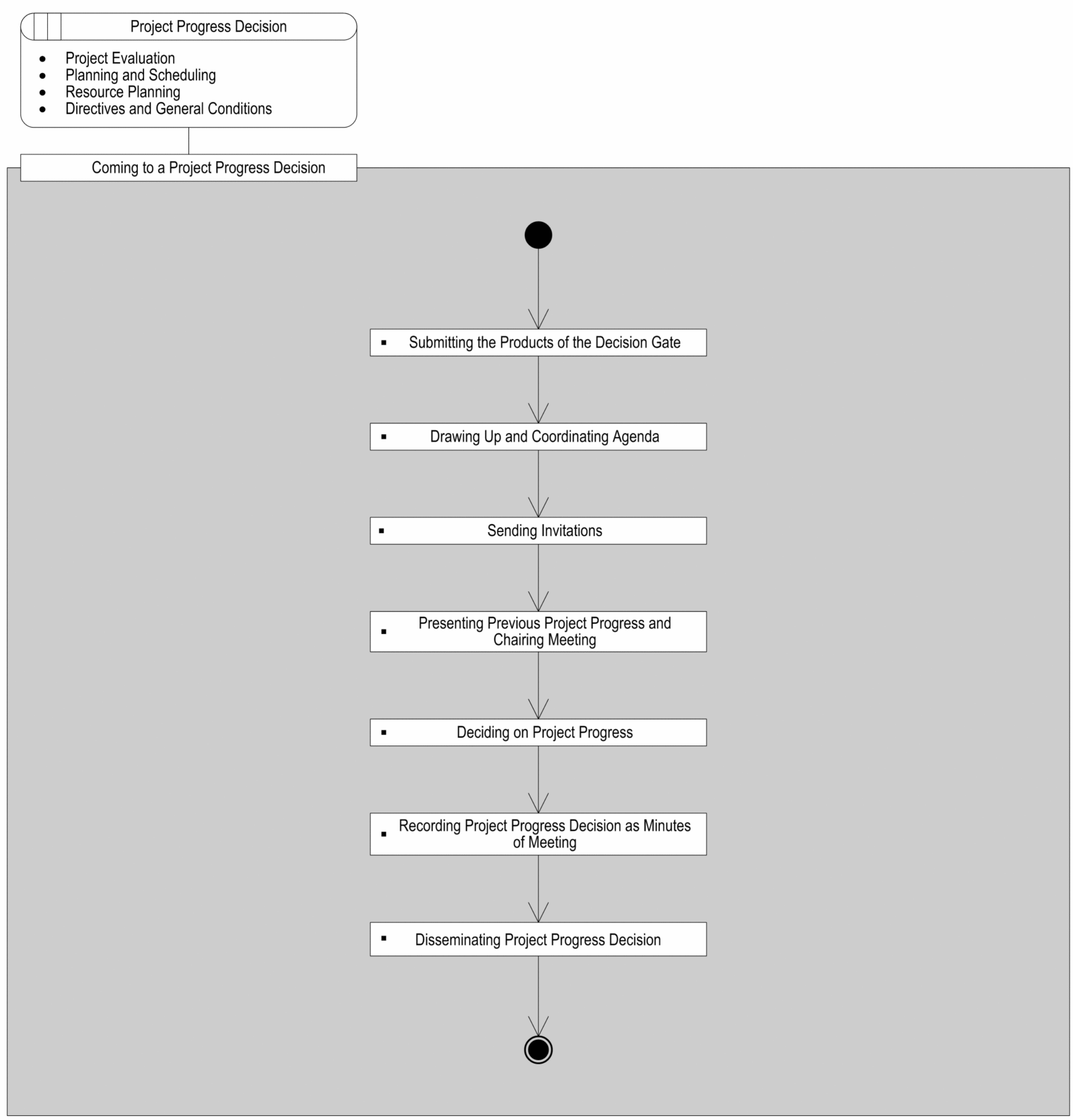

Figure 5: Activity Diagram "Coming to a Project Progress Decision"

3.2.2 Preparing the Project Manual

Work Product: Project Manual

Purpose

The »Project Manual will be used to determine the organizational framework conditions for all participants in the project. In particular for new team members the project manual will serve as lead-in document and information source. An important part of the project manual will be determining the manner in which the V-Modell is used in the project.

The preparation of the »Project Manual will be part of the initialization of the project. However, if the framework conditions change in the course of the project, then the »Project Manual will have to be updated.

When the Project Manual is prepared, first the application profile shall be determined and analyzed. Project-Specific adaptations shall be made to thus determine a suitable project execution strategy. Then the project execution has to be planned and coordinated with all stakeholders in the project. This approach may be repeated until the coordination is accomplished. Then the project kick-off will be initiated (see Figure 6).

Activity Flow

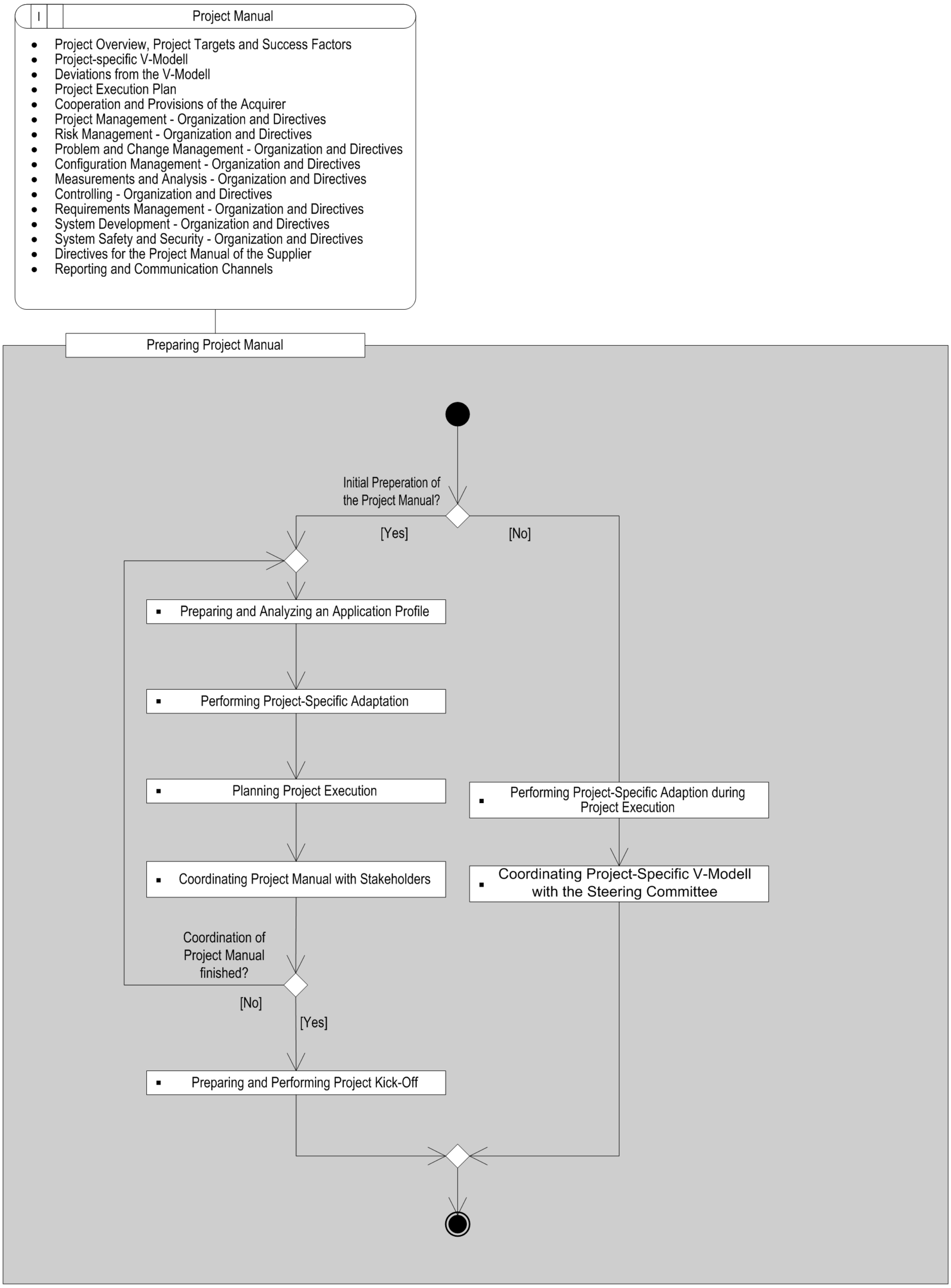

Figure 6: Activity Diagram "Preparing the Project Manual"

3.2.2.1 Preparing and Analyzing an Application Profile

Subject: Project Manual: Project-Specific V-Modell

The project-specific adaptation of the V-Modell, the so-called »Tailoring, will be limited to selecting the »Project Type and - based on this - a suitable »Project Type Variant. This selection leads to the specification of mandatory »Process Modules and possible approaches for the development of a »Project Execution Strategy. In addition, there are project characteristics, which enable the selection of optional process modules. When the project manual will be prepared, it usually will not be necessary to select or cancel individual activities and products. The project-specific » Product Instances and the »Activity Instance will be determined when drawing up the »Project Plan (see activity »Planning Project).

The first step in determining the mandatory number of process modules to be used for the project or the suitable project execution strategy will be to prepare an »Application Profile: The application profile will characterize the project with regard to the »Project Characteristic specified by the V-Modell. For each of these project characteristics fixed values will be specified from which a selection has to be made. An example of an application profile can be found in the Part »Fundamentals of the V-Modell in the Chapter »Tailoring. The complete listing of the project characteristics and their possible values for the characterization of »V-Modell Projects are found in the »V-Modell Reference Tailoring.

The second step will consist of the analysis of the application profile. The »Project Execution Strategy follows from the Tailoring process. The selection of a project type and - afterwards - the selection of a project type variant specify a framework sequence for the project. Project characteristics may provide additional variations for the sequence, e.g., within the scope of a sub-contract award. Thus the concrete project execution strategy is determined after project type and project type variant have been selected and a value has been assigned to all project characteristics.

3.2.2.2 Realizing Project-Specific Adaptation

Subject: Project Manual: Project-Specific V-Modell

The project-specific »Project Execution Strategy may also consist of a combination of the sequences determined within the framework of the application profile. A system may be developed, for example, in accordance with the »Incremental System Development, while an integration project may be simultaneously executed with prefabricated components in accordance with »Component-Based System Development.

Furthermore, additional process modules will have to be added to those »Process Modules whose use is mandatory as far as this is considered appropriate. For this purpose the »V-Modell Reference Tailoring will include a list of the process modules of the V-Modell. In this reference, also the purpose of the individual process modules will be explained.

If process modules are added, then the dependencies of the process modules will have to be considered. If a process module is selected, then also additional process modules in the topic »Project-Specific V-Modell may have to be considered. Possible dependencies are shown in the »Process Module Map in the »V-Modell Reference Tailoring.

Certain process modules will require the selection of further process process modules. This will be described using the relations "Muss gewählt werden" ("Has to be selected") or "Mindestens einer muss gewählt werden" ("At least one has to be selected"). Contrary to this, there will be also process modules that are used alternatively: They will never be used together in a project.

If for example the process module "System Security" is to be additionally included in the project-specific V-Modell, then either the process module "Specification of Requirements" or at least one of the process modules "System Realization", "SW Development" or "HW Development" will also have to be included. If for example the decision is made to include "SW Development", then in any case also "System Realization" will have to be used in the project.

3.2.2.3 Planning Project Execution

Subject: Project Manual: Project Execution Plan

The project-specific »Decision Gates will emerge in the context of a V-Modell-project from the selected »Project Execution Strategy. Depending on the project, decision gates will be scheduled in the form of milestones. This will be exemplarily shown in the Part »Fundamentals of the V-Modell, and there in Chapter »Project Planning. Depending on the selected project execution strategy, certain decision gates may be project specifically passed through several times.

All decision gates described in the V-Modell shall be scheduled. When making each »Project Progress Decision, the products assigned to a decision gate shall be submitted to the »Steering Committee (see activity »Coming to a Project Progress Decision). It will not be necessary to fix target dates for all decision gates as soon as the project starts. Detailed planning may be done in the »Project Plan while the project is under way. However, the sequential order of the decision gates according to the selected project execution strategy shall be observed. In this process it should be attempted to distribute the target dates for the decision gates evenly over the duration of the project.

It must always be possible to verify decision gates using objective criteria, and they will therefore be linked to the completion of products. The decision gates of the V-Modell will specify in each case the number of V-Modell products that willhave to be submitted. When defining the project-specific decision gates, the »Work Products of the V-Modell shall be listed in the project execution plan, since it is often impossible to provide a detailed definition of the concrete »Product Instances at the start of the project. For planning the product specimens related to the decision gates the »Project Plan shall be used.

When planning the products of the decision gates, deviations from the specifications laid down in the V-Modell may occur. It may be agreed upon that at the individual decision gates instead of all products required in the V-Modell only part of them has to be submitted. »Project Status Reports, however, shall be submitted for each decision gate.

3.2.2.4 Coordinating the Project Manual with all Stakeholders

Work Product: Project Manual

The »Project Manual will be prepared specifically for each project, taking into account the framework conditions applicable to the project. Special attention will be directed to the coordination with all internal and external parties involved in the project (stakeholders). In case of a supplier project, participation of the acquirer shall be clarified. All project members shall be informed as openly as possible about the contents of the project manual.

3.2.2.5 Preparing and Performing Project Kick-Off

Work Product: Project Manual

Within the framework of the project kick-off, the »Project Leader will call a constituent meeting with all stakeholders and inform them about the task, type, scope and target date situation of the planned project.

Kick-off events will be used for informing and motivating the project team and for internal project marketing. Included in a kick-off event may be the presentation of background information and already performed work and the introduction of future tasks. It may also be used to jointly find a strategy.

3.2.2.6 Performing Project-Specific Adaption during Project Execution

Subject: Project Manual: Project-Specific V-Modell

In the course of the project it may turn out that the project-specific V-Modell developed at the start of the project will have to be adapted to different framework conditions or new findings in order to guarantee an effective and efficient execution of the project. This adaptation may be achieved with the help of dynamic »Tailoring.

If, for example, hardware components are identified that must be developed within the framework of system design, the topic »Project-Specific V-Modell will have to be complemented by the »Process Modules »Hardware Development or »Delivery and Acceptance (Acquirer).

These relations concerning the number of process modules that will have to be used and thus the »Tailoring will be explicitly described by the V-Modell in the form of tailoring-related product dependencies. Tailoring-related product dependencies will always refer from the product that influences the »Tailoring (e. g. the "system architecture"), to the »Project Manual. The »V-Modell Reference Tailoring will include in Chapter »Tailoring-Related Product Dependencies a summary of these relations.

Changes of the originally realized »Application Profile - i. e. adding or removing process modules - or changes concerning the originally agreed process modules whose use is mandatory, shall be coordinated with the »Steering Committee.

Changes in the topic »Project-Specific V-Modell may entail changes of the product templates of the V-Modell. This option is available, because process modules may add topics to the products of other process modules. Thus in rare cases the topic structure of an already finished »Product Instance may change. Whether in this case the product model will have to be completely revised, will have to be decided in the individual case.

3.2.3 Preparing the QA Manual

Work Product:	QA Manual

Purpose

Starting from the existing quality-relevant specifications the quality targets to be pursued, the QA measures and the test items will be determined. The documents, processes and system elements that will be subjected to formal testing are called test items. It also will be defined how the receiving inspection and the final inspection of products will have to be performed.

Specifications for these definitions may be described in the project task or in the user requirements. To be able to list and formulate all definitions in the project manual completely and accurately, coordination between the person in charge of quality assurance and the project management will be required. Furthermore, the feasibility of the QA measures under the given project conditions shall be coordinated with project management.

3.2.3.1 Determining Quality Goals and Requirements

Work Product:	QA Manual

For all quality requirements of the acquirer, which can be implemented in the project task and which are defined in other documents (such as the project specification), binding quality targets for the project that can be implemented shall be determined and formulated. Subsequently measures shall be defined that make it possible to use measurements to verify when the quality targets have been achieved. The measures taken to improve quality may be both engineering and analytical measures. Engineering measures will include all activities that improve the creation process. Analytical measures will determine the appropriate test measures for achieving the quality targets.

3.2.3.2 Determining the Scope of Evaluations

Subjects:	QA Manual: Products to Be Evaluated, QA Manual: Processes to Be Evaluated

When determining the scope of evaluation, both the »Products to be evaluated and the processes to be evaluated shall be identified.

The products to be evaluated are a selection of all products to be created in the project, which shall be subjected to formal evaluation. This may be for example »Segments, »Software Units or »Software Architectures. Even if products are not designated for formal evaluations, the originator himself is required to perform an evaluation.

Compared to the above described procedures, the in-process evaluation of of a project shall evaluate those products that guarantee conformity with the processes, methods or standards described in the topic »Processes to Be Evaluated. The criteria required for evaluating the conformity with the V-Modell are described in »V-Modell XT Compliance Test. To ensure conformity with AQAP, CMMI®, ISO 15288, »ISO 9001:2000 and the V-Modell 97, the products to be tested were already described under »Mapping to Standards.

3.2.3.3 Determining Organization and Directives

Work Product: QA Manual

The specifications with regard to organization and quality assurance approach shall be determined in this subactivity in the »QA Manual. In this context for example the powers of quality assurance with regard to pursuing and enforcing quality assurance targets shall be defined. For project control, measures to correct or solve »Quality Problems in the course of the project shall be determined. These measures and their state in the course of the project shall be documented in the »Quality Status Reports.

If products are to be delivered to the acquirer, then criteria for the final inspection have to be determined. This may involve for example the following aspects:

- Completeness: Are all components specified in the contract included or does a delivery note exist?
- Sufficient documentation: Are all documents and descriptions included or are all required labels (barcodes) of data carriers available?
- Completion of the inspection measures: Have all agreed inspection measures been successfully completed?

As far as off-the-shelf products will be used, it has to be ensured that the quality of these products will satisfy the operational requirements and that an integration into the system that is to be realized will be possible. For this purpose appropriate inspection measures shall be defined.

In the case that a »Sub-Supplier is to be hired, the quality specifications that apply to him will have to be determined. The subcontractor shall comply with and document these specifications when creating his products.

3.2.4 Establishing and Maintaining a Project Management Infrastructure

Work Product: Project Management Infrastructure

Purpose

Within the framework of project initialization the »Project Management Infrastructure shall be established. The establishment and maintenance of the »Project Management Infrastructure is the precondition for the start and performance of the actual project work.

3.2.5 Performing an Estimation

Work Product:	Estimation
Method Reference:	Estimation Models
Tool reference:	Project Planning

Purpose

At the start of a project a rough estimate shall be made. The aim of the rough estimate is to determine expenditure data for the initial planning that are required for example to prepare a competitive »Offer. In the course of the project then several detailed estimates will be made, for example at each decision gate Iteration Scheduled, where the following iteration is planned in detail. The aim of this detailed estimates is to obtain more detailed expenditure data for the planning process. In this case the size of the estimate objects will be smaller and the objects will be described in more detail than in the rough estimate.

If in the course of the project marked deviations from the determined estimates emerge, then a new estimate of the remaining expenditures will be made to be able to adapt the plan.

At the end of the project a planned/actual comparison shall be made to examine how much the »Estimations deviated from the actual expenditures. These results will be be used to improve the methodology for the estimates and as empirical values for follow-on projects.

3.2.5.1 Determining Estimation Methodology and Objects

Work Product:	Estimation

At the start of the »Estimation a suitable estimation method for the Estimation of the Scope and the Estimation of Effort shall be selected.

In literature a large number of estimation methods is described. The most suitable depends on the time of the estimation and the type of the estimation objects. Detailed information about the methods can be found in literature.

It may be practical to combine the different estimation methods. For example one option will be a mixture of the following three estimation methods:

- determine the estimations for most of the estimation objects in a closed estimation meeting,
- derive the remaining estimation objects with the help of the percentage method,
- use COCOMO to perform a plausibility check.

Irrespective of the selected methodology, the estimation objects will have to be determined before the estimation and characterized as accurately as possible. By providing empirical values from previous comparable projects, the accuracy of the estimation will be markedly improved.

3.2.5.2 Determining Estimations

Work Product: Estimation

Practical experience shows that Estimations of Effort are significantly better, if the scope of the estimation object is known in detail. Therefore, first an »Estimation of the Scope and then, on this basis, an Estimation of Effort has to be made.

The approach for determining the estimates and the group of persons involved in the »Estimation depend on the estimation method.

3.2.5.3 Consolidating Estimation Results

Work Product: Estimation

All results of the estimate shall be documented in the product »Estimation. Converting the expenditures into costs will be the task of the commercial project management.

If required, a plausibility check shall performed with a different estimation method, e. g. by using »Estimation Models.

After the »Estimation of Effort has been completed, the estimates shall be compared to the framework schedule and the framework budget. In case of deviations usually the number or the extent of the requirements will have to be reduced and the estimate will have to be adjusted until the feasibility can be guaranteed. In this process will not be permitted, however, to reduce expenditures wholesale and/or to cut quality assurance measures.

3.2.6 Managing Risks

Work Product: Risk List

Purpose

Risk management should be performed prophylactically and periodically in regular time intervals which should be as short as possible. The results shall be documented in the »Risk List. Risk management will include the following steps:

- Identifying and assessing risks and planning measures,
- Monitoring risks and keeping track of the effectiveness of the measures.

3.2.6.1 Identifying Risks and Measures

Subjects: Risk List: Identified Risks, Risk List: Risk Mitigation Measures

Within the scope of risk management risks will be identified and assessed and actions will be planned that can be used to react on already identified risks. These activities will be subsequently described.

Identifying Risks

Possible new project risks will have to be identified continuously, i. e. periodically and/or dependent on events, during the duration of the project, e. g. at the project start, at milestones or when a new phase is entered. For identifying risks at a specific time, risk workshops have proven their value. In these workshops use should be made of the know-how of experts and of the lessons learned from earlier projects. To cover the whole spectrum of potential risks in these workshops, questionnaires will be used. Those are subdivided into different ranges of topics and problems, such as:

- System / Technology to be Developed.
  - Are the requirements to be met by the system stable, clear and feasible?
  - Does the system have precise interfaces?
  - Is the system testable?
  - Is a new technology used?
- Processes / Activities / Documents
  - Is the development process defined and appropriate?
  - Are the participants in the process appropriately trained for their activities?
  - Do all participants in the project know the sequences, the activities and the expected results?
  - Are the planned target dates realistic?
- Organization / Work Environment
  - Is the staff large enough to handle the project?
  - Is the required budget available?
  - Are there dependencies on »Sub-Suppliers?
  - Are the required development environments available?

Identified risks shall be documented in the »Risk List.

If the scope of risk management also includes considering the chances (see the »Project Manual), in addition to the risks also the chances may be identified and documented in the »Risk List. In this context chances may be treated analogous to risks. In the following we will therefore just talk of risks.

Assessing Risks

For each identified risk the probability that it will arise (»Risk Probability) and in case the risk arises the amount of damage (»Risk Damage) will have to be assessed, and from that the »Degree of Risk shall be calculated. It will then be sufficient to provide orders of magnitude for the risk probability and the effects of the risk. Based on the risk measure and on experience, the risk will be assigned to a »Risk Class. The results should be included in the »Risk List.

Planning Actions

To be able to react on the identified risks before they become a problem for the project, it will be necessary to define countermeasures and determine persons in charge and also to plan resources and target dates for the implementation of these actions. Depending on the risk class, one round of the planning process shall be used for making the following decisions and for planning the corresponding actions:

- Risk avoidance: It will be necessary to plan and immediately initiate preventive measures, such as technology changes.

- Risk mitigation or reduction of the risk to a minimum: Situation-dependent actions, such as alternate plans, will have to be defined. For this purpose »Triggers, such as schedule slippage or additional costs, shall to be determined. When they occur, the implementation of these actions shall be started.

- Risk transferral or sharing: Here the risk will have to be shared among different partners or completely transferred to others. For the transferral of the liability for a risk usually a premium will have to be paid to the organization that assumes the liability. Another option will be money reserves, e. g. for contract penalties. However, actions should be planned only for the remaining residual risk.

- Risk acceptance: In this case deliberately no measures should be planned, and in case the risk occurs, its consequences should be taken. This makes sense for example if the resources required for the countermeasures exceed the remaining level of damage. Therefore the »Residual Risk remaining after an action will have to be determined with the help of »Risk Probability, »Risk Damage, »Degree of Risk and »Risk Class data. The resources required for the implementation of the action should not exceed the difference between the amount of risk and the amount of the remaining risk. In case countermeasures will be dispensed with, it shall be checked whether money reserves, e. g. for contract penalties, shall be set aside.

Planning data for agreed countermeasures shall be documented in the »Risk List and included in the »Project Plan and the cost estimate.

3.2.6.2 Monitoring Risks and Measures

Subjects:	Risk List: Identified Risks, Risk List: Risk Mitigation Measures

The state of the risks and the success of the actions that will be initiated to eliminate the risks shall be assessed regularly with regard to their success and, if necessary, corrected. In this process changes in risk probability and risk damage shall be estimated for all risks. This may lead to a change in »Risk Class. Risks that are no longer relevant shall be removed from consideration. Planned countermeasures, in particular for risks for which the risk class has been reduced, shall be reviewed.

The »Triggers for initiating the actions shall be monitored and, if necessary, actions triggered.

In critical situations risks shall be reported in time to the management. Reporting on the current risk state will be an integral component of the »Project Status Report.

In case a risk occurs, usually crisis management will be required. For predictable risks it will be possible to fall back on preplanned actions. If the risk has not been identified yet, the damage will have to be limited. With regard to documentation, reporting and monitoring, these risks shall be handled just like risks that were identified early.

3.2.7 Planning Project

Work Product:	Project Plan
Method Reference:	Project Planning and Control
Tool reference:	Project Planning

Purpose

Planning is the preparation of future actions. Planning means to decide in advance how an objective is to be reached - i. e. what is to be done when and by whom. The aim of this activity is to plan the products, the necessary activities, the resources and the target dates for the project.

In this activity the approach initially will require planning the project execution. This will be followed by planning the decision gates and, in the next step, the product and activity structure. On the basis of this finally the work packages will have to be defined and also integrated into the plan. Parallel to this sequence process testing shall be planned, and finally the project plan shall be coordinated with the stakeholders (see Figure 7).

Since the future course of the project can be predicted only with some uncertainty, and since the actual sequence can adjust itself only to a limited degree to the planned sequence, a repeated revision of the project planning will be rather the norm than the exception. The activity »Planning Project is an ongoing activity that extends from project initialization to the end of the project. Project planning will have to be initialized at the start of the project and updated iteratively in the further course of the project. Each revision of the »Project Plan shall be completed at least when the project-specific decision gates are reached. The revisions shall also be included in the »Project Plan.

Product structure, project structure, target dates, expenditures and resources will all be included in the topic Integrated Planning of the »Project Plan.

Activity Flow

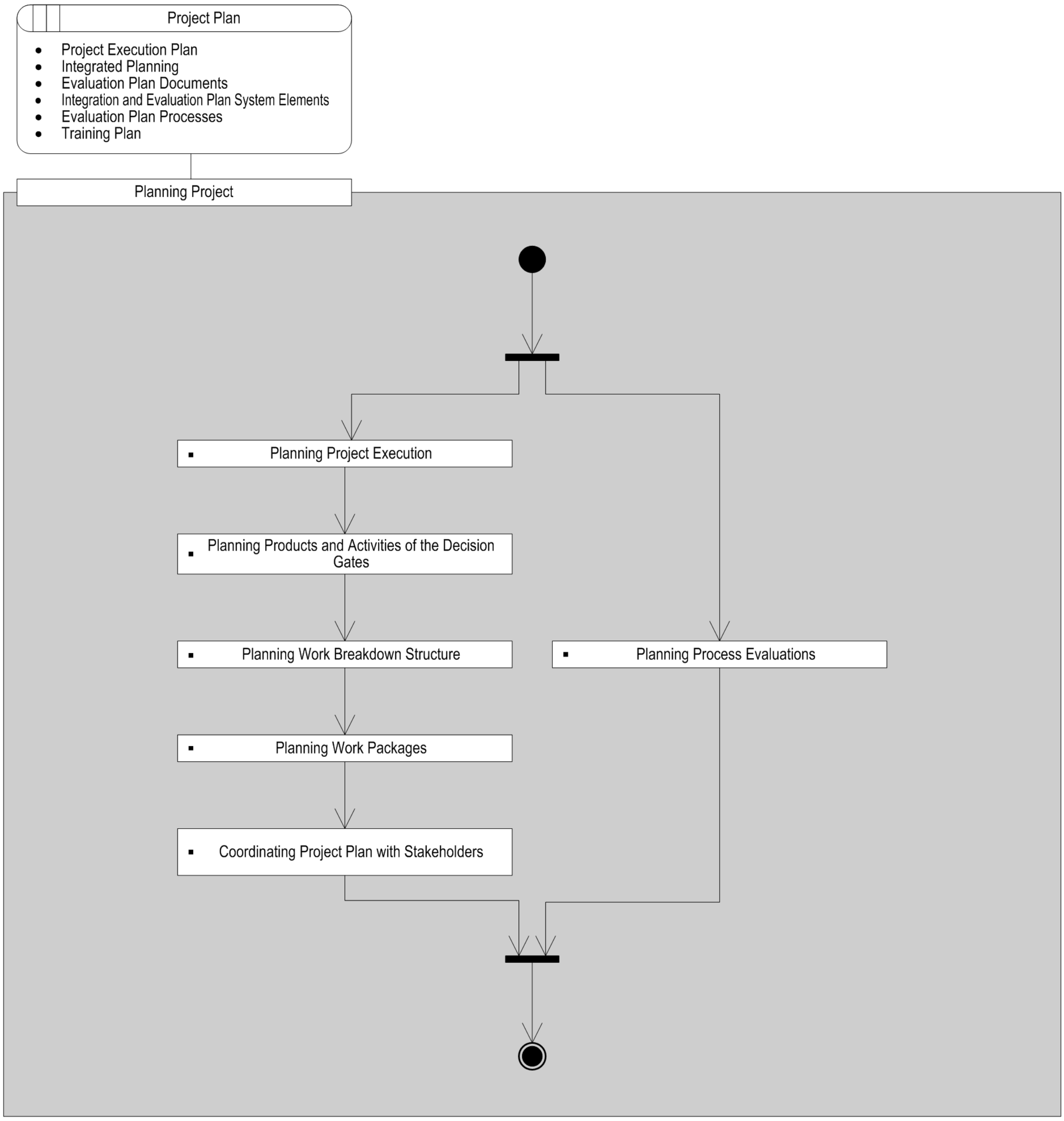

Figure 7: Improvement Measures "Planning a Project"

3.2.7.1 Planning Project Execution

Subject: Project Plan: Project Execution Plan

The already prepared contents of the topic »Project Execution Plan from the »Project Manual shall be adopted and specified. While the »Project Manual will still not provide target dates for all »Decision Gates, at this point target dates for the further course of the project will have to be determined as far as possible. Also the respective »Product Instances to be submitted for the individual decision gates will have to be provided in full.

The schedule for the decision gates shall oriented according to the order of the decision gates in accordance with the selected »Project Execution Strategy. Plans shall be made at least for the next cycle of the project execution strategy. In case of the project execution strategy »Project (Acquirer) Including Development, Enhancement or Migration for example at least one cycle from the decision gate »System Specified to the decision gate »Acceptance Completed shall be planned. In case of incremental development also the overall horizon of the planning must be determined, i. e. a schedule must be established also for the additional decision gates »Acceptance Completed (there may be several of these points) and finally for the decision gate »Project Completed.

The »Project Execution Plan will be used as a management-oriented point of view of the Integrated Planning. When using a computer-aided planning tool, an obvious solution will be to maintain the Integrated Planning inside the tool and to generate the »Project Execution Plan as the quantity of all decision gates from integrated planning.

3.2.7.2 Planning Products and Activities of the Decision Gates

Subject: Project Plan: Project Execution Plan

In the context of a V-Modell project the »Product Instances to be planned will be derived from the »Product Types described in the V-Modell. In order to plan a »Decision Gate, all product specimens to be submitted at the respective decision gates shall be scheduled in the »Project Execution Plan depending on the project:

Certain products, such as the »Final Project Report, shall to be scheduled in the project so that they are prepared once, other products, such as quality assurance products, shall to be scheduled several times depending on the project. Rules for the project-specific elaboration of the products will be provided by the product dependencies of the category »Generative Product Dependency of the V-Modell.

Some Products, such as the »Project Plan itself, will be included in several decision gates. Their revision and submission within the framework of the decision gates shall be scheduled several times.

Once the product specimens are determined, the activities that shall be executed and that lead to their creation are derived from them on the basis of the V-Modell. They will be scheduled in the »Project Execution Plan and in the topic Integrated Planning in a way that they will be completed with the target date of the respective decision gate.

3.2.7.3 Planning Work Breakdown Structure

Work Product: Project Plan

Within the scope of this activity also those activities will be planned in detail that are not used for the creation of the »Product Instances that will have to be submitted in the project-specific »Decision Gates. In the planning process all activities will be taken into account that will be included in the »Process Modules to be used in the project. The V-Modell therefore lives up to its character as a checklist for the completeness of the planning process.

The detailed planning of the activities shall be made each time at least to the next decision gate. Within the scope of the project not all product models that have to be created can be scheduled from the beginning, since the existence of certain product models can be derived only from other product specimens.

In development projects the structure of the system to be developed will have a decisive influence on the »Project Plan . Certain activities, such as the realization of a software unit shall be scheduled specially for each planned »Software Unit. The hierarchical arrangement of all components of a system in a product work breakdown structure plan can be a methodical tool for the preparation of the »Project Plan. In the product work breakdown structure plan the structure of the whole system to be developed shall be included. The V-Modell, however, does not require a special topic for the product work breakdown structure plan.

In the topic Integrated Planning not only the component of the system to be developed, but also management products shall be considered. For example, »Project Status Reports can be identified only after the contents of the topic »Reporting and Communication Channels were determined for the specific project in the »Project Manual. The »Project Manual itself may be scheduled and prepared already at the start of the project and will be therefore listed from the beginning. In the V-Modell these relations - when the existence of a product is specified by another product - will be described explicitly by a product dependency of the category of Generative Product Dependencies.

When the product models were determined, they shall be allocated to the decision gates. If required, product models may be allocated to several decision gates, and thus also several models may have to be completed.

The V-Modell may be used to derive from the product models directly the activities to be scheduled, because for each V-Modell product there is exactly one activity that completes it. In the topic Integrated Planing the activities shall be scheduled in a way that they will be completed at the latest with the target date of the decision gate. The following shall apply to the target date for the start of each activity: An activity that will process a created product model must not start earlier than the activity that will create the product model for the first time. In network planning terminology this is thus a start-start action sequence.

If required, sub-activities also shall be included in the Integrated Planning process.

3.2.7.4 Planning Work Packages

Work Product: Project Plan

The established product and »Activity Structure of the topic Integrated Planning will be used as a basis for the »Estimation of Effort, sequencing and time scheduling, the assignment of tasks and responsibilities, cost planning and the tracking of costs parallel to the project.

This planning will be performed on the basis of »Work Packages. Since the individual activities of the V-Modell, although they are important to the checklist, are too small for planning tasks, work packages may be formed that combine several activities. Target dates or resources will then be allocated in the topic »Integrated Planning on the basis of work packages. The work packages defined in the topic »Integrated Planning will furthermore be an important basis for the communication in the project.

To define the project-specific work packages, different structure types are conceivable, for example based on

- the organizational units performing the work,
- the time sequence, i. e. based on »Project Section, or
- the logic according to which the activities match, i. e. for example corresponding to the disciplines of the V-Modell, such as system design, system realization and testing.

The following points will have to be considered when formulating the work packages:

- There must be only one responsible person for each work package.
- An unambiguous task description must be formulated for each work package, and it must also be possible to check whether it was executed.
- Work packages should be self-contained work units with clear interfaces to other work packages.
- The scheduled time required for the work should not be too long relative to the duration of the project, because otherwise it is very difficult to control.
- How work packages are put together depends on the risks incurred. High-risk tasks have to be broken down into smaller work packages than routine tasks.

3.2.7.5 Coordinating Project Plan with Stakeholders

Work Product: Project Plan

Planning activities shall be coordinated with all external and internal participants, the so-called stakeholders. In addition to the involvement of the acquirer, it will be essential to coordinate target dates and resources with the fields quality assurance, configuration management, system development, and other projects concerned. In case of particularly critical target dates the approval of as many stakeholders as possible will have to be explicitly obtained and documented.

3.2.7.6 Planning Process Evaluations

Subject:	Project Plan: Evaluation Plan Processes

All process testing shall planned. The planning should include both determining the tasks and the responsibilities and identifying and determining the resources for the processes that will be formally tested. In this context the specifications provided in the »QA Manual shall be considered. Planning of the test shallbe coordinated with the project management and scheduled so that it is harmonized with project progress. The approach to planning process testing should be as follows:

- Subsequently to the preparation of the QA manual, the resources for the processes to be tested should be listed and the tasks and responsibilities for the test should be defined.

- All process tests planned for formal testing in the QA manual shall tbe considered in the planning from the beginning of the project. If further process tests are required in the course of the project, planning should be extended accordingly.

3.2.8 Assigning a Work Order

Work Product:	Work Order

Purpose

When placing work orders, different approaches are conceivable. A project-specific approach will be determined in the »Project Plan in the topic »Project Management - Organization and Directives.

For placing work orders in large projects an obvious approach will be as follows:

»Work Packages defined in the project plan shall be placed as work orders. A »Work Order will include all necessary information required by internal or external staff members to fulfill their tasks. The »Work Order shall be prepared at the start of a project and updated in the course of the project each time when an internal or external team member will be newly charged. The work order shall be placed in writing.

In smaller projects work orders shall be collected and managed exclusively in an action list. In these projects meetings shall be used to agree and to place work orders and to check whether work is done on them. Work orders in the form of action lists are mostly work orders where the expenditure is a small number of man-days.

3.2.9 Performing Life Cycle Cost Calculation

Work Product:	Life Cycle Cost Calculation
Method Reference:	Cost-Benefit Analysis, Estimation Models

Purpose

The aim of this activity is to calculate all expected costs of planning stage, the planned project costs, the expected »Manufacturing Costs and the projected costs of use and to derive the commercial result.

Firstly, the expected development costs will have to be determined on the basis of the project structure and be combined to accounts that make sense from a managerial point of view.

Secondly, the expected manufacturing costs will have to be estimated on the basis of the »Product Structure, evaluating the elements of the overall system on the basis of empirical knowledge with regard to the manufacturing costs.

In addition, the costs of planning stage and the costs of use will have to be determined bysed on the life cycle specifications.

Beyond that, the risks and chances regarding the above-mentioned topics will have to be assessed with regard to costs

With the help of this information the monetary result will have to be planned, i. e. the cost-effectiveness of the project will have to be evaluated. In addition, from this information target costs for the overall system and its elements will have to be determined.

3.2.9.1 Estimating Costs of Planning Stage

Work Product: Life Cycle Cost Calculation

The costs at planning stage will be calculated for the requirements specification phase until the award of contract. They include costs for the requirements specification, project defintion, request for proposals and contract award.

3.2.9.2 Estimating Project Costs

Work Product: Life Cycle Cost Calculation

Based on what was defined in the integrated planning of the »Project Plan, the overall costs of the completion of the project shall be determined on the basis of the »Estimation of Effort with regard to personnel, material and expenditure on material.

They shall be valued at the hourly rates or the commercial surcharge and be regulated by way of the project duration. In addition, risks and chances shall be assessed with regard to costs and with the help of the »Risk List.

The aim is to determine all costs that are to be expected for the development of the overall system in the project.

3.2.9.3 Establishing Accounts

Work Product: Life Cycle Cost Calculation

The accounts shall be derived mainly from the project structure plan. The expenditures determined shall be used to value the costs of each individual »Work Package and to integrate them into accounts that make sense from the managerial point of view.

In this process the »Account Structure may be established in accordance with the product structure plan so that it will be possible to show how the costs are allocated to the individual elements of the overall system. However, also other principles of order, such as a breakdown according to development disciplines or the products to be delivered, will be possible.

Expenditures on material and non-cash contributions, such as travel or contracted services, will be mostly recorded on separate accounts or allocated to the individual elements of the »Product Structure or broken down according to the above-mentioned principles.

3.2.9.4 Estimating Manufacturing Costs

Work Product: Life Cycle Cost Calculation

As a basis for an estimate of the »Manufacturing Costs of the hardware the »Product Structure, respectively the architecture of the overall system shall be used (see also the product structure plan of the »Project Plan).

The assembly and manufacturing technology for the individual hardware elements of the overall system shall be determined in detail down to unit level. Characteristic parameters in this context will be for example size, weight, assembly technique, printed circuit type and component complement.

The manufacturing costs shall be determined in analogy to similar system elements or units developed earlier, additional determining factors being the manufacturing location and the available know-how and - in case of new technologies - possible learning curves.

In the course of the project the data and assumptions used shall be recorded and occassionally reviewed (see »Commercial Project Status Report).

3.2.9.5 Estimating Costs of Use

Work Product: Life Cycle Cost Calculation

The costs of use will first be calculated at the beginning of the project in the Outline of the Life Cycle and the Overall System Architecture, when the the life cycle is considered during the preparation of the Requirements Specification.

Afterwards, the product Overall System Specification is the basis for the calculation, which may be refinded in the course of the project development

3.2.9.6 Planning of the Overall Project Result

Work Product: Life Cycle Cost Calculation

The cost-effectiveness of the project should be planned with the help of the expected costs of planning stage and project costs as well as the planned »Manufacturing Costs and the deviations of the costs of use.

The project costs spread over the business years shall be included each time in turnover and result, taking into account payment milestones, etc.

Using the manufacturing costs that were determined and the expected annual quantity, the turnover and the result from the sales of the overall system shall be calculated and spread over the corresponding business years.

In order to determine the total utility, the costs of planning stage and the expected deviations of the costs of use shall also be included into the economic analysis.

3.3 Reporting

The »Discipline »Reporting includes all »Work Products and »Activityies which are distributed to the stakeholders in accordance with the project-accompanying reporting system specified in the Project Manual. This discipline includes all state reports, e.g., »Project Status Report , »Quality Status Report and »Final Project Report , and current internal project daybooks, e.g. »Project Diary and »Metrics Analysis.

3.3.1 Holding a Meeting

Work Product: Meeting Document

Purpose

Meetings may be held for various purposes and at various occasions not explicitly listed by the V-Modell. They may be held both periodically, e. g. as a weekly "jour fixe", or dependent on an event, e. g. before a milestone is reached, and they may be held both internally and together with the acquirer. Important meetings should already be included in the project plan. Meetings should include the following steps (see Figure 8):

- Each meeting will be scheduled, and an »Invitation willbe sent to the participants.
- The meetings will be chaired by the person who sent the invitations or a person in charge in accordance with the point listed in the »Invitation. He should guide the discussion in the direction of the specified aim of the meeting. For a meeting a rigid time management should be planned.
- At the start of the meeting the inviting person will explain the necessity, the distribution, the scheduling and the form of the minutes and determines the recorder.
- Decisions shall be included explicitly in the minutes.

- For agreed tasks an obvious approach will be to formulate work orders in the form of an action list (see activity »Assigning a Work Order).

Activity Flow

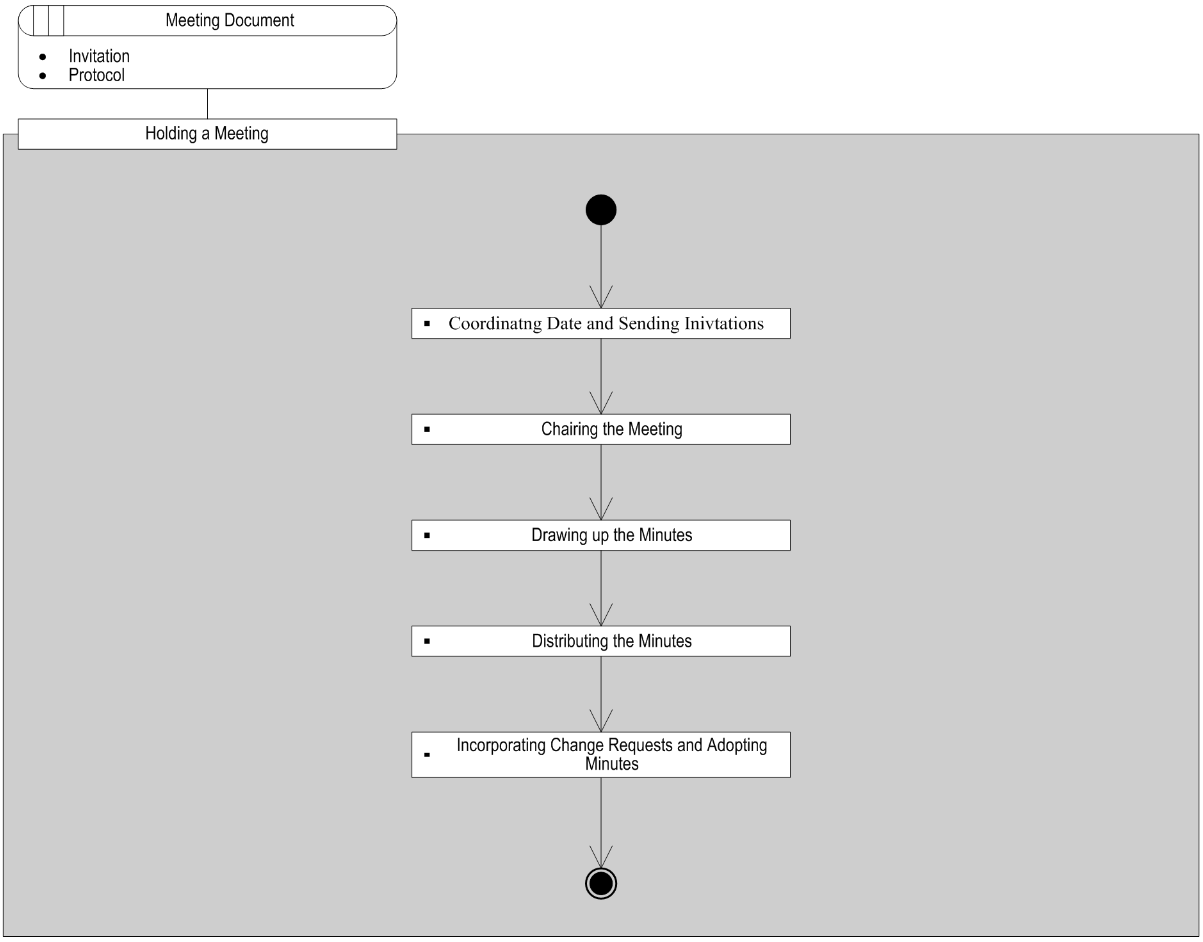

Figure 8: Activity Diagram "Holding a Meeting"

3.3.2 Keeping a Project Diary

Work Product: Project Diary

Purpose

Only if the experience gained in the course of the project is continuously safeguarded, will it be possible to learn from it - for future projects, but also for the current project.

For keeping a »Project Diary the »Project Leader will be responsible. This should be done

- in documented form,
- periodically, i. e. daily or at least weekly, and
- according to a fixed structure with regard to features that are typical of project success (for example the features included in the topic »Lessons Learned).

3.3.3 Collecting Measurement Data

Work Product:	Measurement Data

Purpose

For all »Metrics defined in the project the »Measurement Data shallbe collected and placed in the specified filing structure (see »Project Management Infrastructure). In this process measurement times, measurement units, persons taking part in data collection and possible support with tools will depend on the »Measurement Data Types. They are defined in the »Project Manual and in the »Metrics Catalog.

The »Project Leader will be responsible that each person concerned provides the relevant measurement data. He will make spot plausibility checks to ensure the authenticity of the measurement data.

3.3.4 Calculating and Analyzing Metrics

Work Product:	Metrics Analysis

Purpose

The »Metrics shall be calculated in accordance with the specifications in the »Metrics Catalog or the »Project Manual and subsequently analyzed. They will be calculated by applying formulas, such as cyclomatic complexity, error per lines of code, error per logic element, and planned and current expenditures for an activity at the time x.

The results shall be prepared as follows:

- The metrics shall be presented in a clear arrangement, e. g. in diagrams or tables.
- The metrics shall be interpreted.
- The decision documentation shall be prepared, including suggestions for actions to be initiated or suggested solutions.

These results shall be documented, presented to the target groups, discussed with them and subsequently communicated within the framework of the accompanying reports. Then the target groups shall decide whether and how appropriate measures are to be initiated. In case of schedule problems, for example the »Project Leader may determine jointly with the »Steering Committee that in consultation with the acquirer the system will be realized in two increments.

When metrics will be analyzed, compliance with the data protection directives will be required. This will be in particular true for metrics that will be used organization-wide: The »Measurement Data and the associated analyses and interpretations will then also frequently be made available to other project staffs so that they may use the lessons derived from them, e. g. for their project planning. One example of this are empirical values for estimates of project scope and »Estimation of Effort.

3.3.5 Preparing Commercial Project Status Report

Work Product:	Commercial Project Status Report
Method Reference:	Project Planning and Control

Purpose

The the costs of planning stage, project costs (actual costs), the expected »Manufacturing Costs and the costs of use will be tracked in regular intervals, which shall be defined in each case, and the deviations from the planned values (should-cost) shall be determined.

Based on the actual project costs and the »Estimation of the state of manufacture, the costs that will have been accumulated until the end of the project (Cost to Complete) shall be estimated and used to determine the expected cost state at the end of the project (Cost at Completion).

Together with the expected future risk costs, these estimates shall be used to check the planned project result and the target costs in regular intervals. In case of possible deviations, the project management shall be informed, who may initiate appropriate correcting measures.

At the end of the project, the commercial result of the project should be presented in the final »Commercial Project Status Report.

3.3.6 Preparing Project Status Report

Work Product: Project Status Report

Purpose

The preparation of a »Project Status Report will be a project monitoring instrument that will make it possible to identify deviations from the plan at an early date and to respond to them in time. Project status reports will be used either internally to provide information to the own management and/or, in case of a supplier project, to provide information to the acquirer.

In the project status report the current progress of the project, deviations from the planned set targets and the risks that were determined mainly by way of risk analysis will be presented. In addition, the report will outline the status and any problems of individual partial processes.

The project status report will be prepared in accordance with the specifications of the project manual at fixed target dates, periodically or after the occurrence of special events, and it will be distributed to the designated recipients.

For this purpose, the so-called actual data will be collected. They include firstly the state of the work, for example when the specified target was reached and the requirements were met, and secondly the resources used and the expenditures. Then these actual data will be compared with the set values from the project plan and the estimated expenses that still will have to be incurred. In this process it will also be necessary to check and document whether all stakeholders in the project performed the tasks that they accepted and will be able to fulfil their commitments in future.

In case of an actual or foreseeable exceedance of the set targets, control measures will be initiated that are intended to make it possible to reach project targets that are at risk. This includes

- changing milestones,
- changing priorities,
- providing special treatment of critical products,
- changing the distribution of resources and personnel,
- adaptating contracts,
- adding personnel or

- outsourcing of subprojects that were set up as separate units.

In the project status report the »Project Leader will suggest control measures that are to be initiated and thus prepare a »Project Progress Decision.

The project status report will always be prepared in a standardized form and distributed as defined in the project manual.

3.3.6.1 Determining Overall Project Progress

Subject: Project Status Report: Overall Project Progress

The Project Leader shall concentrate the most important project progress values of the individual sub-projects, thus determining the appropriate values for the overall project. For this purpose, he shall establish joint reporting dates for all sub-projects in such a way that a representative conglomeration for the project progress of the overall project can be determined. In addition, he shall select those project progress values which are important for controlling the overall project. The Project Leader shall determine the critical path of the overall project, which is based on the aggregation of the project progress values of all sub-projects.

3.3.7 Preparing Quality Status Report

Work Product: Quality Status Report

Purpose

Within the framework of the preparation of the »Quality Status Report, the quality state of the project shall be documented. For this purpose a summary of the progress of the project with regard to the quality situation of the processes and sub-processes, the documents and system elements in the reporting period shall be prepared. Also suggestions for improvements in the project sequence shall be determined and described.

The Quality Status Report will based on the analysis of the test logs and will in particular be used to provide information to the »Project Leader and probably to the »Steering Committee.

3.3.8 Concluding Project

Work Product: Final Project Report

Purpose

The aim of an orderly conclusion of a project will be the preparation of the »Final Project Report for the acquirer, respectively the in-house management.

In a final meeting the results of the project shall be presented. In this meeting the initial situation and the project aims shall be compared to the results of the project. The progress of the project shall be shown and in a discussion in the group the potential for the improvement of future projects shall be identified.

3.4 Configuration and Change Management

The »Discipline »Configuration and Change Management includes the »Work Products and »Activityies »Product Library and »Product Configuration, which are the central products and activities of »Configuration Management. The »Problem and Change Management is also represented in this discipline by the respective products, from the product »Problem Report / Change Request to the product »Change Decision.

3.4.1 Preparing Problem Report/Change Request

Work Product:	Problem Report / Change Request
Tool reference:	Change Request Management

Purpose

Each V-Modell role may prepare for various reasons a problem report or a change request. The aim will be, always the same, however, i. e. to effect a change of the product or a deviation from specified requirements. Reasons for this may be for example development problems, problems with regard to schedule and cost, changes in legal provisions or the improvement of the chances on the market. Change requests may be motivated "directly", for example if a concrete problem arises in the development or during service use by the developer/user, or "indirectly", e. g. caused by the desire to improve the product and to use for this purpose a user poll conducted by the marketing department.

When generating a problem report, the problem identified by the applicant will have to be described when the solution will be still lacking. Compared to this, in the change request both the problem and possible solutions shall to be presented. The form of a problem report or a change request will depend on the specifications in the change management of the project manual. The report or the request will be submitted to the competent person in charge of changes.

The problem report/change request should always include the following information:

- Information regarding identification, such as applicant, project, the configuration concerned
- Description of the problem or the desired change
- Reasons why the change is desired, i. e. explanation of the benefit or damage that results if the change is not implemented
- Possibly a suggested solution from the point of view of the applicant.

3.4.2 Assessing Problem Report/Change Request

Work Product:	Problem/Change Evaluation
Tool reference:	Change Request Management

Purpose

Topical processing and assessment of problem reports and change requests will be required. For the assessment the competent person in charge of changes should identify the roles who are assigned to the products or topics affected by the change and who have the necessary technical and system- and project-relevant knowledge.

To assess the problem report/change request, at first an analysis of the effects shall be made. In this analysis it will be examined what possible consequences the implementation of the change request may have for the development project or the system in the in-service phase. In this context not only technical aspects, but also financial and organizational aspects shall be considered. Also possible risks connected with the implementation of a change for the project shall be included in the analysis.

In a next step suggested solutions shall be worked out how the request for change may be implemented. The suggested solutions shall be presented in sufficient detail so that they can be reconstructed by the competent change steering group.

Finally it shall be decided which suggested solution would be the most suitable. For this recommendation appropriate reasons shall be given. This must include a statement on the priority of the implementation, and also estimates concerning the expenditure and the effects on the project/system shall be provided.

3.4.2.1 Analyzing Problem

Work Product: Problem/Change Evaluation

The problem described in the problem report or the change request will have to be analyzed. When doing this, it shall be checked whether the problem requires a solution or whether it can be neglected. If it turns out that the problem will have to be solved, the cause of the problem will have to be determined. If it is a system error, it will have to be determined whether the error lies in the requirements, the design or in the realization, i. e. in the code, respectively the hardware. The analysis of the cause will be made easier if during system development existing relations are documented (tool-based) in a relation or an impact model.

If the change request includes a change of requirements, such as a new or improved functionality, it will have to be examined how this functionality can be integrated without conflict into the existing requirements specification. If the desired change - in case of an existing product - refers to an improvement of the system, it will have to be examined whether the described improvements can be implemented as outlined in the change request.

If the change request comes from the acquirer and if it refers to a change of an already agreed or the integration of a new requirement, a corresponding amendment of the contract will have to be prepared, harmonized and signed. Without an amendment to the contract will not be possible to implement a solution to the problem.

3.4.2.2 Proposing Solutions

Work Product: Problem/Change Evaluation

Based on the description of the problem in the problem report or the change request, it will have to be determined how a desired change can be implemented. In this context it also will have to be outlined whether the problem can be solved completely or only in parts. Each suggested solution should include at least the following information:

- those parts of the system that are affected by the change (such as business processes, system elements or requirements);
- that phase of the development process in which the change incurs (i. e. design, coding or integration);
- the description of the solution to the problem;
- the description of the required expenditures and
- the impact of the required changes on the project (for example on time, costs, personnel or resources).

When considering the suggested solutions, it should also be taken into account whether it is possible to maintain the required security level when they are implemented.

3.4.2.3 Making a Recommendation

Work Product:	Problem/Change Evaluation

To be able to make a recommendation when assessing a problem report or a change request, the suggested alternative solutions will have to be evaluated based on their impact. Based on the scores, a decision shall be made, which also shall be substantiated. For the evaluation in particular technical criteria should be used.

3.4.3 Deciding on Changes

Work Product:	Change Decision
Tool reference:	Change Request Management

Purpose

The change steering group will meet at regular intervals or in urgent cases as required and deal with all change requests on which a decision is due. For each change request a decision shall be made about how to further proceed with it. Each decision of the change steering group shall be binding. Should those decisions involve conflicts, escalation of these conflicts should be according to the specifications in the project manual. As a basis for making a decision the products »Problem Report / Change Request and »Problem/Change Evaluation will be used.

When making a decision, the following steps shall be taken (see Figure 9):

- Preparing the decision, this means collecting change requests and related assessments and arranging them in groups, preparing and distributing the agenda for the meeting and mailing invitations.
- Presenting change requests and assessments and determining decision criteria. Examples of decision criteria are:
    - Costs incurred

  - Availability of acquirer funding, if the change request is made by the acquirer and the changes are no longer covered by the existing contract
  - Availability of personnel and other required resources
  - Project delay
  - Technical suitability of the suggested solution
- Adopting change decision and laying down its implementation
- Determining the impact of the change
- Recording the change decision in the change decree
- Distributing and communicating the change decision.

If the change decision should require a contractual measure, such as changing the requirements, this will be noted down accordingly.

Activity Flow

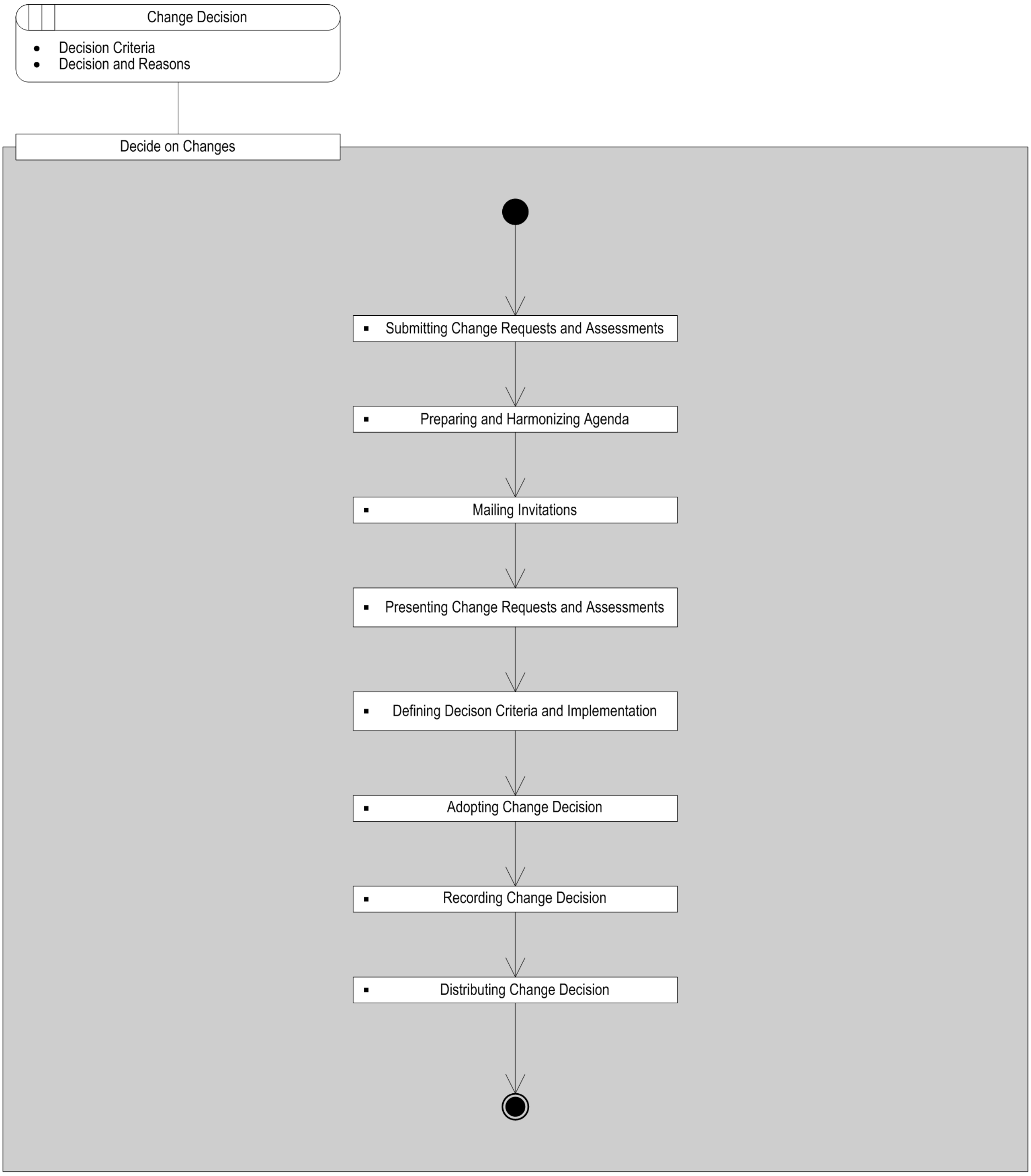

Figure 9: Activity Diagram "Deciding on Changes"

3.4.4 Maintaining Change Status List

Work Product: Change Status List

Tool reference: Change Request Management

Purpose

The aim of maintaining the »Change Status List is to centrally document and to update all relevant information about requirements for a development project or a system in the in-service phase. The Change Status List shall be updated whenever new information becomes available. In this case the process for a new change request will be for each change request identical.

Each receipt of a change request shall be registered with all necessary data. It shall be checked whether these data are complete and comprehensible so that they are suitable for further processing. Then all required changes for the realization of the change requests shall to be derived and their feasibility checked. Also responsibilities for their implementation shall be determined and target dates for monitoring purposes defined. In addition, all measures required for realization shall be identified, described and updated in the Change Status List. If this is an existing change request, this activity will be limited exclusively to updating the Change Status List by documenting the current state of the implementation of a change request (see Figure 10).

Each state that may be assigned to a request shallbe determined in the project manual.

Activity Flow

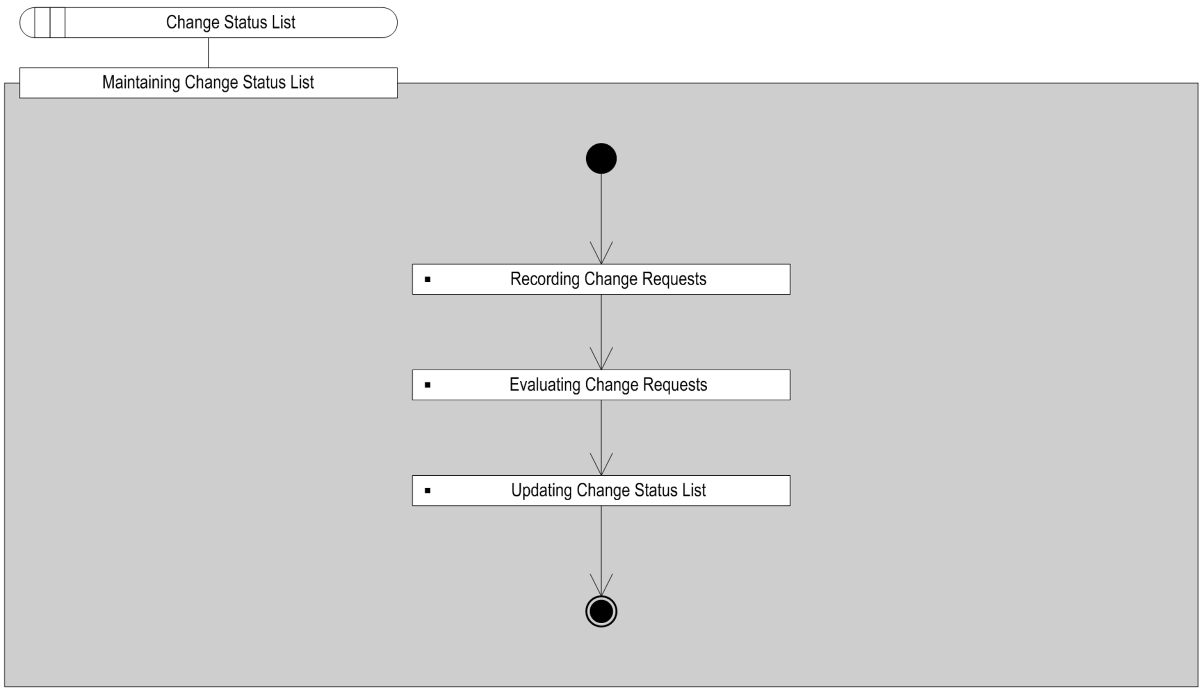

Figure 10: Activity Diagram "Maintaining a Change Status List"

3.4.4.1 Recording Change Requests

Work Product: Change Status List

The change request shall be received and the appropriate values - applicant, date of receipt, reference to the change request - shall be entered from the request into the »Change Status List.

3.4.4.2 Evaluating Change Requests

Work Product: Change Status List

When checking the change requests, it shall be examined whether all necessary information in the application is complete and consistent. If this is not the case, the missing information shall be obtained from the applicant or the request shall be returned to the applicant with a statement in which this is noted.

3.4.4.3 Updating Change Status List

Work Product: Change Status List

When updating the »Change Status List a distinction shall be made whether these are already existing or new change requests. New requests shall be added, existing requests shall be updated. The update will be required as soon as either a new problem report/a new change request will be submitted or the processing state of a change request will change. The information affected by the update will be:

- The change state, for example "requested", "intended", "rejected", "postponed", "commissioned" and "accomplished";
- Assessment, decision or implementation target dates;
- References to the change assessment or the »Change Decision.

3.4.5 Managing Product Library

Work Product: Product Library

Tool reference: CM Tool

Purpose

The establishment and maintenance of the product library will include the initial storage of the products to be configured and the storage of new versions of these products (subactivity »Initializing and Administering Products). This activity will also include the compilation of product releases, i. e. product quantities of products with the same version.

The products shall be secured and archived in accordance with the specifications of the »Project Manual (subactivity »Saving and Archiving Products).

For the decision gates or for the information of the project management the library shall be exploited and configuration management reports shall be prepared (subactivity »Preparing CM Evaluations) (see Figure 11).

Activity Flow

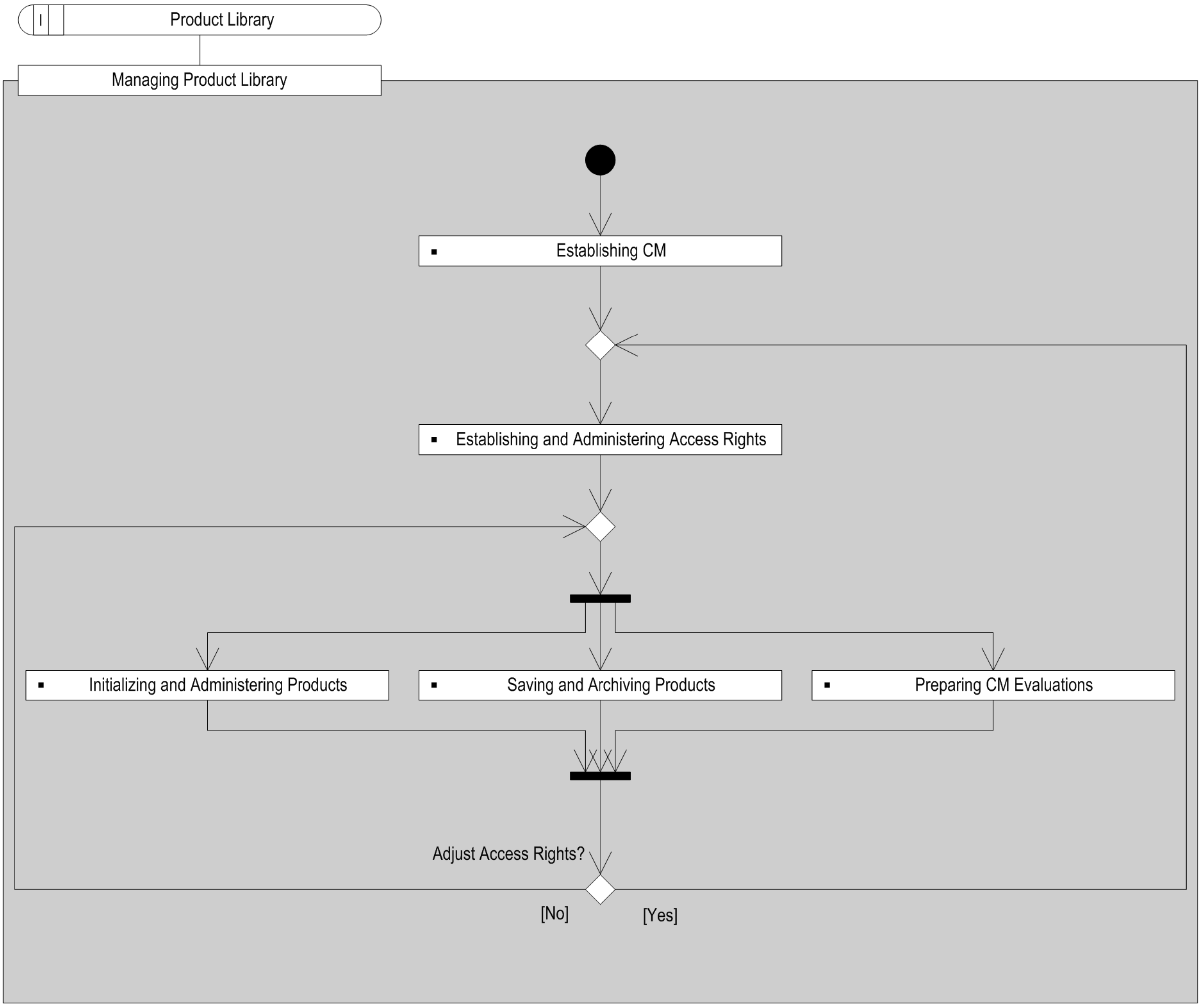

Figure 11: Activity Diagram "Managing the Product Library"

3.4.5.1 Establishing CM

Work Product: Product Library

To establish configuration management, the following steps will be necessary:

- Establishing the project for initialization and administration of the associated products in the »Product Library using CM tools such as databases;
- Establishing the defined conventions of the identifiers in accordance with the »Project Manual in the product library.

When establishing the product library, the IT security objectives and measures from the security concept, such as access privileges, control mechanisms and personal data protection generally shall to be considered with regard to the CM tool. Also when storing the products during the project, the IT security rules as laid down in the »Project Manual shall be observed.

3.4.5.2 Establishing and Administering Access Rights

Work Product: Product Library

The access privileges of the stakeholders in the project to products of the »Product Library shall be established and administered accordingly.Access privileges shall be established in a way that their allocation will be as much as possible related to product state and role. Access privileges of the project staff shall to be administered depending on the requirements of the project, e. g. granting access privileges to new members of the project staff or additional deputies. After work on the project will be finished, access rights may have to be withdrawn if required.

3.4.5.3 Initializing and Administering Products

Work Product: Product Library

The product - document, hardware, firmware, software or possible combinations -, which fulfills a function and has to be determined and administered for configuration management purposes shall be registered with identifiers, such as designation, »Product State, version, action officer and date, in the »Product Library and initialized in accordance with the conventions of the identifiers (see »Project Manual).

An already existing product ID shall be updated for example by generating different versions. If the product is an off-the-shelf product, e.g., an »External Unit, an External Hardware Module or an External Software Module, which is developed or procured externally, rules analoguous to those for the initialization and administration of the product library according to the »Project Manual will apply.

Configuration management will administer the products as a function of their identifiers. The product administration shall be used to make sure that the tracking of and a fallback on previous versions of the product will be possible.

To "administer" a product means that a product is initialized and administered physically in the library with identifiers, which are also called metadata. Examples of metadata are document number, version, date, author and product state. The originals - also called »Measurement Data Types - may be stored in a different tool and archived depending on the requirements (see subactivity »Saving and Archiving Products). An example of primary data is the software code. There must be a one-to-one correlation between the metadata set and the measurement data types.

3.4.5.4 Saving and Archiving Products

Work Product: Product Library

Securing and archiving products will be performed in each case to the required extent, which will be based on project requirements and specifications in the »Project Manual:

- continuous securing of results: in regular intervals that will be determined by the projects all results available to configuration management shall be secured;
- securing of results before the completion of a project: before a project will be completed, all project-relevant results will have to be secured reliably and in accordance with the requirements, for example using long-term archiving for five, ten or thirty years, so that they can be reproduced at any time. Individual products or the whole project may then be reused at a later date.

3.4.5.5 Preparing CM Evaluations

Work Product: Product Library

For the preparation of decision gates or to inform the project management about the monitoring of the progress of the products the product library shall be used. In this process all products shall be identified that determine a product configuration of the pending decision gate (see also Figure 12).

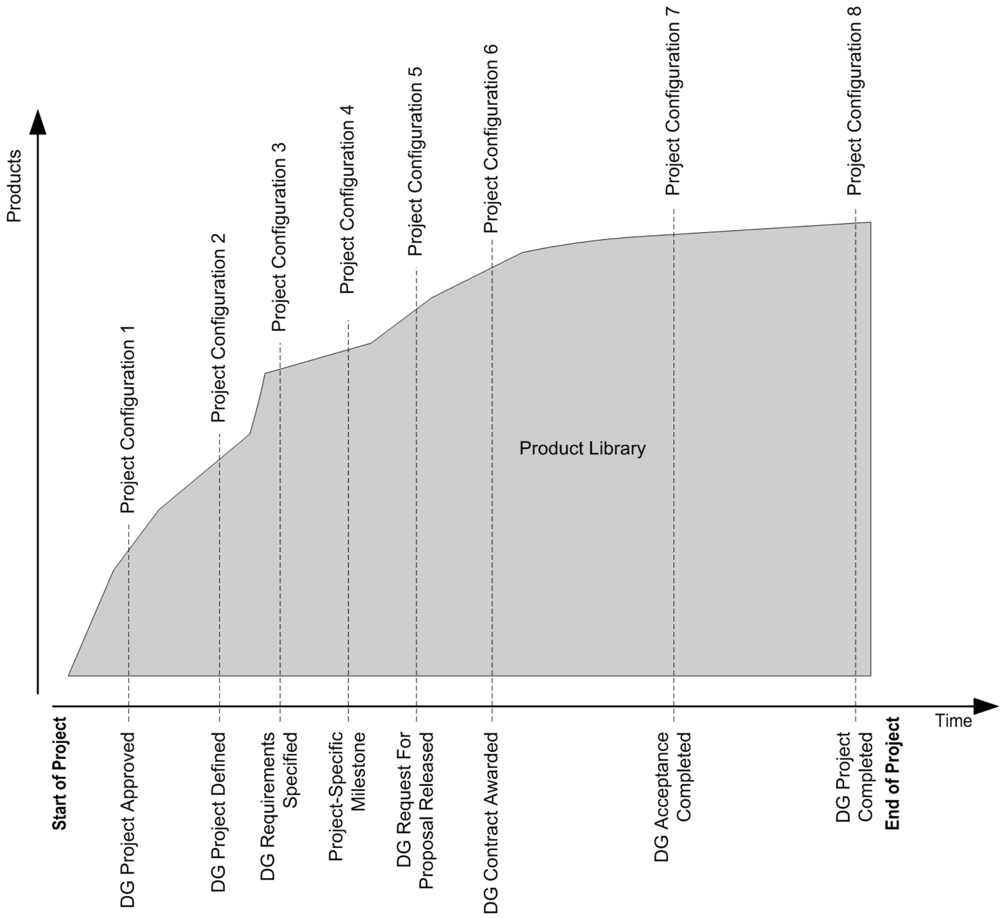

Figure 12: Decision Gates and Product Configurations

The use or the project library will be based on the specifications described in the »Project Manual. Within the framework of this subactivity, the CM evaluations, such as determining the state of products, the state of a decision gate or the state of a project, shall be prepared, documented and made available to a defined group of people. To illustrate the current product state and the associated change actions, for example evaluations in the form of state lists from the product library shall be generated, such as:

- Status list with statements concerning the identification of the configurations,
- Status list of the products.

3.4.6 Managing Product Configuration

Work Product:	Product Configuration
Tool reference:	CM Tool

Purpose

»Product Configurations are used for the identification of products which "belong together" with regard to contents and which are in a specific version and product state. The product dependencies described in the V-Modell provide a certain clue for the establishment of product configurations. A product configuration is generated at least at every decision gate. Methodical notes for handling product configurations may be found in the subactivity »Initializing and Updating Configuration.

In addition, the task of configuration management will be to prepare products for delivery in accordance with the contractual conditions. The so-called release management, which is described in the subactivity »Document Delivery Data, is intended to distribute and coordinate all deliveries in a controlled manner.

3.4.6.1 Initializing and Updating Configuration

Work Product:	Product Configuration

The »Product Configuration shall be initialized in the »Product Library in accordance with the conventions defined in the »Project Manual, using identifiers such as name, »Product State or version. For products that belong together, unambiguous relationships - such as referencing or establishment of hierarchies - shall be established by way of the product dependencies described in the V-Modell (for example: »Segments include several elements). If a product is part of a configuration, at least all product versions with product dependencies shall be integrated into this configuration.

A product configuration is generated at least at every decision gate. It will include at least the products to be submitted at the respective decision gate. This documents the project progress and ensures a repeatable quality assurance. The project-specific rules according to which the product configuration has to be updated shall be defined in the »Project Manual , such as version update, update of the product states and name conventions.

The product configurations shall ensure that a quantity of products which belong together can be configured at any time. For this purpose, procedures that automate the required configuration steps can be developed. All relationships and correlations that exist between the individual products shall be evident from the product configurations. Also the possibility or necessity of different configuration variants, such as country-specific variants, shall be taken into account.

3.4.6.2 Document Delivery Data

Work Product: Product Configuration

Within the scope of the documentation of delivery information, product configurations shall be prepared and documented in a way that complies with the agreed conditions for delivery and the specifications in the Project Manual. This is also called release management.

If for example software is delivered, it shall be described how a data carrier shall be prepared. In accordance with this delivery procedure for the preparation of a data carrier, an installation procedure shall also be prepared if required. At this point, configuration management may act as the central delivery authority.

Moreover, this subactivity will be used for controlled distribution and coordination, thus establishing the prerequisites for a controlled overview over all deliveries.

Typical questions include:

- What configuration was delivered?
- When and to whom was the delivery made?
- What storage or transmission medium was used?
- For what purpose was the delivery made?

3.5 Evaluation

This »Discipline includes all products and activities required for testing documents, system elements and processes. Evaluation specifications define the requirements posed on form and contents of the evaluation object. They shall be prepared, taking into account the specifications of the »QA Manual. Evaluation procedures include information and specifications for the sequence of tests and evaluation cases for system elements. Evaluation reports document the results of a test and indicate problem areas. They are the basis for »Quality Status Report. The »Qualification Record provides a summary description of all qualifications.

3.5.1 Preparing Evaluation Specification Product Configuration

Work Product: Evaluation Specification Product Configuration

Purpose

When the Evaluation Specification Product Configuration is prepared, the document to be evaluated shall be designated and referenced, and the evaluation criteria shall be described. The criteria are listed in the subject Evaluation Criteria. The evaluation criteria shall be determined so accurately and comprehensively that a successful and adequate evaluation is possible.

3.5.2 Evaluating Product Configuration

Work Product:	Evaluation Report Product Configuration

Purpose

The evaluation is intended to deterimine whether the product configuration is faultless. The result and any problems encountered shall be documented.

Within the scope of the evaluation, the following questions shall be analyzed and assessed:

- Are all configuration units provided with correct identifiers?
- Are all configuration units filed as specified?
- Is the product configuration complete?
- Was the configuration developed in accordance with the specified procedure?
- Are all configuration units in a consistent condition?
- Can products that belong together be configured at any time?

3.5.3 Preparing Evaluation Specification Document

Work Product:	Evaluation Specification Document
Method Reference:	Review

Purpose

When preparing the »Evaluation Specification Document the document to be tested shall be named and referenced and the criteria used for the test shall be described. The criteria will be listed in the topic »Evaluation Criteria. The definition of the evaluation criteria shall be so concrete and comprehensive that a successful and adequate test will be possible.

3.5.4 Evaluating Document

Work Product:	Evaluation Report Document
Method Reference:	Review

Purpose

When testing a document, the quality of its contents and the consistency in relation to other dependent documents shall be assured. Testing will be based on the evaluation plan, the evaluation criteria and the »QA Manual and must not be performed by the creator himself.

During testing the document shall be analyzed and evaluated. This may be done for example on the basis of the following criteria:

- Is the document intelligible, easily surveyed, well structured and complete?
- Are the products, from which the document to be tested originated, available?
- Are the requirements against which the document is to be tested all documented, clear and intelligible?
- Was there compliance with the guidelines, standards, templates and processes to be used?

If the document is a specification, it also may be validated, if required, when screening the contents. In this case the receiver/user of the allocated system element will check, whether his expectations have been taken into account in the specification. An example of this is the testing of the interface specification by the »System Integrator.

The results of the test steps shall be described in the evaluation report so that they can be traced and provided with a summary and evaluation. The results of the the test may be incorporated for example in review statistics - e. g. in the degree of coverage, the number of annotations per page, the ratio of conducted to planned reviews or the number of errors found as a function of error class.

In case of a successful test, the state of the document shall be changed from "submitted" to "completed". Otherwise the state of the document to be tested and of all documents with contents depending on this document shall be specified "in preparation". This does not depend on whether the documents had already been submitted or completed. After rejection of the evaluation object, it shall be revised and resubmitted. In each case the project management shall be informed about the evaluation result.

3.5.5 Preparing Evaluation Specification Process

Work Product:	Evaluation Specification Process
Method Reference:	Process Analysis

Purpose

In the activity »Evaluation Specification Process the processes to be tested shall be designated and the evaluation criteria shall be specified. The criteria will be listed under the topic »Evaluation Criteria. The criteria shall be worked out so precisely and comprehensively that successful and adequate testing will be possible.

3.5.6 Evaluating Process

Work Product:	Evaluation Report Process
Method Reference:	Process Analysis

Purpose

Process testing, also called process audit, means testing individual steps of an overall process. In process testing not the result of a process step, such as a document, but the execution of the step itself, which is characteristic of the process, has to be tested on the basis of agreed process descriptions. The aim is to determine whether the processes listed in the »QA Manual fulfill their allocated specifications (»Evaluation Specification Process).

By way of process testing it can also be determined that the actually executed process is better than the process depicted in the process description. Should it turn out that it is possible to optimize the process description, it has to be adapted to the real process.

In process testing possibly all processes in the project may have to be tested, with the planning processes and the project management having higher priority. Process testing may be arranged on the basis of the experience or »Metrics of earlier projects. In some processes testing may also be initiated by an event in the project, such as the deviation of a measurable quantity from a specified value. Testing will often also be initiated when problems occur, if there are for example serious deviations of planning from the actual state. In this case process testing is to reveal the cause of the problems.

When testing the process, it shall be examined at first whether the formal requirements for the »Evaluating Process have been met. The process shallbe analyzed and evaluated. This may be done on the basis of the following criteria list:

- Is the process intelligible, clear, well structured and complete?
- Have all subprocesses and steps that make up the process that is to be tested been executed?
- Are all evaluation criteria against which the process is to be tested documented, precise and intelligible?
- Have all applicable guidelines, standards and templates been complied ?

After testing the contents it has to be determined whether the individual steps of the actual process are executed in accordance with the requirements contained in the »QA Manual and the »Evaluation Specification Process.

During the test the results shall be laid down in the test log. Additionally, process deviations shall be documented so that they can be traced, and a summary and an assessment shall be provided. Beyond that, the test may be used for the classification of suppliers by auditing their processes. This may be done for example in the form of supplier audits.

When testing QA activities themselves, generally a suitable allocation of roles shall be provided to avoid role conflicts. Furthermore, the project management shall always be informed about the evaluation result.

3.5.7 Preparing Evaluation Specification Usability

Work Product: Evaluation Specification Usability

Purpose

The preparation of the »Evaluation Specification Usability will start during the »System Specification with the definition of scenarios. In this definition a complex task setting of a user in a defined user role shall be described. It will consist of a number of associated use cases or test items that describe the overall scenario.

Such a use case is defined by

- an **Identifier** characterizing the use case,
- the description of a **use situation**, in which the user is in his role defined by the scenario at the dialog workstation during the operation of the application system;
- the description of a **work task** the user is to perform in the described use situation at the dialog workstation;
- the description of a **test target** that specifies what has to be achieved or tested with the use case and
- the description of **discussion points between supplier and user**.

Thus the possibility that typical work tasks can be realized by the prototypes developed within the framework of the accompanying human factors engineering will be traceable and can be tested. The prototypes have to be iteratively evaluated and tested with representatives of the users. The results of prototype development should be taken into account in the specification and, if possible, as early as in the requirements specification.

In the following one use case will be outlined as an example.

- **Identifier:** Prepare new order from the archive.
- **Use situation:** A new order is transmitted to the user by the central office. He remembers that a similar order exists already in the centrally available archives that contain the orders.
- **Work task:**
  1. Loading the appropriate order for the user from the central archives.
  2. Making changes/amendments based on the transmitted parameters of the loaded order from the archives.
  3. Starting the new order.
- **Test target:** Analyze the dialogue order-archive, analyze the navigation in categories, execute activities for amending the order, start the function Order from the dialogue "Order Archives".
- **Discussion points between supplier and user:** Is the structuring of the archives in categories sufficient, is it necessary to have for each order an explicit name that can be freely specified by the user or is a search function required?

In addition to the user cases, usability tests shall be established and analyzed. The aim of early usability tests is to familiarize the user with the prototypes and to give them an initial realistic impression of the dialogues of the workstation. The usability tests shall be designed in a way that they can be performed at the workstation that will be set up as a prototype under working conditions that will be as realistic as possible. For all tests the test evaluation procedures shall be described.

The usability tests should be specified in a way that the documented evaluation results can be used in the further course of interface implementation.

3.5.7.1 Specifying Evaluation Strategy

Subject: Evaluation Specification Usability: Evaluation Strategy

The evaluation strategy shall be derived from and refined based on the »User Tasks Analysis and the specified general conditions. Afterwards, it shall be documented in the »Evaluation Specification Usability.

Evaluation requirements shall be prepared for every evaluation object listed in the evaluation plan. If relevant, the connection between the evaluation requirements and requirements documents shall be demonstrated.

The evaluation case structure, i.e., the fundamental structure of each evaluation case, shall be specified.

Depending on the case, also safety and security shall be taken into account. Thus, the evaluation method will be based on the safety and security level/action matrix specified in the »Project Manual and the criticalities specified for the respective functional unit.

3.5.7.2 Deriving Evaluation Cases

Subjects:	Evaluation Specification Usability: Evaluation Cases, Evaluation Specification Usability: Evaluation Strategy

The evaluation cases of the individual evaluation objects shall be established on the basis of the evaluation requirements in the evaluation specification. For each evaluation case the coverage matrix of the evaluation specification shall describe what architectural elements and interfaces and what requirements are verified.

The structure of the evaluation case should be based on the evaluation strategy in accordance with the definitions of the evaluation case structure. For each input value the expected specified reaction shall be described.

When establishing a system, the evaluation cases generated in the self-check shall be considered. As far as this is required, these evaluation cases shall be supplemented or modified.

3.5.7.3 Allocating Evaluation Cases to Requirements

Subject:	Evaluation Specification Usability: Allocation of Evaluation Cases

Each specified evaluation case shall be allocated to the requirement from which it was derived. This shall be documented in the coverage matrix of the evaluation specification. Frequently several evaluation cases, e. g. good behavior or various exceptional behaviors, will be specified and allocated to one requirement. It may also be quite possible that one evaluation case tests several requirements at the same time.

3.5.7.4 Identifying and Determining Protective Measures

Subject: Evaluation Specification Usability: Protective Measures

See Identifying and Determining Protective Measures in activity Preparing Evaluation Specification Delivery.

3.5.7.5 Determining Evaluation Environment

Subject: Evaluation Specification Usability: Evaluation Environment

All requirements concerning the evaluation environment shall be defined. This will include both functional and non-functional requirements, depending on the test requirements, methods and criteria. On top of that all additional required resources shall be determined, for example integration environment, line issues or special operating personnel, such as crane operators, or personnel with a safety qualification.

If there are several evaluation environments, the individual evaluation cases shall be allocated to them.

It must be possible to unambiguously identify each evaluation environment by its configuration identifier so that an allocation to the system elements to be tested for reasons of replicability will become possible.

In case the complexity of the evaluation environment is high, the latter should be generated in a special subproject.

3.5.8 Evaluating Usability

Work Product: Evaluation Report Usability

Purpose

Within the framework of usability testing it shall be determined whether an application will be fit for use. For example it shall be ensured that all required information is displayed, that the order of the fields is correct, that the dialog sequences are clear and that all terms are precisely formulated and comprehensible for the user.

Testing will start with the performance of the usability tests. In these tests application cases, each consisting of the description of an application situation and a work task, shall be displayed to the user on a separate screen, such as a notebook, and read out to him in a loud voice. Then the user will deal with the respective task, instructed and supported by a person responsible for human engineering matters and sitting next to the test subject. Alternatively, a notebook with tasks may be specified that will have to be worked off in the course of the test. In each case problems, open issues, wishes, impressions and errors shall be directly addressed and recorded.

It has proved to be worthwhile to seek expert opinions and expert reviews concerning the dialog concept prior to conducting the user test and to take them into account in the validation.

During the test for example the method of thinking out loud in which everything the user thinks and feels while working on the task will be expressed in a loud voice.

During testing it has proved to be successful to start working on individual interface components, such as input fields, lists and menus, and then to check whether these elements are appropriate for use. This will apply also to overarching aspects, such as the nesting of windows, the arrangement of information and the distribution of functions among buttons and menus.

In the follow-up of the tests a small group of people (»Ergonomics Manager and developers) should once more review all records with regard to critical scenarios. Problems, open issues, but also design decisions that proved to be good, should be documented.

In the evaluation report the results of the evaluation cases with regard to usability shall be laid down. The documented results may be used again in the further course of interface implementation as a checklist for design decisions that still will have to be made or that have already been made.

If it turns out that errors occurred during the test, those errors shall be evaluated and prioritized before changes in the development process will be implemented.

3.5.8.1 Verifying Usability

The evaluation object has to be verified based on its evaluation specification. In this context evaluation objects may be either arbitrary system elements or even (partial) deliveries. During the verification all evaluation cases defined in the evaluation specification have to be realized. For the system elements system, »Segment, SW unit/HW unit, SW component/HW component and SW process module/HW process module the corresponding evaluation procedure has to be completed. During the evaluation the associated evaluation report has to be prepared. In this record the result achieved for each evaluation case has to be documented such that it can be replicated. The result has to be compared with the expected result. Deviations from the expected result have to be marked as errors. For each evaluation case a summary evaluation has to be provided.

If the test was passed, a state change from "submitted" to "accepted" has to be arranged, otherwise a change from "submitted" back to "in preparation".

3.5.8.2 Validating Usability

During the validation the recipient of the evaluation object, i. e. the acquirer or the »System Integrator, shall check whether the evaluation object meets his expectations and has the properties required for the planned use. Evaluation objects may be in this case either (partial) deliveries or any system element.

During the validation the »Inspector of the evaluation object may conduct tests in any sequence and depth, and the evaluation object should always provide an acceptable evaluation result. Depending on the state of manufacture of the evaluation object, a validation may be conducted

- in the form of a simulation based on intermediate results;
- in the form of an evaluation of the planned properties of a system element based on a prototype;
- as an evaluation step within the framework of an execution decision, for example at the end of a development step during incremental system development;
- in the form of an evaluation of the completed evaluation object.

The results of the validation shall be written down in the evaluation report.

If the result of the validation is negative, the acceptance of the evaluation object will be reduced. One reason for this may be that between project start and the time of the evaluation the expectations of the acquirer with regard to the functionality of the product have changed. This may be discovered early if validations are performed during the whole system development process.

3.5.9 Preparing Evaluation Specification System Element

Work Product:	Evaluation Specification System Element
Method Reference:	Test

Purpose

The »Evaluation Specification System Element will be based on the requirements and the interfaces in the »System Specification and the »External Unit specification and the »System Implementation, Integration and Evaluation Concept, respectively the »Enabling System.

From the System or enabling system Implementation, Integration and Evaluation Concept the evaluation strategy for the concrete system element shall be derived so that no unnecessary redundant tests will be performed and that the tests will be well-balanced. The evaluation strategy of the system element will then determine the nature and degree of detailing of the evaluation cases to be defined for the system element. These evaluation cases will be derived from the requirements and interfaces of the System Specification, Hardware Specification, Software Specification, External Unit Specification, External Hardware Module Specification or External Software Module Specification. They will be used to verify that the evaluation object meets the above-mentioned specifications.

For a consistency check the allocation of the evaluation cases to the requirements shall be described, for example in a coverage matrix.

As far as tests are concerned that present an environmental hazard or pose a danger to the persons performing these tests, protective measures shall be defined and considered. This may be for example protective shelters for destructive testing or breathing protection or sound insulation.

A major influence on evaluation strategy and evaluation cases will have the evaluation environment, which shall be explicitly determined at this point.

Activity Flow

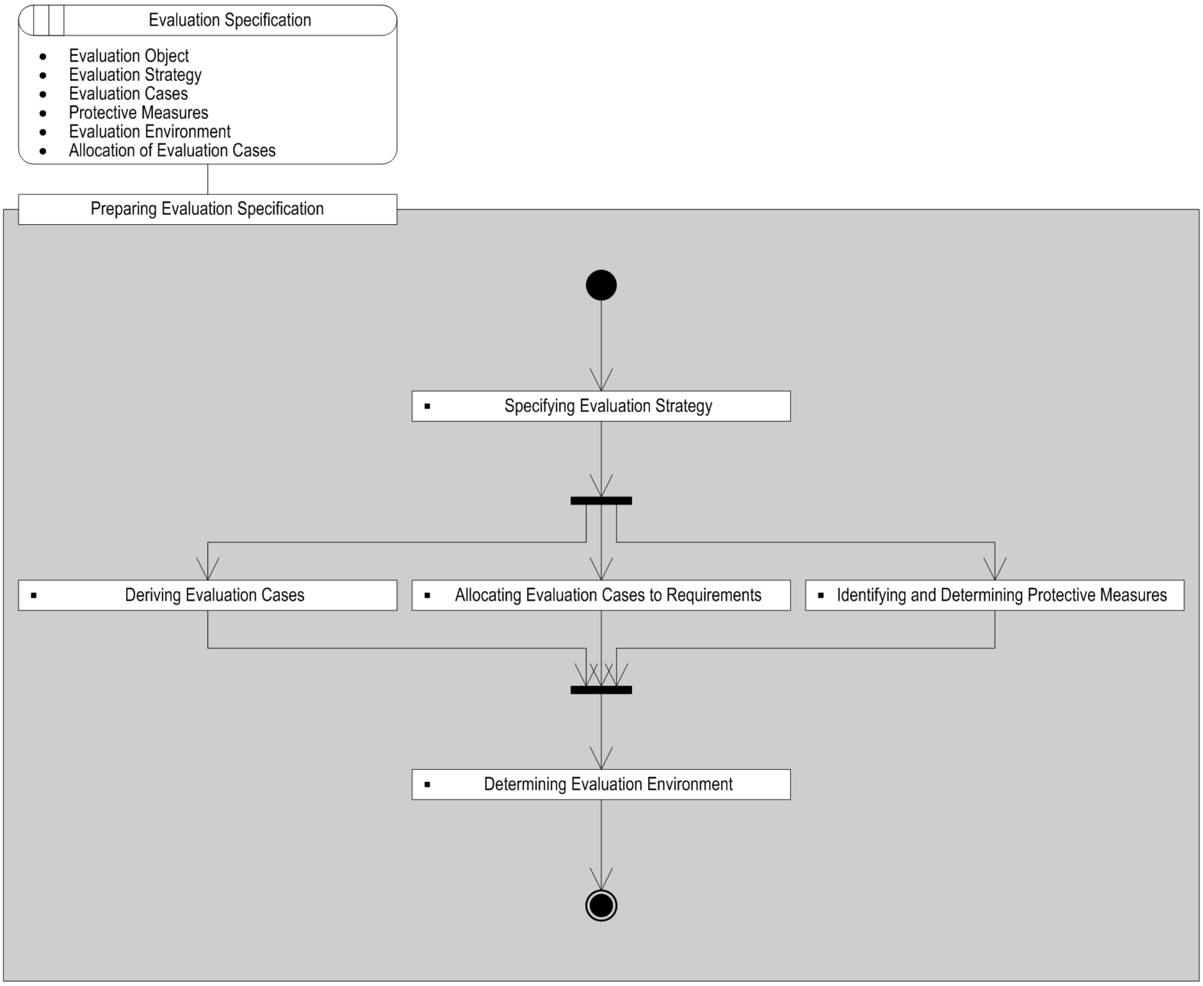

Figure 13: Activity Diagram "Preparing Evaluation Specification System Element"

3.5.9.1 Specifying Evaluation Strategy

Subject: Evaluation Specification System Element: Evaluation Strategy

See Specifying Evaluation Strategy in activity Preparing Evaluation Specification Delivery.

3.5.9.2 Deriving Evaluation Cases

Subjects: Evaluation Specification System Element: Evaluation Cases, Evaluation Specification System Element: Evaluation Strategy

See Deriving Evaluation Cases in activity Preparing Evaluation Specification Usability.

3.5.9.3 Allocating Evaluation Cases to Requirements

Subject: Evaluation Specification System Element: Allocation of Evaluation Cases

See Allocating Evaluation Cases to Requirements in activity Preparing Evaluation Specification Usability.

3.5.9.4 Identifying and Determining Protective Measures

Subject: Evaluation Specification System Element: Protective Measures

See Identifying and Determining Protective Measures in activity Preparing Evaluation Specification Delivery.

3.5.9.5 Determining Evaluation Environment

Subject: Evaluation Specification System Element: Evaluation Environment

See Determining Evaluation Environment in activity Preparing Evaluation Specification Usability.

3.5.10 Realizing Evaluation Procedure System Element

Work Product: Evaluation Procedure System Element

Purpose

This activity will describe the realization of the »Evaluation Procedure System Element that may be for example a System, »Segment, Unit, Component and Process Module Evaluation or Review. The input used by the evaluation procedure will be the »Evaluation Specification System Element. The evaluation cases described in this specification will be implemented as means for verification. The »Evaluation Procedure System Element will mainly be used to stimulate the input for the »System Elements and to check the output.

During the realization emphasis should be placed on the use of known and established test methods and test assets and on the reuse of evaluation procedures. As far as possible, it should be planned to automate the testing to provide a regression capability.

Based on the definition of the evaluation cases, exact work instructions shall be prepared for the »Inspector. If required, actions related to the preparation and the follow-up of the test as well as the individual test steps shall be described together with the interactions of inspector and test facility during the test in a kind of "script".

3.5.11 Evaluating System Element

Work Product: Evaluation Report System Element

Method Reference: Simulation, Test

Purpose

Testing of a system element will consist of several steps. Prior to the actual testing it shall be checked whether the formal requirements have been met so that the contents of the system element can be tested.

While inspecting the system element, it will be necessary to work through the following testability checklist:

- Is the system element to be tested easy to understand, is it designed in a way that it is clear and is it complete?
- Are all products available from which the system element that is to be tested originated?
- Are all requirements for which the system element has to be checked documented, precise and comprehensible?
- Were the applicable guidelines, standards, templates and processes observed?

In case the formal requirements were met, the system element that is to be tested still will have to be verified and validated. The results of these tests will be recorded in the evaluation report.

3.5.11.1 Verifying System Element

See Verifying Usability in activity Evaluating Usability.

3.5.11.2 Validating System Element

See Validating Usability in activity Evaluating Usability.

3.5.12 Preparing Evaluation Specification Delivery

Work Product: Evaluation Specification Delivery

Purpose

Based on the specifications in the »QA Manual, the necessary steps for the receiving inspection shall be specified. If acceptance testing is performed at the manufacturer's location, a receiving inspection will not be required. It will be necessary, however, to determine the desired configuration of the evaluation object.

The evaluation cases shall be derived from the requirements included in the »Contract, and each requirement shall be covered by at least one evaluation case.

3.5.12.1 Specifying Evaluation Strategy

For each system element the evaluation strategy shall be derived from the System Implementation, Evaluation and Integration Concept or from the »Enabling System Implementation, Integration and Evaluation Concept and refined. Subsequently it shall be documented in the »Evaluation Specification System Element.

For each evaluation object listed in the evaluation plan testing requirements shall be established. Provided it is relevant, the connection between test requirements and the requirement documents shall be described.

The evaluation case structure, i. e. the principal setup of each evaluation case, shall be defined.

Furthermore, depending on the defined evaluation strategy, the test method with regard to test types and verification methods shall be described for each evaluation object.

If safety and security must be considered, the test method will be determined on the basis of the safety and security level/method matrix in the »Project Manual and the criticalities defined for the respective functional unit.

3.5.12.2 Deriving Evaluation Cases

See Deriving Evaluation Cases in activity Preparing Evaluation Specification Usability.

3.5.12.3 Allocating Evaluation Cases to Requirements

See Allocating Evaluation Cases to Requirements in activity Preparing Evaluation Specification Usability.

3.5.12.4 Identifying and Determining Protective Measures

Subject: Evaluation Specification Delivery: Protective Measures

For each test of a system element it shall be determined whether a hazard may result from this test. Depending on the hazard, such as danger to persons, objects or property, and on the risks to be expected, protective measures shall be determined, defined and documented. When the protective measures are specified, it shall also be considered which safety-critical and security-critical functions will not be tested but simulated due to the potential hazard.

3.5.12.5 Determining Evaluation Environment

See Determining Evaluation Environment in activity Preparing Evaluation Specification Usability.

3.5.13 Evaluating Delivery

Work Product: Evaluation Report Delivery

Purpose

The »Delivery is accepted. On the basis of the »Evaluation Specification Delivery it shall be subjected to the receiving inspection and the acceptance test.

In the receiving inspection the delivery will be checked for completeness. In the acceptance test the acquirer shall be involved in the testing of the system or the subsystem. In the acceptance test a verification, i. e. the evaluation cases specified in the »Evaluation Specification Delivery, shall be performed. Afterwards the system may be further validated in accordance with the expectations of the users. The deficiencies that occur in this process may be reworked by the supplier on the basis of a courtesy arrangement or they may be negotiated, which may involve a »Change Decision and a »Contract Addendum. The results of the validation, however, will not influence the issuance of the »Statement of Acceptance, as far as this is not governed by special contractual arrangements.

The results of the receiving inspection and of the acceptance test shall be recorded in the »Evaluation Report Delivery. In case the acceptance was not successful, the acceptance test will be performed again after the rework was completed, and the evaluation report will be updated.

3.5.13.1 Verifying (Partial) Delivery

See Verifying Usability in activity Evaluating Usability.

3.5.13.2 Validating (Partial) Delivery

See Validating Usability in activity Evaluating Usability.

3.5.14 Keeping Qualification Record

Work Product: Qualification Record

Purpose

In the »Qualification Record all required qualification data of the products that are part of the overall system shall be collected. The record shall be set up, and all required qualifications shall be named. Finally, in the course of the project all required qualifications shall be obtained.

3.5.14.1 Setting up Qualification Record

Work Product: Qualification Record

The »Qualification Record will be set up within the framework of this activity, using a chart for recording and depicting the required qualifications from the user requirements. All qualifications listed in this chart shall be obtained in the course of the project.

3.5.14.2 Obtaining Qualifications

Work Product:	Qualification Record

All qualifications required in the chart shall be obtained in the course of the project and documented in the form of references to the evaluation reports. In case of qualifications that have to be obtained externally, e. g. by authorizing authorities such as the German Technical Control Association (TÜV) or DEKRA, is shall be taken into account when the schedule is set up that the time required for the test, which - depending on the individual case - may be longer.

3.6 Acquisition and Contracting

This »Discipline summarizes all products and activities prepared during the request for proposal and contracting procedure. For the request for proposal, the following products must be prepared: »RFP Concept, »Request for Proposal, »Criteria Catalog for Assessment of Offers and »Offer Assessment. For contracting, the following products are necessary: »Contract and »Contract Addendum. The »Evaluation Specification Delivery, »Evaluation Report Delivery and »Statement of Acceptance are required for the acceptance. Finally, this discipline includes some »Interface Products, which will be prepared by the contracter and provided to the acquirer, e.g., »Offer (Supplier), »Delivery (Supplier), »Project Status Report (Supplier) and »Final Project Report (Supplier).

3.6.1 Determining RFP Concept

Work Product:	RFP Concept
Method Reference:	RFP Support

Purpose

Since there are many ways to award a contract, a concept shall be selected based on a list of criteria. In this process the following rules will apply to public acquirers and to private enterprises:

Public Acquirers

Applicable rules for awarding contracts, such as »VOL (Conditions Concerning Contracts for Supplies and Services), »VOB (Conditions Concerning Contracts for Public Works), »VOF (Conditions Concerning Contracts for Freelance Services) or »GWB (Act against Restraints of Competition), shall be observed. These will include decision criteria that are already definitely specified. As an example of this approach, the approach from the »UfAB III (a group developing the technical basis for the tendering and evaluation of IT services) may be used. The award procedure will also depend on whether explicit suggested solutions are already available or whether the »Request for Proposal shall be made on the basis of requirements.

Private Enterprises

First a decision shall be made whether there shall be a competitive tender process or whether an internal preselection of potential suppliers shall be made. The criteria for this shall be defined, and there may be possibly guidelines that apply to the entire organization. Possible criteria will be the nature of the procurement (i. e. IT, buildings, services, follow-on order) and the budget.

On the basis of the criteria it shall be substantiated why a particular bidding concept was selected. The criteria, the evaluation and the decision will be recorded in the product »RFP Concept.

The RFP Concept may include a »Distribution List. This will be based on, among other things, a supplier list that will be maintained by the procurer and that will include suppliers that so far have been found satisfactory. This list will be requested by the »Purchaser. For suppliers not included in this list it may be necessary to perform a supplier evaluation.

3.6.2 Preparing Request for Proposal

Work Product:	Request for Proposal
Method Reference:	RFP Support

Purpose

The purpose of this activity is to prepare the »Request for Proposal and to send it to potential suppliers.

The role »RFP-Manager shall plan this task jointly with the »Project Leader so that information with regard to schedule, cost and quality can be included in the request for proposal. At this point, it will thus be absolutely necessary to review the budget that is available for the planned order. In case of public acquirers, the estimated budget will affect the way the contract is awarded. In the public sector the budget that may be stated in an request for proposal will be binding. It will be not possible to withdraw an already published request for proposal due to lack of funding. An example of how an request for proposal will be prepared and what contents will have to be included can be found in the »UfAB III.

The RFP Manager will use the »Requirements Specification - e.g. the »External Unit Specification, the »External Hardware Module Specification or the »External Software Module Specification - and the draft contract to prepare the »Request for Proposal. In this process, all necessary guidelines resulting from the »RFP Concept will have to be observed. In the private sector, company regulations will frequently exist, which specify the contents of request for proposal and contracts. When preparing an request for proposal, the following aspects will have to be considered:

- Requirements on the system to be developed
- Specifications concerning the process, the development environment and the CM and QA measures
- Specifications concerning meetings, reporting and reviews at the acquirer's location
- legal (non disclosure agreement, running contracts), commercial (inquiries for prices, warranty, license) and organizational aspects (points of contact at the supplier's location) that later will become part of the »Contract.

As defined in the »RFP Concept, the complete »Request for Proposal will be mailed or published in the related official gazettes.

3.6.3 Peparing Criteria Catalog for Assessment of Offers

Work Product:	Criteria Catalog for Assessment of Offers
Method Reference:	RFP Support, Evaluation Process

Purpose

In the public sector the »Criteria Catalog for Assessment of Offers shall be prepared at the same time as the »Request for Proposal. After the time the request for proposal was published, it will no longer be permitted to change the criteria catalog. The criteria catalog will be based on the »RFP Concept and the requirements on the system to be developed. From this the evaluation criteria will be derived. Weighting factors and possibly exclusion criteria, so-called knockout criteria, shall be determined. A detailed example of the preparation of a criteria catalog can be found in the »UfAB III.

3.6.4 Assessing and Selecting Offers

Work Product:	Offer Assessment
Method Reference:	RFP Support

Purpose

The incoming »Offers (»Offer (Supplier)) shall be subjected to a test that mostly consists of several stages. At each evaluation stage all offers that are still in the running shall be tested and evaluated one after the other. The results of the test stage shall be recorded.

The test may for example consist of the following stages:

Formal Testing

The offers will be subjected to a formal test. This will include for example checks whether the offers were submitted within the prescribed time and whether the offers address all parts of the »Request for Proposal.

Qualification Test

It will be checked whether the supplier is qualified to carry out the order. Aspects that will be considered in this context are for example size, solvency, competence, capability and reliability. In the competition with selected participants this check will be performed first and used to pre-select the potential suppliers to whom the request for proposal will then be sent.

Cost-Effectiveness Test

The offers will be checked for cost-effectiveness. In this process the aspects concerning the contents shall be checked on the basis of the criteria catalog for the evaluation of the offers and the price-performance ratio shall be determined.

The results of the tests shall to be recorded in the »Offer Assessment. The offers may also be negotiated in retrospect with the bidders. The supplier with the best score will be selected. A detailed example of an evaluation with the associated tests, the contents and the approach can be found in the »UfAB III.

Public acquirers will have to fulfill the specifications linked to the award procedures, in particular key dates, target dates and special regulations with regard to the opening of the offers and the possibilities for renegotiation.

3.6.5 Awarding Contract (Acquirer)

Work Product: Contract

Purpose

The basis for the contract negotiations will be the »Request for Proposal and the »Offer (Supplier) of the potential supplier. The »Contract will be negotiated with that supplier that was selected during the »Offer Assessment. Depending on the RFP Concept, this may lead to changes in requirements or other specifications.

The supplier shall attach to the contract the contract-relevant parts of his project manual and his »QA Manual. Prior to the start of contract negotiations, the budget will be again checked by the commercial department. In case of public acquirers this is not permitted. In the public sector an request for proposal can be stopped at this time only if it is proved that there is a lack of cost-effectiveness. Depending on the »RFP Concept, in the public sector the contract negotiations may be dropped. In this case the contract will be replaced by the request for proposal and the best economic offer.

After successful contract negotiations the contract can be concluded. The procurer, the commercial department the supplier and the »Executive will be involved in the contract conclusion. Usually each company shall meet requirement regarding contract, such as VOL/B, VOB/B, »EVB-IT (Supplementary Contractual Terms for IT Procurement), BVB (Special Contractual Terms) and AGB (General Terms and Conditions). These will have to be taken into account when contracts are drafted.

3.6.6 Awarding Contract Addendum (Acquirer)

Work Product: Contract Addendum

Purpose

If after the conclusion of the contract changes are desired that would go beyond the scope of the contract, for example with regard to the scope of work, a »Contract Addendum may become necessary. This will usually be initiated by the supplier and negotiated with the acquirer. The procedure will be analogous to the approach in the contract negotiations.

3.6.7 Issuing Statement of Acceptance (Acquirer)

Work Product: Statement of Acceptance

Purpose

Each (partial) »Delivery, for which an acceptance statement has to be issued will be checked with an acceptance test (see »Evaluating Delivery). Deficiencies detected in the acceptance test shall be summarized in a deficiency list and evaluated. Depending on the seriousness of the deficiencies, it must be decided whether the acceptance may be only with reservation or whether it may even be refused. This decision and a possible deficiency list will be documented in the »Statement of Acceptance.

Acceptance will be completed when the acceptance statement for the total contract that is provided after the last delivery bears the signature of the acquirer.

3.7 Requirements and Analyses

The »Discipline Requirements and Analyses comprises all »Work Products and »Activityies which specifiy the user requirements based on a project proposal (prestudy) and the contract.

In addition, this discipline includes analyses of specific system aspects, e.g., a »Legacy System Analysis as basis for the migration of a system, a market survey for the use of off-the-shelf products, or an »User Tasks Analysis for describing ergonomic aspects. The documentation of the contract award decision (make-or-buy) for a system element and the market survey as basis for decision-making are also included in this discipline.

3.7.1 Determining Requirements Overall Project

Work Product:	Requirements Specification Overall Project

Purpose

The aim of the activity will be to specify the requirements and an outline of the acquirer's overall system design in such a way that the overall project can be subdivided into sub-projects. This activity will also create the preconditions for the traceability of user requirements over the whole life cycle of a system.

In an iterative process, user requirements shall be continuously refined and improved until their quality and detail will be sufficient for a subdivision of the overall project into sub-projects. This will be done by making analyses, setting priorities, making evaluations and establishing a quality assurance process for all user requirements. After checking the user requirements with regard to their feasibility, cost-effectiveness and affordability, the overall project can be subdivided into sub-projects, which can be realized independently.

When defining the the Requirements Specification Overall Project, the initial situation and the objective shall be described at first. This is followed by the preparation of the functional and non-functional requirements. At the same time, an »Outline of the Life Cycle and the Overall System Architecture shall be prepared. The Outline of the Overall System Architecture is the most important foundation fo the subdivision of the overall project into sub-projects.

The process of defining the requirements will end with the analysis of the quality of the requirements and the preparation of the scope of delivery and the acceptance criteria.

3.7.1.1 Describing Initial Situation and Objectives

Subject:	Requirements Specification Overall Project: Initial Situation and Objectives

See Describing Initial Situation and Objectives in activity Determining Requirements.

3.7.1.2 Specifying Functional Requirements

Subject: Overall System Specification: Functional Requirements

See Specifying Functional Requirements in activity Determining Requirements.

3.7.1.3 Specifying Non-Functional Requirements

Subject: Requirements Specification: Non-Functional Requirements

See Specifying Non-Functional Requirements in activity Determining Requirements.

3.7.1.4 Preparing Outline of System Life Cycle and Overall System Architecture

Subject: Requirements Specification Overall Project: Outline of the Life Cycle and the Overall System Architecture

See Preparing Outline of System Life Cycle and Overall System Architecture in activity Determining Requirements.

3.7.1.5 Determining Risk Acceptance and Safety and Security Levels

Subject: Requirements Specification: Safety and Security Relevant Requirements, Risk Acceptance and Safety and Security Levels

See Determining Risk Acceptance in activity Determining Requirements.

3.7.1.6 Determining Sub-Projects

Subject: Project Manual: Sub-Projects

The individual elements of the overall system architecture shall be analyzed in order to determine if the overall project can be subdivided into sub-projects which will be executed independently. If the project cannot be subdivided into completely "autonomous" sub-projects, the interdependences between the sub-projects shall be described. These interdependences can be described based on technical interfaces, delivery items, schedules and resources.

Afterwards, the functional and non-functional requirements posed on the overall project shall be assigned to the respective sub-projects.

A specific sub-project Integration must be defined in order to integrate the sub-projects to be realized.

3.7.1.7 Analyzing Quality of Requirements

Subjects:	Requirements Specification: Outline of the Life Cycle and the Overall System Architecture, Overall System Specification: Acceptance Criteria, Overall System Specification: Functional Requirements, Overall System Specification: Non-Functional Requirements

See Analyzing Quality of Requirements in activity Determining Requirements.

3.7.1.8 Specifying Scope of Delivery and Acceptance Criteria

Subjects:	Requirements Specification Overall Project: Scope of Delivery Overall Project, Overall System Specification: Acceptance Criteria

See Specifying Scope of Delivery and Acceptance Criteria in activity Determining Requirements.

3.7.2 Preparing Overall Project Requirements Evaluation

Work Product:	Evaluation of the Overall Project Requirements Specification

Purpose

The aim of the activity Preparing Overall Project Requirements Evaluation is that the acquirer checks and evaluates the user requirements that are available by that time in a way that the possible realization risk becomes as transparent and manageable as possible for him. This task can be performed successfully only if all stakeholders are involved in this process.

The acquirer will check the functional and non-functional requirements that will be available by that time for their technical feasibility, affordability, cost-effectiveness and importance. This is the task of the acquirer.

This approach will be characterized by the fact that the evaluation criteria for the evaluation of the requirements will be at first established, prioritized and evaluated. Finally, the evaluated requirements shall be integrated into the project

3.7.2.1 Specifying Evaluation Criteria

Subject:	Evaluation of the Overall Project Requirements Specification: Evaluation Criteria Overall Project

For the activity »Preparing Overall Project Requirements Evaluation, it will be important that all stakeholders know at the outset according to which evaluation criteria the requirements will be tested.

Evaluation criteria shall be defined and prioritized in order to be able to negotiate the functional (use cases) and the non-functional requirements in a transparent and rational way.

As far as possible the »Requirements Engineer (Acquirer) may already make a suggestion for the assignment of the respective relevant evaluation criteria to the functional requirements/use cases and the corresponding non-functional requirements.

In a (standardized) evaluation catalog, the following evaluation criteria should be observed in any case:

1. Accomplishment of tasks and missions
2. Compliance with statutory obligations
3. Compliance with standardization and harmonization requirements
4. Benefits (possible types of benefits may be gained for example in the public sector in the field of IT cost effectiveness considerations)
5. Cost-effectiveness, costs (subdivision into cost categories)
6. Realization risks
7. Technical feasibility within the specified timeframe
8. Availability of and demand for budget funds
9. Framework conditions and requirements, e. g. political guidelines, standards, infrastructure requirements
10. Possibility of saving by using off-the-shelf products
11. Target dates, schedules
12. Quality aspects, performance aspects
13. Safety and security aspects

In order to be able to achieve relevant statements, the use of weighted evaluation procedures - e.g. WSM (weighted scoring model) or AHP (analytic hierarchy process) - may be useful, particularly for the »Evaluation of Off-the-Shelf Products. However, it should always be taken into account that the formal framework does not lead to a disproportionate effort and that its methodology does not anticipate or prefer specific results.

The evaluation criteria shall be archived in suitable form so that their reuse will be possible.

3.7.2.2 Evaluating Requirements

Subject: Evaluation of the Overall Project Requirements Specification: Evaluation Results Overall Project

The requirements shall be evaluated on the basis of the »Evaluation Criteria Overall Project. Together with the developers of the user requirements and supported by experts for system architecture and system design, the »Requirements Engineer (Acquirer) will perform the following work steps:

Analysis of Operational Necessity

The stakeholders will review the operational necessity of individual requirements. Both the non-functional and the functional requirements shall be reviewed. The result of the review will be candidates for requirements that are not classified operational.

How relevant the requirements are shall be discussed in each case by the stakeholders. In this process risks and safety and security aspects of the individual requirements shall be weighed, roughly estimated and possibly reclassified with regard to their importance. It may also be necessary to check to what extent individual requirements can be dropped by merging them with others.

Should there be no agreement on the necessity of individual requirements when evaluating the various requirements, the »Requirements Engineer (Acquirer) shall prepare a proposal for the decision makers.

Analysis of Technical Feasibility

If the »Decision Gate »Requirements Specified has been completed, the requirements shall be checked for their technical feasibility. When doing this, it is recommended to fall back on possible approximate technical solutions for the realization of the functional and non-functional requirements. The result will be documented in the »Outline of the Life Cycle and the Overall System Architecture. Should the acquirer be unable to perform this task, the »Requirements Engineer (Acquirer) shall take care that an »Outline of the Life Cycle and the Overall System Architecture will be prepared by experts. This outline ("approximate system architecture"), where the requirements will be already assigned to the respective elements of the architecture, will form a valuable basis for describing possibilities for technical solutions.

The requirement of ensuring economic efficiency and estimable use of resources for the solution to be prepared necessitates a rough analysis regarding the use of off-the-shelf products. Practice shows that Acquirers increasingly have and develop technical knowhow and competence for developing solutions. In many cases, this capability is already required of the Acquirer (particularly in case of IT organizational units). A »Market Survey for Off-the-Shelf Products provides the necessary database. The further proceedings in the project may be determined by using the defined (prioritized) evaluation procedures. This corresponds to a qualified »Make-or-Buy Decision.

All results of the technical feasibility studies shall be unambiguously related to the functional and non-functional requirements. It will be especially important that at this point a possible use of off-the-shelf products will be already evaluated. T

Checking Cost-effectiveness and Affordability of the Requirements

Within the scope of the activity »Preparing Requirements Evaluation, considerations regarding the cost-effectiveness shall be made. They are to provide an answer to the question whether a cost-effective realization of the requirements will be possible and whether meeting individual requirements will be profitable in the sense of that the benefits will exceed the costs. When the cost-effectiveness considerations are made, attention should be paid to the following aspects:

- The requirements and their resulting costs shall be made so transparent that the decisions made can be traced by the responsible decision makers of the project.
- Should it be not possible to quantify the cost estimates, at least an order of priority of the possible costs for the individual requirements shall be established.
- The users should once more seize the opportunity to look critically at the "value" of individual functional and non-functional requirements of the planned IT system.
- Should it not be possible to express the benefits in monetary units (for example replacement of the old process with cost savings), qualitative aspects of the benefits should be used (for this purpose in the public sector IT cost effectiveness considerations may be used). If the benefits are not quantifiable, the following aspects should be considered:
    - a possible increase in performance when carrying out tasks and acceleration of work flows and processes
    - the possibility to provide information to decision makers and the controlling staff by supporting the decision and/or command and control process
    - the urgency of a replacement and the lack of flexibility of the legacy system will be highlighted for example by a high error rate, failures, system crashes, maintenance problems, manpower shortages, too narrow limits concerning development or expansion, interface problems and lack of user-friendliness.
    - the stipulated compliance with statutory requirements, e. g. by meeting data protection/data security requirements and orderly work flows according to internal standards.

3.7.2.3 Integrating Evaluation Results

Subject:	Evaluation of the Overall Project Requirements Specification: Evaluation Results Overall Project

The acquirer shall document the results of the user requirements evaluation in the product Evaluation of the Overall Project Requirements Specification and make them accessible to all roles participating in the evaluation process.

Afterwards, the affected requirements shall be changed or amended in order to integrate the Evaluation Results Overall Project into the Overall Project Requirements Evaluation.

The Requirements Engineer (Acquirer) shall ensure that the results achieved in the evaluation process are traceable also for persons not participating in the activity Peparing Overall Project Requirements Evaluation.

The resulting consequences for the project may be assessed differently. According to one possibility, the results on the preliminary system architecture and off-the-shelf products will not be integrated into the request for proposals since the acquirer expects innovative and cost-effective solutions from the industry.

According to another possibility, the results may be used for defining the scope of delivery and the future development of the RFP concept.

3.7.3 Determining Requirements

Work Product:	Requirements Specification
Method Reference:	Requirements Analysis, Business Process Modeling
Tool reference:	Requirements Management

Purpose

The aim of the activity will be to determine the requirements of the user in a way that they will be the basis for the request for proposal, the placing of orders, the design, the acceptance and the changes of the system. This activity will also create the preconditions for the traceability of user requirements over the whole life cycle of a system.

In an iterative process user requirements shall be continuously refined and improved until their quality and detail will be sufficient for external or internal placing of orders. This will be done by making analyses, setting priorities, making evaluations and establishing a quality assurance process for all user requirements. After checking the user requirements with regard to their feasibility, cost-effectiveness and affordability, they will be sufficiently mature to be an object of an request for proposal.

When defining the requirements, at first the initial situation and the objective shall be described. This is followed by the preparation of the functional and non-functional requirements. At the same time an »Outline of the Life Cycle and the Overall System Architecture shall be prepared. The process of defining the requirements will end with the analysis of the quality of the requirements and the preparation of the scope of delivery and the acceptance criteria (see Figure 14).

Activity Flow

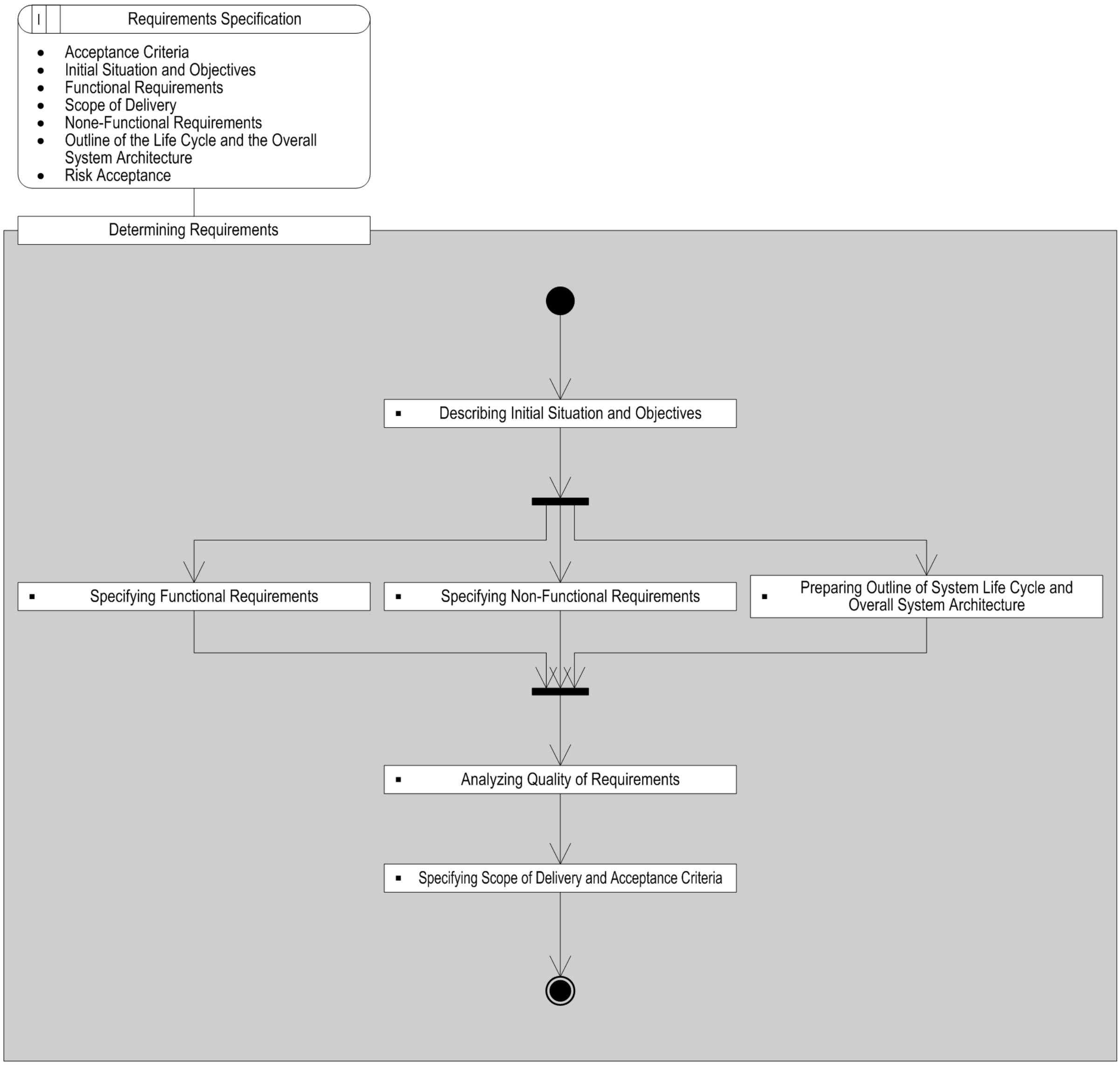

Figure 14: Activity "Determining Requriements"

3.7.3.1 Describing Initial Situation and Objectives

Subject: Requirements Specification: Initial Situation and Objectives

The initial situation shall be described by the acquirer. On the side of the supplier the functionalities of the system, the system boundaries and the system environment, the external interfaces, safety and security requirements, other important requirements and assumptions and ideas concerning the characteristics of the system shall be specified over the whole life cycle. For this purpose all available documents shall be registered, screened and condensed to the main statements in a form that is clearly arranged. From the participants ("stakeholders") possibly background information shall be obtained, which may better illustrate the topic even to an outsider.

3.7.3.2 Specifying Functional Requirements

Subject: Requirements Specification: Functional Requirements

For the preparation of the topic »Functional Requirements business processes have to be analyzed, functional requirements have to be recorded and described, and the requirements have to be depicted in the form of use cases. In the following these activities will be described.

Analysis of Supported Business Processes

For an analysis of the business processes it is recommended to classify the requirements. Thus for example a distinction can be made between the application system, the business processes, the utilization system or the individual work processes.

In a top-down approach - starting with overarching management processes - the individual business processes shall be defined and described in a way that it can be seen which of these processes are to be supported by the new system. The business processes shall be described as comprehensively as possible in order to permit an integration of the system into the existing corporate organizational procedures, even if the system supports only parts of the processes. The business processes shall be analyzed, and a decision shall be made whether optimizations are required. If possible, these optimizations shall be initiated and completed prior to the start of the project so that they can be used as a basis for the analysis and specification of the functional requirements. The business processes to be supported will be determined in the following steps:

1. At first the actual system shall be analyzed. This step is optional and should be performed in particular if the functions of the system to be generated (e. g. of a system that is yet to be developed) are known only partly or not at all or if parts of an existing system are to be adopted when generating the system. This will apply also to systems that are yet to be developed and whose development is outsourced. As early as during the analysis descriptions of the setup, the structure and of the interfaces of the system and the environment shall be provided.

2. Furthermore, an analysis of the field or domain of application shall be made. This model will be used for the communication between acquirer, supplier and user. It may be used in other projects as a reference model for planning systems in the same field of application.

3. Finally desired process flows shall be defined. This will be done on the basis of the current state analysis. In this step it first shall be examined what events of the system to be generated influence the business processes considered (by the current state analysis) and how they influence the system. Also the business processes shall be broken down into work processes and coordinated with the persons concerned. They shall be newly specified and documented. Subsequently it shall be evaluated which of the specified desired processes have to be adopted in the system to be generated and what changes to existing parts of the system may be necessary. Furthermore, it shall be evaluated which work processes in the existing system may be changed by the new system.

Recording and Describing the Functional Requirements in Text Form

After preliminary checks the functional requirements will be recorded and described in text form. In the first step the problem area shall be processed and the recording of the requirements shall be prepared organizationally and technically, e. g. by

- analyzing system documents and market studies;
- tracing specific knowledge within the business division;
- preparing and testing questionnaires;
- informing the participants about the tools to be used, such as for example
    - a template for the description of the requirements in text form;
    - a format for the short description of a requirement in one sentence with typical examples;
    - the quality criteria that are to be used for requirements (quality attributes according to ISO standard 9126) and
    - a style guide for the formulation of requirements.

For determining the requirements there is no standard technique that is suitable for all requirements in a project. When selecting the technique for determining the requirements, in particular the degree of detail of the requirements will play a role. The following techniques have proven their worth for requirements:

- **Creativity techniques** are suitable for collecting initial ideas and providing an initial general account of the system to be developed. Examples of these techniques are brainstorming, the Metaplan technique, mind mapping, structured workshops or problem-solving meetings.
- **Observation techniques** are suitable for determining both requirements at a very detailed level and subconscious requirements. Examples of these techniques are field observation and apprenticing.
- **Interview techniques** with questionnaires, interviews, notes put down by the interviewed persons themselves and on-site acquirers are suitable for determining requirements of any degree of detail.
- **History-oriented** techniques are suitable for integrating existing solutions into a new system. They make it possible to reuse lessons learned from system developments that have already been successfully completed.

When collecting requirements in text form, the previously defined features/attributes for each requirement also have to be recorded. Alternatively, they may be described using graphical notations.

One problem that occurs when making this description are implicit assumptions by the users and also by the people who are in charge of the realization. These problems occur because some stakeholders consider facts, which are, however, not known to others, to be obvious and not worth mentioning. Those implicit assumptions have to be worked out and pointed out together with the users, because they frequently include important requirements.

Specifying Functional Requirements in the Form of Use Cases

The requirements that were determined finally will have to be written down in the form of use cases. This will be done in three steps. At first use cases shall be defined. Then scenarios shall be developed, and finally use cases shall be described.

On the basis of the preliminary work, the »Requirements Engineer (Acquirer) and the users have to define the possible use cases ("scenarios"). The definition of the use cases may be based on the previously described process descriptions.

For required coordination processes between the stakeholders scenarios have to be specified. Scenarios describe a system from the perspective of possible utilization situations. The scenarios for the future system and its operation shall be developed and documented in joint meetings. On the basis of the submitted scenarios, also an understanding of the interests, demands and expectations of the individual stakeholders that is common to the different groups shall be developed. These scenarios will then be the basic material for descriptions in the form of use cases. In the process also agreement should be reached on the definition of a template for the description of the use case (for example possible task-specific additions to the "standard template").

Subsequently the functional requirements for the planned IT system shall be described for the identified use cases ("scenarios"). For this purpose a uniform use case template shall be developed that specifies the main elements of the use case templates, such as the primary and secondary actors, the sequence of actions of the use case or the prerequisites for the start.

3.7.3.3 Specifying Non-Functional Requirements

Subject: Requirements Specification: Non-Functional Requirements

When specifying the requirements, the specified framework conditions and requirements for the system properties and the safety and security shall be recorded, and the process conditions shallbe specified. In case of non-functional requirements the description may be mostly made in text form. However, the requirements should be measurable, testable and decidable. The various categories will be described in the topic »Non-Functional Requirements.

Recording of the Specified Framework Conditions

Specified framework conditions shall be determined already at the beginning of the recording of all non-functional requirements, since they will affect the contents of all other requirements. When doing this, it will be possible to fall back on the results of the topic »General Conditions and Constraints.

Recording of the Requirements for the System Properties

The recording of the requirements for the system properties should follow the recording of the specified framework conditions. For this purpose for example the FURPS pattern

- Functionality,
- Usability,
- Reliability,
- Performance,
- Supportability,

may be used. As far as it is possible at this time, the quality requirements for the system shall be recorded concurrently with the functional requirements when describing the use cases. The individual components of the FURPS pattern may be characterized as follows:

- To describe the functionality, the requirements for the suitability of the functions, the accuracy of the calculations, the interoperability and the safety and security of the individual functions shall be established. For example:
  - in a spelling check, at least 98 percent of all cases shall be covered;
  - all sums of money shall be calculated to 2 decimal places; numbers shall be rounded commercially.
- To describe the usability, requirements for learnability, utility of operation, intelligibility (e. g. the handling of the help function) and for the interfaces (Look and Feel) shall be established. For example:
  - desired learning effort;
  - statements concerning the expected time future users will require for learning;
  - instructions and training requirements.

  - When the average user uses the system, the error rate must be less than 2 percent.

- To describe reliability, requirements for fault tolerance and the ability to recover shall be established, such as maximum times for re-establishing operational readiness after failures.

- To describe efficiency, requirements for times, for the throughput, for the prospective quantities, for the availability and for the maximum load requirements. For example:

  - reaction times (from this event... to the reaction);

  - repetition factors (inputs are provided in intervals of 10 seconds, the system has to handle this quantity);

  - data storage (the storage of up to x MB should not take longer than y seconds);

  - utilization (between 9 a. m. and 5 p. m. the system must be capable of supporting 300 users at the same time);

  - expectations of the acquirer with regard to the operational capability of the system or product.

- To describe supportability, requirements shall be established with regard to the resources required for maintenance and changes, release cycles, portability and to the growth potential and scalability of the system. For example:

  - maintenance must not affect the end user;

  - the effort required for certain changes, e. g. the installation of a new upgrade, must not exceed xx man days;

  - the frequency of changes must not exceed a defined rate per defined unit of time;

  - new releases should be offered to the user only n times per unit of time.

Determining the Process Conditions for the System

The determination of the process conditions will affect in particular the requirements for the creation phase, for operations and maintenance and for logistics.

- The acquirer will determine for example which development method (e.g. the incremental method) shallbe used, what technical standards or other regulations have to be complied with, how quality assurance shall be performed at the locations of all stakeholders or what partner commitments shall be taken into account.

- For the acceptance of the system, the requirements with regard to the processes to be performed, the responsibilities, the stakeholders and the approach shall be established.

- For the introduction phase of the system the requirements shall be specified with regard to how the new system or its configuration levels have to be installed at the locations of the acquirer and the users, considering in particular the requirements for the replacement of a legacy system (e. g. parallel operation). When defining the requirements for the introduction of the system, the technical and organizational framework conditions shall be considered, in particular if it is planned to distribute the system components among different locations.

- It will be primarily necessary to place demands on the qualification of the operating and maintenance personnel and to formulate requirements concerning the sustainability of an effective configuration management. Possibly, a concept for an efficient software maintenance and modification system or the realization of a long-term maintenance and operating concept must be demanded from the supplier.

- It will be necessary to define the demands that are placed on the logistic elements during the realization and in particular during the in-service phase. For this purpose requirements shall be established with regard to training, service use, maintenance, repair, sparing, and the logistic support structure.

3.7.3.4 Determining Risk Acceptance

Subject: Requirements Specification: Safety and Security Relevant Requirements, Risk Acceptance and Safety and Security Levels

The decision whether to accept risks when using a system that is to be developed will be made by the acquirer or by future users of the system. The aim of this subactivity will therefore be to determine the acceptance of the risks incurred when using the system that is to be developed and to specify the safety and security levels of the requirements from the point of view of the acquirer. This will define a guideline for the realization of the system and influence the risk reduction measures to be taken and, beyond that, also the costs entailed by these measures. The following steps shall be performed to determine acceptance:

- determining possible hazards;

- identifying the potential occurrences of damage associated with them;

- considering in which damage categories (such as personal injuries, material damage, property damage, environmental damage, damage to the reputation, product failures) the occurrences of damage can be placed;

- determining suitable damage classes;

- classifying possible damage and allocating it to the damage classes;

- assessing the probabilities of the occurrence of damage (e. g. frequent, probable, occasional, unlikely, unthinkable) as well as the impact/level of damage;
- assessing the risks (probability of occurrence times damage level) and defining risk classes;
- evaluating the risks (intolerable, tolerable with limitations).

From these elements the corresponding risk acceptance values shall be determined (threshold levels or risk acceptance matrix).

The safety and security levels for all requirements shall be determined and specified based on the requirements including safety and security requirements and the outline of the overall system architecture. For the execution of the project it shall be determined what safety and security standard to apply and what safety and security level is desired, which then will regulate the details (possible or required risk reduction measures).

An example of possible (not standardized) damage categories (personal injuries, material damage, property damage etc.), damage classes (catastrophic, critical, marginal etc.) and safety and security levels can be found in the following figure (cf. »DIN EN IEC 61508).

Personal Injuries	Material Damage, Property Damage, Economical Loss	Enviroment	Reputation	Failure to Perfom the Task, Loss of Production in percent	Safety and Security Level, Damage Class
Multiple Casualties	Very heavy damage	Massive impact	International impact	>30	Catastrophic
A few Casualties or multiple seriously injured People	Heavy damage	Large impact	National impact	>10	Critical
A few seriously injured people or multiple lightly injured people	Medium damage	Slight impact	Limited impact	5<10	Marginal
At the most lightly injured People	Slight damage	Slight local impact	Slight local impact	1<5	Negligible
No Injuries	No damage	No impact	No impact	0<1	Not Relevant

Figure 15: Example of Possible Damage Categories, Damage Classes, Safety and Security Levels

The frequencies shall be quantified as a function of the environment.

The following »Risk Class (A-D) may be used (cf. »DIN EN IEC 61508):

Risk classes	Meaning
A	Intolerable
B	Undesirable and only allowed, if a risk minimisation is not feasible or the costs outweigh the damages
C	Tolerable with safety review
D	Tolerable with normal project review

Figure 16: Examples of risk classes

With the aid of risk classes the evaluation of risks as tolerable and intolerable is documented within the risk acceptance matrix (cf. »DIN EN IEC 61508):

		Impact			
		catastrophic	critical	marginal	insignificant
Occurence	often	A	A	A	B
	probable	A	A	B	C
	occasional	B	B	C	C
	improbable	C	C	D	D
	unthinkable	C	D	D	D

Figure 17: Example of a risk acceptance matirx

The occurences are to be quantified according to environmental conditions.

3.7.3.5 Preparing Outline of System Life Cycle and Overall System Architecture

Subject: Requirements Specification: Outline of the Life Cycle and the Overall System Architecture

When preparing the »Outline of the Life Cycle and the Overall System Architecture, initial conceptions concerning a preliminary architecture and the operating environment shall be developed, looking at the preliminary architecture primarily from a functional point of view. The decomposition of the preliminary architecture should be selected in accordance with the degree of detail of the requirements. The architecture should already offer initial suggestions for solutions to the development of logistic concepts, of the system and of the required »Enabling System s during the life cycle, dealing with operations, maintenance and repair of the system and disposal.

The Outline of the Overall System Architecture is an important foundation for suvditiding an overall project into several sub-projects which can be realized independently.

After »Evaluating Requirements, the requirement fields that are suitable in accordance with the Market Survey and »Evaluation of Off-the-Shelf Products, will be identified as potential sub-projects.

3.7.3.6 Analyzing Quality of Requirements

Subjects: Requirements Specification: Non-Functional Requirements, Requirements Specification: Outline of the Life Cycle and the Overall System Architecture, Overall System Specification: Acceptance Criteria, Overall System Specification: Functional Requirements

The analysis of the quality of requirements will make it necessary to define the criteria for quality, to check the quality of the project specification and to correct deficiencies of requirements.

Definition of the Quality Criteria

At first quality criteria shall be defined and imparted to all stakeholders as early as possible. At the latest at this point the quality criteria should be determined to check the »Requirements Specified. The criteria that are necessary for the project should be selected from the following quality criteria for requirements:

- Unambiguity (Does each requirement permit only a single interpretation?)
- Completeness (Have all necessary functions been taken into account?)
- Checkability (Is it possible to check that the requirements are met?)
- Consistency (Are the requirements conflicting?)
- Intelligibility (Is the requirement intelligible to all stakeholders?)
- Origin (Is the origin/justification of the requirement clearly described?)
- Flexibility and correlations (Is it possible to change the requirement without affecting other requirements?)
- Traceability (Can each requirement be unambiguously identified?)

- Abstractability (Is the requirement independent of the implementation?)
- Classificability with regard to importance (Are there risks with regard to the feasibility and stability of the requirement in the whole life cycle?)
- Suitability (Do the defined system functions correspond to the wishes and needs of the user?)

Quality Check of the Requirements (Project Specification)

The design of the product »Requirements Specification or »Requirements Specification Overall Project, in particular the individual use cases included in these requirements, and the non-functional requirements, shall be checked on the basis of the defined quality criteria. During the quality check in particular the completeness criterion will require a pragmatic approach. This will be done by evaluating

- whether all categories of the non-functional requirements were dealt with;
- whether all functions that were listed as necessary are described in full;
- whether all users/stakeholders were included or
- whether the document still includes notices saying "yet to be accomplished".

Checking the traceability of requirements will be of paramount importance. This has to be assured during the whole duration of the project and, beyond that, over the whole life cycle of a IT system, i. e. both forwards and backwards. In this context "Backwards" means: Where does which requirement come from (what is its origin)? "Forwards" means: Where, when and by whom has which requirement been developed or implemented? Attention should be paid that questions concerning the verification of the implementation of the requirement can be answered, such as: How was a requirement implemented? And by whom and when was which requirement changed?

When preparing requirements, attributes shall be introduced that ensure that decisions will be documented so that they can be reconstructed and that it can also be reconstructed that "legal" requirements have been met (e. g. verification of compliance with the duty of care or that appropriate reviews were conducted with the presentation of their results). Recording traceability may require a major effort. Therefore it shall be checked whether it was determined what information are recorded and how the traceability data will be structured and stored. For this purpose the use of a tool may be considered.

The results of the quality check will be finally documented in a list that includes deficiencies and findings.

- Defining quality criteria for the validation of requirement

- Using the specified quality criteria to check the requirement
- Documenting of the deficiencies found

Eliminating the Deficiencies and Processing for the Evaluation of the User Requirements

Before it will be possible to finish the requirements document, the requirements have to be processed and assessed and deficiencies have to be eliminated. The deficiencies found, such as contradictions, redundancies, incompletions and uncertainties, have to be eliminated together with the stakeholders in talks or workshops. In case of conflicts an authorized person shall bring about a decision. This will have be recorded in a protocol.

- In case it is found that not all possible patterns of behavior of the system are specified in the requirement or that the conditions contradict each other, the requirement shall be corrected and completed.
- The same applies also if the logical structure of a requirement is incomplete or inconsistent.
- The requirements shall be revised with regard to style, e. g. by making improvements concerning generalizations, omissions, exaggerations, lack of clarity etc.

For extensive requirements it is recommended to perform additional interim tests or reviews already at the time when the requirements are being prepared.

If as late as in the quality assurance process terms emerge that are understood differently by the users, the prepared glossary shall be updated.

In accordance with the decisions concerning the elimination of the deficiencies, which are documented in the deficiency catalog in the list that contains the findings, the requirements and the glossary will be revised.

After the elimination of the deficiencies that were found, a final check shall be made of the requirements document, which then shall be prepared for the assessment of the requirements. In this process the data that are important to requirements controlling shall be processed in a way that they are clearly arranged, traceable and measurable, and that they are available to all stakeholders.

3.7.3.7 Specifying Scope of Delivery and Acceptance Criteria

Subjects:	Requirements Specification: Acceptance Criteria, Requirements Specification: Scope of Delivery

In order to determine the »Scope of Delivery or the »Scope of Delivery Overall Project, all already defined products and services from the »Project Manual, which shall be delivered by the supplier to the acquirer in the course of the project of after the acceptance of the system (or of parts of the system), shall be included. For each »Delivery the following information shall be provided:

- short designation (or other unambiguous identifier);
- number or quantity;
- suppliers and
- place of delivery and recipient.

Because of the scheduling of the deliveries, the results of the »Project Manual shall be considered. When determining the scope of delivery, the impact of the selected shall be taken into account.

Acceptance criteria will be the binding foundation of the integration and test phase for future acceptance. For the functional requirements, for example, they shall be divided into the components initial situation, action and expected result, and they shall be described. From the point of view of the overall project, advancing this task into the definition phase of the requirements will not mean any additional effort.

For determining the acceptance criteria an appropriate selection, preparation, documentation and checking of the acceptance criteria will be required.

In this context it has paid off to derive early evaluation cases from the functional requirements/quality criteria. Thus it will be possible to achieve a high degree of completeness and consistency of the requirements and acceptance criteria.

Selecting Requirements Categories for the Acceptance Criteria

The following requirements categories will for example be suitable for the preparation of acceptance criteria and should be used for this purpose:

- Quality requirements
- System realization requirements
- Logistics requirements
- Requirements concerning the acceptance procedure
- Requirements concerning service and operations (maintenance and change services)
- Safety and security requirements
- Requirements based on existing framework conditions

- Requirements for the introduction of the system

In each case the acceptance criteria must make it possible to check the main functions. It has to be determined

- how the selected requirements shall be checked (e. g. by using documents, analysis, demonstrators or test or only "implicitly") and
- which parts of the system (e. g. overall system and/or individual components) shall be tested.

Developing Acceptance Criteria

For each selected requirement the acceptance criteria shall be developed in the following steps.

- Determining acceptance criteria on the basis of use cases. It must be possible to check all cases of system behavior specified in one use case with the acceptance criteria for a requirement. The number of the required acceptance criteria will therefore depend on the logical structure of the conditions of the use case:
    - For a requirement that does not include any conditions, in general only a single acceptance criterion will be necessary. If the requirement includes a single condition (i. e. the requirement has the form "If the condition exists, then action 1, otherwise action 2"), at least for both cases an acceptance criterion will have to be developed. When doing this, care should be taken that the case, in which the condition is not fulfilled ("otherwise"), is stated in the requirement. If this case is missing, the requirement should be first clarified and completed (see below).
    - If the requirement interlocks or connects several conditions with each other, the number of the necessary acceptance criteria may be determined with the help of a decision table.

3.7.4 Preparing Requirements Evaluation

Work Product:	Requirements Evaluation
Method Reference:	Evaluation Process

Purpose

The aim of the activity »Preparing Requirements Evaluation is that the acquirer checks and evaluates the user requirements that are available by that time in a way that the possible realization risk becomes as transparent and manageable as possible for him. This task can be performed successfully only if all stakeholders are involved in this process.

The functional and non-functional requirements that will be available by that time will be checked by the acquirer for their technical feasibility, affordability, cost-effectiveness and importance. This task shall be performed by the acquirer.

This approach will be characterized by the fact that the evaluation criteria for the evaluation of the requirements will be at first established, prioritized and evaluated. Finally the evaluated requirements shall be integrated into the project (see Figure 18).

Activity Flow

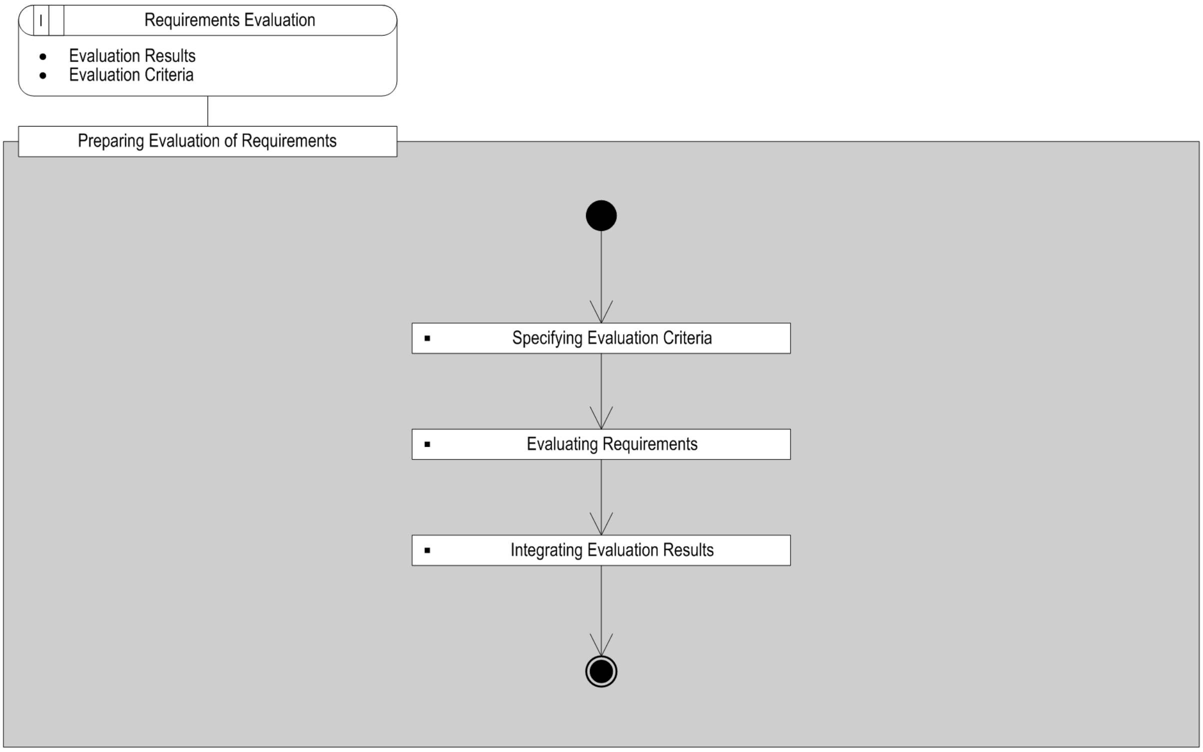

Figure 18: Activity Diagram "Preparing Requirements Evaluation"

3.7.4.1 Specifying Evaluation Criteria

Subject: Requirements Evaluation: Evaluation Criteria

For the activity »Preparing Requirements Evaluation it will be important that all stakeholders know at the outset according to which evaluation criteria the requirements will be tested.

In order to be able to negotiate the functional (use cases) and the non-functional requirements in a transparent and rational way, evaluation criteria shall be defined.

As far as possible the »Requirements Engineer (Acquirer) may already make a suggestion for the assignment of the respective relevant evaluation criteria to the functional requirements/use cases and the corresponding non-functional requirements.

In a (standardized) evaluation catalog in any case the following evaluation criteria should be observed, and the criteria should be sorted according to their importance:

1. Accomplishment of tasks and missions

2. Compliance with statutory obligations
3. Compliance with standardization and harmonization requirements
4. Benefits (possible types of benefits may be gained for example in the public sector in the field of IT cost effectiveness considerations)
5. Cost-effectiveness, costs (subdivision into cost categories)
6. Realization risks
7. Technical feasibility within the specified timeframe
8. Availability of and demand for budget funds
9. Framework conditions and requirements, e. g. political guidelines, standards, infrastructure requirements
10. Possibilities of saving costs by using off-the-shelf products
11. Target dates, schedules
12. Quality aspects, performance aspects
13. Safety and security aspects

In order to achieve relevant results, the use of weighted evaluation procedures - e.g. WSM (weghted scoring mdel) or HAP (analytic hierarchy process) - may be useful particularly for the evaluation of off-the-shelf poducts.

The evaluation criteria shall be archived in suitable form so that their reuse will be possible.

3.7.4.2 Evaluating Requirements

Work Product: Requirements Evaluation

The requirements shall be evaluated on the basis of the previously defined »Evaluation Criteria. Together with the developers of the user requirements and supported by experts for system architecture and system design, the »Requirements Engineer (Acquirer) of the acquirer will perform the following work steps:

Analysis of Operational Necessity

The stakeholders will review the operational necessity of individual requirements. Both the non-functional and the functional requirements shall be reviewed. The result of the review will be candidates for requirements that are not classified operational.

How relevant the requirements are shall be discussed in each case by the stakeholders. In this process risks and safety and security aspects of the individual requirements shall be weighed, roughly estimated and possibly reclassified with regard to their importance. It may also be necessary to check to what extent individual requirements can be dropped by merging them with others.

Should there be no agreement on the necessity of individual requirements when evaluating the various requirements, the »Requirements Engineer (Acquirer) shall prepare a proposal for the decision maker.

Analysis of Technical Feasibility

Is the necessity of the »Requirements Specified , the requirements shall be checked for their technical feasibility. When doing this, it is recommended to fall back on possible approximate technical solutions for the realization of the functional and non-functional requirements. The result will be documented in the »Outline of the Life Cycle and the Overall System Architecture. Should the acquirer be unable to perform this task, the »Requirements Engineer (Acquirer) shall take care that an »Outline of the Life Cycle and the Overall System Architecture will be prepared by experts. This outline ("approximate system architecture"), where the requirements will be already assigned to the respective elements of the architecture, will form a valuable basis for describing possibilities for technical solutions.

The requirement that the solution to be developed should be cost-effective and that the consumption of resources should be calculable necessitates a preliminary analysis regarding the possible use of off-the-shelf products. Practice shows that acquirers increasingly have and develop technical solution know-how and competence. In many cases, this is one of the capabilities required of an acquirer (particularly in IT organizational units executing IT projects for functional areas).

A »Market Survey for Off-the-Shelf Products provides the necessary data base. The use of the defined (weighted) evaluation procedures can determine the further proceedings in the project. This corresponds to a qualified make-or-buy decision on side of the supplier.

All results of the technical feasibility studies shall be unambiguously related to the functional and non-functional requirements. It will be especially important that at this point a possible use of off-the-shelf products will be already evaluated. The approach employed should be analogous to the subactivity »Evaluating Off-the-Shelf Products.

Checking Cost-effectiveness and Affordability of the Requirements

Within the scope of the activity »Preparing Requirements Evaluation, considerations regarding the cost-effectiveness shall be made. They are to provide an answer to the question whether a cost-effective realization of the requirements will be possible and whether meeting individual requirements will be profitable in the sense of that the benefits will exceed the costs. When the cost-effectiveness considerations are made, attention should be paid to the following aspects:

- The requirements and their resulting costs shall be made so transparent that the decisions made can be traced by the responsible decision makers of the project.
- Should it be not possible to quantify the cost estimates, at least an order of priority of the possible costs for the individual requirements shall be established.
- The users should once more seize the opportunity to look critically at the "value" of individual functional and non-functional requirements of the planned IT system.
- Should it not be possible to express the benefits in monetary units (for example replacement of the old process with cost savings), qualitative aspects of the benefits should be used (for this purpose in the public sector IT cost effectiveness considerations may be used). If the benefits are not quantifiable, the following aspects should be considered:
  - a possible increase in performance when carrying out tasks and acceleration of work flows and processes
  - that it will be made possible to provide information to decision makers and the controlling staff by supporting the decision and/or command and control process
  - the urgency of a replacement and the lack of flexibility of the legacy system will be highlighted for example by a high error rate, failures, system crashes, maintenance problems, manpower shortages, too narrow limits concerning development or expansion, interface problems and lack of user-friendliness.
  - the stipulated compliance with statutory requirements, e. g. by meeting data protection/data security requirements and orderly work flows according to internal standards.

To estimate costs, allocate funding or determine the budget, concepts - which at this time may still be very rough - of an architecture that provides a solution and technical solutions provided by the market in off-the-shelf products shall be considered.

Preparing Evaluation Results

On the basis of the evaluation, the following alternatives for further handling of user requirements will have to be identified:

1. Confirmation that it is possible to realize a requirement economically.

2. Changes of requirements:

   - Those requirements that are absolutely necessary for the operational use of the system shall be realized in any case with suitable technical solutions, possibly neglecting cost-effectiveness considerations.

   - Those requirements that can not or only partly covered economically by possible technical solutions - in particular by off-the-shelf products - shall be indicated. Their relevance to the system shall be shown and a suggestion shall be made how to meet those requirements. In this connection the following options will be conceivable:

     - Requirements that do not have to be covered should be marked "non realizable", since they cannot be realized within a foreseeable planning period. This does not mean, however, that they are cancelled completely.

     - Requirements that are not covered may be modified in a way that they are met by the functionality of one or more off-the-shelf products.

     - For requirements that are not covered, "adaptation" work on the finished product will be suggested that is still affordable within the framework of the budget. In requirements controlling risks and safety and security will be examined and discussed.

The result of the subactivity »Evaluating Requirements will be the harmonized functional and non-functional requirements that are cost-effective, necessary, affordable and technically feasible.

3.7.4.3 Integrating Evaluation Results

Work Product: Requirements Evaluation

The acquirer shall document the result of the evaluation of the user requirements in the product »Requirements Evaluation and make it available to all roles participating in the evaluation process.

Subsequently the »Evaluation Results shall be integrated in the product »Requirements Specification by changing and supplementing the requirements concerned.

The »Requirements Engineer (Acquirer) shall take care that the results achieved in the evaluation process can be reconstructed also by persons not involved in the activity »Preparing Requirements Evaluation.

The resulting consequences for the projects may be evaluated differently. One possibility is that the results developed for the preliminary system architecture and off-the-shelf products are not integrated into the request for proposals since the acquirer expects innovative and cost-effective solutions proposals from the industry.

An other possibility is the use of the result for defining the scope of delivery for the future development of the RFP concept.

3.7.5 Analyzing User Tasks

Work Product: User Tasks Analysis

Purpose

Within the scope of the »User Tasks Analysis, the user tasks that will be supported in the future by the new system shall be described. This should include the preparation of user profiles and the description of the physical user environment.

3.7.5.1 Preparing User Profiles

Work Product: User Tasks Analysis

When preparing the user profile analysis, the characteristics of the future users of the system shall be recorded and written down. Depending on these analytical results, criteria for the quality of software ergonomics shall be formulated and weighted for each characteristic of the users. From the weighted quality criteria, user friendliness can be optimized for the related characteristics.

To determine the user characteristics, it may be checked for example

- with regard to the required expert knowledge, whether the system to be developed is a workplace used by laymen or experts,
- whether the users are experienced or inexperienced computer users and
- whether they use the system permanently, i. e. several hours per day, or only sporadically, i. e. once a week.

If due to workflow reengineering required changes that lead to a new task definition and a new workflow become necessary, an intensive introduction of the participating users to the new operational procedures shall be provided. This should include the collection of user feedback that is to be incorporated into the design of the user interface.

3.7.5.2 Analyzing Physical Operation Environment

Work Product: User Tasks Analysis

An analysis of the physical work environment of the dialogue system and of the user who works with it shall be made.

The design of the dialogue system from the point of view of the environment may be influenced for example by the location of the system (office, hall or public place), the influences due to noise/sound, light, dirt, climate and vibrations and by other disturbances from outside, such as the danger of vandalism when automatic machines are concerned.

Thus due to the environmental conditions for example an information terminal for tourists in a public place will be designed differently from a workplace in a travel agency. In case of a danger of vandalism when a terminal is used, it will be practical to equip it with a touch-sensitive screen instead of a mouse, while the workplace in a travel agency may well be equipped with a mouse and a keyboard.

3.7.5.3 Collecting User Tasks

Work Product: User Tasks Analysis

From the start the person in charge of ergonomics should be involved in the analysis of the overall system so that the interactions of the user with the system can be appropriately designed.

At first the wishes and ideas of the users should be ascertained, and the functionality of the system should be visualized graphically.

From the business and operational targets of the system to be developed fundamental design targets with regard to the suitability of the tasks and the ability to handle the new user interfaces shall be derived. Business and operational targets will be specified for the most part by top management on the side of the acquirer and in this case shall be adopted as a requirement. In this context it would be conceivable that a company might plan to make it possible to sell its products over the internet. The requirement could be in this case that when designing the internet site a "digital salesperson" has to be realized that resembles a real salesperson as closely as possible.

When the wishes and ideas of the users will be known, the approximate functionalities and sequences shall be described with the help of graphic or simple text-based languages or notations, which all stakeholders should be able to understand, if possible without a major introduction effort. The working principle of the overall system may be documented for example on the basis of use cases and the central operational sequences may be modeled and depicted in the form of simple flow diagrams. By marking all passages in the system descriptions where the user interacts with the system, the dialogues and tasks that shall be supported by the system can be derived.

In order to refine the system, context questionsshall be formulated. Together with the users the related defined context questions shall be answered completely and documented in writing for each dialogue or each task previously identified in the analysis process. The questions that should be posed will include for example:

- When will this task be performed (trigger, precondition)?
- By whom will this task be performed?

- Why will this task be performed (objective of the action, post-condition)?
- How often will the task be performed?
- What shall be done in detail when performing the task?
- What additional means will be required?
- What exceptions from the normal approach (exceptional/special cases) will exist?
- What will initial design ideas look like?
- What wishes/suggestions shall be considered from the point of view of the users when the dialogue will be designed?

The detailed description of all dialogues and tasks will be the crucial basis for the design and realization of the user interfaces. Before this the dialogues should be structured and combined to groups of interactions that belong together. Thus dialogues may be prepared hierarchically.

3.7.6 Preparing Data Protection Concept

Work Product: Data Protection Concept

Purpose

A data protection concept shall be prepared for a project if the project deals with personal data.

This activity is intended to prepare and update a project-related data protection concept. During the preparation and updating of the data protection concept, the contents of the concept shall be verified for correctness, consistency and completeness and be adapted as required.

During service use, the data protection concept shall be updated in case of a change of provisions, technical modifications, extension of functionalities, construction measures, etc.

The activity "Preparing Data Protection Concept" describes a planned approach for fulfilling data protection requirements. The measures required for covering the requirements will be specified in the data protection concept.

In order to achieve a high data protection level, the following steps - among others - shall be executed when preparing the concept:

- Determining the legal foundations for handling personal data,
- describing the origin of personal data and the collecting method,
- providing a system survey focussing on system elements which process personal data,
- determining the protection requirements for personal data,
- identifying possible risks incurred when handling personal data,

- determining data protection requirements (legal, technical, organizational, personnel and material requirements) and determining measures for covering the requirements.

This includes, e.g., the following aspects:

- Describing the administration and handling of personal data on data carriers and servers,
- specifying the necessary controls,
- specifying the obligation to notification,
- specifying release procedures,
- regulating possible job data processing.

3.7.7 Preparing Information Security Concept

Work Product: Information Security Concept

Purpose

This activity is intended to prepare and update a project-related IT security concept. In detail, for example, statements on the following aspects relevant for safety and security will be specified:

- Operational environment
- Protection requirements
- Directives / requirements from other projects
- Information security requirements
- Information security measures
- Risks remaining
- Emergency planning
- Directives for other projects / agencies

3.7.7.1 Describing Operational Purpose

Subject: Information Security Concept: Presentation of the Project and the Operational Environment

The project, for which the Information Security Concept will be prepared, shall be identified. The project identification includes information on the identification of the project (e.g. DP identification number) and general information on the project (e.g. Project Managers, classification, relations to and dependencies on other projects).

Operational purpose and operational environment shall be described briefly.

3.7.7.2 Analyzing Protection Requirements

Subject: Information Security Concept: Protection Requirements

The information structure of the processed or transferred information shall be determined. The protection requirements regarding confidentiality (based on the classification of the information), integrity, authenticity and availability shall be specified.

3.7.7.3 Presenting System Architecture

Subject: Information Security Concept: System Architecture from an IT Security Point of View

The system architecture of the selected solution shall be decribed as seen from an »Information Security point of view, taking into account the modes of operation (dedicated, system high, compartment und multi-level).

3.7.7.4 Determining Information Security Requirements

Subject: Information Security Concept: Information Security Requirements

The »Information Security requirements shall be determined, subdivided into technical, organizational, personal and material information security requirements.

3.7.7.5 Determining Information Security Measures

Subject: Information Security Concept: Information Security Measures

The information security measures required to implement the »Information Security requirements shall be described, subdivided into technical, organizational, personal and material information security measures. The products designed to implement the information security measures shall be identified.The intended information security measures shall be coordinated with the Acquirer. In addition, the information security measures shall be matched with the risk reduction measures in the product Hazard and Risk Analysis - Functional Safety (e.g. regarding redundancy, inconsistency).

3.7.7.6 Analyzing Risks Remaining

Subjects: Information Security Concept: Information Security Measures, Information Security Concept: Risks Remaining

This sub-activity shall describe which information security requirements will be fulfilled by which information security measures.

If information security requirements cannot be covered completely by information security measures, the hazards for availability, integrity, authenticity, and confidentiality will be identified and classified.

For every resulting risk, it shall be determined whether it is tolerable or not.

For every risk classified as intolerable, it shall be examined whether a strengthening of the measures can reduce the respective risk to such a degree that it will become tolerable.

If a risk is classified as intolerable and cannot be remedied by a strengthening of measures, a solution which is also acceptable from an economic point of view shall be developed (e.g. identification of transitional measures, change of functionality, abandonment of IT use).

The complete analysis will be included into the Annex of the Information Security Concept as project-specific Hazard and Risk Analysis - Information Security. The main statements of the analysis will be documented in the subject Risks Remaining.

3.7.7.7 Executing Emergency Planning

Subject: Information Security Concept: Emergency Plan

The emergency measures required for the project shall be developed. This includes particularly the detailed description of the approach for restoring system functionality after a partial or total failure of the system

3.7.7.8 Preparing Standards for Verifying the Effectiveness of the Measures

Subject: Information Security Concept: Standards for Verifying the Effectiveness of the Measures

This partial activity is intended to continuously improve and optimize the Information Security Concept. Standards for verifying the effectiveness of the measures for maintaining information security shall be specified. This includes also specifications for necessary training and sensitization measures.

3.7.8 Performing and Evaluating Safety and Security Analysis

Work Product:	Safety and Security Analysis
Method Reference:	Design Verification, Fault/Reliability Analysis
Tool reference:	Construction/Simulation

Purpose

The »Safety and Security Analysis will be made for those system elements that were identified to be safety-relevant in the related implementation, integration and evaluation concepts.

During the development the »System will be subdivided into subsystems (»Segments, »Hardware Units, »Software Units, »Hardware Components, »Hardware Modules, »Software Components, »Software Modules). Each of these subsystems, just like its parent system, will be associated with a risk. In each decomposition step this risk shall be determined and specified.

On the basis of the contractually specified safety requirements/risk acceptance a hazard and risk analysis shall be made to decide in the system development process which hazards will exist, what the resulting risk will be and how risk reduction measures can be used to reduce the risk to an acceptable level. In particular the following steps will be required for each system element:

- The hazards will have to be identified.
- Potential damage resulting from the hazards shall be determined.

- The risks connected with the hazards and damage will have to be assessed.
- The acceptance of the risks shall be determined on the basis of available criteria.
- For all risks that are classified as not acceptable risk reduction measures will have to be defined.

In this context it will also have to be checked whether for risk reduction technical measures - such as design changes - or organizational measures - such as changes in the planning - shall be preferred. If design changes are necessary, the desire to make a change shall be reported via a problem report or a change request. If several alternatives for risk reduction are available, this will be stated in the desire for change and incorporated in the change proposal. If no solution is found, a solution to this topic has to be found together with the acquirer.

3.7.8.1 Identifying Hazards and Classifying Damage

Work Product: Safety and Security Analysis

For each system element (architectural element or hardware/software component) the potential hazards that may lead to an occurrence of damage shall be determined. For each identified hazard the damage level shall be determined and the damage class - depending on the damage category concerned - shall be allocated.

3.7.8.2 Performing System Safety and Security Analysis

Work Product: Safety and Security Analysis

For each system-critical system element a »Safety and Security Analysis shall be made. For each identified hazard possible causes and their related risks shall be estimated and evaluated with regard to occurrence, importance and detection. If the result of the evaluation is a value that exceeds a defined threshold value or is outside of the accepted range, risk reduction measures shall be defined for the system element considered. The results of the analysis - causes, occurrence probabilities, risks and risk acceptance - shall be documented.

3.7.8.3 Identifying and Determining Risk Reduction Measures

Subject: Safety and Security Analysis: Safety and Security Measures

For all risks rated not acceptable in the »Safety and Security Analysis, risk reduction measures shall be determined. These measures will influence on the one hand - in the form of engineering measures such as redundancy, identification, authentication and access control - the realization and on the other hand, when analytical QA measures are concerned, the testing procedure. The risk reduction measures shall be selected from the safety and security specifications of the project manual.

The identified measures shall be analyzed and evaluated with regard to their impact during the execution. In this process for example the degree of risk reduction or the effort required for implementation shall be determined. Beyond that also the impact on activation, operation, deactivation and the operating personnel can be determined. The results of this analysis and evaluation shall be documented and used as a basis for determining appropriate measures for the implementation of a risk reduction effort. The decision making process in turn also shall be documented.

If no suitable »Safety and Security Measures are found or if additional promising risk reduction measures exist or are conceivable, then negotiations shall be conducted with the acquirer, and the solution found this way shall be requested and documented in a problem report or a change request.

3.7.9 Analyzing Legacy System

Work Product: Legacy System Analysis

Purpose

In the »Legacy System Analysis at first a »System Outline and a »Functional Overview shall be worked out. For this purpose tools, such as code analyses, interviews with experts (the Delphi method) or documentation (if available), will be used.

The interfaces of the legacy system with adjacent systems identified in the »System Outline shall be analyzed and evaluated together with the respective persons in charge. The interfaces and their dependencies shall be described and their relevance to the reworked or newly developed system shall be determined (see »Interface and Dependency Analysis).

The structure of the »Data Model in the legacy system shall be determined; in particular the existing relations and integrity conditions and the condition of the data shall be identified. Data analysis should be made with the help of suitable tools as are usually directly provided by data bases.

3.7.9.1 Preparing a System and Function Summary

Subjects: Legacy System Analysis: Functional Overview, Legacy System Analysis: System Outline

At the start of a »Legacy System Analysis a system and function summary shall be worked out. In this process an adequate understanding of the legacy system has to be achieved. The following information sources will be used:

- Interviews with experts (developers, maintenance personnel and users of the legacy system),
- Documentation of the legacy system (as far as it is available) and
- Code analyses.

The aim will be to obtain an overview of the approximate architecture of the system and the technology that is used and to understand the role of the system in its environment.

3.7.9.2 Specifying Interfaces and Dependencies

Subject: Legacy System Analysis: Interface and Dependency Analysis

For the interface analysis the interfaces of all adjacent systems of the legacy system that are identified in the »System Outline shall be evaluated.

Together with the persons in charge of the respective interfaces, the interface descriptions will be verified for their correctness and, if necessary, revised.

3.7.9.3 Performing Data Analysis

Subjects:	Legacy System Analysis: Data Model, Legacy System Analysis: System Outline

A data analysis will be used to determine the »Data Model of the legacy system and the state of the data. For this purpose the following steps will be necessary:

- All databases on which the system works will have to be identified and localized.
- With the help of tools the current data schema will have to be read from each database.
- From the contents the data model of the legacy system will be derived.

In addition the data shall be examined to determine their condition. If the database contains data that do not reflect a valid condition, this is called junk data. Junk data may not necessarily interfere with the system itself, but may have a negative impact on a possible migration. For example, samples may be used to check data quality.

3.7.10 Performing Market Survey for Off-the-Shelf Products

Work Product:	Market Survey for Off-the-Shelf Products
Method Reference:	Evaluation Process

Purpose

When performing the »Market Survey for Off-the-Shelf Products, information shall be collected about various off-the-shelf products and prepared for further use.

In an acquirer project, the basis for this will be - depending on when the survey is conducted - the »Project Proposal or the »Requirements Specification in combination with the gross system architecture.

In order to obtain the information, the following steps will be necessary:

- From the requirements criteria will have to be derived for searching for and rating off-the-shelf products.
- A candidate list will have to be drawn up.
- For all off-the-shelf products that were found and that are included in the candidate list summaries will have to be prepared.

- It will have to be noted where additional information, such as product sheets, product specifications and performance characteristics, are filed or can be found.

The results will be evaluated in the »Requirements Evaluation and - depending on the evaluation results - integrated into the »Requirements Specification.

In a supplier project, the basis for this will be the »Overall System Specification, a draft of the »System Architecture, the »External Unit Specification, the »External Hardware Module Specification, or the »External Software Module Specification, since these specifications will contain requirements in the respective typical degree of detail.

In order to obtain the information, the following steps will be necessary:

- From the requirements criteria will have to be derived for searching for and rating off-the-shelf products.
- A candidate list will have to be drawn up.
- For all off-the-shelf products that were found and that are included in the candidate list summaries will have to be prepared.
- It will have to be noted where additional information, such as product sheets, product specifications and performance characteristics, are filed or can be found. The results of the market survey shall be provided to the »Process Module »System Development.

3.7.11 Performing Make-or-Buy Decision

Work Product:	Make-or-Buy Decision
Method Reference:	Evaluation Process

Purpose

For each »External Unit, »External Hardware Module or »External Software Module , it shall be determined whether it makes strategic and economic sense to buy the element as a off-the-shelf product or to subcontract it. In order to make a decision the following aspects shall be checked:

- Within the scope of the strategic analysis a market survey shall be performed, and it shall be checked whether in-house products will be available, whether the re-use of existing products will play a role and whether criteria of a product family will have to be considered.
- For the economic analysis a cost-benefit assessment shall be made, and the available budget shall be considered. Necessary adaptations (hardening or wrapping technologies) of the off-the-shelf products to the specified operating conditions also shall be taken into account, i. e. when using off-the-shelf products, the costs and the integration risk of new adapter software or hardware that may have to be developed shall be considered.
- If the external element is a candidate for an off-the-shelf product, the off-the-shelf products identified in the market survey shall be evaluated and possible candidates shall be rated.
- Finally, an evaluation of possible alternatives and a decision for the realization of the external unit will be made.

3.7.11.1 Performing Analyses

Subjects: Make-or-Buy Decision: Strategic Analysis, Make-or-Buy Decision: Economic Analysis

To be able to make a substantiated decision whether to buy or outsource a unit, it will be necessary to execute strategic and economic analyses. A »Strategic Analysis will be used for example to evaluate dependencies on suppliers or »Sub-Suppliers. It also shall be checked to what extent adjustments to existing products will become necessary.

Within the scope to the economic analysis, monetary aspects will have to be taken into account. In this context it should be evaluated what financial impact the use of off-the-shelf products will have in the future.

3.7.11.2 Evaluating Off-the-Shelf Products

Subject: Make-or-Buy Decision: Evaluation of Off-the-Shelf Products

In preparation for the use of off-the-shelf products the following steps will be required:

1. **Drawing up a list of criteria:** In a list of criteria the criteria for the selection of a off-the-shelf product shall be defined.

2. **Drawing up a list of candidates:** From the »Market Survey for Off-the-Shelf Products possible off-the-shelf products for the system element in question will be obtained. Apart from a market survey, furhter candidates may be identified using the project manual, the »Contract, the creation of the system or the specification of the requirements. The candidates shall be documented in a candidate list.

3. **Checking and prioritizing candidates:** Based on the list of criteria, the possible candidates shall be subjected to a thorough examination and subsequently rated. If necessary,

   - test installations of the software shallbe made and

   - data sheets, specifications and samples of the hardware shall be procured.

The off-the-shelf products shall be checked for their technical suitability with particular emphasis on system integration and the adjustments that may be required for this purpose. It shall be evaluated to what extent the requirements are met by the individual off-the-shelf products.

Economic efficiency considerations concerning the use of off-the-shelf products will be made in the topic »Economic Analysis of the »Make-or-Buy Decision.

3.7.11.3 Evaluating Result

Subject: Make-or-Buy Decision: Assessment and Result

When evaluating the results of the analysis, a comparison shall be made between the creation of the system in-house and the use of off-the-shelf products for the creation of the system. The evaluation criteria may be economic, technical and strategic requirements. As a result, a decision shall be made, substantiated and documented.

3.8 System Elements

The discipline System Elements comprises all elements to be realized during system development. These include the target systems (system and enabling systems), segments used as units for structuring sub-systems and hardware and software development elements (units, components and modules). In addition, »External Units or products of the type »External Hardware Module or »External Software Module are available for the integration of elements which were not developed within the scope of the project.

The system elements represent the hierarchical structure of a system or »Enabling System Figure 13. For system development, the system elements, beginning with hardware and »Software Modules, will be integrated in accordance with the hierarchical structure.

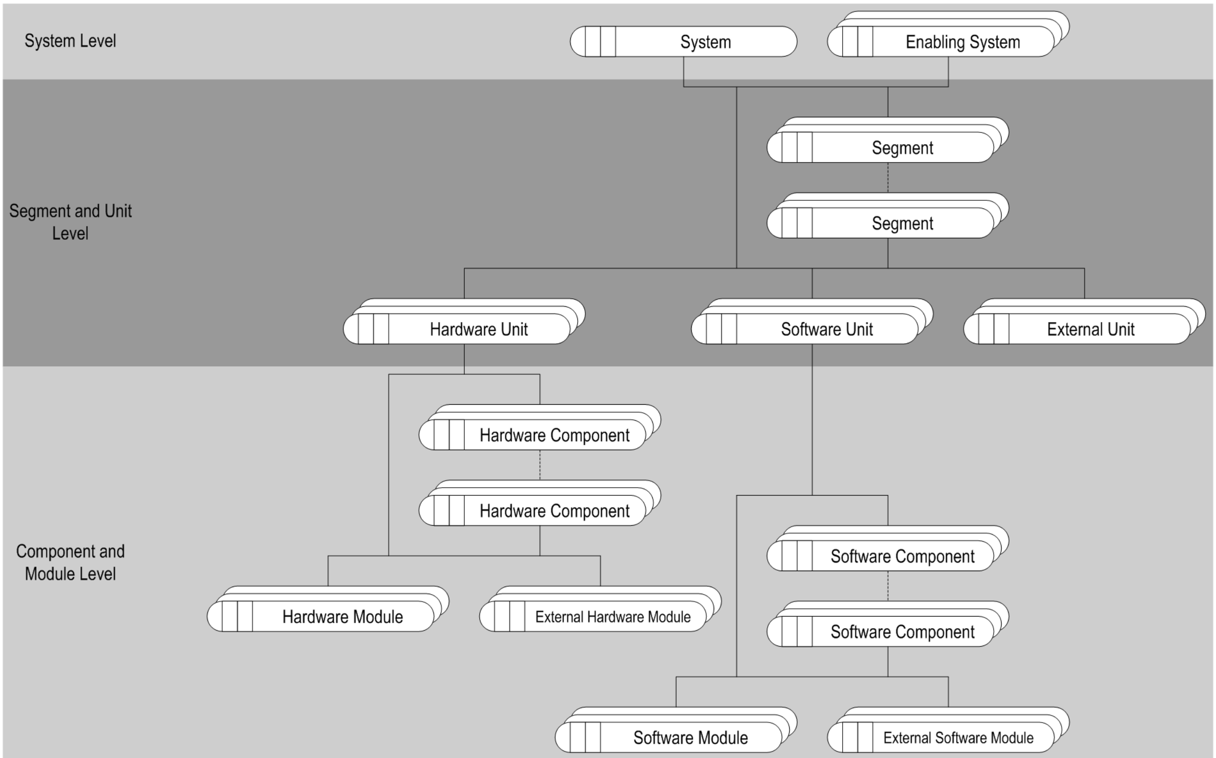

Figure 19: System Architecture Hierarchy

3.8.1 Integrating into System

Work Product: System

Purpose

The basis of the integration of the system or of a »Enabling System will be the »Segments, »Hardware Units, »Software Unit or products of the type »External Unit provided within the framework of the integration. In accordance with the decomposition structure of the architecture, these system elements will be integrated into the system or »Enabling System with the corresponding Implementation, Integration and Evaluation Concept describing the integration plan and the integration approach.

The integration schedule will be established in the subactivity System Element Integration and Evaluation Plan in the project plan.

In accordance with the specifications in the »QA Manual and in the Implementation, Integration and Evaluation Concept, a test, in which the requirements will be verified, shall be performed for the finished system or enabling system.

In case of a successful completion of the tests, the system may be made installable in the operational environment and prepared for »Delivery to the acquirer. enabling systems will be included in the scope of delivery in accordance with the delivery criteria.

3.8.2 Integrating into Enabling System

Work Product: Enabling System

Purpose

See Aktivity Integrating into System.

3.8.3 Integrating into Segment

Work Product: Segment

Purpose

Integration into the »Segment will be based on the Software and »Hardware Units provided in the software and hardware development and on »External Units.

In accordance with the integration plan, segments shallbe created from the different units. Segments may be in turn integrated into other segments, until all system elements will joined to the complete system.

Segments designated for tests in accordance with the evaluation strategy have to be verified after integration on the basis of the »Evaluation Specification System Element.

3.8.4 Taking over External Unit

Work Product: External Unit

Purpose

»External Units shall be taken over by the respective supplier. For each external unit a receiving inspection shall be performed, regardless of whether it is a off-the-shelf product, a subcontract, a reusable component or a line issue.Based on the specifications in the »QA Manual, the necessary steps for the receiving inspection shall be specified. The evaluation cases shall be defined in the »Evaluation Specification Delivery. Beyond that an external unit shall be included in the »Product Library. During the integration external units will be treated similar to Hardware and »Software Units.

3.8.5 Integrating into Hardware Unit

Work Product: Hardware Unit

Purpose

A »Hardware Unit will be realized by integrating »Hardware Components. In this process, the integration plan in the hardware implementation, integration and evaluation concept will define the integration structure and the integration sequence and approach. If required in the evaluation strategy, the hardware unit shall be subjected to a test performed by an external »Inspector after the integration.

After their integration hardware units should always be subjected to a developer test. This test may be based on the »Evaluation Specification System Element.

3.8.6 Integrating into Software Unit

Work Product: Software Unit

Purpose

A »Software Unit will be realized by integrating »Software Components. In this process the integration plan in the software implementation, integration and evaluation concept will define the integration architecture and the integration sequence and approach. If required in the evaluation strategy, the finished software unit shall be subjected to a test performed by an external »Inspector.

After their integration, software units should always be subjected to a developer test. This test may be based on the »Evaluation Specification System Element.

3.8.7 Integrating into Hardware Component

Work Product: Hardware Component

Purpose

A »Hardware Component will be realized by the integration of hardware components, »Hardware Modules or products of the type »External Hardware Module. In this process, the integration plan in the hardware implementation, integration and evaluation concept will define the integration architecture and the integration sequence and approach. If required by the evaluation strategy, the hardware component shall be subjected to a test performed by an external »Inspector after its integration.

After their integration hardware components should always be subjected to a developer test. This test may be based on the »Evaluation Specification System Element.

When integrating programmable logic, the following tasks shall be performed:

- Generation of a technology-specific programming file from technology-independent code,

- Integration of the programming file into the target hardware,
- Gradual activation,
- Execution of a technology-dependent timing simulation,
- Testing of the dynamic sequences.

3.8.8 Preparing External Software Module Specification

Work Product:	External Software Module
Method Reference:	Requirements Analysis, System Analysis
Tool reference:	Requirements Management, Integrated Development Environment, Construction/Simulation, Modeling Tool

Purpose

The Software Specification shall indicate the requirements and interfaces for the product External Software Module. These shall be integrated into the External Software Module Specification and realized by means of a sub-contract, an off-the-shelf product or a furnished item.

The External Software Module Specification specifies the acceptance criteria for the receiving evaluation in the Evaluation Specification Delivery. It will be integrated into the contract with the subsupplier.

3.8.9 Integrating into Software Component

Work Product:	Software Component

Purpose

A »Software Component is realized by the integration of software components, »Software Module or »External Software Modules. In this process, the integration plan in the software implementation, integration and evaluation concept defines the integration architecture and the integration sequence and approach. If required by the evaluation strategy, the finished software component has to be subjected to a test performed by an external »Inspector.

After their integration software components should always be subjected to a developer test. This test may be based on the »Evaluation Specification System Element.

3.8.10 Taking over External Hardware Module

Work Product:	External Hardware Module

Purpose

The products of the type »External Hardware Module shall be taken over from the respective supplier. For every product External Hardware Module, a receiving evaluation shall be conducted, regardless of the fact if the module is based on an off-the-shelf product, a sub-contract, a reusable component or a furnished item.

The necessary receiving evaluation steps shall be specified based on the QA Manual. Evaluation cases shall be specified in the Evaluation Specification Delivery. In addition, an External Hardware Module shall be included into the Product Library. External Hardware Modules will be integrated like Hardware Units.

3.8.11 Realizing Hardware Module

Work Product:	Hardware Module

Purpose

The implementation of the »Hardware Modules will include both the manufacturing of the hardware and the coding of the programmable logic. The hardware module shall be produced according to the set of drawings. Bought-out components (external units) shall be procured, tested, possibly adapted and installed. The implementation procedure shall be based on the specification of the »Hardware Implementation, Integration and Evaluation Concept. If required in the evaluation strategy, the hardware module shall be subjected to a test performed by an external »Inspector after the integration.

When developing programmable logic, the programming specification (e. g. pseudocode, specification language, MATLAB reference) shall be translated to statements of the implementation language. It will be necessary to adhere to the following worksteps:

- Programming in compliance with the standards, guidelines and style guides defined in the Project Manual;
- Development of compiling procedures for the preparation of the technology-independent functional simulation;
- Functional, technology-independent simulation of the modules, paying regard to the coverage of as many branches as possible;
- Integration of the individual modules and IP cores into the component at the level of the description language (contents of a programmable building block);
- Performance of a functional simulation.

In order to improve quality, it is recommended to perform a code walk-through through the process modules in accordance with the four-eye principle. At the end of the activity, a technology-independent compiled code of the component of a programmable building block will be available.

3.8.12 Taking over External Software Module

Work Product:	External Software Module

Purpose

The products of the type »External Software Module shall be taken over from the respective supplier. For every product External Software Module, a receiving evaluation shall be conducted, regardless of the fact if the module is based on an off-the-shelf product, a sub-contract, a reusable component or a furnished item.

The necessary receiving evaluation steps shall be specified based on the QA Manual. Evaluation cases shall be specified in the Evaluation Specification Delivery. In addition, an External Software Module shall be included into the Product Library. External Software Modules will be integrated like Software Units.

3.8.13 Realizing Software Module

Work Product:	Software Module

Purpose

A »Software Module shall be implemented in accordance with the requirements of its »Software Specification or the specification of a parent software element. The implementation approach shall be based on the specifications in the implementation, integration and evaluation concept. If required by the evaluation strategy, the finished software process module shall be subjected to a test performed by an external »Inspector.

After their implementation software process modules should always be subjected to a developer and integration test. This test may be based on the »Evaluation Specification System Element.

The realization of software process modules may include the following aspects:

- Programming in compliance with the standards and guidelines defined in the project manual;
- Development of compiling, linking, loading, installation and generation procedures;
- Corrections until the compiling and linking procedures are error-free;
- If necessary, programming of test and simulation runs.

3.9 System Specifications

The »Discipline »System Specification comprises »Work Products and »Activityies supporting the entire specification process from the overall system to individual software and »Hardware Elements.

In addition to the central product »Overall System Specification, the product group includes four specification types: the »System Specification for System Elements, the »External Unit Specification which specifies units which were not developed within the scope of the project and a Hardware and »Software Specification as well as an »External Hardware Module Specification and an »External Software Module Specification for each system element.

The specifications are closely connected with regard to contents. Proceeding from the Overall System Specification, functional and non-functional requirements of the acquirer will be described and refined in the system specifications and finally, as interfaces, in the specifications of hardware and »Software Element s. In this way, a continuous and repeatable development process and a suitable tracking of requirements can be realized.

3.9.1 Preparing Overall System Specification

Work Product:	Overall System Specification
Method Reference:	Requirements Analysis, System Analysis

Tool reference: Requirements Management, Integrated Development Environment, Modeling Tool

Purpose

Within the framework of the development of the »Overall System Specification, a preliminary overall system architecture will be developed on the basis of the functional and non-functional requirements from the project specification, and the requirements will be assigned (see Figure 20). To make sure that the requirements are correct and complete, they ideally will be evaluated and, if necessary, improved and expanded, by organization-specific requirements with the support of the acquirer and all stakeholders.

Subsequently an iterative process will be introduced, in which a life cycle analysis will be performed and a stable, preliminary architecture of the system, of possible enabling systems and of the logistic support will be defined on the basis of the requirements. The specific requirements will be assigned to these elements of the architecture. The interfaces between the systems and to the environment will be described in an interface list. The acceptance criteria for the future system will be defined parallel to the requirement assignment process.

At the end of the process, the scope of delivery will be defined. Then the requirements will have to be reconstructed, both from the »Overall System Specification to the »Requirements Specification and from the overall system specification to the system and possible enabling systems and to the logistic support.

Activity Flow

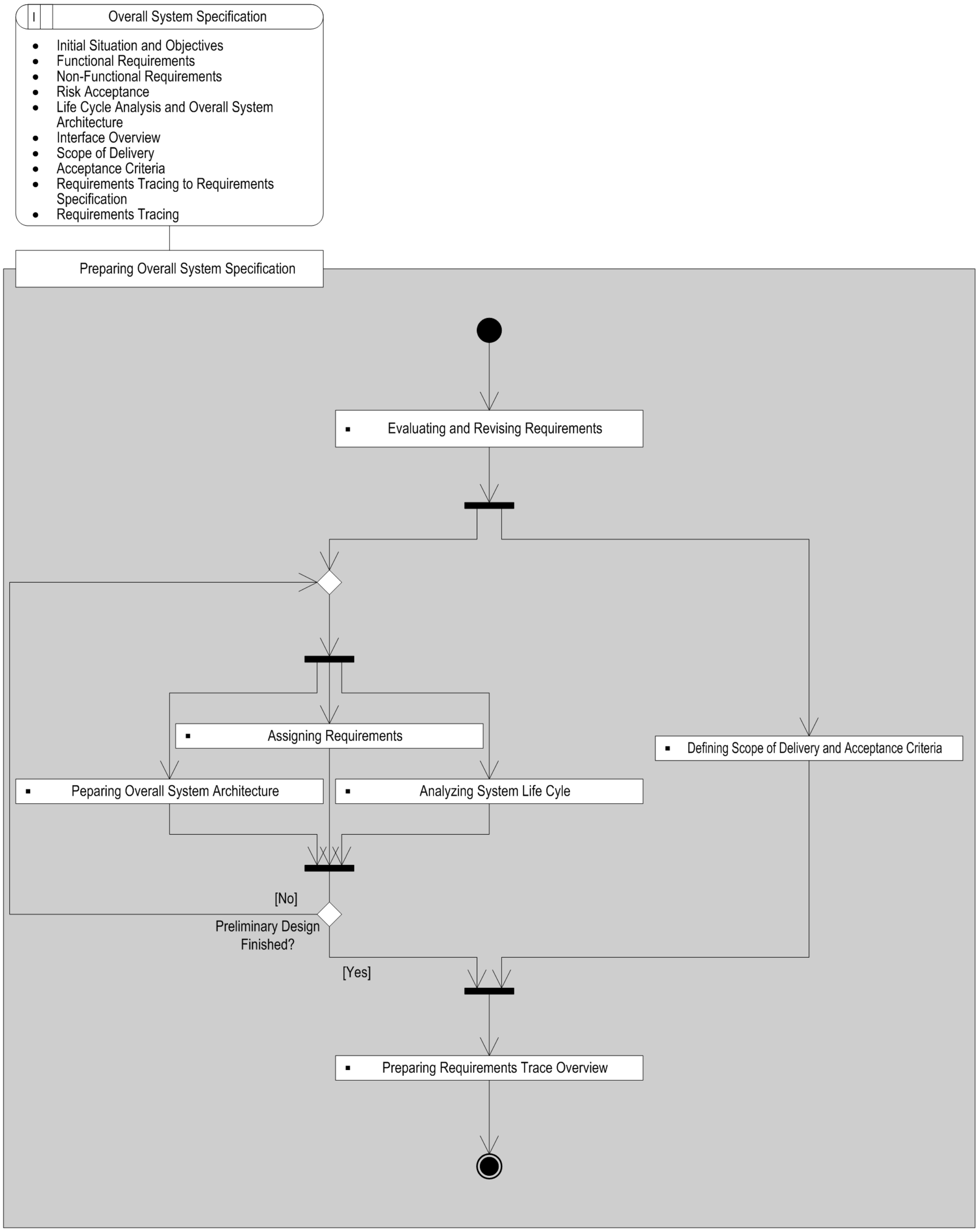

Figure 20: Activity Diagram "Preparing Overall System Specification "

3.9.1.1 Evaluating and Revising Requirements

Subject: Overall System Specification: Requirements Tracing to Requirements Specification

The requirements specified in the subjects Functional Requirements and Non-Functional Requirerments of the requirements specification shall be detailed and, if necessary, revised, stated more precisely and supplemented by additional necessary organization-specific requirements in the requirements specification.

3.9.1.2 Analyzing System Life Cycle

Subject: Overall System Specification: Life Cycle Analysis and Overall System Architecture

When designing the overall system architecture, the first step will be to analyze which life cycle phases of the system have to be supported. These phases will follow directly or indirectly from the evaluated and revised specifications.

3.9.1.3 Preparing Overall System Architecture

Subjects: Overall System Specification: Life Cycle Analysis and Overall System Architecture, Overall System Specification: Interface Overview

Starting with the evaluated and revised specifications and the »Outline of the Life Cycle and the Overall System Architecture in the user specifications (project specification), the overall system architecture shall to be designed.

At first the overall system shall be subdivided into the elements system, »Enabling Systems and logistic support. The interfaces between these elements shall be identified and outlined. At this point it will also be already possible to refine the system or the enabling systems down to the next segment level.

3.9.1.4 Assigning Requirements

Subjects: Overall System Specification: Life Cycle Analysis and Overall System Architecture, Overall System Specification: Interface Overview

Parallel to the design of the overall system architecture, the evaluated and revised requirements shall be assigned to those elements of the architecture that were designated when the overall system architecture was developed, and the interface list shall be drawn up.

At the same time the assignment process may be used to identify new elements of the overall system architecture and to add them to the »Interface Overview. It shall be checked for each requirement whether it will have be assigned to the system, to a »Enabling System or to logistics.

3.9.1.5 Defining Scope of Delivery and Acceptance Criteria

Subjects:	Overall System Specification: Acceptance Criteria, Overall System Specification: Scope of Delivery

When defining the scope of delivery and the acceptance criteria, it shall be determined which parts (for example documentation or enabling systems) will have to be delivered to the acquirer together with the system and which acceptance criteria have to be fulfilled.

The information about the scope of delivery and the acceptance criteria shall be adopted directly from the user requirements (project specification) and, if necessary, put in more concrete terms.

3.9.1.6 Preparing Requirements Trace Overview

Subject:	Overall System Specification: Requirements Tracing

As soon as the preliminary design of the architecture has been completed and the scope of delivery and the acceptance criteria have been defined, it shall be checked whether all requirements were assigned to the system elements. For this purpose the elements of the overall system architecture (system, »Enabling Systems, logistic support) shall be related to the non-functional requirements and interfaces of the system. For verification purposes the specified constraints (see the »Project Manual) shall be taken into account.

Provided it was possible to successfully establish all relations, this will verify that all requirements and constraints that were made were addressed by the elements of the system architecture.

3.9.2 Preparing System Specification

Work Product:	System Specification
Method Reference:	Requirements Analysis, Prototyping, System Analysis
Tool reference:	Requirements Management, Integrated Development Environment, Modeling Tool

Purpose

In the specification the requirements and interfaces for each respective system element (System, »Enabling System, Segment) that has to be described shall be determined and accurately described.

When developing the specification (see Figure 21), interfaces and non-functional requirements for the system element will be identified. This will followed by the parallel refinement and assignment of those interfaces and requirements based on the parent system or segment. The design decisions have to be documented in the system specification. Provided the realization that has been prepared will prove to be workable, it will be possible to proceed to the tracing of the requirements. If this will not be the case, the realization will have to be revised.

Requirements usually will bedescribed in text form. The description of the interface specification may assume different forms. Usually graphic description methods in combination with explanatory text will be used.

Activity Flow

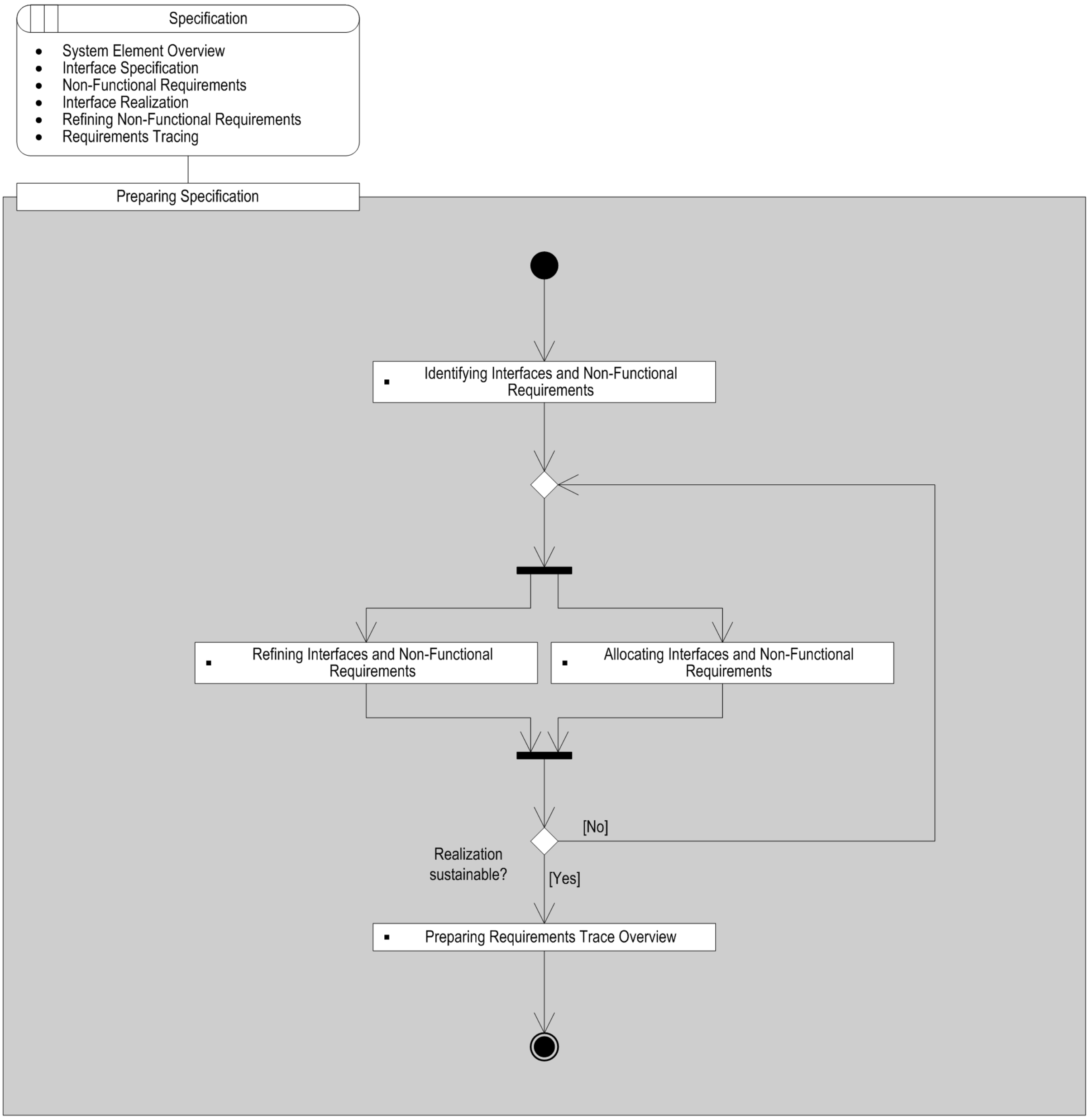

Figure 21: Activity Diagram "Preparing System Specification"

3.9.2.1 Identifying Interfaces and Non-Functional Requirements

Subjects: System Specification: Non-Functional Requirements, System Specification: Interface Specification

The interfaces and non-functional requirements for the system element shall be derived from the specifications of parent system elements. The result will be the complete description of the interface of the system element and the interactions with its environment.

For the description temporal - defined by protocols - and spatial - defined by the underlying communication structure - aspects of the interaction will have to be taken into account. Also possible states of the system element will have to be determined and described appropriately (for example fluid/solid/gaseous state of a material, open/closed position of a mechanical component or high/low bit state).

3.9.2.2 Refining Interfaces and Non-Functional Requirements

Subjects: System Specification: Interface Realization, System Specification: Refining Non-Functional Requirements

The identified functional and non-functional requirements will be refined (specified) and put in more concrete terms. The refinement will be made in a way that the requirements will be assigned to system elements of the next lower level and put in more concrete terms. In this process the assignment of the refined requirements should be based on an abstract architecture. i. e. for the time being the refinement will be made without taking into account the concrete architecture.

3.9.2.3 Allocating Interfaces and Non-Functional Requirements

Subjects: System Specification: Interface Realization, System Specification: Refining Non-Functional Requirements

The refined interfaces and non-functional requirements shall be assigned to the system elements that will have a secondary position in the system hierarchy, taking into account the following aspects:

- Each interface and non-functional requirement shall be assigned to at least one element of the (support) system architecture.
- Each non-functional requirement and interface shall be assigned to the element with the lowest level of detail, which will make it possible to meet the requirement completely. Normally the universal set of requirements and interfaces will have to be assigned to different levels of detail.
- If a non-functional requirement or interface is of importance to more than one element, it will be necessary to weigh within the framework of the assignment which individual elements of the architecture will finally have to fulfill it.
- This assignment shall be made in a way that it will be possible to prove that the requirement has been met by testing the respective system element.

3.9.2.4 Preparing Requirements Trace Overview

Subject: System Specification: Requirements Tracing

If it turns out that a specified realization is workable, it will first have to be checked whether all interfaces and non-functional requirements of the parent system element were realized. Also it will have to be made sure that the refined interfaces and non-functional requirements were completely assigned to the system elements of the next level of the architecture.

3.9.3 Preparing External Unit Specification

Work Product:	External Unit Specification
Method Reference:	Requirements Analysis, System Analysis
Tool reference:	Requirements Management, Integrated Development Environment, Modeling Tool

Purpose

In the »System Specification the requirements and interfaces for the »External Unit shall be marked. They shall be adopted to the »External Unit Specification and realized within the scope of a subcontract, a off-the-shelf product or a line issue.

The external unit specification shall be included in the »Contract with the »Sub-Supplier.

3.9.4 Preparing Hardware Specification

Work Product:	Hardware Specification
Method Reference:	Fault/Reliability Analysis, System Analysis
Tool reference:	Requirements Management, Integrated Development Environment, Construction/Simulation, Modeling Tool

Purpose

In the specification, the requirements and interfaces for each respective hardware element (hardware unit, hardware component or hardware module) that will have to be described shall be defined and accurately described.

For the preparation of the specification (see Figure 21) - analogous to the »System Specification - interfaces and non-functional requirements for the hardware element will be defined, followed by the parallel refinement and assignment of those interfaces and requirements on the basis of the super-ordinate hardware unit or hardware component. The design decisions shall be documented in the hardware specification. If the prepared realization proves to be workable, it will be possible to proceed to the requirement tracking survey. If this is not the case, the realization will have to be revised.

Requirements usually will be described in text form. The specification of the interface may be formalized in various ways. Usually this will be done by using graphic description methods in combination with explanatory text.

3.9.4.1 Identifying Interfaces and Non-Functional Requirements

Subjects:	Hardware Specification: Non-Functional Requirements, Hardware Specification: Interface Specification

Assigned super-ordinate interfaces (see the interface description) and non-functional requirements will have to be identified. At the level of the »Hardware Components the assigned interfaces and non-functional requirements of the super-ordinate »Hardware Unit will be for example adopted without refinement and change as a starting point.

3.9.4.2 Refining Interfaces and Non-Functional Requirements

Subjects: Hardware Specification: Interface Realization, Hardware Specification: Refinement of Non-Functional Requirements

The refining of the interfaces (see the »Interface Specification) and the non-functional requirements will include the following steps:

- With the identified interfaces and non-functional requirements, solutions will have to be defined. In this process the way of looking at the higher level of the architecture will be changed from considering it a "black box" to considering it a "white box". This will mean for example naming the »Hardware Modules in the specification of a »Hardware Component.
- On the basis of the "white box", the identified super-ordinate interfaces and non-functional requirements will be refined.
- In this process also additional, previously unconsidered interfaces and »Non-Functional Requirements may be defined.

It must be possible to verify all interfaces and non-functional requirements and to assign them to the next lower hierarchy level.

3.9.4.3 Allocating Interfaces and Non-Functional Requirements

Subjects: Hardware Specification: Interface Realization, Hardware Specification: Refinement of Non-Functional Requirements

The refined and additionally defined interfaces and non-functional requirements shall be allocated to the hardware elements identified in the "white box". It is recommended to make this description in tabular form.

3.9.4.4 Preparing Requirements Trace Overview

Subject: Hardware Specification: Requirements Tracing

Within the scope of the requirement tracking survey, it will be made sure that all requirements and interfaces will be refined. It shall be checked whether

- for each requirement or interface of a »Hardware Unit there will at least one representation at the level of the »Hardware Components,

- for each requirement or interface of a hardware component there will be at least one representation at the level of the »Hardware Modules,
- with a distributed assignment of a requirement or an interface (the sum of the weight requirements for hardware components is for example equal to the weight requirement defined in the associated hardware unit) this will be fulfilled to the full extent by the subordinate hardware elements.

In every hierarchical design step (e. g. from a hardware unit to hardware components) this requirement shall be tracked.

3.9.5 Preparing External Hardware Module Specification

Work Product:	External Hardware Module Specification
Method Reference:	Requirements Analysis, System Analysis
Tool reference:	Requirements Management, Integrated Development Environment, Construction/Simulation, Modeling Tool

Purpose

The Hardware Specification shall indicate the requirements and interfaces for the product External Hardware Module. These shall be integrated into the External Hardware Module Specification and realized by means of a sub-contract, an off-the-shelf product or a furnished item.

The External Hardware Module Specification specifies the acceptance criteria for the receiving evaluation in the Evaluation Specification Delivery. It will be integrated into the contract with the subsupplier.

3.9.6 Preparing Software Specification

Work Product:	Software Specification
Method Reference:	System Analysis
Tool reference:	Modeling Tool

Purpose

In the specification the requirements and interfaces for each respective software element (software unit, software component or software process module) to be described shall be defined and accurately described.

For the preparation of the software specification (see Figure 21) - analogous to the »System Specification - interfaces and non-functional requirements for the software element will be defined, followed by the parallel refinement and assignment of those interfaces and requirements on the basis of the parent software unit or software component. The design decisions shall be documented in the software specification. If the prepared realization proves to be workable, it will be possible to proceed to the requirement tracking survey. If this is not the case, the realization will have to be revised.

Requirements usually will be described in text form. The specification of the interface may be formalized in various ways. Usually this will be done by using graphic description methods in combination with explanatory text.

3.9.6.1 Identifying Interfaces and Non-Functional Requirements

Subjects: Software Specification: Non-Functional Requirements, Software Specification: Interface Specification

Assigned parent interfaces (see the interface description) and non-functional requirements will have to be identified. At the level of the »Software Components the assigned interfaces and non-functional requirements of the super-ordinate »Software Unit will be adopted for example without refinement or change as a starting point.

3.9.6.2 Refining Interfaces and Non-Functional Requirements

Subjects: Software Specification: Interface Realization, Software Specification: Refinement of Non-Functional Requirements

The refining of the interfaces (see the interface description) and the non-functional requirements will include the following steps:

- With the identified interfaces and non-functional requirements, solutions will have to be defined. In this process the way of looking at the higher level of the architecture will be changed from considering it a "black box" to considering it a "white box". This will mean for example naming the »Software Modules in the specification of a »Software Component.

- On the basis of the "white box" the identified parent interfaces and non-functional requirements will be refined. In this process also additional, previously unconsidered interfaces and non-functional requirements may be defined. It must be possible to verify all interfaces and to assign them to the next lower hierarchy level.

At the respective hierarchy levels the refinement of the interfaces and non-functional requirements will lead to the following activities:

- If necessary, method calls wull have to be refined and assigned to several software elements.

- Parameter value ranges will have to be concretized and refined.

- Exceptions will have to be assigned to the methods of the subordinate elements.

3.9.6.3 Assigning Interfaces and Non-Functional Requirements

Subjects: Software Specification: Interface Realization, Software Specification: Refinement of Non-Functional Requirements

The refined and additionally defined interfaces and non-functional requirements shall be assigned to the software elements identified in the "white box". It is recommended to make this description in tabular form.

3.9.6.4 Preparing Requirements Trace Overview

Subject: Software Specification: Requirements Tracing

Within the scope of the requirement tracking survey it will be made sure that all requirements and interfaces will be refined. It shall be checked whether

- for each requirement or interface of a »Software Unit there will be at least one representation at the level of the »Software Components,
- for each requirement or interface of a software component there will be at least one representation at the level of the »Software Modules,
- with a distributed assignment of a requirement or an interface this will be fulfilled to the full extent by the subordinate software elements.

In every hierarchical design step (e. g. from a software unit to software components) this requirement shall be tracked.

3.10 System Design

The »Discipline System Design includes »Work Products and »Activityies supporting the architectural design and defining a suitable development process.

In the V-Modell, the architectural design is developed at two hierarchy levels - the level of the system or »Enabling System and the unit level. The preliminary design and the design decisions are documented in specific architectural documents. The development process and the integration and evaluation process are specified in the appropriate implementation, integration and evaluation concepts.

Architectural documents and implementation, integration and evaluation concepts are closely connected. It must be possible to develop all system, hardware and »Software Elements identified in the architecture by using the respective implementation, integration and evaluation concept. In addition, system architecture and integration architecture must be consistent in order to ensure the correct implementation of architectural decisions.

The discipline System Design includes an additional product especially for migration projects - the so-called »Migration Concept. This concept specifies the mapping of the legacy system and the new system and the execution of the migration.

3.10.1 Preparing System Architecture

Work Product: System Architecture

Method Reference: Design Verification, Prototyping, System Design

Tool reference: Modeling Tool

Purpose

Starting from the requirements in the »Overall System Specification, a possible structure of the system architecture, respectively a enabling system architecture, will be designed within the framework of an iterative development process.

The development process of the architecture (see Figure 22) will start with the identification of the architectural drivers and the parallel definition of the evaluation criteria. Architectural drivers will usually be explicitly or implicitly provided in the requirements and determine basic characteristics of the architecture (for example a bus structure when communications are concerned or a layer architecture for decomposition). When developing a enabling system, it will have to be considered that they should be possibly integrated and - as far as possible and meaningful - homogeneous (for example a toolchain from one manufacturer). In particular they should support a traceable and end-to-end development process.

Parallel to this evaluation criteria will be defined for the architecture to be developed. They will have to be taken into account in the design of the architecture and provide the basis for future design evaluation.

The documentation of an architectural design will be done by modelling different views on the system. In a first step all views that describe the system appropriately shall be defined. Those views will be modeled with the help of tools and modeling languages (e. g. UML) and supplemented by explanatory texts.

The architecture developed and documented this way will be subjected to a design verification with regard to the requirements and the evaluation criteria.

Activity Flow

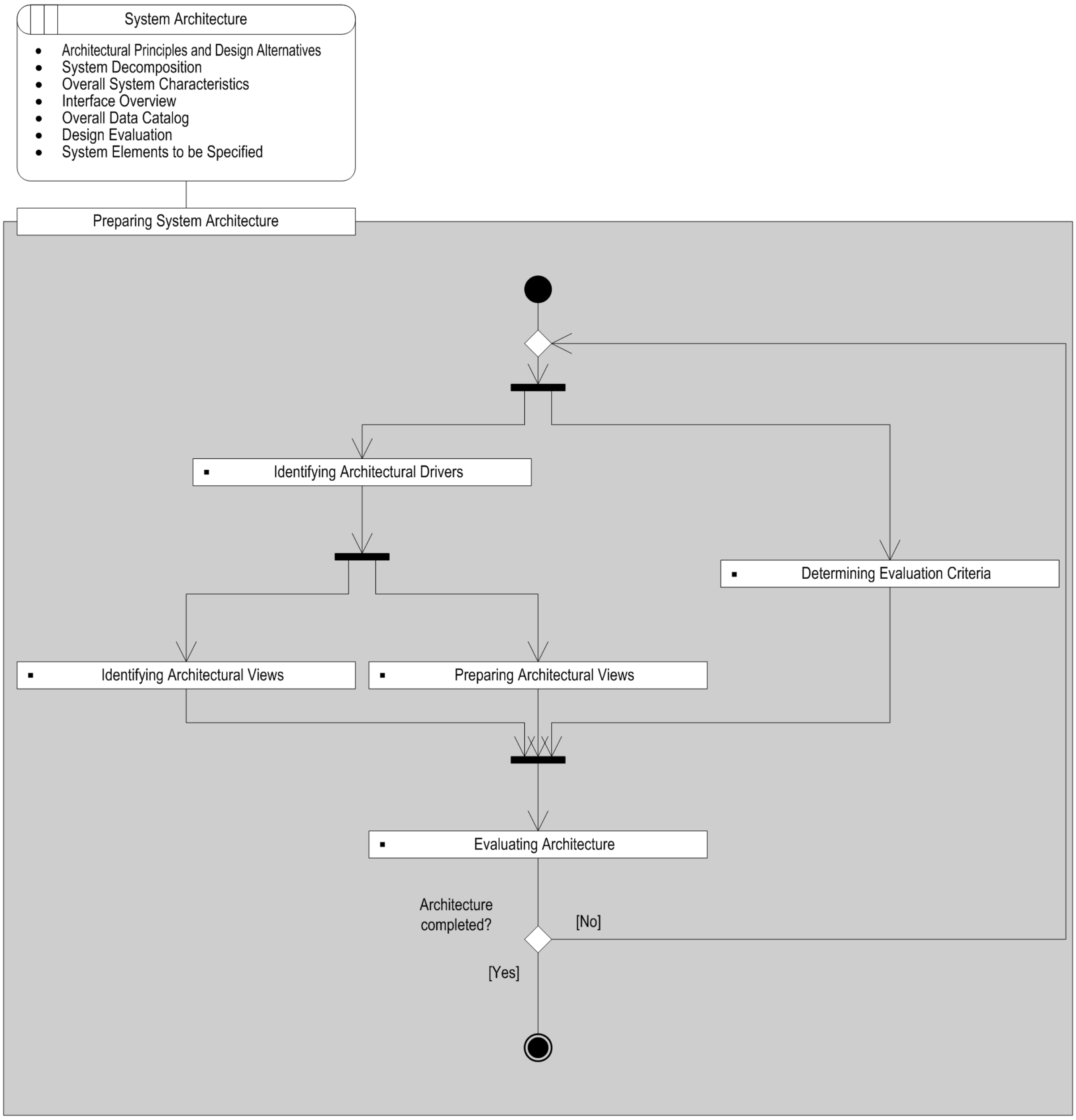

Figure 22: Activity Diagram "Preparing System Architecture"

3.10.1.1 Identifying Architectural Drivers

Subjects: System Architecture: Architectural Principles and Design Alternatives, System Architecture: Overall System Characteristics

For the design of the system architecture in a first step all drivers that will have an impact on the design shall be identified. Examples of architectural drivers will be:

- a decision in favor of a multi-tier architecture

- a desired reuse/reusability of elements
- the required system type (embedded, software-intensive, data-centric)
- the life cycle phases that will have to be supported
- strategic aspects (product family, company philosophy, know-how, resources, economic aspects)
- safety and security.

3.10.1.2 Determining Evaluation Criteria

Subject: System Architecture: Architectural Principles and Design Alternatives

It will be necessary to determine evaluation criteria for the architectural design. The criteria will provide the characteristics according to which the selected design of the architecture will have to be tested. The identification of evaluation criteria will be based in particular on the non-functional requirements defined in the »System Specification. The task of the architecture will be to support those requirements appropriately.

The evaluation criteria shall be ranked and weighted. Additional criteria will be aspects such as interface complexity, usability of off-the-shelf products and suitability of the technical concepts or development specifications.

3.10.1.3 Identifying Architectural Views

Subjects: System Architecture: System Decomposition, System Architecture: Interface Overview, System Architecture: Overall Data Catalog

Starting with the identified architectural drivers, the selection of suitable architectural views shall be continued. A view will describe the system from a particular point of view. Views will be used to reduce the complexity of architectures. In literature frequently a distinction will be made between the following views:

- Static view for the description of the structure of a system (decomposition)
- Dynamic view for the description of the behavior and of the interactions at the interfaces.

Depending on the requirements and the system that has to be developed, the selection of the views may be adjusted at will. The selected views will determine which aspects of the architecture will have to be described.

3.10.1.4 Preparing Architectural Views

Subjects: System Architecture: System Decomposition, System Architecture: Interface Overview, System Architecture: System Elements to be Specified, System Architecture: Overall Data Catalog

The identified views of the architectural design shall be prepared. For each view the relevant architectural aspects will be worked out with the help of suitable description languages.

For the views that will be mentioned as examples in the subactivity Identifying Architectural Views, the following description techniques may be used:

- For the description of the static view: class or component diagrams.
- For the description of the dynamic view: state transition diagrams and interaction diagrams.

Since this is practical, tools should be used to prepare descriptions of the views in a coherent model. In this context tools will frequently support the presentation and ensure consistency within the model. Depending on the method used and the respective tool support, the model may be used as a basis for code generation. A tool-based verification will also be possible.

3.10.1.5 Evaluating Architecture

Subject: System Architecture: Design Evaluation

It will have to be made sure that the selected architectural design will be suitable for the system and workable. The architecture described in the views shall be evaluated on the basis of the evaluation criteria. Within the framework of the evaluation, it shall be checked whether the selected architecture will meet all requirements and be compatible with the interfaces. If this is the case, then the architecture will be assumed to be stable. For the evaluation design verification methods may be used.

3.10.2 Preparing Enabling System Architecture

Work Product: Enabling System Architecture

Purpose

See Aktivity Preparing System Architecture.

3.10.2.1 Identifying Architectural Drivers

Subjects:	Enabling System Architecture: Architectural Principles and Design Alternatives, Enabling System Architecture: Overall System Characteristics

See Identifying Architectural Drivers in activity Preparing System Architecture.

3.10.2.2 Determining Evaluation Criteria

Subject:	Enabling System Architecture: Architectural Principles and Design Alternatives

See Determining Evaluation Criteria in activity Preparing System Architecture.

3.10.2.3 Identfying Architectural Views

Subjects:	Enabling System Architecture: Enabling System Decomposition, Enabling System Architecture: Interface Overview, Enabling System Architecture: Overall Data Catalog

See Identifying Architectural Views in activity Preparing System Architecture.

3.10.2.4 Preparing Architectural Views

Subjects:	Enabling System Architecture: Enabling System Decomposition, Enabling System Architecture: Interface Overview, Enabling System Architecture: System Elements to be Specified, Enabling System Architecture: Overall Data Catalog

See Preparing Architectural Views in activity Preparing System Architecture.

3.10.2.5 Evaluating Architecture

Subject:	Enabling System Architecture: Design Evaluation

See Evaluating Architecture in activity Preparing System Architecture.

3.10.3 Preparing Style Guide for Man-Machine Interface

Work Product:	Man-Machine Interface (Style Guide)
Tool reference:	GUI Tools

Purpose

The rules for designing the man-machine interface may either be adopted from already existing specifications or derived from the results of the task analysis.

For the development of a style guide in a first step general design rules shall be defined. Ideally it will be possible to directly adopt a a specified style (for example Windows Style). A style will determine for example colors, shapes, line width and line direction, the use of shadings or the management of user interfaces, their elements, menu commands, pop-up menu or keyboard commands. Specifications will emerge also from organization-specific design guidelines.

For the user interfaces that will have to be developed all relevant elements will be determined on the basis of the »User Tasks Analysis and the requirements. In accordance with the style found, design rules will be assigned to each element. To obtain ergonomic user interfaces, particular attention shall be directed to consistency and clear structuring.

3.10.3.1 Determining Design Principles and Alternatives

Work Product:	Man-Machine Interface (Style Guide)

When developing user interfaces, knowledge and experience shall be considered that make the handling of the system for the user easier and more efficient. An ergonomic user interface will not only be more pleasant to operate (as aresult, it will be accepted by the users), but may also considerably reduce the cost factor working hours when the necessary skills for the system will be acquired and the system will be used; thus it will lead to higher productivity.

Most user interfaces will be strongly influenced by the respective specialty of the associated use case. Standard tasks that will turn up during execution in several user interfaces (for example searching for or entering specialist data) should therefore be mostly be performed the same way unless the specialty will require an exception: For example, in a search dialogue in special cases a conversational guidance that deviates from the standard may be more user-friendly.

For special tasks or utilization contexts it will be thus necessary to find a balance between global consistency and a user interface that will be optimized for the utilization context. In each case identical elements will have to be formed similarily in varying dialogues.

3.10.3.2 Identifying and Structuring Operation Elements

Subject:	Man-Machine Interface (Style Guide): Identification and Structure of Operation Elements

The operation elements, such as windows, menus, sliders, buttons or turnbuttons, shall be identified or derived from the user profiles listed in the »User Tasks Analysis, the functions that will have to be supported and the environmental conditions, respectively the hardware and software constraints. These operation elements will have to be structured in accordance with the »Design Principles and Alternatives of the man-machine interface.

3.10.3.3 Determining Design Rules

Work Product: Man-Machine Interface (Style Guide)

Based on the specified design guidelines, design regulations shall be allocated to all identified operation elements. In addition to the design regulations for operation elements, additional design regulations for dialogues and windows shall be defined. Apart from the pure look ("look and feel") of an operation element, additional design regulations concerning conversational guidance, help mode and window design shall be defined.

Design Rules for Conversational Guidance

The dialogue design will include for example an efficient conversational guidance, an appropriate error handling and the identification and homogeneous design of dialogue types. With regard to a uniform and thus efficient operation, it will be important for systems with a variety of different dialogues that all dialogues will proceed logically to the same pattern or at least to a small number of patterns. This will be guaranteed by the use of dialogue types. A dialogue type will describe the logical sequence of a whole class of dialogues and may be defined by a state transition diagram or by an activity diagram. This will primarily concern the use case dialogues. In this context it will be important that the number of dialogue types that are defined will be as small as possible across the system. One dialogue type and thus also one state transition diagram will be assigned to each use case dialogue.

Design Rules for the Help Mode

The help mode will support the user in carrying out the dialogues. For the development of the help mode some basic design regulations will have to be observed:

- There should be an entry page with a table of contents.
- There should be a search page for help topics.
- There should be a contextual help for individual fields and use case dialogues.
- General information about the application should be available.

Design Rules for Windows

As dialogues will describe the sequences for the interaction with the application, windows will play the role of the interface between user and application. Windows will be composed of operation elements. Design regulations for windows will thus consider less the look of individual operation elements than rather the partition and design of the window area. When defining the design criteria for windows, in particular the following questions will have to be considered:

- How will the operation elements be distributed in the window (layout)?

- Where will the heading bar be and what elements will it contain?
- What functions will be offered in the menu?
- How will the start of the windows and the application take place?
- How will the application support the modification of the window size?
- What types of dialogue windows will be required? Examples will include query dialogues, reference dialogues, selection dialogues and input dialogues.
- Will it be necessary to use a log-in dialogue for log-in?

3.10.4 Preparing Hardware Architecture

Work Product:	Hardware Architecture
Method Reference:	Design Verification, Fault/Reliability Analysis
Tool reference:	Construction/Simulation, Modeling Tool

Purpose

Within the framework of the preparation of the architecture a »Hardware Architecture of the hardware unit shall be derived from the requirements and defined.

The process of preparing the architecture (see Figure 23) will start with the identification of the architectural drivers and, parallel to that, the definition of the evaluation criteria. Subsequently the architectural views will be identified and worked out.

The latter activity corresponds to the actual design process. The architecture that will have been worked out will be finally evaluated on the basis of the evaluation criteria and selected. The process of preparing the architecture may be carried out in several cycles.

Activity Flow

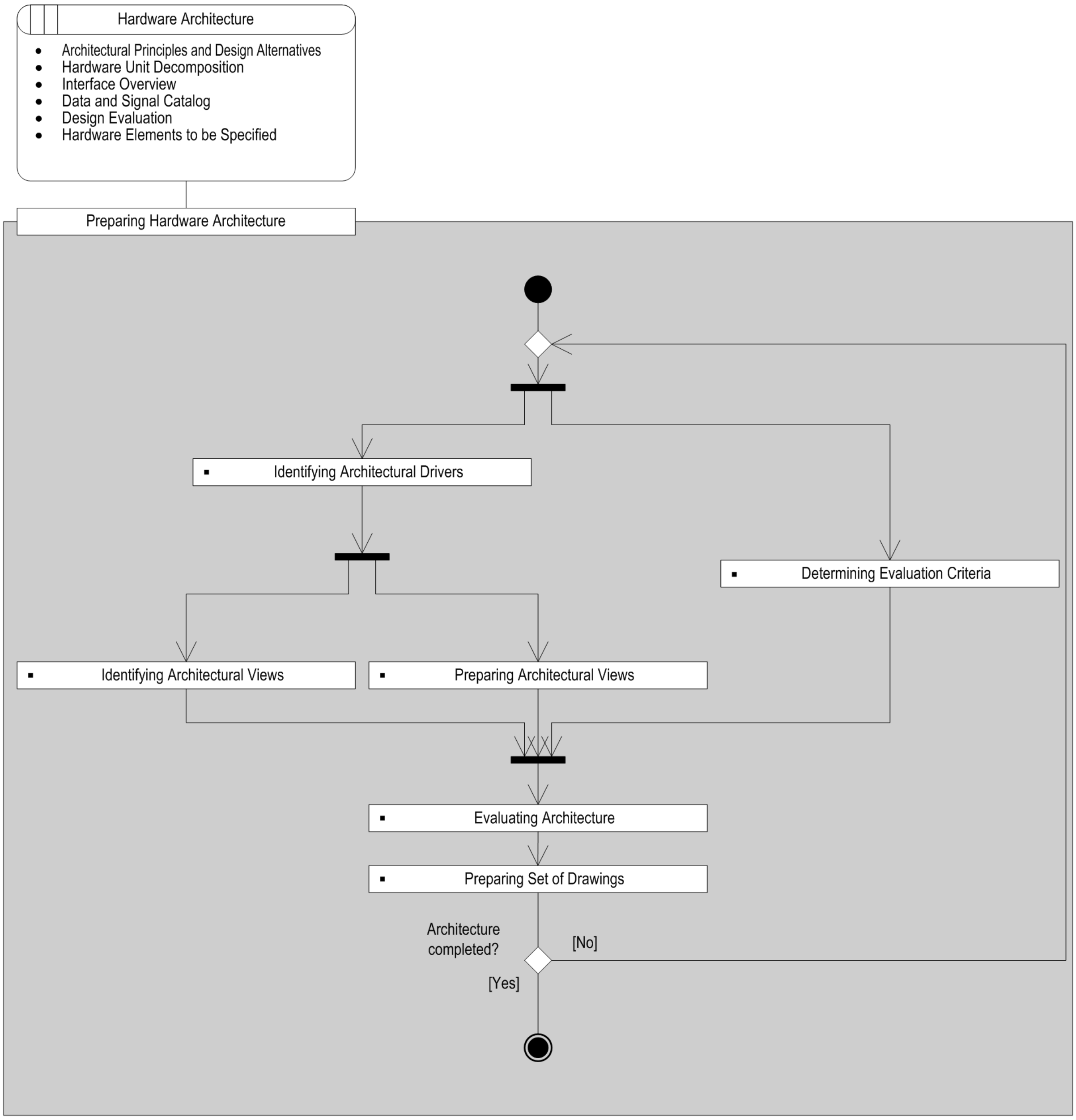

Figure 23: Activity Diagram "Preparing the Hardware Architecture"

3.10.4.1 Identifying Architectural Drivers

Subject: Hardware Architecture: Architectural Principles and Design Alternatives

When identifying architectural drivers, principles for the design of a »Hardware Architecture shall be defined. This may include the following requirements:

- Comparable complexity of the hardware elements

- Minimum number of physical or logic interfaces
- Decoupling of safety-critical and safety-uncritical hardware elements
- Use of bought-out components, such as COTS products (in the form of products of the type External Hardware Module)
- Modularity and reusability

3.10.4.2 Determining Evaluation Criteria

Subject: Hardware Architecture: Architectural Principles and Design Alternatives

Within the scope of this subactivity, different perspectives (views) on the hardware shall be defined (for this see also the description regarding Identifying Architectural Views in the activity Preparing System Architecture).

In the simplest case »Hardware Architectures will be a hierarchical decomposition of the hardware with the associated physical hardware elements, including the interfaces (structural view) and the description of the communication and interaction between the hardware elements or the hardware elements and the environment (protocol view).

It will be possible to define arbitrary additional views on the hardware, which may relate for example to the power consumption, the distribution of masses or the reliability of the hardware.

Appropriately several different views should be prepared to permit easy access and to improve the understanding of the architecture.

3.10.4.3 Identifying Architectural Views

Subjects: Hardware Architecture: Data and Signal Catalog, Hardware Architecture: Hardware Unit Decomposition, Hardware Architecture: Interface Overview

Within the scope of this subactivity various perspectives on the hardware shall be defined. This will include for example

- the hierarchical decomposition of the hardware with the associated physical hardware elements, including the interfaces (structural view);
- the description of the communication and interaction between the hardware elements or the hardware elements and the environment (protocol view).

It will be possible to develop arbitrary views on the hardware, which may relate for example to the power consumption, the distribution of masses or the reliability of the hardware.

Appropriately several different views should be prepared to permit easy access and to improve the understanding of the architecture.

3.10.4.4 Preparing Architectural Views

Subjects: Hardware Architecture: Data and Signal Catalog, Hardware Architecture: Hardware Unit Decomposition, Hardware Architecture: Interface Overview, Hardware Architecture: Hardware Elements to be Specified

Each identified hardware architectural view will have to be prepared (for this see also the description regarding Preparing Architectural Views in the activity Preparing System Architecture). This will include the following steps:

- Identification of the elements and their dependencies within a view,
- Selection of a suitable notation (for example graphically or in text form) for the representation of the view,
- Selection of a suitable tool for the development, preparation and representation of the view,
- Preparation of the view with the selected tools and notations.

Within the scope of the structural view it would be for example possible to prepare a detailed description of the data and signals of a »Hardware Unit with programmable logic. This will include aspects of the representation, such as an identifier, a format description, the range of values, the resolution and an introductory description, as a minimum requirement.

3.10.4.5 Evaluating Architecture

Subject: Hardware Architecture: Design Evaluation

Based on the defined evaluation criteria, the architecture shall be evaluated. For this purpose it may be for example necessary to make analyses, to conduct simulations, to develop prototypes (rapid prototyping) or to build demonstrators.

If an architecture fulfills the evaluation criteria completely, it may be used as a basis for the further development process.

3.10.4.6 Preparing Set of Drawings

Work Product: Hardware Architecture

After the selection of the final architecture, the set of drawings of the »Hardware Unit shall be prepared for manufacturing. For this purpose the following activities shall be carried out:

- Preparation of sketches, construction plans and interface drawings,

- Description of the construction process,
- Identification of the materials,
- Preparation of the wiring diagram,
- Preparation of parts lists,
- Preparation of the connector board layout based on the wiring diagram,
- Preparation of design drawings,
- Preparation of connection diagrams.

As a rule, large parts of the set of drawings can be automatically generated by the appropriate tools.

3.10.5 Preparing Software Architecture

Work Product:	Software Architecture
Method Reference:	Design Verification, Prototyping, System Design
Tool reference:	Modeling Tool

Purpose

When preparing the architecture, a »Software Architecture of the software unit shall be derived from the requirements and defined.

The process of preparing the architecture (see Figure 22) will start with the identification of the architectural drivers and the parallel definition of the evaluation criteria. Then architectural views will be identified and prepared. This preparation will correspond to the actual design process.

The architecture that was prepared will be finally reviewed and selected on the basis of the evaluation criteria. The process of preparing the architecture may be carried out in several cycles.

3.10.5.1 Identifying Architectural Drivers

Subject:	Software Architecture: Architectural Principles and Design Alternatives

When identifying architectural drivers, principles for the design of a »Software Architecture shall be defined. This may be for example the following requirements:

- Distribution specifications
- Decoupling of safety-critical and safety-uncritical software elements

- Use of off-the-shelf products in form of products of the type External Software Module (COTS, open source components, software components provided for re-use)

- Modularity and reusability.

3.10.5.2 Determining Evaluation Criteria

Subject: Software Architecture: Architectural Principles and Design Alternatives

For the design of the architecture of the »Software Unit evaluation criteria shall be defined. These criteria will specify for which properties the selected architectural design will have to be evaluated. The identification of evaluation criteria will be based in particular on the non-functional requirements defined in the »Software Specification. The task of the architecture will be to support these requirements appropriately.

The evaluation criteria shall be prioritized and weighed. Additional criteria will be aspects such as licensing, development efforts or availability of already existing software elements (reuse).

3.10.5.3 Identifying Architectural Views

Subjects: Software Architecture: Data Catalog, Software Architecture: Software Unit Decomposition, Software Architecture: Interface Overview

In this subactivity different perspectives (views) on the software shall be defined (see also the description regarding Identifying Architectural Views in the activity Developing Architecture).

In the simplest case »Software Architectures will be the hierarchical decomposition of the software with the associated software elements, including the interfaces (structural view), and the description of the communication and interaction between the software elements or the software elements and the environment (dynamic view).

It will be possible to define arbitrary additional views on the software, which may relate for example to the deployment, the work flow or the data.

Appropriately several different views should be prepared to permit easier access and to improve the understanding of the architecture.

3.10.5.4 Preparing Architectural Views

Subjects: Software Architecture: Data Catalog, Software Architecture: Software Unit Decomposition, Software Architecture: Interface Overview, Software Architecture: Software Elements to be Specified

Each of the defined architectural views on the software shall be prepared (see also the definition for Preparing Architectural Views in the activity Developing Architecture). This will include the following steps:

- Identification of the elements and their dependencies within a view,
- Selection of a suitable notation (for example graphically or in text form) for the representation of the view,
- Selection of a suitable tool for the development, preparation and representation of the view,
- Preparation of the view with the selected tools and notations.

3.10.5.5 Evaluating Architecture

Subject:	Software Architecture: Design Evaluation

The architectureshall be evaluated on the basis of the defined evaluation criteria. For this purpose it may be for example necessary to define scenarios for the evaluation criteria and to verify their implementation in the architecture or, in individual cases, to develop prototypes of critical elements.

If an architecture fulfills the evaluation criteria completely, it may be used as a basis for the further development process.

3.10.6 Preparing Database Design

Work Product:	Database Design
Method Reference:	Database Modeling

Purpose

The specialist »Data Model in the project specification shall be derived for the »Database Design and represented in the logical data model. Finally the physical data model, which will serve as a template for the database schema, shall be prepared from the logical data model by refining and normalizing this model and by defining integrity constraints.

3.10.6.1 Deriving Logical Data Model

Subject:	Database Design: Logical Data Model

To derive the technical »Data Model, the entities of the specialist data models shall be determined. Across the whole system the entities shall be combined in one model. The attributes and their data types shall be defined, and the relationships between the entities shall be determined.

The logical data model shall be checked for consistency with the design of the architecture of the »Software Units. For each entity of the logical data model one mapping onto elements of one of the »Software Architectures shall be defined. Across the different models mapping rules between architectures and the database shall be defined uniformly.

When using object-oriented paradigms with a relational database (which is one of the most frequent combinations), this is also called object-relational mapping. In this case rules shall be provided that describe how to solve common »Database Design problems uniformly. The rules will provide for example guidelines for:

- the mapping of the entities on tables. Is generally a mapping on a scale of 1:1 used or is the structure of the tables independent of the entities?
- the handling of n:m relationships between entities. A common solution will be to use an additional table for relationships.
- the handling of keys. Which attributes will represent the keys? Are there additional technical keys required?
- the mapping of the inheritance of entities. Different options for this will be described in the literature.
- the degree of (de)normalization. To what degree will normalization be performed? To what degree will denormalization be performed (data warehouse)?
- the implementation of the map. This will be done tool-based, for example with the help of a persistence framework.

3.10.6.2 Designing Database Structure

Subject:	Database Design: Physical Data Model

For designing the actual database schema the technical »Data Model shall be expanded by technical aspects of the database; for example consistency conditions, views or technical keys have to be introduced. The aim will be to develop a schema from which the schema in the database can be directly generated.

3.10.7 Preparing System Implementation, Integration and Evaluation Concept

Work Product:	System Implementation, Integration and Evaluation Concept
Method Reference:	System Design, Test
Tool reference:	Requirements Management, Integrated Development Environment, CM Tool, Construction/Simulation, Modeling Tool

Purpose

When preparing the system or subsystem implementation, integration and evaluation concept (see Figure 24), the realization, step-by-step build-up and quality assurance of the designed system have to be defined.

The desired process will be used as a guideline for the preparation of the concept. In a first step, all relevant requirements and framework conditions shall be formulated in the Project Manual respectively by the acquirer. Those requirements and framework conditions will be considered when describing all environments that will be necessary for the realization of the system.

On this basis, it shall be determined in what order, in which environments and with which tools realization, installation and testing shall be carried out. The aim will be the definition of an appropriate iterative development process.

An integration plan shall be defined as additional information for integration. It will describe which instances of the system elements will be integrated in which sequence into a system.

When the integration plan has been determined, it shall be defined which of the elements in the integration plan will have to be subjected to testing. The rules for this will be provided by the evaluation strategy. For each requirement, the integration plan shall specify which elements shall be tested in order to verify that they meet the requirements.

The evaluation strategy and the integration may influence each other. The individual integration steps shall be defined therefore in a way that evaluation redundancies will be avoided and that risks will be reduced to a minimum by early quality assurance measures. Before the integration begins, it must be ensured that the segments or units to be integrated are in the »Product State »Finished and that they fulfil their respective specifications. The impact on system architecture and »Enabling System Architecture shall be considered.

Activity Flow

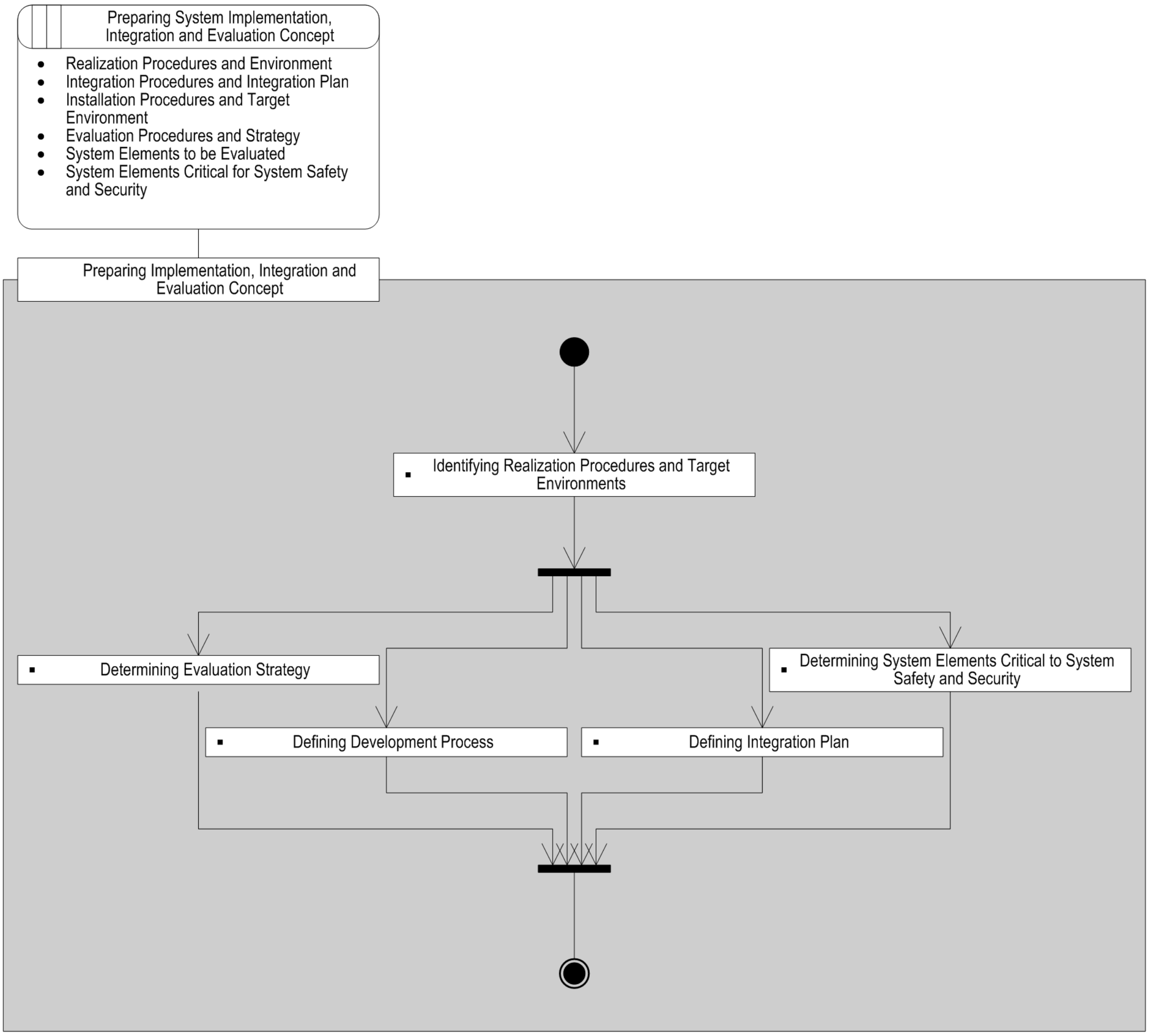

Figure 24: Activity Diagram "Preparing System Implementation, Integration and Evaluation Concept"

3.10.7.1 Identifying Realization Procedures and Target Environments

Subjects: System Implementation, Integration and Evaluation Concept: Installation Procedures and Target Environment, System Implementation, Integration and Evaluation Concept: Realization Procedures and Environment

As preparation for the development process relevant requirements and framework conditions from the project manual shall be identified and defined. For example, the following may be specified:

- the programming language to be used (e. g. Ada, Java, C++, VHDL),
- the platforms to be used (e. g. operating system, communications system),

- the development environment to be used (e. g. IDE, compiler, binder),
- the target environment to be used (e. g. FPGA, processor family),
- the methods be used (e. g. OOA, OOD, SA, OOSE, SD),
- the standards and guidelines to be used (e. g. ISO standards, German DIN standards, VGA standards),
- the line issues and »Enabling Systems to be used (e. g. test equipment, master tooling, host systems, personnel with special training).

3.10.7.2 Defining Development Process

Subjects: System Implementation, Integration and Evaluation Concept: Installation Procedures and Target Environment, System Implementation, Integration and Evaluation Concept: Integration Procedures and Integration Plan, System Implementation, Integration and Evaluation Concept: Evaluation Procedures and Strategy, System Implementation, Integration and Evaluation Concept: Realization Procedures and Environment

When defining the development process, it shall be determined how the requirements and interfaces of the specification can be realized in the system elements.

The process will define a uniform system development approach for all stakeholders in the project. The selected approach should be supported by the selected development environment. An appropriate documentation of this approach will support the familiarization of new stakeholders in the project with the new work.

3.10.7.3 Preparing Integration Plan

Subject: System Implementation, Integration and Evaluation Concept: Integration Procedures and Integration Plan

Parallel to the definition of the development process, the integration architecture shall be derived from the system architecture, and the building plan for the system elements shall be laid down. In this connection at first the system elements that shall be integrated and, on top of that, the integration sequence shall be determined for all system elements.

In order to permit the realization of the integration, also the requirements for each system element shall be described in the order of integration (for example the cabling sequence, individual steps of the software download on the hardware or the description of a makefile).

3.10.7.4 Determining Evaluation Strategy

Subjects: System Implementation, Integration and Evaluation Concept: Evaluation Procedures and Strategy, System Implementation, Integration and Evaluation Concept: System Elements to be Evaluated

For determining the evaluation strategy the specifications from the »QA Manual shall be adopted. In the evaluation strategy the following shall be determined:

- Which requirements will be tested for each integration step with which environment?
- Which requirements will be tested at what level of the system elements? Usually quality requirements, just as environmental requirements, will be verified at higher levels.
- Which system elements will be verified together because of dependencies concerning content and structure? Typically »Segments will be tested on a vibrating table as a whole and not each of the individual components of the segment.
- Which tests will be covered by simulation at which level? For destructive testing an obvious solution will be to conduct simulations at the lower levels of the system elements and to perform the actual test during final acceptance or at higher system levels.

The individuals of the system elements will refine the evaluation strategy and determine how it is implemented.

3.10.7.5 Determining System Elements Critical to Safety and Security

Subject: System Implementation, Integration and Evaluation Concept: Safety and Security Relevant System Elements and Safety and Security Measures

See Determining System Elements Critical to Safety and Security in activity Preparing Enabling System Implementation, Integration and Evaluation Concept.

3.10.8 Preparing Enabling System Implementation, Integration and Evaluation Concept

Work Product: Enabling System Implementation, Integration, and Evaluation Concept

Purpose

See Aktivity Preparing System Implementation, Integration and Evaluation Concept.

3.10.8.1 Identifying Realization Procedures and Target Environments

Subjects: Enabling System Implementation, Integration, and Evaluation Concept: Installation Procedures and Target Environments, Enabling System Implementation, Integration, and Evaluation Concept: Realization Procedures and Environment

See Identifying Realization Procedures and Target Environments in activity Preparing System Implementation, Integration and Evaluation Concept.

3.10.8.2 Defining Development Process

Subjects: Enabling System Implementation, Integration, and Evaluation Concept: Installation Procedures and Target Environments, Enabling System Implementation, Integration, and Evaluation Concept: Integration Procedures and Integration Plan, Enabling System Implementation, Integration, and Evaluation Concept: Evaluation Procedures and Strategy, Enabling System Implementation, Integration, and Evaluation Concept: Realization Procedures and Environment

See Defining Development Process in activity Preparing System Implementation, Integration and Evaluation Concept.

3.10.8.3 Preparing Integration Plan

Subject: Enabling System Implementation, Integration, and Evaluation Concept: Integration Procedures and Integration Plan

See Preparing Integration Plan in activity Preparing System Implementation, Integration and Evaluation Concept.

3.10.8.4 Determining Evaluation Strategy

Subjects: Enabling System Implementation, Integration, and Evaluation Concept: Evaluation Procedures and Strategy, Enabling System Implementation, Integration, and Evaluation Concept: System Elements to be Evaluated

See Determining Evaluation Strategy in activity Preparing System Implementation, Integration and Evaluation Concept.

3.10.8.5 Determining System Elements Critical to Safety and Security

Subject: Enabling System Implementation, Integration, and Evaluation Concept: Safety and Security Relevant System Elements and Safety and Security Measures

When identifying safety and security critical elements, those system elements, for which there will be a risk and for which a security classification will be required, shall be identified and documented. This may be either the system or »Enabling System itself or those system elements that will emerge during the decomposition.

For every determined danger, possible causes and risks shall be evaluated and assessed with regard to their the risk of occurrence, the risk detection and the importance of the risk - particularly with a view to the possible damage - and possible risk-minimization measures shall be identified.

If the evaluation provides a result which lies above a specified threshold value, the respective system element will be regarded as safety and security critical, and a »Safety and Security Analysis shall be conducted. The safety and security classification of every system element depends on the evaluation of its specific danger and risk potential

For each system element considered it shall be determined,

- whether it will be safety and security-relevant (yes/no);
- which danger may arise from the system element;
- which possible damage may be caused;
- what the safety and security level (which is sometimes also called criticality level, assurance level or evaluation assessment level) of the system element will be;
- whether a hazard and safety analysis will be required or
- whether additional measures or documentation elements, such as validation plan or safety and security report, will be required in accordance with the defined safety and security standard.

3.10.9 Preparing Hardware Implementation, Integration and Evaluation Concept

Work Product:	Hardware Implementation, Integration and Evaluation Concept
Method Reference:	Process Analysis, Test
Tool reference:	Construction/Simulation, Modeling Tool, Test Tool

Purpose

When preparing the hardware implementation, integration and evaluation concept (see Figure 24), it shall be determined how the developed hardware unit will be realized, how it will be assembled step by step and how its quality assurance will be carried out.

The preparation of the concepts will start with the identification of realization and target environment requirements. This will be followed by the definition of the development process and the evaluation strategy and the preparation of the integration plan. These sub-activities shall be carried out at the same time. A detailed description will be provided in the activity »Preparing System Implementation, Integration and Evaluation Concept.

3.10.9.1 Identifying Standards for Realization and Target Environments

Subjects: Hardware Implementation, Integration and Evaluation Concept: Installation Procedures and Target Environments, Hardware Implementation, Integration and Evaluation Concept: Realization Procedures and Environments

For the realization of the hardware elements specifications shall be defined. In this process for example realization standards (such as German Military standards, German DIN standards and IPC standards) or occupational safety requirements shall be determined. Also a realization environment shall be selected.

When developing programmable logic, the following preliminary tasks for the installation in the target environment shall be performed:

- Definition of generating procedures for the transformation of the technology-independent code into the technology-specific programming file
- Definition of installation procedures for the integration of the programming file into the target hardware
- Description of the generation of the programming file (usually synthesis and placement)
- Description of the integration of the programming file into the target hardware.

3.10.9.2 Defining Development Process

Subjects: Hardware Implementation, Integration and Evaluation Concept: Installation Procedures and Target Environments, Hardware Implementation, Integration and Evaluation Concept: Integration Procedures and Integration Plan, Hardware Implementation, Integration and Evaluation Concept: Evaluation Procedures and Strategy, Hardware Implementation, Integration and Evaluation Concept: Realization Procedures and Environments

When defining the development process, the realization and installation approach shall be described. Care will have to be taken that the dependencies as regards content will be appropriately considered and described. When developing the hardware elements, it will be already possible to integrate and test some of the elements while the realization of other hardware elements will not yet have been finished.

Finally hazard and risk analyses shall be made for those hardware elements that will be classified critical to security. Based on the results of the analyses, engineering and analytical measures for ensuring system security and integrity of the »Hardware Unit shall be defined.

3.10.9.3 Preparing Integration Plan

Subject: Hardware Implementation, Integration and Evaluation Concept: Integration Procedures and Integration Plan

The assembly and the step-by-step testing of the hardware elements shall be described in detail. Integration and activation may proceed step by step. »Hardware Modules or »Hardware Components will be integrated into substructures. By adding additional hardware elements, additional substructures may emerge. Substructures may be relevant both to the integration process and to manufacturing. The complete structure then will represent the completely integrated »Hardware Unit.

3.10.9.4 Specifying Evaluation Strategy

Subjects: Hardware Implementation, Integration and Evaluation Concept: Evaluation Procedures and Strategy, Hardware Implementation, Integration and Evaluation Concept: Hardware Elements to be Evaluated

Starting from the evaluation strategy of the parent »System Implementation, Integration and Evaluation Concept or »Enabling System, the evaluation strategy for the hardware elements shall be derived. From the point of view of cost-effectiveness, functionality, complexity, safety and security, quality and efficiency the hardware elements to be tested shall be determined. As a rule, the specified hardware elements should be tested.

The individual steps of the evaluation procedure and the test methods shall be documented in summary form.

3.10.9.5 Determining Hardware Elements Critical to Safety and Security and Security

Subject: Hardware Implementation, Integration and Evaluation Concept: Safety and Security Relevant Hardware Elements and Safety and Security Measures

Hardware elements critical to safety and security shall be identified and allocated to appropriate safety and security levels. It will also have to be specified whether it will be necessary to prepare a »Safety and Security Analysis.

A detailed description can be found in the »Work Step Determining System Elements Critical to Safety and Security in the activity »Preparing System Implementation, Integration and Evaluation Concept.

3.10.10 Preparing Software Implementation, Integration and Evaluation Concept

Work Product: Software Implementation, Integration and Evaluation Concept

Method Reference:	Review, Test
Tool reference:	Compiler, CM Tool

Purpose

When preparing the software implementation, integration and evaluation concept (see Figure 24), it shall be determined how the developed software unit will be realized, how it will be assembled step by step and how its quality assurance will be carried out.

The preparation of the concepts will start with the identification of the realization and target environment requirements. This will be followed by the definition of the development process and the evaluation strategy and the preparation of the integration plan. These sub-activities shall be carried out at the same time. A detailed description will be provided in the activity »Preparing System Implementation, Integration and Evaluation Concept.

3.10.10.1 Identifying Realization Targets and Target Environments

Subjects:	Software Implementation, Integration and Evaluation Concept: Installation Procedures and Target Environments, Software Implementation, Integration and Evaluation Concept: Realization Procedures and Environments

For the realization of the software elements and the definition of the target environments specifications shall be derived from the project manual or from the »QA Manual.

Specifications may affect the tools or paradigms to be used, and they may define target environments for the software elements. The specifications usually will be based on acquirer requirements or on the specification of various standards and norms.

3.10.10.2 Defining Development Process

Subjects:	Software Implementation, Integration and Evaluation Concept: Installation Procedures and Target Environments, Software Implementation, Integration and Evaluation Concept: Integration Procedures and Integration Plan, Software Implementation, Integration and Evaluation Concept: Evaluation Procedures and Strategy, Software Implementation, Integration and Evaluation Concept: Realization Procedures and Environments

When defining the development process, the realization and installation approach shall be described. Care must be taken that the dependencies as regards content will be appropriately considered and described. When developing the software elements, it will be already possible to integrate and test some of the elements while the realization of other software elements will have not yet been finished.

Finally hazard and risk analyses shall be made for those software elements that will be classified critical to safety and security. Based on the results of the analyses, engineering and analytical measures for ensuring safety and security and integrity of the »Software Unit shall be defined.

3.10.10.3 Preparing Integration Plan

Subject:	Software Implementation, Integration and Evaluation Concept: Integration Procedures and Integration Plan

The integration and the step-by-step testing of the software elements shall be described in detail. »Software Modules or »Software Components will be integrated hierarchically into additional software components and finally into the »Software Unit. In the integration plan the integration architecture and the integration sequence will be defined.

3.10.10.4 Determining Evaluation Strategy

Subjects:	Software Implementation, Integration and Evaluation Concept: Evaluation Procedures and Strategy, Software Implementation, Integration and Evaluation Concept: Software Elements to be Evaluated

Starting with the evaluation strategy of the super-ordinate »System Implementation, Integration and Evaluation Concept or »Enabling System, the evaluation strategy for the software elements shall be derived. It will be determined what testing methods will be used and what software elements shall be tested.

The individual steps of the evaluation procedure and the test methods shall be documented in summary form.

3.10.10.5 Determining Software Elements Critical to Safety and Security and Security

Subject:	Software Implementation, Integration and Evaluation Concept: Safety and Security Relevant Software Elements and Safety and Security Measures

Software elements critical to safety and security shall be identified and classified according to appropriate safety levels. It also shall be specified whether it will be necessary to prepare a hazard or »Safety and Security Analysis.

A detailed description can be found in the »Work Step Determining System Elements Critical to Safety and Security in the activity »Preparing System Implementation, Integration and Evaluation Concept.

3.10.11 Developing Migration Concept

Work Product:	Migration Concept
Tool reference:	Integrated Development Environment

Purpose

When a migration will be planned, content, scheduling and organizational aspects shall be considered. It shall be defined in detail how the migration shall be carried out and which data and interfaces shall be migrated.

The framework conditions for the migration shall be identified, and the strategy for carrying it out shall be determined. Migration stages with activities that shall be carried out shall be planned, and it shall be determined how changes of the respective stage could be cancelled if required (rollback strategy).

The data flow shall be defined, and the condition of the data shall be examined. Depending on the results, the data transformation shall be defined. The migrated parts of the system will represent units of the system that shall be developed and will be integrated after the migration.

3.10.11.1 Specifying Migration Approach

Subjects: Migration Concept: Migration Strategy, Migration Concept: Migration Overview, Migration Concept: Rollback Strategy

When planning and carrying out a migration all essential framework conditions shall be taken into account. This will include for example the time window that will be available for a migration, the effects a failure of the migration would have on the business processes or the available personnel and the know-how.

Depending on the results, the strategy for carrying out the migration will be determined.

3.10.11.2 Defining Data Map

Subject: Migration Concept: Data Migration

For the definition of the data map the »Data Model of the legacy system and the physical data model of the new system shall be compared. For each field the map will be defined in concrete terms. When doing this, for example the following aspects shall be considered:

- Will the structure of the legacy system be adopted and what will possibly have to be adapted?
- Which field of the old data model will be mapped on which field of the new data model and what will the map look like?
- On which data types will the data of the field mapped? Will it be necessary to carry out a type conversion?
- Which changes will have to be made on the data themselves?
- Will parts of the data will not be migrated?

The definition of the data map and the »Data Migration should be tool-based. Today a number of tools, for example in the field of data warehouses or provided by the databases themselves, that support this work suitably, are available.

3.10.11.3 Planning Migration

Subject: Migration Concept: Migration Plan

The execution of the migration shall be planned. The migration shall be planned in detail within the time window determined in the strategy, allowing sufficient time for a possible rollback of the changes.

For planning purposes the activities that shall be carried out will be identified and described, providing information about their duration and determining the responsible persons. The identified activities will be combined in stages that are determined by logical and time considerations.

The »Rollback Strategy will be planned analogously to migration planning. For the stages of migration planning all activities concerning the rollback of changes shall be scheduled, and for each stage the last possible time (from the time and content point of view) for performing a rollback shall be defined.

3.11 Logistic Elements

This discipline summarizes all »Work Product s and »Activityies prepared for implementing the logistic support of a system. It includes primarily the system documentation, which consists of »Training Documentation and »In-Service Documentation . These two logistic elements are mandatory for every system and thus included in the »System Development. The additional »Logistic Elements - »Maintenance Documentation, »Repair Documentation and »Spare Parts Catalog - complement the work products of the type »Logistic Support Documentation if the process module »Integrated Logistic Support was selected (see »Structural Product Dependencies).

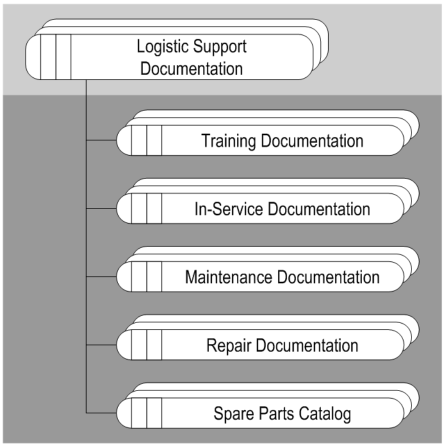

Figure 25: Logistic Support Hierarchy

3.11.1 Preparing Training Documentation

Work Product: Training Documentation

Purpose

The organization of the acquirer shall be considered already in the Overall System Specification. The job profiles for which training measures will be necessary shall be determined.

The training documentation shall enable the student to follow the instruction and make suitable notes. If required, examination papers or training records for training measures shall be developed, which may be used for written or oral examinations on the training subject.

The preparation of training documents will briefly be illustrated by the example of participants documents. At first, scope, structure and time required for the training shall be planned. Important information for this purpose shall include training level and number of students. The necessary contents will primarily be derived from the in-service documentation and prepared for the participants documents according to didactic asepects and to customer demand. Afterwards, the portions belonging to the participants documents will be integrated into the respective layout or the selected medium.

3.11.1.1 Preparation of Training

Work Product: Training Documentation

The training shall be prepared in the following steps:

- Determine the training level of the trainees
- Define the minimum and maximum number of trainees
- Determine the required time and the training tools for each training measure
- Define and structure the learning units
- Define the learning objectives for each learning unit (training objective, broad aim, specific aim)
- Determine required time and training tools for each learning unit.

A curriculum may be used to structure the preparation of training, which in turn will structure the further preparation activities for the »Training Documentation, since for each learning unit defined in the curriculum »Instructor Documentation and »Participants Dokumentation will have to be prepared.

3.11.1.2 Acquiring Data for Training Documentation

Work Product: Training Documentation

»Training Documentation will be based on the »In-Service Documentation, the »Maintenance Documentation and the »Repair Documentation. The most important activities described in these documents will be integral parts of the training.

Further data acquisition will be made in analogy to the subactivity »Acquiring Data for In-Service Documentation in the activity »Defining In-Service Documentation.

3.11.1.3 Didactically Adapting Training Documentation

Work Product: Training Documentation

The training documentation will be based on the In-Service, Maintenance and »Repair Documentation. To impart the training subject, the information included in the documents shall be didactically adapted.

For this purpose; learning objectives shall be specified, pictures and comparisons shall be used and important facts shall be repeated. Also regular progress checks and practical exercises shall be incorporated.

3.11.1.4 Compiling and Integrating Training Documentation

Work Product: Training Documentation

The approach to compiling and integrating »Training Documentation will be analogous to the subactivity »Compiling and Integrating In-Service Documentation of the activity »Defining In-Service Documentation.

3.11.2 Defining In-Service Documentation

Work Product: In-Service Documentation

Purpose

The »In-Service Documentation will enable the user of a system to use this system in accordance with the regulations. It will be directed at persons who will usually differ in their level of education, professional qualification and background knowledge, familiarity with the system (beginner, advanced student, expert) and job profile within the organization. When preparing the documentation, it will therefore be necessary to take into account the needs of the addressees. Even if only the documentation is used, the system will have to disclose itself to every user. In case of addressee groups with large differences in their profiles, several in-service documentations shall to be prepared, for example a tutorial for beginners and a reference manual for experts.

The definition of In-Service Documentation is briefly illustrated by the example of a documentation for installation and operation. First the structure will be designed, e.g., by means of a table of contents. Then the information required for filling the structure with contents will be collected. Afterwards the existing information will be revised editorially according to customer demand. Finally, the portions belonging to installation and operation will be integrated into the respective layout or the selected medium.

3.11.2.1 Defining In-Service Documentation

Work Product: In-Service Documentation

For each document a table of contents shall be prepared, taking into consideration norms and standards requested by the acquirer or generally applicable.

For military technical manuals, special standards will apply, which shall be defined together with the acquirer before the start of the project. For an Interactive Electronic Technical Documentation (IETD) for example the standards ASD Spec 1000D and »AECMA Simplified English will be specified. For documentations on paper, for example, standards such as »GAF T.O. C-2-1 or »H011 shall be used.

For multimedia documentation scripts or other suitable »Templates shall be prepared. Title pages, front matter, style sheets, DTDs and layouts shall be defined as templates.

3.11.2.2 Acquiring Data for In-Service Documentation

Work Product: In-Service Documentation

The collection of information required for the preparation of the documentation (such as texts, pictures, wiring diagrams, internal wiring and assembly diagrams and block diagrams) will precede the preparation of the manuscript.

Information sources will include existing documents, logistic and other databases, drawings generated with CAD systems and all relevant documents produced in the development process. In case documents required for the preparation of the documentation are lacking, they shall be requested immediately.

If required, interviews shall be conducted to obtain additional information. If the documents are prepared in connection with the preparation of training, data collection activities shall be linked. Data acquisition will also include making pictures and procuring multimedia contributions (videos, sound recordings).

3.11.2.3 Editing In-Service Documentation

Work Product: In-Service Documentation

When editing »In-Service Documentation, existing texts shall be formulated so that they will meet the requirements of the acquirers. They also shall be adapted to the required information depth. The wordings used shall be unambiguous, comprehensible and so that they will meet the requirements of the users. Depending on the medium used for publication, information shall be processed in a way that it is text- or picture-oriented.

Existing drawings, block diagrams, diagrams and photographs shall be adapted to the requirements of the documentation and standardized. If required, position numbers shall be inserted and drawings and graphs that are not available shall be prepared. Animations, simulations, interactive presentations, audio and video parts used in electronic multimedia documentation shall be prepared.

Finally safety warnings and security references and references to assemblies exposed to electrostatical hazards shall be incorporated.

3.11.2.4 Compiling and Integrating In-Service Documentation

Work Product: In-Service Documentation

The prepared documentation shall be integrated into the planned layout in accordance with the existing table of contents - in manuals or electronic documentation, depending on the medium. Components supplied by »Sub-Suppliers or partners in a consortium shall be brought in line with the standards used and also integrated into the documentation.

Animations, simulations, interactions and audio and video parts used in multimedia electronic documentation shall be incorporated as required by the script.

The homogeneity of the presentation of text and graphics shall be ensured. Numberings and numbers of figures shall be included so that they will be consistent, and cross-references and hyperlinks shall be prepared or updated.

After integrating the contents, they shall be compared with the realized system hardware/software. In this process in particular the safety warnings and security references shall be checked. Then the final editing will be done.

3.11.3 Preparing Maintenance Documentation

Work Product: Maintenance Documentation

Purpose

The preparation of the »Maintenance Documentation will be based on the analysis of the logistic requirements (see »Analyzing Initial Situation and Logistic Requirements), the logistic support concept and the logistic analyses and calculations. In this context the organization of the maintenance work at the facilities of the acquirer, the maintenance levels and their contents and the actions taken at each maintenance level shall be considered.

Maintenance actions shall be combined in packages in the form of maintenance levels and synchronized with each other. Several actions should be taken at the same time to keep the life cycle costs of the systems as low as possible. This will form the foundation for the »Maintenance Plan.

For each maintenance action it first shall be determined in which steps it will be taken and which particular activities will be required for it. In the »Maintenance Instructions these steps shall be described accurately and replicably so that they can be replicated by the maintenance personnel. Required measuring and test equipment as well as standard and special tooling shall be included in the description.

The »Maintenance Instructions will prepared similar to the »In-Service Documentation, i. e. in the following steps: the instruction will be prepared, the data will be acquired, the instruction will be edited and then compiled and integrated.

3.11.4 Preparing Repair Documentation

Work Product: Repair Documentation

Purpose

The work processes for diagnosis and repair shall be identified, determined and described (see »Analyzing Initial Situation and Logistic Requirements), taking into account the tools and the measuring and test equipment available at the facilities of the acquirer. While the »Diagnosis Instructions will describe diagnostic testing (for example with the help of fault trees), the »Repair Instructions will outline corrective action and the subsequent testing of the repaired system.

The technical author shall describe diagnosis and repair in simple, replicable steps and illustrate them with additional graphical representations. The use of the measuring and test equipment required for this purpose and the use of the standard and special tooling shall be specified. The descriptions shall be accurate, detailed and unambiguous so that the repairman in the organization of the acquirer will be able to execute them without any errors.

The »Repair Instructions and the »Diagnosis Instructions will be prepared similar to the »In-Service Documentation, i.e. in the following steps: the instruction will be prepared, the data will be acquired, the instruction will be edited and then compiled and integrated.

3.11.5 Defining Spare Parts Catalog

Work Product: Spare Parts Catalog

Purpose

The spare parts catalog shall be prepared on the basis of the spare part definition. The spare parts catalog will allow the user to identify and order a spare part. When preparing the catalog, care shall be taken that the catalog is clearly arranged, that the spare parts are unambiguously identified in the »List Section and that the spare part is clearly depicted in the »Illustrated Section.

The »Spare Parts Catalog shall be generated from bills of material, spare parts lists, and engineering drawings. Each spare part shall be defined with a name and made up with a part identifier (for example the stock number) and, if necessary, additional identification numbers. Identification numbers such as ENGDAT or EAN/EANCOM, will for example be required for electronic order and delivery catalogues or EDI data exchange. The engineering drawings shall be converted to three-dimensional projections and three-dimensional exploded views to support the user in the identification of the spare parts.

If the acquirer operates his own logistic information system, the processing sequence, the data elements to be delivered and the data transmission shall be coordinated with the supplier.

For military NATO systems usually a codification (NATO codification) shall be performed. The codification will be specified in the standards »B007 or »ASD Spec 2000M. Essential work steps of the codification will be the identification of the supply item with the help of functional description, bills of material and engineering drawings, the classification on the basis of the above-mentioned documents, the numbering of the supply item by assigning the stock number and the publishing or this stock number in the spare parts catalog and in the NATO Master Catalog of References for Logisticians (NMCRL).

The preparation of the spare parts catalog will be planned in the activity »Planning Project of the »Process Module »Project Management.

3.11.5.1 Defining Spare Parts Catalogue

Work Product: Spare Parts Catalog

Starting point will be the spare parts identified in the product »Logistic Calculations and Analyses. Within the scope of this subactivity the spare parts shall be listed, structured and classified. In case costly graphic projections should be required, they will have to be planned. This will apply in particular to three-dimensional exploded views.

Further actions will be taken analogously to the subactivity »Defining In-Service Documentation in the activity »Defining In-Service Documentation.

3.11.5.2 Acquiring Data for Spare Parts Catalog

Work Product: Spare Parts Catalog

The data acquisition approach for the spare parts catalog will be analogous to the subactivity »Acquiring Data for In-Service Documentation in the activity »Defining In-Service Documentation.

3.11.5.3 Developing Spare Parts Catalog

Work Product: Spare Parts Catalog

In order to develop the spare parts catalog, the data of the parts shall be compiled and, if available, entered into a database. The data shall be exchanged with the acquirer so that they can be checked.

Available drawings, block diagrams and diagrams shall be adapted to the requirements of the catalog and standardized. They will be provided with item numbers to make it easier to locate the parts. Beyond that, drawings and graphics that will not be available shall to be prepared.

3.11.5.4 Compiling and Integrating Spare Parts Catalog

Work Product: Spare Parts Catalog

The approach to compiling and integrating the spare parts catalog will be analogous to the subactivity »Compiling and Integrating In-Service Documentation in the activity »Defining In-Service Documentation.

3.11.6 Integrating into Logistic Support Documentation

Work Product:	Logistic Support Documentation
Method Reference:	Review, Test
Tool reference:	Construction/Simulation

Purpose

From the documentation and the »Training Documentation, the »Logistic Support Documentation shall be prepared, taking into account all requirements of the »Overall System Specification. Depending on the required scope of logistic support, additional specifications of the products Logistic Support Concept and Logistic Support Planning shall be considered.

An acceptance inspection by the acquirer, which may be necessary (for example »Delivery of test review drafts of technical documentation), shall be planned. Additionally, it shall be ensured that the logistic elements will be subjected to »Configuration Management and that the prepared documents will be archived.

The integration into the support documentation will be carried out in the activity »Planning Project of the »Process Module »Project Management.

3.12 Logistic Conception

Up to 80 percent of the system life cycle costs may be influenced by the logistic concept, which is a significant basis for optimizing life cycle costs, thus being decisive for acceptance and success of the in-service use.

The discipline Logistic Concept comprises products and activities required for planning and developing the logistic support. It includes the »Logistic Support Specification, a »Logistic Support Concept and »Logistic Calculations and Analyses.

3.12.1 Preparing Logistic Support Specification

Work Product:	Logistic Support Specification
Method Reference:	Requirements Analysis, System Analysis
Tool reference:	Requirements Management, Modeling Tool

Purpose

On the basis of the »Overall System Specification the requirements concerning the logistic support to be realized and the »Logistic Elements shall be defined via the »Logistic Support Specification. The specification for logistic support at the highest level will be prepared in close coordination with the acquirer.

The logistic support specification shall be prepared in the form of a document or a data package within the framework of a Logistic Support Analysis (LSA, see »MIL-STD 1388-1A and »MIL-STD 1388-2B).

3.12.1.1 Analyzing Initial Situation and Logistic Requirements

Subjects:	Logistic Support Specification: Initial Situation, Logistic Support Specification: Logistic Requirements

When the initial situation will be analyzed, the actual situation at the location of the acquirer will be recorded and analyzed. These considerations will become important if a system of this kind already exists and is to be replaced by a new one or if the system to be developed is to be integrated into existing organizational procedures or technology.

The operational environment in which the system shall be used and its physical load shall be described to the point that all circumstances concerning its use, maintenance and repair will be known. The use or modification of existing logistic resources shall be examined.

Nature and extent of the required maintenance and repair actions shall be determined. These may be compiled and presented as follows:

1. On the basis of a »Fault/Reliability Analysis, the fault possibilities of the system shall be analyzed and described. The presentation of the results should be based on the selected system architecture.

2. On the basis of the identified fault possibilities the preventive and corrective actions required for defect removal shall be presented.

3. On the basis of the »Fault/Reliability Analysis the frequency of the identified corrective and preventive actions that is to be expected shall be determined and presented.

Also the requirements from the »Overall System Specification shall be analyzed and further specified. Requirements to be met with regard to availability, supportability, reliability, maintainability etc. shall be defined and put into more concrete terms as far as this is possible and can be derived from the »Overall System Specification. Additional requirements will result from the analysis of relevant norms, regulations and standards.

The specification shall include quantitative estimates that make it possible to determine the correct order of magnitude when making fundamental logistic decisions. If required, logistic calculations and analyses shall be made.

3.12.1.2 Refining and Allocating Logistic Requirements

Work Product:	Logistic Support Specification

The logistic support specification will be developed in an iterative approach in which it will be refined. The requirements shall be assigned step by step to the logistic elements and other logistic resources (for example special tooling and measuring and test equipment).

3.12.1.3 Preparing Requirements Tracing Survey

Subject:	Logistic Support Specification: Requirements Tracing

In the »Requirements Tracing process it shall be ensured that the requirements will be completely and correctly mapped on the logistic elements and other logistic resources.

It shall be checked whether all requirements were allocated. For this purpose relations shall be established between the logistic elements or other logistic resources and the requirements.

3.12.2 Preparing Logistic Support Concept

Work Product:	Logistic Support Concept
Tool reference:	Project Planning

Purpose

On the basis of the »Logistic Support Specification, the logistic support concept shall be developed iteratively. Logistic support and the logistic elements shall be designed and represented. Major influencing factors will be the expected life cycle costs and the impact on system availability. The establishment of logistic supportability, the clearance of the system for service use and the »Disposal of the system shall be planned.

Logistic support will be planned in the activity »Planning Project of the »Process Module »Project Management.

3.12.2.1 Defining Directives and General Conditions

Work Product:	Logistic Support Concept

The requirements and framework conditions, in particular the logistic outline concept, shall be prepared together with the acquirer. If it is not possible to prepare concrete information, assumptions shall be made that will make sense for the system to be delivered or that can be derived from already existing similar systems.

3.12.2.2 Analyzing System Architecture

Work Product:	Logistic Support Concept

The architecture of the system shall be analyzed. For each element of the architecture logistically relevant data, such as part number (identification number, order number) and reliability (see »Logistic Calculations and Analyses), shall be obtained and prepared so that they will be clearly arranged.

3.12.2.3 Developing, Evaluating and Selecting Alternatives

Work Product: Logistic Support Concept

Several alternatives for logistic support shall be developed and presented. For each alternative logistic elements shall be determined. Then the alternatives that were developed shall be compared with regard to how they meet the requirements, in particular concerning the expected system availability and the life cycle costs. These indicators shall be determined for each alternative on the basis of identical framework conditions (which frequently will be assumptions) and shall be presented explicitly. The selection of an alternative will be made in close coordination with the acquirer, since this decision will influence the availability and the life cycle costs.

3.12.2.4 Preparing Logistic Support Concept

Work Product: Logistic Support Concept

The starting point will be the selected alternative. Logistic support shall be developed on the basis of the demand for support and the logistic resources required for this purpose. Major factors in this context will be the interfaces of the system to the operating environment, the interplay between the logistic resources and the organizational conditions at the location of the acquirer.

The logistic support documentation shall be described together with the other logistic resources (such as standard/special tooling, measuring and test equipment, training equipment, spare parts) that exist or will have to be procured or prepared.

Depending on the logistic framework concept that is taken as a basis for the system, further support services may be necessary that will go beyond service use, maintenance and repair and additional system maintenance activities. Those services shall be determined and also presented.

3.12.2.5 Describing Interaction of Logistic Resources

Work Product: Logistic Support Concept

In addition to the general outline of logistic support, a summary overview of the interfaces shall be prepared in which the interaction between the system, the »Enabling System and the logistic elements will be described, taking into account the following connections:

- Internal connections between the logistic elements
- Interfaces between the logistic resources that emerge as enabling systems
- Interfaces with the system
- External interfaces of the system, the enabling systems and the logistic elements to elements in its environment that will be logistically relevant (for example materiel management system, transport system, logistic facility).

Logistic requirements, such as availability, can be met only when these elements will interact. Regulations concerning organizational and technical measures for maintenance and repair and system maintenance during operations shall be described and coordinated with the acquirer.

3.12.2.6 Establishing Logistic Supportability and Transfer to In-Service Use

Work Product: Logistic Support Concept

The establishment of logistic supportability and the clearance for service use shall be planned and presented. They will be carried out in close coordination with the acquirer, since the acquirer also will have to provide services. Those services may include the following:

- Providing infrastructure for the integration of logistic resources
- Providing logistic resources that are already available at the acquirer
- Providing personnel for operation, maintenance/repair and spare parts supply for training on the system
- Providing personnel for operation, maintenance/repair and spare parts supply for conducting operations or service trials (operational testing)

The establishment of logistic supportability and the clearance for service use will be planned in the activity »Planning Project of the »Process Module »Project Management.

3.12.2.7 Preparing Disposal

Work Product: Logistic Support Concept

»Disposal will include decommissioning (for a return to service) and final disposal of the system.

The conceptual preparation of the decommissioning of a system has to be made near the time the system will be prepared, because this will be the only time the technical knowledge will be on hand. If for a system, which has been in service use for 30 years, decommissioning is prepared just when the system is decommissioned, this may mean a great expense, because details of the technology and material used will no longer known.

The conceptual preparation of the disposal also shall be made near the time the system is prepared. Details of harmful substances will be analyzed during development and form the best basis for the preparation of disposal. In some cases the disposal will also influence the design of the system, because in case there will be an obligation to take back a specific substance, disposal may become expensive for the manufacturer. Therefore the manufacturer will select a design of his system whose disposal is easier. Materials whose disposal will be difficult or that will be ecologically harmful shall be documented.

3.12.3 Performing Logistic Calculations and Analyses

Work Product:	Logistic Calculations and Analyses
Method Reference:	Fault/Reliability Analysis, Logistic Support Analysis

Purpose

As a result of the calculations and analyses, logistic support may be designed. In addition, possible false decisions or deficiencies in the development shall be identified early and corrected (design influence). Logistic analyses shall be made parallel to the development activities. The results that are obtained shall be provided directly so that they can be used for decisions on changes and adaptations of the design.

Before calculations and analyses will be made, it shall be coordinated with the acquirer to what extent and at what time data will be provided. Furthermore is shall be clarified in what form - paper, data carrier, software tool - the data will be provided, processed and passed on. After making the analyses and calculations and before the results will be submitted to the acquirer, the quality of the results shall be verified and ensured.

3.12.3.1 Planning Calculations and Analyses

Work Product:	Logistic Calculations and Analyses

The tailoring of the norms and standards to be used to the respective product will be carried out by the »Logistics Developer, who will select the applicable norms and standards in the required version in accordance with the contract documents (see »Fault/Reliability Analysis). If no particular norm is specified, the most suited standar (with regard to costs, data availability) will be used. The norms and standards will define a large part of the analyses and calculations that will have to be made.

In case of very complex systems, in particular flying systems, the acquirer will demand a »Logistic Support Analysis (LSA). The LSA will be described in the military standards »MIL-STD 1388-1A and »MIL-STD 1388-2B and include the logistic analyses and calculations.

Logistic calculations and analyses will be planned in the activity »Planning Project of the »Process Module »Project Management.

3.12.3.2 Acquiring Data for Calculations and Analyses

Work Product:	Logistic Calculations and Analyses

The basic data from the software and hardware development shall be collected. Typically this will concern bills of material, wiring diagrams, documents produced in the development process (for example hardware architecture) and additional information sources, for example standard information about components and equipment and component information from the developer or from equipment engineering.

3.12.3.3 Performing Calculations and Analyses

Work Product: Logistic Calculations and Analyses

After acquisition of the data and the tailoring of the norms and standards that shall be applied to the order, the necessary analyses and calculations shall be made. If weaknesses of the design are identified during the analysis, the responsible »System Architect shall be consulted.

3.12.3.4 Preparing Report on Project Results

Work Product: Logistic Calculations and Analyses

The results of the logistic calculations and analyses shall be clearly arranged and presented in the product »Logistic Calculations and Analyses. This will include also the description of identified weak points. If this is technically and contractually possible, suggestions for tradeoffs or improvement potentials shall be identified.

The verified results shall be described and also explained and commented.

After their verification and release, the results shall be submitted to the acquirer and, if necessary, presented. After the report was accepted, the activities can be finished.

3.13 Process Improvement

The discipline »Process Improvement includes all products and activities prepared and maintained within the scope of the introduction and maintenance of an organization-specific process model. This includes the »Assessment of a Process Model, the development of an »Process Model Improvement Concept and finally the description of an improved organization-specific process model.

3.13.1 Performing a Process Model Assessment

Work Product: Assessment of a Process Model

Method Reference: Process Analysis

Purpose

There will be several approaches for performing the »Assessment of a Process Model. The preferred methods should be those that lead to concrete improvement proposals and thus provide explicit cues for a goal-oriented process improvement. In the following it will be described how a specific process model shall be evaluated (see Figure 26).

At first, the assessment method (e.g. »V-Modell®XT Konformität, »V-Modell®XT Assessment, »CMMI® , or »SPICE Model) must be selected. For process evaluation purposes, participants shall be determined and projects selected as required in the planning and preparation phase. If »V-Modell®XT Konformität was selected as assessment method, the assessment is purely theoretical. It is not necessary to select and analyze projects. Instead, the processes to be assessed are analyzed by using a questionnaire defined for the »V-Modell®XT Konformität. This selection - and afterwards also the results - shall be communicated to all participants, but preferably to all members of the organization.

Subsequently inquiries and interviews shall be conducted with the stakeholders and with management. Direct questioning may also be supplemented or replaced by a questionnaire that will be filled out by the stakeholders themselves or by evaluating only documents. Then the results of the inquiry shall be analyzed with regard to strengths and weaknesses and interpreted and supplemented with improvement proposals.

At the end of the evaluation of the process the results shall be documented in a report that will include the following:

- objective and management support,
- a strength-weakness profile of the evaluated processes and
- an activity plan.

Since the result of the process evaluation includes sensitive project data of an organization, the »Assessors will be expected to have qualities such as trustworthiness, impartiality and integrity.

Activity Flow

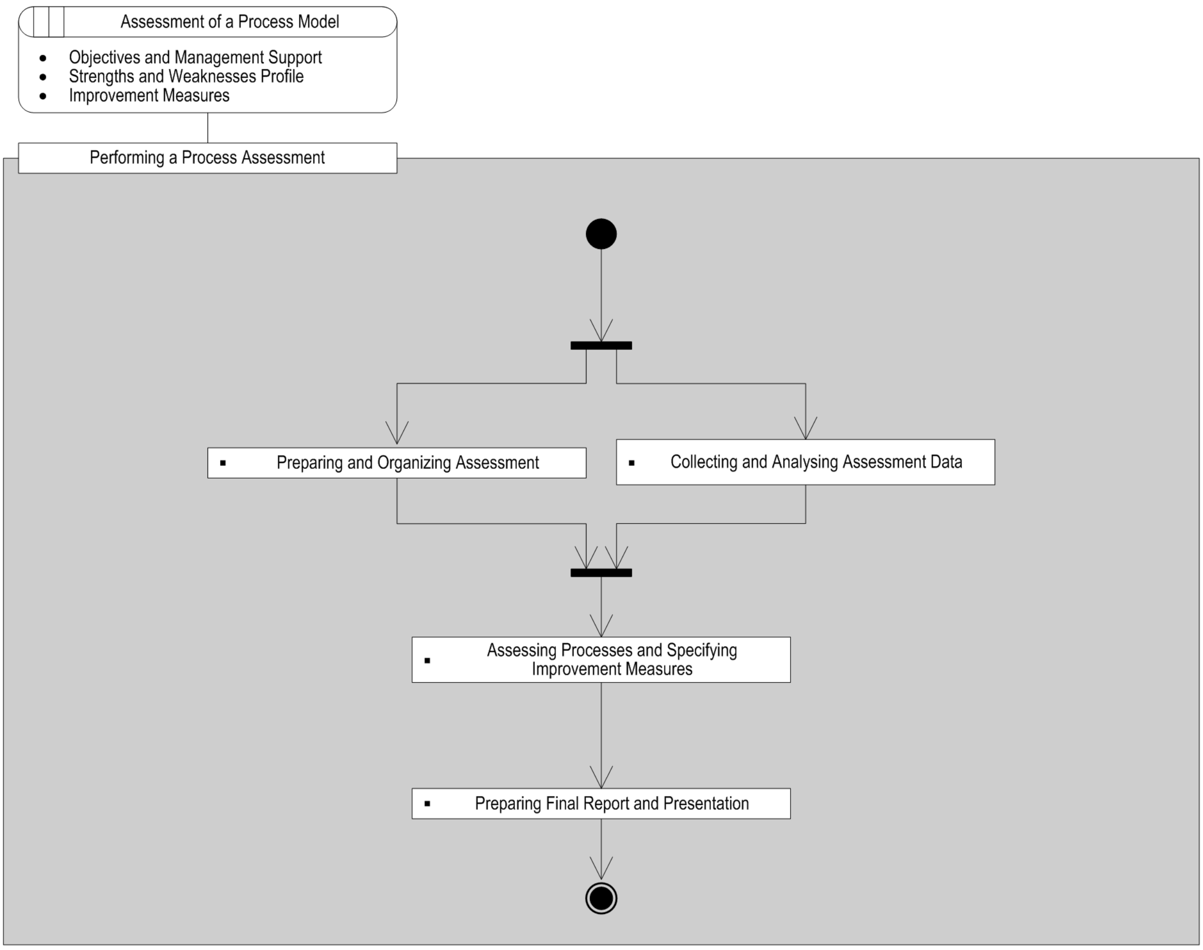

Figure 26: Activity Diagram "Performing a Process Model Assessment"

3.13.1.1 Preparing and Organizing Assessment

Subject: Assessment of a Process Model: Objectives and Management Support

For the preparation of the evaluation the following steps will be required:

- Planning the evaluation,
- Organizing kick-off meeting,
- Organizing the involvement of the management.

The evaluation, which will be already planned in the project plan of the improvement project, now will have to be planned in detail by determining participants and selecting projects and communicating them within the organization.

During the kickoff meeting the stakeholders in the improvement project, the management and the project members shall be told the most important things about the execution of the evaluation and the confidentiality of the data.

The involvement of the management into the evaluation approach shall be discussed. In this process questions concerning the strategy and the future of the business area should be discussed.

When the evaluation will have been performed, additional process areas or new participants in the interview may emerge, which then also will have to be included in the planning.

3.13.1.2 Collecting and Analyzing Assessment Data

Subject: Assessment of a Process Model: Strengths and Weaknesses Profile

Within the scope of this subactivity, all relevant data of the processes that will be available in the organization shall be collected. This w ill include:

- Process descriptions,
- »Templates and
- Documents.

Also interviews with all stakeholders, the persons with specific functions and the management about the planned process areas shall be conducted and documented. The interviews may be based on a questionnaire for a process model (for example CMMI©). The interviews may also be replaced or supplemented by an answer to the written questionnaire.

Subsequently the process evaluation data shall be evaluated by analyzing the interview protocols and the questionnaires. In this process it also shall be checked whether the scope of the evaluation and the evaluation model were covered.

3.13.1.3 Assessing Processes and Specifying Improvement Measures

Subject: Assessment of a Process Model: Improvement Measures

The processes shall be evaluated against a model (e.g. »V-Modell®XT Konformität, »V-Modell®XT Assessment, »CMMI® , »SPICE), against the specifications within the organization or against standards. This may include for example grading the degree of maturity of a process. Also concrete suggestions for the subsequent improvement activities shall be determined. Then it will be discussed with the management which improvements according to the action plan may be used to improve the degree of process maturity of the organization.

3.13.1.4 Preparing Final Report and Presentation

Work Product: Assessment of a Process Model

The results of the evaluation shall be documented in a final evaluation report (»Assessment of a Process Model) and presented in a final presentation to all stakeholders and to the management.

3.13.2 Specifying Process Improvement

Work Product: Process Model Improvement Concept

Purpose

Starting from the process improvement measures suggested in the product »Assessment of a Process Model, the requirements for process improvement shall be defined.

Based on these requirements, the »Realization Concept shall be prepared, which will define general specifications for the piloting and broad introduction of the organization-specific process model. The realization concept will be used as a basis for the »Piloting Concept, which will include detailed planning for piloting.

3.13.2.1 Determining Objectives, Management Support and Requirements

Subjects: Process Model Improvement Concept: Requirements, Process Model Improvement Concept: Objectives and Management Support

The objectives of the improvement project (for example reaching the »V-Modell®XT Konformität or a »CMMI® level) shall be defined and described with regard to the business objectives. In this process the most important improvement measures from the »Assessment of a Process Model shall be selected and specified as requirements for process improvement. It may be advantageous and right to implement prioritized and important measures instead of carrying out all measures.

Further requirements will result from exploiting the »Experience Base. The lessons learned reports from all projects realized to date, which will be contained in this database, will include the lessons learned with regard to the individual process areas of the organization-specific process model. This information will be used as input for the improvement project.

These requirements will form the basis for the realization and »Piloting Concept. The key of the success of an improvement project will be that it will be supported without reservation by the management. This support shall be documented in proper form for all stakeholders.

3.13.2.2 Preparing Realization and Piloting Concept

Subjects:	Process Model Improvement Concept: Piloting Concept, Process Model Improvement Concept: Realization Concept

Starting with the requirements and objectives, solutions to process improvement and in particular an approach for their implementation shall be prepared and described in the »Realization Concept. When preparing the realization concept, an important part will be the description of the method how an »Organization-Specific Process Model shall be prepared. In this context the following questions in the realization concept shall be addressed:

- Which processes will be used in the organization-specific approach model?
- What will the interfaces between the processes look like?
- How will the processes depend on each other?
- What will the interfaces of the development processes to the other business processes outside the process model look like?
- How will the processes be coordinated with each other?

Based on the realization concept, training measures for the staff of the process improvement projects shall be planned, incorporated into the »Training Plan and carried out.

One or more projects shall be used for the piloting of process improvement. Basis and guideline for piloting will be the »Piloting Concept that will include the necessary information for the exemplary implementation approach. The piloting concept will be that version of the realization concept that was revised for the pilot project. Within the scope of the preparation of the piloting concept, a pilot project shall be selected and its selection substantiated. Based on the piloting concept, training measures for the staff of the pilot project shall be planned analogously to the realization concept, incorporated into the training plan and carried out.

3.13.3 Preparing, Introducing and Maintaining an Organization-Specific Process Model

Work Product:	Organization-Specific Process Model

Purpose

The execution of process improvement will start with the preparation or revision of the contents of the organization-specific process model. This will ensure that the parts of the organization-specific process model will have reached a state in which they are operational and tested, respectively accepted, and that their broad introduction can be carried out organization-wide.

Also part of the process improvement will be the testing of the processes for conformity against required national, international or organization-specific standards. If necessary, the process descriptions shall be adapted to these standards.

For process improvement the lessons learned reports from the projects shall be analyzed. They will include lessons that were learned from the process areas already introduced with earlier process improvements. These lessons learned will be important clues for the revision of, for example, process descriptions or document templates (see Figure 27).

Activity Flow

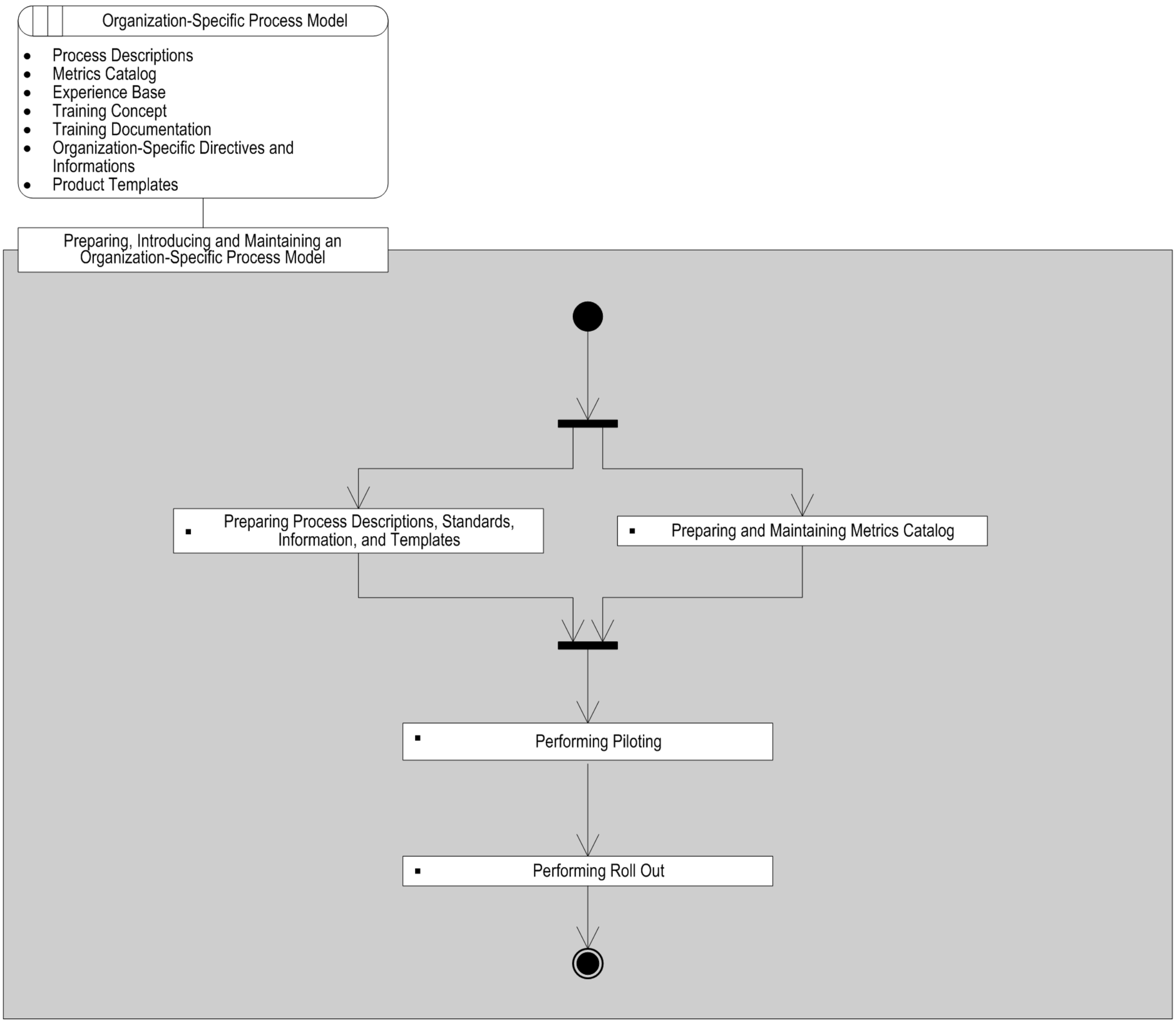

Figure 27: Activity Diagram "Preparing, Introducing and Maintaining an Org.-Specific PM"

3.13.3.1 Preparing Process Descriptions, Standards, Information, and Templates

Subjects: Organization-Specific Process Model: Experience Base, Organization-Specific Process Model: Organization-specific Directives and Informations, Organization-Specific Process Model: Process Descriptions, Organization-Specific Process Model: Training Concept, Organization-Specific Process Model: Training Documentation

In this subactivity the following elements shall be prepared or - if they already exist - revised and maintained:

- »Process Descriptions
- »Templates for process descriptions (»Product Templates)
- Training concepts for process training (»Training Concept)
- Documents and information for process training (»Training Documentation)
- »Organization-specific Directives and Informations
- Project execution strategies
- Rules for adapting the organization-specific process model to the project conditions
- Coordination of subprocesses
- »Experience Base.

The rules for the adaptation of the organization-specific process model will permit the project-specific selection of process elements and project execution strategies.

3.13.3.2 Preparing and Maintaining Metrics Catalog

Subject: Organization-Specific Process Model: Metrics Catalog

When preparing the metrics catalog, the following approach shall be used:

- At first groups of objectives and the objectives that will be relevant to the projects shall be determined or derived from primary targets.
- To support the pursuit of these objectives, »Metrics shall be defined that make quantitative and qualitative statements in this context. Metrics will be based on »Measurement Data Types that also shall be defined in the metric catalog. Also analysis methods shall be specified and it shall be determined how to communicate the results.

Defining Measuring Objectives

Measuring objectives shall be adopted or determined from the targets of the specifications, for example from the topics »Project Overview, Project Targets and Success Factors, »Measurements and Analyses - Organization and Directives of the project manuals of individual projects or from the objectives of the organization. Additional objectives may be determined for example by conducting interviews with the target groups (for example »Project Leaders, quality assurance representatives, line superiors).

If the objectives are not detailed enough they shall be refined. For the primary objective 'to be the first on the market' the resulting project objectives will be for example 'meeting the deadlines', 'minimizing project risks', 'planning and ensuring quality from the start'.

Starting with the measuring objectives, questions shall be derived that can be answered by using metrics. This will include for example questions such as the state of the project with regard to the planned deadlines or how much progress has been made in the field of quality assurance.

Defining Metrics and Measuring Data Types

On the basis of the questions, metrics and measuring data types shall be defined, linked to the respective measuring objective and documented in the »Metrics Catalog. For determining metrics, formulas from the measuring data types shall be used. Values for measuring data types may be numerical data or also elements of selection lists, for example values for the presumable project expenditures: "according to plan"; "exceeds planned values by five percent", "exceeds planned values by ten percent"; "exceeds planned values by more than ten percent". If metrics are not based on numerical data, they are also called soft metrics. Metrics may also be composed of other metrics.

For each metric it shall be determined how and by whom the measurement data shall be analyzed, in what form the »Metrics Analysis shall be processed and how and when the result shall be communicated. For this purpose it will be stated for example that the metric shall be visualized in form of a bar chart, a curve or a table, and in what report types it shall be distributed. It must be taken into account that the metrics analysis may answer the questions connected with the metric.

For every measurement data type, the measurement times, measurement units and the persons involved in the measurement must be defined. To support the acquisition of »Measurement Data , an appropriate repository structure shall be provided. This may be a distributed structure, because depending on the metric the associated measuring data may be deposited in different tools. In individual cases it may also be necessary to provide corresponding tool support.

The metric catalog shall be updated continuously. New metrics that have proven their worth in projects shall be adopted. Based on lessons learned reports from the projects or due to changed framework conditions, individual metrics shall be revised or, from case to case, deleted.

Example

Business objective: "To be first on the market"

Primary project objective: "The product is available in time for the XY fair"

Detailed objectives:

- Meeting deadlines,
- Assuring quality.

Questions:

- Is it possible to meet the planned deadlines?
- Have the planned quality assurance measures for documents been taken, how far are they advanced?
- Is the system to a very large extent free from faults? How many faults are reported in the system and on how many defects trouble-shooting has been performed?

Metrics from the metrics catalog:

- To what degree the deadlines in the project have been met: The currently planned milestone deadlines are shown in relation to time in the course of the project, thus visualizing milestones. In addition it can be seen at what time which milestone was moved.
- Percentage of documents and reviews already covered: The number of inspected documents is compared to the total of planned documents.
- Fault statistics: The number of faults that have been closed is compared to the number of faults that are still open at the time of the report. This includes providing all fault signals and error messages.

3.13.3.3 Performing Piloting

Work Product: Organization-Specific Process Model

The prepared organization-specific process model shall be translated into the world of actual projects. Since it may still include faults and shortcomings, it shall be tested in a pilot project. The exemplary implementation of the process improvement provides evidence whether it will be suited for subsequent broad introduction. The extent of the pilot project should be visible at a glance, and the selected project should not be particularly critical. Faults and problems that occurred during piloting shall be eliminated in the process descriptions, and the lessons learned shall be recorded in a lessons learned report.

The execution of piloting will include the following subtasks:

- Preparing the piloting
- Training the pilot users
- Executing the piloting by supporting the pilot project
- Finishing the piloting
- Feedback/experience gained with the process
- Improving the process description

For piloting suitable operational projects shall be selected on the basis of criteria such as:

- For many pilotings a synchronization with the project start of the operational project is very useful.
- As far as possible the pilot project will not be a critical project (with regard to the business case).
- The stakeholders are receptive to process improvements.
- It is possible for the pilot project to cover the process improvements (e. g. no hardware improvement for a software project).
- The project is representative of the development projects of the organization.
- Because of process improvements, a particular payoff is expected for the pilot project (for example elimination of particular problems).

In the kick-off for the pilot project all participating persons shall be familiarized with the forthcoming tasks, and the contents of the »Piloting Concept shall be presented.

Based on the piloting concepts, training measures for the staff of the pilot project shall be planned, incorporated into the »Training Plan and carried out.

3.13.3.4 Performing Roll Out

Work Product: Organization-Specific Process Model

The broad introduction of the product improvement may be executed organization-wide if after piloting the process components of the product »Organization-Specific Process Model have reached an operational, tested and accepted state. Time schedule, resources and approach for the broad introduction were already described in the »Realization Concept.

For the broad introduction different approaches may be used, which will be described in the concept of realization. The process may be implemented top-down (starting at the highest hierarchical level of the organization and then going down) or just-in-time (starting for each project when a suitable time in the life cycle has been reached). The approach that will cover best the improvement possibilities and organizational requirements should be selected.

Broad introduction will include the following steps:

- Communication and embedding in the organization structure
- Kick-off
- Training of staff
- Coaching during the broad introduction

Like piloting, process implementation or broad introductions will start with a kick-off as an important component. Communication measures will be generally crucial for a successful and lasting process improvement. The communication concept was already described in the realization concept.

Based on the realization concept, training measures shall be planned and carrierd out. Necessary procedureal steps include the selection of personnel to be trained, scheduling, organizing the necessary resources and training the instructors as required. After the training has been completed, the lessons learned data base will record the training level of the staff members in order to provide a survey of their qualification. In addition, assessment sheets of the trainees will be evaluated, improvement possibilities will be determined and the offered training will be revised.

Coaching will be another important factor in the successful implementation of the process improvement into project practice. Coaching will accompany the operational projects in selected phases (for example project initialization) and during the whole project. It is to support the approach and to provide assistance in critical situations. The approach will thus be based on the previously prepared and piloted process description and include support for the application of new procedures, the preparation of documents from templates, the use of tools or the participation in meetings. Coaching may be performed in several ways, for example as part-time consulting or as full-time work on the operational project.

One of the main objectives of coaching (in addition to project support) will be to comprehensively impart knowledge complementary to the training, so that the extent of coaching can be reduced in the course of the project, the project staff will be able to use the process techniques independently and thus a lasting application of the process improvement can be ensured. This will also be done by the active involvement of project staff in the improvement project, who will be later available as points of contact for their colleagues and serve as multipliers for the process improvements. Furthermore, this is to encourage the project staff to advance process improvement topics by actively participating in shaping them.

4 Activity Index (According to Disciplines)

5 Activity Index (alphabetically)

6 List of Figures

Part 7: V-Modell Reference Mapping to Standards

V-Modell® XT

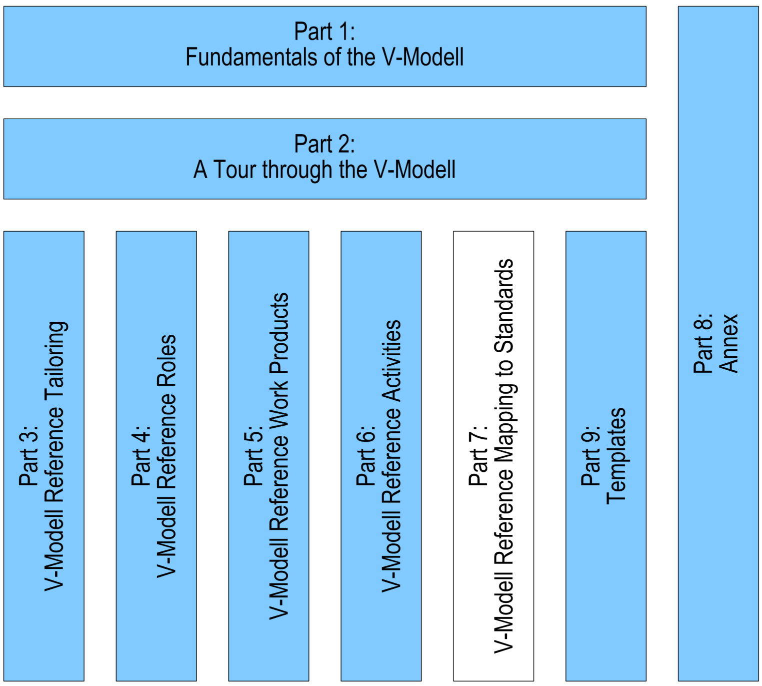

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Table of Contents

1 Introduction

1.1 Objectives

The system development project environment requires increasingly the use of national or international conventions (norms, de-facto standards, regulations). The conventions that have to be used may be specified and/or it may be possible to select them. It is essential, however, that the conventions used are compatible with each other and do not contradict each other. For this purpose it is necessary to know and understand the objectives of the conventions and their mutual connections.

The »V-Modell Reference Mapping to Standards therefore deals with a number of conventions whose most important contents are related to elements of the V-Modell. Thus it indicates to what extent the V-Modell covers these conventions or to what extent it is compatible with them.

1.2 Audience

This V-Modell Reference addresses in particular all people who are already familiar with another standard and either want to classify this standard in relation with the V-Modell or seek a quick lead-in from this standard to the V-Modell. Beyond that this V-Modell Reference also provides clues for an approach for retraining persons, who are familiar with one of the described conventions, to the V-Modell.

1.3 Contents and Structure

This V-Modell Reference takes a look at the following conventions:

- AQAP 150 (Allied Quality Assurance Publication, NATO Quality Assurance Requirements for Software Development)
- CMMI® (Capability Maturity Model Integration)
- ISO 15288 (Life Cycle Management - System Life Cycle Processes)
- »ISO 9001:2000 (Quality Management Systems - Requirements)
- V-Modell 97 (Development Standard for German Federal IT Systems, Process Model as of June 1997)

In each of these »Mapping to Standards at first a brief presentation is given of the contents and the objective of the standard considered. The further breakdown is then made depending on the structure of the standard discussed. There is a short introduction to each group of topics of the standard. In the actual representation of the standard the topics of the standard to be represented are listed on the left side and opposite to them on the right side those elements of the V-Modell that cover or fulfill these topics.

2 Mapping to other Standards

2.1 Mapping to AQAP-150

The NATO standard AQAP-150 (**A**llied **Q**uality **A** ssurance **P**ublication) was published in March 1993. In September 1997 the second edition was presented. In this comparison with the V-Modell the German version of this second edition was used.

For NATO (**N**orth **A**tlantic **T**reaty **O** rganization) software projects, regulations require the AQAP standards. In addition to AQAP-150 there is also the standard AQAP-2110, whose structure is identical with that of ISO 9001and which fully integrates the latter and supplements it with additional NATO requirements. AQAP-2110 thus defines in accordance with ISO 9001 requirements concerning the definition and implementation of a quality management system at the organizational level.

AQAP-150 establishes requirements for the planning, execution and control of software projects and supplements AQAP-2110 with the project-specific point of view. AQAP-150 requires the development of a software quality system and project-specific software quality management activities. The task of AQAP-150 is to make sure that high quality software is developed by establishing requirements for the development process. In this context quality requirements relate not only to the softwar to be developed itself, but also to software required within the framework of the development process and to off-the-shelf products that are integrated into the software.

This objective corresponds exactly to that of the V-Modell. The latter, however, is not limited to software development, but considers systems in general. The V-Modell covers the requirements established in AQAP-150. Since the V-Modell is a generic process model, however, when adapting the V-Modell to a specific project, it has to be taken into consideration that some specific requirements of the AQAP-150 are considered and documented in the project manual. Further details are described in the individual subsections of this »Mapping to Standards.

2.1.1 Software Quality System (SQS)

AQAP-150 requires that the supplier uses in his project a documented, operational and effective software quality system. This project-specific quality system, which may be part of an organization-wide quality management system, has to be reviewed regularly and systematically in order to guarantee its effectiveness. The project-specific software quality system must include a complete quality management process that must used during the entire duration of the contract. It is to contribute to an early identification and elimination of negative influences on the quality of the results.

Quality assurance is one of the main tasks of fhe V-Modell. The requirements for a software quality system and the regular review of its effectiveness established by AQAP-150 are fully met by the V-Modell.

Element of the standard	Is fulfilled by
Software Quality System (SQS)	Process module: Introduction and Maintenance of an Organization-Specific Process Model, Subject: Project-Specific V-Modell

2.1.2 Project-related Software Quality Management Activities

AQAP-150 requires from the supplier the planning and execution of effective software quality management activities. Those include both management-related and technical processes for the development of quality software. Starting with the contractual requirements, these processes have to ensure that the requirements can be traced down to software units and the elements of the configuration management system. They also have to guarantee that software quality is both verified and validated and that risk management is carried out. In this process the activities of the software quality system have to be based on standards and procedures in the organization-wide software quality system.

In addition to these general requirements, there are further requirements concerning the following points:

Software Project Quality Plan (SPQP)

AQAP-150 includes the following requirement: "The supplier shall document the software quality management activities as related to the project in a SPQP. The SPQP may be a discrete document or part of another plan that is prepared under the »Contract. The SPQP shall carry the signature of approval of those organizational elements having responsibilities identified in the SPQP, and be placed under configuration control. If stipulated in the contract, the SPQP shall be offered to the purchaser for agreement. Once agreed by the purchaser, the SPQP shall form part of the contract."

Identification and Review of Software Requirements

According to the AQAP, the supplier shall identify and review the software requirements and development constraints, have them approved by the responsible authorities and manage them in the configuration management system. If they are developed by the supplier as part of a system contract, they shall be offered to the purchaser, who may disapprove them, subject to the conditions of the contract.

In the V-Modell the acquirer is responsible for preparing the »Requirements Specification for the system to be developed. These requirements are part of the contract (»Contract (Acquirer)). From this the supplier derives the »Overall System Specification and subsequently refines the requirements step by step. If the system includes software units, a »Software Specification is prepared for them within the framework of the step-by-step refinement. The acquirer may determine in the contract that he is offered the software requirements and that he may disapprove them.

The quality of all requirements is assured by the regulations in the V-Modell.

Management

This part of the AQAP-150 deals with the management of the software project. It combines requirements related to the following topics:

- Software development process
- Organization
- Non-conforming Software
- Corrective Action
- Subcontractor Management

- Software Configuration Management (SCM)
- Off-the-Shelf Software
- Non-deliverable Software
- Quality Records
- Documentation Retention
- Handling and Storage of Software Media
- Replication and Delivery

Software Engineering

For software development and maintenance activities AQAP-150 requires the use of recognized methods, procedures and validated tools

Evaluation, Verification and Validation (EVV)

The supplier has to plan, define and implement a process for the evaluation of software methods, techniques, tools, procedures and activities, a process for the evaluation of software items and products and a process for the provision of follow-up action to ensure that necessary changes are made and for subsequent reverification. This EVV process has to be an integral part of the development process and define the roles, objects, implementation criteria, methods and tools and the documentation to be produced.

Maintenance

If required, the supplier has to plan and implement an approach for planning and carrying out maintenance.

These requirements are met by the V-Modell. When preparing the »Project Manual, however, care must be taken that all objects that have to be subjected to configuration management under AQAP-150 actually are subject to configuration management. Examples of this are the »Project Manual, the »Project Plan and specifications and elements of the »Enabling System. In addition, the »Metrics required in AQAP-150, such as fault statistics and testing efficiency, have to be defined in the »Project Manual. The contractually defined requirements of AQAP-150 have to be met also by the »Sub-Suppliers. This has to be specified therefore accordingly in the topics »Directives for the Project Manual of the Supplier and »Directives for the QA Manual of the Supplier. The V-Modell contains recommendations for methods and tool classes. The selection and evaluation of particular methods/tools, however, has to be made with regard to the specific project or the organization. For the topic »Evaluation of Off-the-Shelf Products the requirements of AQAP-150 have to be taken into account for example with regard to documentation and the rights concerning data protection.

Element of the standard	Is fulfilled by

General	Process module: Project Management, Process module: Quality Assurance, Process module: Introduction and Maintenance of an Organization-Specific Process Model, Discipline: Evaluation, Product: Risk List, Product: Project Manual, Subject: Requirements Tracing to Requirements Specification
Software Project Quality Plan (SPQP)	Process module: Problem and Change Management, Product: Project Manual, Product: QA Manual, Product: Project Plan, Product: Contract, Subject: Configuration Management - Organization and Directives
Identifying and Checking Software Requirements	Process module: Specification of Requirements, Discipline: Requirements and Analyses, Discipline: Evaluation, Subject: Configuration Management - Organization and Directives
Software Development Process	Chapter: Decision Gates, Product: Project Manual, Product: Organization-Specific Process Model, Product: Project Management Infrastructure, Product: QA Manual, Subject: Experience Base
Organization	Chapter: Roles, Product: Project Manual, Product: Project Plan, Role: QA Manager, Role: Inspector
Nonconforming Software	Section: Quality Assurance and Product State Model, Discipline: Evaluation, Product: Project Status Report (Supplier), Product: Delivery
Corrective Action	Process module: Measurement and Analysis, Process module: Problem and Change Management, Discipline: Reporting, Discipline: Evaluation

Subcontractor Management	Process module: Delivery and Acceptance (Acquirer), Process module: Problem and Change Management, Discipline: Evaluation, Product: Risk List
Software Configuration Management (SCM)	Process module: Configuration Management, Product: Project Management Infrastructure
Off-the-Shelf Software	Process module: Evaluation of Off-the-Shelf Products, Product: Project Status Report, Subject: Configuration Management - Organization and Directives
Software that is not to be Delivered	Discipline: Evaluation, Product: Enabling System, Subject: Configuration Management - Organization and Directives
Quality Recording	Process module: Measurement and Analysis, Discipline: Reporting, Discipline: Evaluation
Storing the Documentation	Process module: Configuration Management
Handling and Storing Data Carriers	Process module: Configuration Management, Product: Project Management Infrastructure
Replicating and Delivering	Process module: Configuration Management, Product: Statement of Acceptance, Aktivity: Preparing and Making a Delivery
Software Technology	Chapter: Method References, Chapter: Tool References, Discipline: Requirements and Analyses, Discipline: Evaluation

Evaluation, Verification and Validation (EVV)	Chapter: Method References, Chapter: Tool References, Section: Quality Assurance and Product State Model, Process module: Quality Assurance, Process module: Problem and Change Management, Process module: Measurement and Analysis, Process module: Introduction and Maintenance of an Organization-Specific Process Model, Discipline: Evaluation, Product: Project Plan, Product: QA Manual, Product: Enabling System, Product: In-Service Documentation, Product: Project Manual, Product: System Implementation, Integration and Evaluation Concept, Role: Quality Manager

Servicing and Maintaining	Process module: Integrated Logistic Support, Process module: Configuration Management, Projekt type variant: Project (Acquirer) Including System Maintenance

2.1.3 Capabilites and Training of Personnel

To ensure that all participants in the project have the knowledge required for their tasks, training courses have to be conducted.

This requirement is fully implemented by the V-Modell.

Element of the standard	Is fulfilled by
Capabilities and Training of Personnel	Product: Project Plan, Subject: Experience Base, Subject: Training Plan

2.1.4 Access and Participation of the Acquirer

The supplier has to support the acquirer in every way in the evaluation of the software quality system and the verification and validation of the products. "The purchaser shall be afforded unrestricted opportunity to verify conformance of the supplies with contractual requirements. The support tools necessary for evaluation, verification and validation purposes shall be made available for reasonable use by the purchaser." These activities of the acquirer do not represent an acceptance in the legal sense and do not exonerate the supplier from his evaluation, verification and validation activities.

In the V-Modell the cooperation of the acquirer in the preparation and review of the contractually agreed performances may be stipulated in the »Contract. In the topic »Cooperation and Provisions of the Acquirer in the project manual the requirements from the AQAP-150 have to be agreed accordingly.

Element of the standard	Is fulfilled by
Access and Participation of the Acquirer	Discipline: Evaluation, Product: Enabling System, Product: Contract, Subject: Cooperation and Provisions of the Acquirer, Subject: Directives for the Project Manual of the Supplier, Subject: Directives for the QA Manual of the Supplier

2.2 Mapping to CMMI®

Version 1.1 of the Capability Maturity Model Integration® (in the following called briefly CMMI®) was developed by the Software Engineering Institute of the Carnegie Mellon University, Pittsburgh, PA, to be able to carry out interdisciplinary developments, in particular software and system development projects faster and better and to obtain at the same time high quality products. In this process models for software development, system development, integrated product and process development and procurement from suppliers, which previously existed separately, were integrated in a combined model. The history of the original models lead to two layouts with different structures, the stepped layout and the continuous layout. In this »Mapping to Standards only the stepped variant is considered, because it determines the degree of maturity of an organization over all process areas and thus corresponds more closely to the view of the V-Modell. The main structural element of the stepped layout are the process area that are assigned to the maturity levels 2 to 5. In each process area one or more "Specific Goals" exist that have to be achieved in order to comply with the process area. This is done by mastering the "Specific Practices" assigned to the Specific Goals. Beyond that there are also "Generic Goals", one for the maturity level 2 and one for the maturity levels 3 to 5. The "Generic Practices" of those goals have to be complied with for each process area depending on the desired degree of maturity. In principle the essential thing is that for achieving a certain maturity level it is required to achieve the specific and generic goals of all process areas assigned to this and to the lower maturity levels.

At the maturity level 1 the processes mostly do not exist, are "chaotic" or ad hoc. This means that although processes may exist, neither a project-specific nor a company-wide use of these processes is possible. Thus the success of a company depends on the competence or the "heroism" of individual persons. Organizations of the maturity level 1 therefore frequently exceed the budget and schedule of their projects. Successes due to good products are possible, but frequently they cannot be repeated.

In organizations of maturity level 2 the project staff is tasked with the management of requirements and the planning, control, administration and review of processes. The process areas considered at maturity level 2 guarantee that existing procedures are used also during times of stress. At defined points the management is able to reconstruct the progress made in the projects. The operating results are reviewed and monitored and they meet the specified requirements, standards and objectives.

A company of maturity level 3 has a standard process defined across the organization which is continuously improved and adapted by the project staff by »Tailoring. In addition ot process descriptions this standard process includes also tools, a lessons learned database and an organization-wide collection of »Metrics that can be used by the individual projects. The standard process is introduced across the organization and imparted to all employees by way of follow-on training. During utilization it is important to recognize and document the potential for improvement of the processes in the projects and to incorporate it by taking appropriate measures.

An organization of maturity level 4 is required to greatly strengthen the field of measurement and analysis with one focus being the development and maintenance of an organization-wide metric database. It is necessary to collect information that can be analyzed not only qualitatively, but also statistically and quantitatively. For this purpose the performance of important subprocesses that significantly contribute to process performance is measured. Based on the knowledge gained from this information, the processes are improved. In the projects both the processes and the objectives are derived from those of the organization and placed under statistical/quantitative control.

Maturity level 5 organizations continually improve their process performance. Starting with the objectives of the organization and the numbers the processes provide predictable results so that the company can react quickly to chances and changes. Another aspect of the process area is the continuous fault analysis. It is used to identify faults that are caused by regular variations of the processes. On the basis of the results, the causes of the faults have to be determined and eliminated.

Both CMMI® and the V-Modell have the objective to standardize and thus facilitate the interdisciplinary development of systems consisting of software, hardware and externally produced items. The introduction of processes that are standardized across the company improves the development results.

However, the two models use a different approach. The CMMI® process model includes a large number of requirements for processes of an organization that are used to evaluate the processes and to make suggestions for improvement on the basis of the results. By comparison the V-Modell represents a standard process, which can be adapted to the specific project by tailoring. It is also possible to introduce a standard process on the basis of the V-Modell across the organization. The V-Modell offers finished »Templates for documents and includes suggestions for the methods and tools to be used. By comparison the CMMI® process model provides abstracted Best Practices.

Since CMMI® poses requirements on the processes of an organization, the following considerations are based on the assumption that the organization has introduced an organization-wide standard process based on the V-Modell, communicated the resulting expectations of the management and informed all roles about the benefits of the processses. Statements on the fulfilment or non-fulfilment of CMMI® requirements always refer to this standard process. As seen from the perspective of CMMI®, the definition of this standard process and the project-specfic tailoring must ensure that all modules necessary for fulfilling the CMMI® requirements are taken into account. Thus, CMMI® does not regard - for example - the module Measurement and Analysis as mandatory.

Since the V-Modell is based on a complex model with dependencies between the elements, some requirements of the CMMI® are not dirctly covered in the V-Modell by individual products or activities, but by products/activities with multiple applications, automatisms of the model or general regulations mostly described in the introductory chapters, such as:

- Stakeholder Involvement and Commitment is mainly covered by the role model. On top of that, on some points, for example in the project plan, the consent of all stakeholders is explicitly obtained and documented.

- The review, for example of CM activities, is carried out within the framework of the generic activity »Evaluating Process.
- Methods have to be developed when the V-Modell is introduced into the organization or when the project starts. This is supported by the V-Modell with a method pool.
- There is a product state model (see »Quality Assurance and Product State Model) which guarantees that after the implementation of changes all products directly affected by the change and also all products depending on those products are again subjected to a test.

Another basic difference is that the V-Modell XT makes a distinction between acquirer and supplier projects. The activities of the process area "Requirements Management" are therefore for example distributed among two different projects.

In the CMMI® representation only the process areas of the maturity levels 2 and 3 are examined, because the V-Modell does not cover the maturity levels 4 and 5. The V-Modell achieves the Generic Objectives for all process areas that are relevant in the V-Modell. Therefore, contrary to the usual description, they are removed from the process areas and treated like separate process areas.

2.2.1 Requirements Management

The process area "Requirements Management" deals with the management of all requirements. In this process also inconsistencies between all kinds of requirements, plans and results should be identified. Over the entire duration of the project, but in particular at the start, it is important that all participants have a common understanding of the requirements that all commit themselves bindingly to these »Determining Requirements. In the further course of the project changes have to be managed and the bidirectional traceability of changes has to be ensure across all levels. This makes it also possible to identify differences between plans, operating results and requirements in time and to initiate appropriate countermeasures.

Since in contrast to CMMI® the V-Modell separates strictly between acquirer and supplier projects, the activities of this process area are distributed among two projects. In the V-Modell the acquirer is responsible for the »Requirements Specification that are part of the contract. From these requirements the supplier derives the technical view, possibly adds further requirements of his own organization and documents these requirements in the »Overall System Specification.

In the V-Modell only a unidirectional tracing of the requirements is implemented. Thus only the greater part of the process area is covered.

Element of the standard	Is fulfilled by
Manage Requirements	Section: Quality Assurance and Product State Model, Discipline: System Specifications, Discipline: Planning and Control, Product: Requirements Specification, Product: Problem Report / Change Request, Product: Contract Addendum, Product: Evaluation Report Document, Product: Contract, Product: Requirements Specification Overall Project, Subject: Evaluation Plan Documents

2.2.2 Project Planning

The task of project planning is to establish »Estimations and plans, to update those plans and to obtain commitment to those plans from all participants. On the basis of the requirements, the scope, the expenditures and the costs are estimated and a suitable life cycle model is selected. In addition to the budget and the risks, the project plan also includes the scheduling and plans for resources, training courses, data management and the cooperation of all participants. Before the commitment to the project plan can be obtained from all participants, the plan has to be reviewed by all participants, and the required resources have to be coordinated. The project plan forms the basis for the execution and control of the project.

These requirements are covered by the V-Modell.

Element of the standard	Is fulfilled by
Establish Estimates	Chapter: Project Type Variants, Product: Estimation, Product: Life Cycle Cost Calculation, Aktivity: Assigning a Work Order
Develop a Project Plan	Chapter: Decision Gates, Chapter: Roles, Process module: Configuration Management, Product: Life Cycle Cost Calculation, Product: Project Management Infrastructure, Product: Project Manual, Product: Project Plan, Subject: Identified Risks
Obtain Commitment to the Plan	Product: Project Plan, Activity step: Coordinating Project Plan with Stakeholders

2.2.3 Project Monitoring and Control

The process area "Project Monitoring and Control" monitors and controls the execution of a project. In this process deviations from the planning are identified. In addition to project planning parameters, also risks, data management and the integration of all participants are monitored. Periodically and when milestones are reached the progress and the results of the project are reviewed. If necessary, control and corrective measures have to be initiated and monitored.

The process area "Project Monitoring and Control" is completely covered by the V-Modell.

Element of the standard	Is fulfilled by

Monitor Project Against Plan	Chapter: Decision Gates, Process module: Configuration Management, Product: Project Status Report, Product: Risk List, Product: Project Progress Decision

Manage Corrective Actions to Closure	Product: Project Status Report

2.2.4 Supplier Agreement Management

Supplier agreement management deals with the selection and integration of externally procured products. This may be off-the-shelf products, complete developments by »Sub-Suppliers or mixed forms. In this process area not only the well-founded selection of the right product and suitable suppliers, but also the planning and integration of the delivered product into the overall product and the continuing and good cooperation with the supplier down to the acceptance of the product is important.

Supplier Agreement Management is completely covered by the V-Modell.

Element of the standard	Is fulfilled by
Establish Supplier Agreements	Product: Make-or-Buy Decision, Product: Offer (Supplier), Product: Criteria Catalog for Assessment of Offers, Product: Offer Assessment, Product: Contract
Satisfy Supplier Agreements	Product: Market Survey for Off-the-Shelf Products, Product: Make-or-Buy Decision, Product: Project Status Report, Product: Contract Addendum, Product: Evaluation Specification Delivery, Product: Evaluation Report Delivery, Product: Statement of Acceptance, Product: External Unit, Product: External Hardware Module, Product: External Software Module, Subject: Cooperation and Provisions of the Acquirer

2.2.5 Measurement and Analysis

The process area "Measurement and Analysis" serves for the collection and processing of numerically measurable project information required by the management or by the persons in charge of the project for decision-making. This involves defining appropriate »Metric es after the selection of the measurement targets. For the collection, storage and analysis of the »Measurement Data that belong to the metrices suitable procedures have to be developed. In the course of the project those procedures are used, and a graphic description of the measurement results is provided.

The process area "Measurement and Analysis" is completely covered by the V-Modell.

Element of the standard	Is fulfilled by
Align Measurement and Analysis Activities	Product: Project Management Infrastructure, Subject: Measurements and Analyses - Organization and Directives, Subject: Metrics Catalog, Subject: Experience Base
Provide Measurement Results	Product: Measurement Data, Product: Metrics Analysis

2.2.6 Process and Product Quality Assurance

The process area "Process and Product Quality Assurance" deals with the review of processes and work results in order to provide the staff and the management with an objective insight in processes and associated work results. For this purpose processes and work results have to be evaluated against the associated process descriptions, standards and approaches. Deviations from the specifications that are identified in this process are documented, communicated to the stakeholders, corrected and solved.

Process and Product Quality Assurance is covered completely by the V-Modell.

Element of the standard	Is fulfilled by
Objectively Evaluate Processes and Work Products	Discipline: Evaluation, Product: Quality Status Report, Product: QA Manual, Product: Qualification Record
Provide Objective Insight	Product: Qualification Record, Product: Quality Status Report, Product: Final Project Report, Product: Project Diary

2.2.7 Configuration Management

The objective of configuration management is to achieve and maintain the integrity of work results. As a preliminary step those work results are selected that are to be subject to configuration management, and a configuration and change management procedure is introduced. »Product Configurations are defined on which a further buildup is possible and on which it is possible to fall back upon any time. Changes made to all work results that are subject to configuration management are always tracked and regularly reviewed. The integrity of product configurations is guaranteed by way of regular reviews.

Configuration Management is covered completely by the V-Modell, with the limitation that the "Configuration Audit" method is proposed, but not mandatory. In order to achieve CMMI® conformity in this point, the execution of "Configuration Audits" must be determined at the beginning of a project.

Element of the standard	Is fulfilled by
Establish Baselines	Section: Quality Assurance and Product State Model, Product: Product Library, Product: Product Configuration, Subject: Configuration Management - Organization and Directives
Track and Control Changes	Process module: Problem and Change Management, Product: Change Status List, Product: Product Configuration
Establish Integrity	Section: Quality Assurance and Product State Model, Product: Project Status Report, Aktivity: Evaluating Process, Aktivity: Evaluating Document, Activity step: Preparing CM Evaluations

2.2.8 Requirements Development

The process area "Requirements Development" deals with the proactive identification and analysis of requirements. Requirements, expectations, framework conditions and interfaces of the acquirer are analyzed until they are completely understood. The information obtained in this process is translated into acquirer requirements and documented. Now the technical requirements are derived from the acquirer requirements and assigned to the product components. In the next step the interface requirements between the different product components are determined.

All requirements, both the acquirer requirements and the technical requirements, are analyzed. For this purpose operating concepts and scenarios are prepared and on this basis the desired functionality of the product is determined and the necessity and completeness of the requirements is reviewed. Subsequently the requirements and framework conditions of all persons affected have to be harmonized, and a comprehensive validation has to be carried out so that the requirements lead to an end product that works as desired in the environment in which it is used.

The process area "Requirements Development" is covered by the V-Modell.

Element of the standard	Is fulfilled by

Develop Customer Requirements	Product: Requirements Specification, Product: Overall System Specification, Product: Requirements Specification Overall Project

Develop Product Requirements	Discipline: System Specifications, Product: Hardware Architecture, Product: Software Architecture, Product: System Architecture, Product: Enabling System Architecture

Analyze and Validate Requirements	Product: Requirements Specification, Product: System Specification, Product: Requirements Evaluation, Product: Evaluation Report Document, Product: Requirements Specification Overall Project, Subject: Design Evaluation, Activity step: Analyzing Quality of Requirements, Method Reference: Requirements Analysis

2.2.9 Technical Solution

The task of the "Technical Solution" is to translate the requirements into products and product components. The decision criteria are used to select the best variant from the different approaches that were examined in detail. The focus of this process area is on the development of the design of the product be created or of the product component. The collected design documents together with the requirements documents are combined in the so-called technical data package.

During the whole design process again and again decisions have to be made whether the whole product or product components are to be bought-out as off-the-shelf product or awarded as a development contract or whether existing products or components are to be re-used. Based on the design, the product components are implemented and tested and the appropriate documentation is written.

The "Technical Solution" is covered completely by the V-Modell.

Element of the standard	Is fulfilled by

Select Product Component Solutions	Discipline: System Specifications, Product: Hardware Architecture, Product: Software Architecture, Product: System Architecture, Product: Enabling System Architecture

Develop the Design	Discipline: System Specifications, Product: Hardware Architecture, Product: Software Architecture, Product: System Architecture, Product: Enabling System Architecture, Product: Product Configuration, Product: Hardware Implementation, Integration and Evaluation Concept, Product: Software Implementation, Integration and Evaluation Concept, Product: System Implementation, Integration and Evaluation Concept, Product: Enabling System Implementation, Integration, and Evaluation Concept, Product: Make-or-Buy Decision

Implement the Product Design	Process module: Integrated Logistic Support, Discipline: System Elements

2.2.10 Product Integration

The task of product integration is to integrate components to the desired end product, to ensure the functional efficiency of the end product and to deliver the product. For this purpose procedures for carrying out the integration and criteria for the start of the integration have to be defined, and it has to be specified in which order the components are to be integrated. Also the environment required for the integration has to be prepared.

The compatibility of the interfaces is ensured by checking the interface descriptions for correctness and completeness, by solving problems if this should be necessary and by providing the interface descriptions to all stakeholders. Finally the product has to be assembled iteratively from its components. For this purpose the predefined requirements for the start of the integration have to be met. The result has to be verified and validated before the off-the-shelf product or the product component can be delivered.

Product Integration is covered completely by the V-Modell.

Element of the standard	Is fulfilled by
Prepare for Product Integration	Product: Enabling System, Product: Hardware Implementation, Integration and Evaluation Concept, Product: Software Implementation, Integration and Evaluation Concept, Product: System Implementation, Integration and Evaluation Concept, Product: Enabling System Implementation, Integration, and Evaluation Concept

Ensure Interface Compatibility	Process module: Problem and Change Management, Product: Evaluation Report Document, Product: Evaluation Specification Document, Product: Hardware Implementation, Integration and Evaluation Concept, Product: Software Implementation, Integration and Evaluation Concept, Product: System Implementation, Integration and Evaluation Concept, Product: Enabling System Implementation, Integration, and Evaluation Concept, Subject: Interface Overview

Assemble Product Components and Deliver the Product	Section: Quality Assurance and Product State Model, Discipline: System Elements, Product: Product Configuration, Product: Delivery, Product: Hardware Implementation, Integration and Evaluation Concept, Product: Software Implementation, Integration and Evaluation Concept, Product: System Implementation, Integration and Evaluation Concept, Product: Enabling System Implementation, Integration, and Evaluation Concept, Aktivity: Evaluating System Element

2.2.11 Verification

Verification is to ensure that selected work results meet their requirements. At the start of a project it has to be determined which work results are to be verified. It is required to define a verification procedure and to set up the necessary verification environment. Then the work results are verified, the results are analyzed and, if necessary, measures for the correction of errors are initiated. The most important methods for performing the verification are tests and peer reviews.

Verification is covered by the V-Modell with the exception of the requirements concerning peer reviews. The peer reviews, which are important in the CMMI®, are suggested as a method, but not mandatory. To achieve conformity with the CMMI® in this point, different peer review methods must be defined for the introduction of an organization-specific process. At the start of the project, suitable methods must be selected, and execution and scope of peer reviews must be specified and planned.

Element of the standard	Is fulfilled by

Prepare for Verification	Discipline: Evaluation, Product: QA Manual, Product: Hardware Implementation, Integration and Evaluation Concept, Product: Software Implementation, Integration and Evaluation Concept, Product: System Implementation, Integration and Evaluation Concept, Product: Enabling System Implementation, Integration, and Evaluation Concept, Product: Enabling System
Perform Peer Reviews	Discipline: Evaluation, Method Reference: Review
Verify Selected Work Products	Discipline: Evaluation

2.2.12 Validation

The objective of validation is to show that a product or a product component works as desired in its planned target environment. For this purpose the products or product components to be validated are selected, the validation environment is set up and procedures for the performance of the validation are defined. After the performance of the validation the results are analyzed and, if necessary, deficiencies are identified. On this basis it has to be decided whether changes to the requirements or the design are necessary. Auf dieser Basis muss entschieden werden, ob Änderungen an den Requirements oder am Design notwendig sind.

The process are "Validation" is covered completely by the V-Modell.

Element of the standard	Is fulfilled by
Prepare for Validation	Discipline: Evaluation, Product: QA Manual, Product: Hardware Implementation, Integration and Evaluation Concept, Product: Software Implementation, Integration and Evaluation Concept, Product: System Implementation, Integration and Evaluation Concept, Product: Enabling System Implementation, Integration, and Evaluation Concept, Product: Enabling System
Validate Product and Product Components	Discipline: Evaluation

2.2.13 Organizational Process Focus

This process area serves for the identification of potential for improvement and for the planning and implementation of process improvement measures within an organization. To identify process improvement possibilities, the needs of the organization with regard to their processes are determined, and the current processes are evaluated. Within the scope of process evaluation, a profile of strengths and weaknesses of the organization-wide processes and suggestions for improvement measures are prepared. Subsequently the suggested improvement measures are prioritized and those measures that are to be implemented are selected. The implementation is planned and executed. Before the new or revised processes are introduced organization-wide, the quality of these processes in checked in pilot projects.

The process area "Organizational Process Focus" is covered completely by the V-Modell.

Element of the standard	Is fulfilled by
Determine Process Improvement Opportunities	Product: Process Model Improvement Concept, Product: Assessment of a Process Model
Plan and Implement Process Improvement Activities	Product: Process Model Improvement Concept, Product: Project Plan, Product: Organization-Specific Process Model, Subject: Lessons Learned, Subject: Objectives and Management Support, Subject: Experience Base

2.2.14 Organizational Process Definition

The task of the organizational process definition is the definition and maintenance of organizational process elements that can be adapted and used by the individual projects. In addition to process descriptions, process elements include also supporting tools, document templates and training material. Beyond that life cycle models for the project and the system, a metrics database and guidelines for project-specific »Tailoring have to be defined. This information and additional supporting elements are brought together in a library and provided to all staff members of the organization.

The project area "Organizational Process Definition" is covered completely by the V-Modell.

Element of the standard	Is fulfilled by
Establish Organizational Process Assets	Chapter: Project Type Variants, Chapter: Directives and Instructions for Tailoring, Chapter: Tailoring-Related Product Dependencies, Chapter: Decision Gates, Process module: Integrated Logistic Support, Product: Organization-Specific Process Model

2.2.15 Organizational Training

The process area "Organizational Training" deals with everything that concerns the training and follow-on training of the staff and refers to general abilities of the staff members that are required independently of specific projects and for the implementation of the objectives of the organization. For this purpose, the demand for organizational training is identified, a training plan and the necessary »Training Documentation are prepared and the training courses are performed. In order to be able to employ the staff members according to their knowledge level, it is recorded who successfully completed which training courses. A process for the evaluation of the effectiveness of organization-wide training has to be defined and implemented.

The process area "Organizational Training" is implemented in the »Process Module »Introduction and Maintenance of an Organization-Specific Process Model.

Element of the standard	Is fulfilled by
Establish an Organizational Training Capability	Subject: Training Concept, Subject: Training Documentation
Provide Necessary Training	Subject: Training Concept, Subject: Training Documentation, Subject: Experience Base, Activity step: Performing Roll Out

2.2.16 Integrated Project Management

Integrated Project Management integrates the activities of all project management topics into the organization. For this purpose a process suitable for the project is derived from the organizational process. On the basis of this process and the experience-based data from the metrics database the project activities are planned. All plans are combined to an integrated project plan, which is the basis on which the project is monitored and controlled. Since the organization is to learn from the activities of the individual projects, »Measurement Data and lessons learned from the project are provided to the organizational »Experience Base.

Another focus of Integrated Project Management is the cooperation and coordination of all stakeholders. For this purpose critical dependencies have to be identified, considered in the planning process, coordinated with all stakeholders and documented. Problems regarding the coordination between the stakeholders have to be solved.

The process area "Integrated Project Management" is covered completely by the V-Modell.

Element of the standard	Is fulfilled by

Use the Project's Defined Process	Product: Project Status Report, Product: Project Diary, Product: Project Progress Decision, Product: Metrics Analysis, Product: Final Project Report, Subject: Project-Specific V-Modell, Subject: Experience Base

Coordinate and Collaborate with Relevant Stakeholders	Chapter: Roles, Product: Project Plan, Product: Project Manual, Subject: Cooperation and Provisions of the Acquirer, Subject: Project Management - Organization and Directives

2.2.17 Risk Management

The task of risk management is to identify potential risks and to initiate preventive measures in time to avoid a negative impact on the success of the project. For this purpose possible risk sources are identified and risk parameters and »Risk Classes are defined in order to permit a classification of risks. Also a strategy for the identification, monitoring and treatment of risks is determined.

Risks are regularly identified, analyzed and classified. This results in a list of risks that are sorted according to risk classes. For important risks the strategy that was determined has to be used to identify, plan and if necessary implement measures preventing the occurrence of those risks or mitigating their effects.

Risk management requirements are covered completely by the V-Modell.

Element of the standard	Is fulfilled by
Prepare for Risk Management	Subject: Risk Management - Organization and Directives, Subject: Identified Risks, Aktivity: Managing Risks
Identify and Analyze Risks	Subject: Identified Risks
Mitigate Risks	Subject: Risk Mitigation Measures

2.2.18 Decision Analysis and Resolution

Decision Analysis and Resolution support all other process areas when important decisions are made. A formal process is used to evaluate possible alternatives on the basis of defined criteria and to select one alternative. At the start of the project, it is determined for which decisions such a formal process will have to be carried out.

Decision-making starts with the definition of the decision criteria. After the identification of different alternatives, evaluation methods will be selected. Based on the criteria and methods, the alternatives are now balanced one against the other and a solution is selected.

The process area "Decision Analysis and Resolution" is covered completely by the V-Modell.

Element of the standard	Is fulfilled by
Evaluate Alternatives	Product: Organization-Specific Process Model, Product: Project Manual, Product: Project Progress Decision

2.2.19 Institutionalize a Managed Process

The task of the generic objective "Institutionalize a Managed Process" is to make sure that projects are sensibly planned and executed, that the necessary resources are available, that staff members are trained as required by their roles and that the projects are monitored and controlled in accordance with the process descriptions.

In order to cover the generic objective "Institutionalize a Managed Process" completely for the processes managed by the V-Modell, the QA Manual must specify which activities will be subjected to a process evaluation. In this connection, it should be ensured that the activities selected for the evaluation cover all process areas and are adapted to the current requirements in the organization.

In the V-Modell the generic objective "Institutionalize a Managed Process" is covered completely for the process areas that are handled.

Element of the standard	Is fulfilled by
Establish an Organizational Policy	Product: Organization-Specific Process Model
Plan the Process	Section: Project Plan, Product: Project Plan
Provide Resources	Subject: Resource Planning
Assign Responsibility	Chapter: Roles
Train People	Subject: Training Plan
Manage Configurations	Process module: Configuration Management, Process module: Problem and Change Management

Identify and Involve Relevant Stakeholders	Chapter: Roles, Activity step: Coordinating Project Plan with Stakeholders, Activity step: Coordinating the Project Manual with all Stakeholders
Monitor and Control the Process	Product: Project Status Report
Objectively Evaluate Adherence	Product: Evaluation Report Process, Product: QA Manual
Review Status with Higher Level Management	Chapter: Decision Gates, Product: Project Progress Decision

2.2.20 Institutionalize a Defined Process

The task of the generic objective "Institutionalize a Defined Process" is to make sure that project-specific processes are derived from an organizational process in accordance with the »Tailoring guidelines. The process descriptions have to be maintained and lessons learned, »Measurement Data and suggestions for improvement have to be provided to the organizational process library.

In the V-Modell the generic objective "Institutionalize a Defined Process" is covered completely for the process areas that are handled.

Element of the standard	Is fulfilled by
Establish a Defined Process	Subject: Project-Specific V-Modell
Collect Improvement Information	Subject: Lessons Learned, Subject: Experience Base

2.3 Mapping to ISO 15288

The international standard ISO/IEC 15288 "Life Cycle Management - System Life Cycle Processes" (in the following briefly called ISO 15288) in the version dated October 2002 provides a framework of processes that cover the whole life cycle of a system. Its objective and orientation is similar to that of the V-Modell. ISO 15288 uses the basic principles and terms from the standard ISO 12207; the descriptions are similar and differ only in detail.

Compared to the V-Modell, the descriptions of the activities are much less detailed. It is limited mainly to a listing of the activities without examining how to proceed during the individual activities. ISO 15288 also does not know any products, as the V-Modell does, but limits itself to providing so-called "Outcomes" that are the expected results of the processes. For these "Outcomes" neither explicitly required contents nor any designations and formats are specified. The standard further contains no role concept, no references concerning decision gates and project execution strategies and also no support as regards the methods to be used.

As a result, ISO 15288 is not suitable for the direct use in an actual project, but it provides a framework that permits to classify national standards or to perform corresponding detailings or concretizations (including tailoring) of the processes/activities and "Outcomes" in order to arrive at a process model that can be used in practice.

ISO 15288 may be used in the following areas:

- It covers the entire life cycle of a system, including concept, development, production, service use, updating, maintenance and deactivation of systems; the specified processes may be used for a system and its elements iteratively, recursively or competitively.
- It describes all processes required for the life cycle of a system. In this context it does not matter what the objective, the field of application, the complexity, the size or the degree of innovation of the system is. It also does not play a role whether the system is produced as a one-of-a-kind-item, in mass production or by way of adaptation.
- It may be used by organizations both in their role as acquirer and as supplier. Acquirers and suppliers may belong to the same or to different organizations, and the acquirer-supplier-relationship may extend from an informal arrangement to a formal contract.
- It may be used as a basis for the establishment, evaluation and improvement of an organizational business and process model.

In all ISO 15288 (cf. Figure 1) contains 25 processes that form the following four process groups:

- Agreement Processes,
- Enterprise Processes,
- Project Processes and
- Technical Processes.

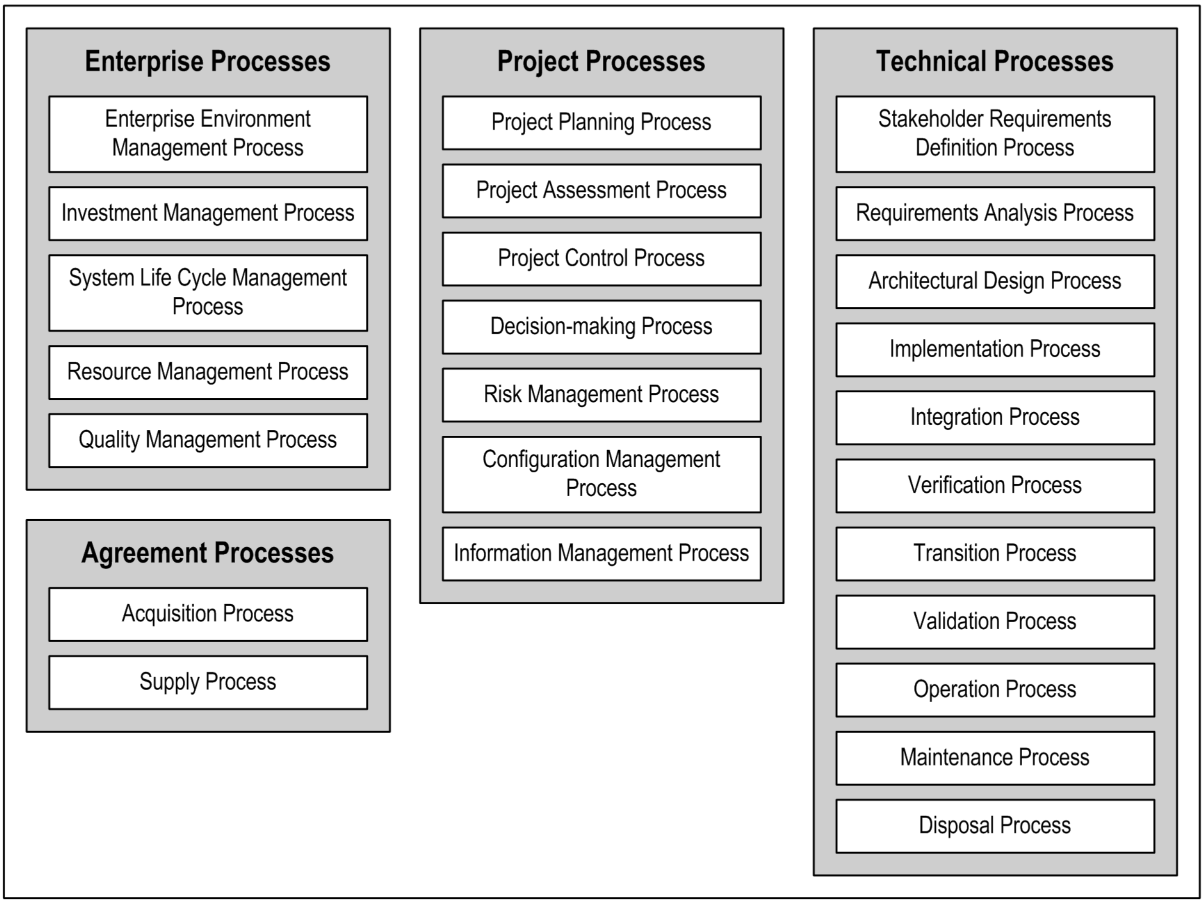

Figure 1: Process Groups of the ISO/IEC 15288 Standard

Each of these processes is described by

- *a Name* used for identification,
- a *Purpose* that describes the global objective of the process at a relatively high level,
- a list of so-called *Outcomes* that indicate what results are expected in case of a successful execution of the process, and
- a list of *Activities* that are used for the structural decomposition of the process and that have to be carried out during the application of the process.

An initial mapping of the V-Modell on ISO 15288 at process group level yields the following allocation, in which one process group of ISO 15288 is covered by several »Disciplines of the V-Modell:

Process Group of ISO 15288 (Figure 1) Disciplines of the V-Modell

Agreement Processes: »Aquisition and Contracting, »Supply and Contracting

Enterprise Processes: »Process Improvement

Project Processes: »Planning and Control , »Reporting, » Configuration and Change Management

Technical Processes: »Evaluation , »Requirements and Analyses, » System Specifications, »System Design, » Logistic Conception, »System Elements, » Logistic Elements

In the following, more detailed mapping of the V-Modell on ISO 15288 the description is also based on the process group structure of ISO 15288. Within a process group each ISO 15288 process is assigned the V-Modell activities - possibly also the process modules or disciplines - that cover this process. In this context "assignment" does not mean equivalence with regard to contents, since the contents of ISO processes and V-Modell activities are distributed differently in the two development standards, but coverage with regard to contents.

For the sake of clarity no V-Modell products (or topics) are shown in the figure. These may be determined simply by way of the V-Modell activities listed.

2.3.1 Agreement Processes

There are two *Agreement Processes*. The purpose of the

- *Acquisition Process* is to obtain a product or service in accordance with acquirer requirements;
- *Supply Process* is to deliver to the acquirer a product or a service that meets his requirements.

The *Agreement Processes* are intended for the establishment of an acquirer/supplier or contract awarder-supplier relationship. The *Agreement Processes* are the basis for the initialization of other project processes. The *Agreement Processes* may be used for various purposes, e. g.

- to negotiate and conclude a »Contract between an acquirer and a supplier for system development work;
- to wind up a concluded contract, e. g. for the procurement of a system or the performance of a service;
- to place work orders to »Sub-Suppliers, consultants or teams within the project;
- to terminate a contract after the delivery of a system or after the work was completed and the payment was made.

The processes *Acquisition* and *Supply* are covered completely by the V-Modell.

Element of the standard	Is fulfilled by
Acquisition Process	Discipline: Acquisition and Contracting, Aktivity: Coming to a Project Progress Decision
Supply Process	Discipline: Supply and Contracting, Aktivity: Coming to a Project Progress Decision

2.3.2 Enterprise Processes

There are five *Enterprise Processes*. The purpose of the

- *Enterprise Environment Management Process* is to define and update the business policy and processes of an organization with regard to ISO 15288;

- *Investment Management Process* is to initiate suitable (internal) projects to achieve the objectives of the organization;
- *System Life Cycle Processes Management Process* is to guarantee that effective life cycle processes that can be used by the organization are available;
- *Resource Management Process* is to provide necessary resources for projects;
- *Quality Management Process* is to achieve that products, services and process implementation meet the quality targets of the organization and to ensure acquirer satisfaction.

The *Enterprise Processes* are intended for that part of the management of a company that is in charge of business policy and the establishment of projects. With these processes the organization provides services that directly or indirectly both specify framework conditions and provide support for the execution of projects. *Enterprise Processes* have to achieve specific goals, such as

- Providing the appropriate environment so that the projects can achieve their goals;
- Ensuring that a procedure exists that regulates the start and discontinuation of projects as well as project changes;
- Ensuring that a company policy and documented procedures are defined that conform with ISO 15288 and are also applicable in the projects;
- Ensuring that appropriate methods and tools are determined and available for an efficient and effective execution of the projects;
- Ensuring that the projects have sufficient resources so that the cost, time and performance requirements can be met within an acceptable risk area and that the project staff is adequately trained;
- Ensuring that delivery items for the acquirer are of an appropriate quality.

The objective of the *Enterprise Processes* surpasses the actual scope of application of the V-Modell as a development standard for systems. However, even those processes at the organizational level can also be covered by »Process Modules of the V-Modell if they are adapted and understood accordingly from the aspect of the execution of organization-wide projects. From this point of view the following statements can be made:

The process *Enterprise Environment Management* is covered completely and the process *System Life Cycle Processes Management* is covered mostly by the V-Modell.

The processes *Investment Management* and *Resource Management* can be realized by a specific adaptation of the V-Modell.

The process *Quality Management* can be covered for the most part by the disciplines Planning and Control and Reporting of the V-Modell.

Element of the standard	Is fulfilled by
Enterprise Environment Management Process	Discipline: Process Improvement

Investment Management Process	Discipline: Planning and Control, Discipline: Requirements and Analyses, Discipline: Evaluation, Discipline: Configuration and Change Management, Discipline: Reporting, Aktivity: Coming to a Project Progress Decision

System Life Cycle Processes Management Process	Discipline: Process Improvement

Resource Management Process	Discipline: Planning and Control, Discipline: Configuration and Change Management, Aktivity: Preparing, Introducing and Maintaining an Organization-Specific Process Model, Aktivity: Preparing Training Documentation, Aktivity: Preparing Logistic Support Specification

Quality Management Process	Discipline: Planning and Control, Discipline: Reporting

2.3.3 Project Processes

There are seven *Project Processes*. The purpose of the

- *Project Planning Process* is to prepare effective and realistic project plans;
- *Project Assessment Process* is to determine the project state;
- *Project Control Process* is to control the execution of the project and to make sure that the project is within the planned time frame and budget and that the technical objectives are achieved;
- *Decision-making Process* is to evaluate alternatives and select the best possible approach;
- *Risk Management Process* is to minimize the impact of possible events that may be reflected in changes in quality, costs, time or technical characteristics;
- *Configuration Management Process* is to ensure the integrity of all results of a project or process and to make them available to the relevant personnel;
- *Information Management Process* is to pass on relevant information during - and if necessary also after - the life cycle of the system to the right recipient early, completely and reliably.

The *Project Processes* are used for the management of the activities of the *Technical Processes* and for the satisfactory winding up of a »Contract. The results of the *Project Processes* are the preparation and updating of planning, the monitoring of project progress with regard to adherence to the plans and the implementation of system requirements, the control of the expenditures, the making of decisions, risk management and reporting. They support and influence the implementation of the *Technical Processes*.

In development projects *Project Processes* are carried out at each level of the system structure. These processes are used when *Enterprise Processes* or activities concerning one phase in the life cycle of the system, including service use, maintenance and deactivation, are carried out.

If several projects are to be carried out at the same time in a company, *Project Processes* have to be defined in a way that their implementation is possible jointly for all those projects.

In the V-Modell the *Project Processes* are covered completely by V-Modell activities and the concept of the »Decision Gates, although there is no general decision-making process in the V-Modell.

Element of the standard	Is fulfilled by
Project Planning Process	Discipline: Planning and Control
Project Assessment Process	Discipline: Reporting, Discipline: Evaluation, Aktivity: Coming to a Project Progress Decision
Project Control Process	Process module: Problem and Change Management, Aktivity: Preparing the Project Manual, Aktivity: Planning Project, Aktivity: Coming to a Project Progress Decision
Decision-making Process	Aktivity: Preparing the Project Manual, Aktivity: Deciding on Changes, Aktivity: Coming to a Project Progress Decision, Aktivity: Keeping a Project Diary, Aktivity: Preparing Project Status Report
Risk Management Process	Aktivity: Preparing the Project Manual, Aktivity: Managing Risks
Configuration Management Process	Process module: Configuration Management, Aktivity: Preparing the Project Manual
Information Management Process	Aktivity: Preparing the Project Manual, Aktivity: Preparing Project Status Report, Aktivity: Preparing Commercial Project Status Report, Aktivity: Keeping a Project Diary, Aktivity: Managing Product Library

2.3.4 Technical Processes

There are eleven *Technical Processes*. The purpose of the

- *Stakeholder Requirements Definition Process* is to define the requirements for a system and to include all stakeholders in the process;
- *Requirements Analysis Process* is to transform the professional point of view of the requirements into a technical point of view;
- *Architectural Design Process* is to work out a solution that meets the system requirements;
- *Implementation Process* is to realize a specified system element;
- *Integration Process* is to use elements to prepare a system that corresponds to the architectural design;
- *Verification Process* is to verify that all requirements are met by the system;
- *Transition Process* is to transition the system to operational service use;
- *Validation Process* is to show that the system meets the expectations of the users when it is in service use;
- *Operation Process* is to use the system to deliver the expected performance;
- *Maintenance Process* is to maintain the capability of the system to deliver the required performance;
- *Disposal Process* is to end the existence of the system as such.

The *Technical Processes* are applicable across all phases of the life cycle of a system.

The following processes have to be carried out when developing a system: *Stakeholder Requirements Definition Process, Requirements Analysis Process, Architectural Design Process, Implementation Process, Integration Process, Verification Process, Transition Process* and *Validation Process*.

These processes should be carried out to create the preconditions for entering a new phase of the life cycle or for its end. They may be used for example in the early phases to develop a system concept, to determine technological necessities and to plan future development costs, schedules and risks. In the intermediate phases they may be used to define and realize a new system. In the later phases they may be used to introduce new technologies in the in-service phase or to perform modifications.

The other three *Technical Processes* (*Operation Process - Maintenance Process - Disposal Process)* may be used in any phase of the life cycle to achieve the objectives of the phase and to support the system development processes. The *Operation* and the *Maintenance Process* may be carried out for example to support a special version of the system. The *Disposal Process* may be carried out to deactivate legacy system (parts) or to dispose of undesired by-products of the service use of the system.

The processes *Stakeholder Requirements Definition*, *Requirements Analysis*, *Architectural Design*, *Implementation*, *Integration, Validation* and *Verification* are covered completely by the V-Modell.

In the process *Maintenance* it has to be taken into account that in the V-Modell maintenance is covered within the scope of a separate project and that the related approach is covered by a separate »Project Execution Strategy (Servicing and Maintaining Systems).

For the processes *Transition*, *Operation* und *Disposal* the V-Modell determines only the requirements for the performance of the tasks that are necessary in these processes, but not the performance of the tasks themselves (the V-Modell requires for example an operating concept, but it does not determine how the operating concept is to be implemented).

Element of the standard	Is fulfilled by
Stakeholder Requirements Definition Process	Discipline: Requirements and Analyses
Requirements Analysis Process	Discipline: Requirements and Analyses, Discipline: System Specifications, Aktivity: Preparing Logistic Support Specification
Architectural Design Process	Discipline: System Design, Aktivity: Preparing Logistic Support Specification, Aktivity: Performing Market Survey for Off-the-Shelf Products, Aktivity: Performing Make-or-Buy Decision, Aktivity: Performing and Evaluating Safety and Security Analysis
Implementation Process	Discipline: System Design, Discipline: System Elements, Aktivity: Performing Logistic Calculations and Analyses, Activity step: Initializing and Updating Configuration
Integration Process	Discipline: System Elements, Discipline: System Design, Aktivity: Integrating into Logistic Support Documentation, Aktivity: Managing Product Configuration, Activity step: Initializing and Updating Configuration
Verification Process	Process module: Measurement and Analysis, Discipline: Evaluation, Discipline: System Design, Aktivity: Preparing the QA Manual
Transition Process	Discipline: Logistic Conception, Discipline: Logistic Elements
Validation Process	Discipline: Evaluation

Operation Process	Aktivity: Preparing Logistic Support Specification, Aktivity: Defining In-Service Documentation, Aktivity: Preparing Training Documentation, Aktivity: Preparing Problem Report/Change Request, Aktivity: Maintaining Change Status List, Aktivity: Preparing Logistic Support Concept

Maintenance Process	Process module: Problem and Change Management, Projekt type variant: Project (Acquirer) Including System Maintenance, Discipline: System Design, Discipline: Logistic Conception, Discipline: Logistic Elements, Aktivity: Preparing Project Status Report

Disposal Process	Aktivity: Preparing Logistic Support Specification, Aktivity: Preparing Logistic Support Concept, Aktivity: Managing Product Configuration

2.4 Mapping to ISO 9001:2000

The international standard »ISO 9001:2000 (in the following briefly called ISO 9001) determines requirements for the quality management system whose introduction is a strategic decision made by an organization. The transposition of ISO 9001 to an European Norm (EN) was performed by the CEN management center and supported by CEN/BT WG 107. In this process the text of the international standard was approved by CEN without any changes.

If a contract-awarder requires a quality management system according to ISO 9001, this may be demonstrated on the side of the supplier by submitting the appropriate valid certificate from an accredited certification body.

If a supplier or an organization wants to obtain a certificate according to ISO 9001, it has to run and maintain a quality management system. In this context it has to be noted that such a certificate may also be issued to individual parts of a company. If a contract requires a certificate as a precondition it therefore has to be made sure that all parts of the company of the supplier that participate in the project are certified.

To obtain a ISO 9001 certificate, among other things all processes in the certified area have to be regulated by documented procedures. The V-Modell is such a documented procedure for methodical system development that covers the entire system life cycle. In contrast to other documented procedures, the V-Modell represents a very comprehensive documented procedure that integrates many subprocesses. It meets the requirements of ISO 9001 for the technical product development process. In addition to the V-Modell, however, there will be also other processes in an organization - as for example production processes - that will have to be considered within the framework of ISO 9001. Thus the V-Modell describes only one part of the variety of processes that can be found in an organization. To obtain a ISO 9001 certificate, the organization therefore has to make sure that also for these processes the requirements of ISO 9001 are met.

ISO 9001 requires a quality management system at organizational level. In contrast to this, the V-Modell defines procedures and approaches for projects. Here the project-specific process model is derived from an organization-specific process model on the basis of the V-Modell (see »Introduction and Maintenance of an Organization-Specific Process Model). Thus ISO 9001 and the V-Modell have different objectives. As a result, the V-Modell does not cover requirements of ISO 9001 that apply to more than one project, such as the establishment and the maintenance of a quality management system or the definition of an organization-wide quality policy. The V-Modell ensures, however, that the organization-wide requirements, as far as they concern the product development process, are implemented in the projects.

Starting with the points of the structure of ISO 9001, this »Mapping to Standards considers to what extent the requirements described in the ISO 9001 are met by the V-Modell at project level or - when the introduction, measurement and improvement of processes is concerned - by the »Process Module »Introduction and Maintenance of an Organization-Specific Process Model at the organizational level.

2.4.1 Quality Management System

ISO 9001 requires the establishment, the documentation, the maintenance and the continuous improvement of a quality management system in an organization. This requires identifying the necessary processes, determining the interaction between these processes and ensuring their execution, control and continuous improvement. For this purpose the processes have to be monitored, measured, and analyzed, and the necessary resources and information have to be provided. If one of these processes is outsourced from the organization, control of this process has to be ensured and it must be recognizable in the quality management system that this process was outsourced.

The documentation of the quality management system includes the quality policy and a quality management manual. A process for the control of documents and records must be available, i. e. the quality of the documents has to be assured and their management and availability must be guaranteed.

The V-Modell is one of the system development processes considered within the framework of the quality management system. For this subprocess the general requirements with regard to definition, execution, control and improvement of processes and the documentation requirements are fulfilled. The introduction of a quality management system itself, however, is not the function of the V-Modell.

Element of the standard	Is fulfilled by
Quality Management System - General Requirements	Process module: Introduction and Maintenance of an Organization-Specific Process Model, Process module: Measurement and Analysis, Process module: Quality Assurance, Process module: Project Management
Documentation Requirements - General	Process module: Project Management, Process module: Quality Assurance, Process module: Introduction and Maintenance of an Organization-Specific Process Model

Quality Management Manual	Product: QA Manual
Document Management	Chapter: Basic Concepts of the V-Modell, Section: Quality Assurance and Product State Model, Process module: Configuration Management, Process module: Problem and Change Management, Aktivity: Evaluating Document
Record Management	Process module: Configuration Management, Discipline: Evaluation, Product: Qualification Record, Product: Project Manual, Product: QA Manual

2.4.2 Responsibility of Management

In this context emphasis is placed on the obligation and responsibility of top management with regard to the development and realization of a quality management system. Of special importance in this process are the aspects acquirer orientation, quality policy, planning of the quality management system, definition of the responsibility and authority, communication within the organization and evaluation of the quality management system by top management.

Due to its concept, the V-Modell makes a major contribution to acquirer orientation. It is guaranteed that the quality policy defined by top management is implemented by the organization-specific and project-specific process model defined on the basis of the V-Modell. Because of the role concept and the reporting regulations, the requirements with regard to responsibilities, authority and communication for the process controlled by the V-Modell are met. The »Process Module »Introduction and Maintenance of an Organization-Specific Process Model defines a method for the evaluation and continuous improvement of the organization-specific process model. Regular improvement projects on this basis have to be initiated by top management, however. The definition of the quality policy itself and the implementation of the requirements defined in this chapter for all processes that - apart from the V-Modell - also belong to the quality management system (such as the production process) are not part of the V-Modell.

Element of the standard	Is fulfilled by
Commitment of Management	Product: QA Manual, Product: Process Model Improvement Concept
Customer Orientation	Process module: Specification of Requirements, Process module: System Development, Discipline: Evaluation

Quality Policy	Product: QA Manual, Product: Process Model Improvement Concept
Quality Targets	Product: QA Manual
Planning of the Quality Management System	
Responsibility, Authority and Communication	Chapter: Roles, Product: Project Plan
Representative of Top Management	Role: Quality Manager
Internal Communication	Discipline: Reporting
Management Evaluation - General	Product: Assessment of a Process Model
Evaluation Input	Discipline: Reporting, Discipline: Evaluation, Product: Assessment of a Process Model, Subject: Experience Base
Evaluation Results	Product: Process Model Improvement Concept

2.4.3 Resource Management

The organization must provide personnel resources and the necessary infrastructure to realize and maintain the quality management system and to increase acquirer satisfaction by the implementation of acquirer requirements. The staff must be appropriately trained and they must be aware of the importance of their work and their contribution to the achievement of the quality targets.

For that part of the quality management system that is governed by the V-Modell these requirements are met.

Element of the standard	Is fulfilled by
Allocating Resources	Chapter: Roles, Product: Project Plan, Product: Project Management Infrastructure

Personnel Resources - General	Chapter: Roles, Product: Project Plan

Capability, Awareness and Training	Product: Project Plan, Subject: Training Concept, Subject: Experience Base

Infrastructure	Product: Project Management Infrastructure, Product: Enabling System

Work Environment	Product: Project Management Infrastructure, Product: Enabling System

2.4.4 Product Realization

The range of topics concerning product realization deals with the planning of product realization, acquirer-related processes, development, procurement, production and delivery of services and the control of monitoring and measuring tools.

The planning of product realization includes defining quality targets and requirements, introducing and implementing processes, determining test activities that include verification and validation and also the documentation required for product realization.

Requirements for acquirer-related processes deal with the identification and evaluation of requirements for the product and with the communication with the acquirer.

The range of topics concerning development includes the planning, input, results, evaluation, verification and validation of the development work and the control of development changes.

The procurement process has to make sure that the procured product meets the requirements. The requirements for the product to be procured and for the quality management system of the supplier have to be determined. Suppliers have to be selected on the basis of their capabilities to deliver the product in accordance with the requirements of the organization. The criteria for supplier selection have to be defined and the selection of the suppliers has to be documented.

The topic product and service process combines the following aspects: control of production and delivery of services, validation of the processes for production and delivery of services, marking and traceability, acquirer property and product preservation.

The organization has to identify the necessary monitoring and measuring tools required for the verification of he conformity of the product. It also has to monitor and measure the products appropriately to check their conformity and to initiate countermeasures in case of deviations.

The V-Modell is not focused on production processes. Production requirements and the related necessary monitoring and measuring tools are thus not part of the V-Modell. All other requirements are covered by the V-Modell.

Element of the standard	Is fulfilled by

Planning Product Realization	Product: Project Plan, Product: Project Manual, Product: QA Manual
Determining the Requirements with Regard to the Product	Product: Overall System Specification, Product: Contract (Acquirer), Product: Contract Addendum (Acquirer)
Evaluation of Requirements with Regard to the Product	Product: Requirements Evaluation, Product: Assessment of Request for Proposal
Communication with the Customer	Product: Offer, Product: Contract (Acquirer), Product: Contract Addendum (Acquirer), Product: Statement of Acceptance
Development Planning	Product: Project Plan, Product: QA Manual
Development Input	Product: Overall System Specification
Development Results	Product: System, Product: Segment, Product: Hardware Unit, Product: Software Unit, Product: External Unit, Product: Delivery, Product: External Hardware Module, Product: External Software Module
Development Evaluation	Product: Project Progress Decision
Development Verification	Discipline: Evaluation
Development Validation	Discipline: Evaluation
Managing Development Changes	Process module: Problem and Change Management, Product: Contract Addendum
Procurement Processes	Process module: Delivery and Acceptance (Acquirer), Process module: Evaluation of Off-the-Shelf Products

Procurement Information	Product: Request for Proposal
Verifying Procured Products	Product: Evaluation Report Delivery, Product: Evaluation Specification Delivery
Managing Production and the Supply of Services	
Validating the Processes for Production and for the Supply of Services	
Identification and Traceability	Process module: Configuration Management
Customer Property	
Preserving Products	
Managing Monitoring and Measuring Tools	

2.4.5 Measuring, Analyzing and Improving

The organization is required to plan and realize an approach for the monitoring, measuring, analysis and improvement both of products and of the quality management system. This ensures that the products meet the requirements, that the processes of the quality management system deliver the desired results and that acquirer satisfaction is guaranteed. Also audits of the quality management system should be performed in defined intervals. A product that does not meet the requirements has to be marked, and its unintended use or delivery have to be prevented. The analysis of the measured data must make possible statements about acquirer satisfaction, the satisfaction of product requirements, process and product features and suppliers. On the basis of these statements, the organization of the quality management system must be continuously improved. The organization must take corrective measures to eliminate failure causes. Possible failures are prevented with preventive measures. The measures must be in a reasonable proportion to the impact of possible failures.

The V-Modell includes the »Process Modules »Introduction and Maintenance of an Organization-Specific Process Model und »Measurement and Analysis. Those process modules describe a process for defining »Metrics and for determining and analyzing the accompanying data for the evaluation and improvement of that part of the quality management system that is being realized by the V-Modell. It is the responsibility of the organization to execute in regular intervals improvement projects that are based on this approach.

The quality assurance measures defined in the V-Modell make sure that a product developed in accordance with the V-Modell will meet the requirements and that the greatest possible acquirer satisfaction will be achieved. The process module »Safety and Security includes an approach that in case of critical products helps to avoid or minimize risks that may arise from the operation of the product. Thus the V-Modell guarantees that the requirements of ISO 9001 concerning the topics measurement, analysis, product improvement and product development process are met. However, corresponding processes will have to be defined additionally for all other processes of the quality management system, such as the production process.

Element of the standard	Is fulfilled by
Measuring, Analyzing and Improving - General	Process module: Measurement and Analysis, Process module: Introduction and Maintenance of an Organization-Specific Process Model
Customer Satisfaction	Product: Statement of Acceptance, Activity step: Validating System Element
Internal Audit	Product: Evaluation Report Process, Product: Quality Status Report, Product: Assessment of a Process Model
Monitoring and Measuring Processes	Product: Evaluation Report Process, Product: Assessment of a Process Model, Product: QA Manual
Monitoring and Measuring the Product	Discipline: Evaluation, Product: QA Manual
Management of Defective Products	Chapter: Management Mechanisms of the V-Modell, Section: Quality Assurance and Product State Model, Product: Problem Report / Change Request
Data Analysis	Product: Project Diary, Product: Assessment of a Process Model, Product: Metrics Analysis, Product: Measurement Data, Product: Statement of Acceptance, Activity step: Validating System Element
Continuous Improvement	Product: Assessment of a Process Model
Corrective Actions	Process module: Introduction and Maintenance of an Organization-Specific Process Model, Process module: Problem and Change Management

Preventive Measures	Process module: Introduction and Maintenance of an Organization-Specific Process Model, Process module: Safety and Security

2.5 Mapping to V-Modell 97

The V-Modell 97, which is part of the development standard for Federal IT systems, is the predecessor of the M-Model XT. Its objective, to regulate the approach for the development of IT systems, was similar to that of the V-Modell XT. But in contrast to the V-Modell 97, which is focused on activities, the V-Modell XT is focused on products.

The most important novelties in the V-Modell XT as regards contents are regulations for hardware development, logistics, commercial project management and process improvement. Regulations that existed already in the V-Modell 97 have been elaborated further, taking into account the state of the art. In this context in particular the fact should be mentioned that the interfaces between contract awarder and supplier projects are described explicitly.

Furthermore, a number of additional concepts have been introduced in the V-Modell XT, for example the »Project Execution Strategy and the »Decision Gates. Also major changes were made to the tailoring concept.

With regard to their structure, there are considerable differences between the V-Modell 97 and the V-Modell XT. The V-Modell XT is composed of so-called process modules and the V-Modell 97 is subdivided into four submodels (see Figure 2):

- Project Management submodel (PM)
- Quality Assurance submodel (QS)
- Configuration Management submodel (KM)
- System Development submodel (SE)

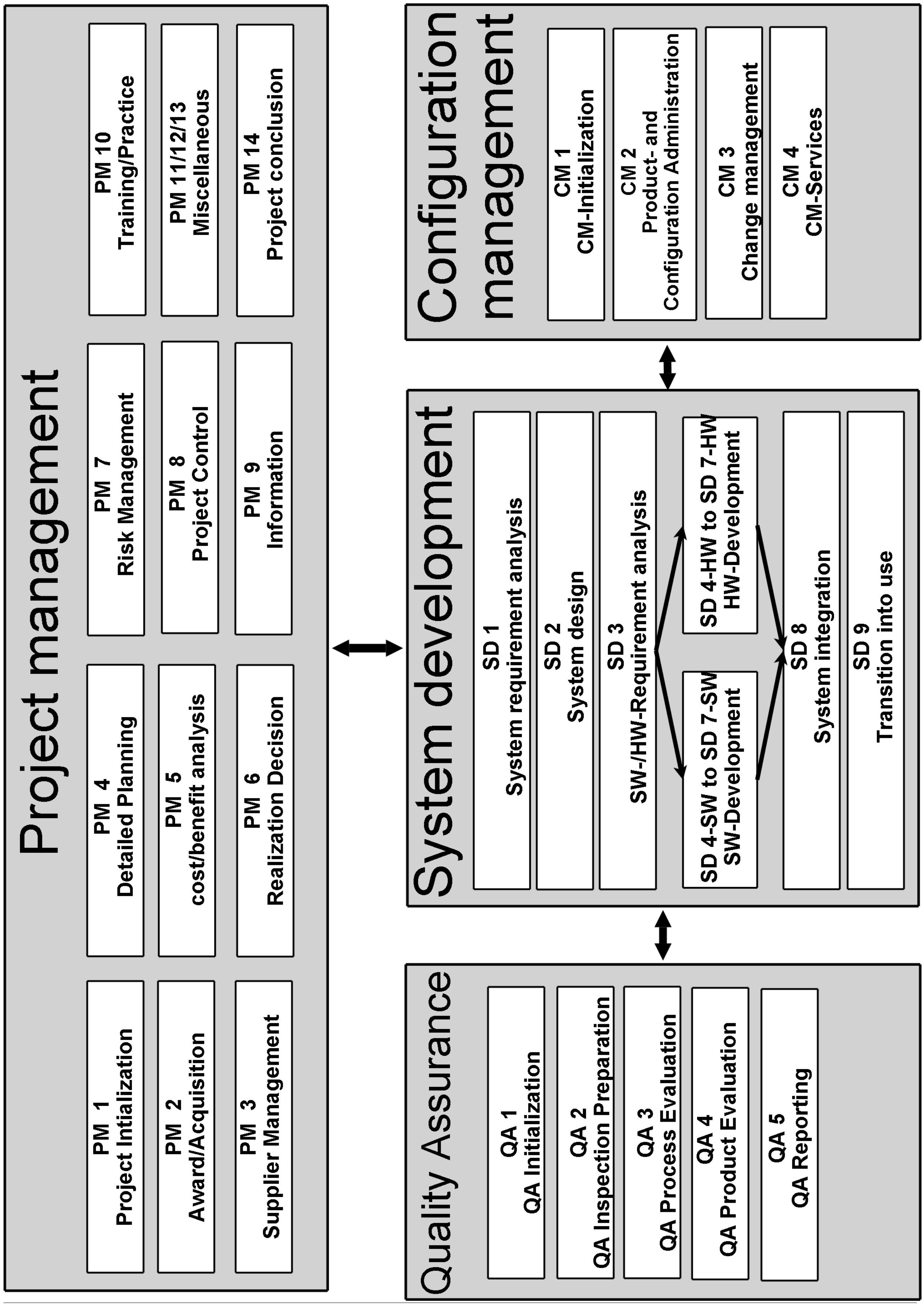
Project management
PM 1
Project Intialization
PM 2
Award/Acquisition
PM 3
Supplier Management
PM 4
Detailed Planning
PM 5
cost/benefit analysis
PM 6
Realization Decision
PM 7
Risk Management
PM 8
Project Control
PM 9
Information
PM 10
Training/Practice
PM 11/12/13
Miscellaneous
PM 14
Project conclusion
Quality Assurance
QA 1
QA Initialization
QA 2
QA Inspection Preparation
QA 3
QA Process Evaluation
QA 4
QA Product Evaluation
QA 5
QA Reporting
System development
SD 1
System requirement analysis
SD 2
System design
SD 3
SW-/HW-Requirement analysis
SD 4-SW to SD 7-SW
SW-Development
SD 4-HW to SD 7-HW
HW-Development
SD 8
System integration
SD 9
Transition into use
Configuration management
CM 1
CM-Initialization
CM 2
Product- and
Configuration Administration
CM 3
Change management
CM 4
CM-Services

Figure 2: Structure of the V-Modell 97

In this standard mapping the terms of the individual submodels of the V-Modell 97 are mapped on corresponding model elements of the V-Modell XT.

2.5.1 Project Management Submodel (PM)

The Project Management Submodel regulates the tasks and functions of the technical project management in the development process. These regulations do not affect any organizational definitions.

The activities defined in the PM submodel include the planning and control of project-internal activities, the assignment of project-internal roles and the installation of an interface with project-external units (supplier).

Products and activities of the Project Management Submodel may be mapped on the products and activities of the »Process Module »Project Management in the V-Modell XT; only some products, such as the memorandum or the internal notice, do not have a direct counterpart in the V-Modell XT, where they are covered by the »Reporting system. And although the activities Staff Training and Training/Instruction can be recorded in the »Project Plan of the V-Modell XT, they are not explicitly listed as activities in the V-Modell XT.

Element of the standard	Is fulfilled by
Project Management Submodel (PM)	Process module: Project Management
Activity PM 1 - Project Initialization	Aktivity: Preparing the Project Manual, Aktivity: Planning Project
Activity PM 2 - Awarding/Procurement	Discipline: Acquisition and Contracting
Activity PM 3 - Contractor Management	Product: Project Status Report (Supplier), Product: Project Progress Decision, Product: Change Status List
Activity PM 4 - Detailed Planning	Aktivity: Planning Project
Activity PM 5 - Cost-Benefit Analysis	Aktivity: Coming to a Project Progress Decision, Aktivity: Performing Make-or-Buy Decision
Activity PM 7 - Risk Management	Aktivity: Coming to a Project Progress Decision

Activity PM 7 - Risk Management	Aktivity: Managing Risks
Activity PM 8 - Project Control	Aktivity: Preparing Project Status Report, Aktivity: Coming to a Project Progress Decision
Activity PM 9 - Information Service/Reporting	Aktivity: Preparing Project Status Report
Activity PM 10 - Training/Job Familiarization	Aktivity: Planning Project
Activity PM 11 - Providing the Resources	Aktivity: Coming to a Project Progress Decision
Activity PM 12 - Placing Work Orders	Aktivity: Assigning a Work Order
Activity PM 13 - Familiarization of the Staff	Aktivity: Assigning a Work Order
Activity PM 14 - Project Completion	Aktivity: Concluding Project
Product PM - Memorandum	Discipline: Reporting
Product PM - Evaluation of Offers	Product: Offer Assessment
Product PM - Work Order	Product: Work Order
Product PM - Invitation	Product: Meeting Document
Product PM - Internal Note	Discipline: Reporting
Product PM - Cost-Benefit Analysis	Product: Project Proposal, Product: Make-or-Buy Decision
Product PM - Final Project Report	Product: Final Project Report

Product PM - Project Manual	Product: Project Manual
Product PM - Project Plan	Product: Project Plan
Product PM - Minutes	Product: Meeting Document
Product PM - Factual Report	Discipline: Reporting, Product: Market Survey for Off-the-Shelf Products
Product Report - Status Report	Product: Project Status Report

2.5.2 Quality Assurance Submodel (QS)

The Submodel QS manages the quality assurance tasks and functions in the system and software development process. In contrast to the informal evaluations in the Submodel SE, it is demonstrated in this submodel that specified requirements are met. This is done within the framework of a verification and so that it is objectively traceable. These requirements can be found in the documents User Requirements and Technical Requirements of the Submodel SE.

The Quality Assurance Submodel is partly mapped on the V-Modell-XT-»Process Module »Quality Assurance. Beyond that the system-related parts of the Quality Assurance Submodel turn up again in the process module »System Development of the V-Modell XT, because this is where the development of the evaluation specifications for system elements and the testing of the system elements is located.

Element of the standard	Is fulfilled by
Quality Assurance Submodel (QS)	Process module: Quality Assurance, Process module: System Development, Process module: Project Management, Process module: Usability and Ergonomics, Process module: Delivery and Acceptance (Acquirer)
Activity QS 1 - QA Initialization	Aktivity: Preparing the QA Manual, Aktivity: Planning Project
Activity QS 2 - Preparation for Testing	Aktivity: Preparing Evaluation Specification Document, Aktivity: Preparing Evaluation Specification Process, Aktivity: Preparing Evaluation Specification System Element, Aktivity: Preparing Evaluation Specification Usability, Aktivity: Preparing Evaluation Specification Delivery, Aktivity: Realizing Evaluation Procedure System Element

Activity QS 3 - Process Control of Activities	Aktivity: Evaluating Process

Activity QS 4 - Testing Products	Aktivity: Evaluating Document, Aktivity: Evaluating System Element, Aktivity: Evaluating Usability, Aktivity: Evaluating Delivery

Activity QS 5 - QA Reporting	Aktivity: Preparing Quality Status Report

Product QS - Test Plan	Product: Project Plan

Product QS - Test Protocol	Product: Evaluation Report System Element, Product: Evaluation Report Usability, Product: Evaluation Report Process, Product: Evaluation Report Delivery, Product: Evaluation Report Document

Product QS - Test Procedure	Product: Evaluation Procedure System Element

Product QS - Test Specification	Product: Evaluation Specification Usability, Product: Evaluation Specification Document, Product: Evaluation Specification Delivery, Product: Evaluation Specification Process, Product: Evaluation Specification System Element

Product QS - QA Plan	Product: QA Manual

2.5.3 Configuration Management Submodel (KM)

The Submodel KM makes sure that products can be unambiguously identified, connections and differences between different versions of a configuration remain recognizable and product changes can be made only in a controlled way.

That part of configuration management that deals with versionizing of products and »Product Configurations, can be mapped on the »Process Module »Configuration Management of the V-Modell XT. In the V-Modell XT configuration management is less extensive, because today configuration management is usually supported by tools.

In the V-Modell XT the products and activities dealing with the controlled implementation of changes may be mapped on elements of the process module »Problem and Change Management. Beyond that, this process module is also in charge of fault management.

Element of the standard	Is fulfilled by

Configuration Management Submodel (KM)	Process module: Configuration Management, Process module: Problem and Change Management, Process module: Project Management
Activity KM 1 - Planning	Aktivity: Preparing the Project Manual
Activity KM 2 - Product and Configuration Management	Aktivity: Managing Product Configuration
Activity KM 3 - Change Management (Configuration Control)	Process module: Problem and Change Management
Activity KM 4 - KM Services	Process module: Configuration Management
Product KM - Change Request/Problem Report	Product: Problem Report / Change Request
Product KM - Change Order	Product: Change Decision
Product KM - Change Message	Product: Change Status List, Product: Product Configuration
Product KM - Change Status List	Product: Change Status List
Product KM - Change Proposal	Product: Problem/Change Evaluation
Product KM - KM Plan	Product: Project Manual
Product KM - Configuration Identification Document	Product: Product Configuration
Product KM - Project History	Product: Project Diary

2.5.4 System Development Submodel (SE)

The Submodel SE combines all activities that are used directly for system development and the respective development documents.

For the most part these activities turn up again in the V-Modell XT in the »Process Module »System Development and in the process module »Software Development. Only some products, such as information about the user manual, information about the operation manual and information about the diagnosis manual and the software problem and change concept, are mapped on the process module »Integrated Logistic Support.

In the V-Modell XT the product Technical Requirements of the V-Modell 97 is already covered also in the specifications, for example in the »System Specification and the »Hardware Specification.

Element of the standard	Is fulfilled by
System development Submodel (SE)	Process module: System Development, Process module: Integrated Logistic Support, Process module: Software Development, Process module: Hardware Development
Activity SE 1 - System Requirements Analysis	Discipline: Requirements and Analyses, Aktivity: Preparing Overall System Specification
Activity SE 2 - System Design	Aktivity: Preparing System Architecture, Aktivity: Preparing System Specification, Aktivity: Preparing External Unit Specification, Aktivity: Preparing Enabling System Architecture, Aktivity: Preparing System Implementation, Integration and Evaluation Concept, Aktivity: Performing and Evaluating Safety and Security Analysis
Activity SE 3 - SW/HW System Requirements Analysis	Aktivity: Preparing Software Specification, Aktivity: Preparing Hardware Specification, Aktivity: Preparing Software Implementation, Integration and Evaluation Concept, Aktivity: Preparing Hardware Implementation, Integration and Evaluation Concept, Aktivity: Preparing External Hardware Module Specification, Aktivity: Preparing External Software Module Specification
Activity SE 4-SW - Preliminary SW Design	Aktivity: Preparing Database Design, Aktivity: Preparing Software Architecture
Activity SE 5-SW - Detailed SW Design	Aktivity: Preparing Database Design, Aktivity: Preparing Software Architecture
Activity SE 6-SW - SW Implementation	Aktivity: Realizing Software Module

Activity SE 7-SW - SW Integration	Aktivity: Integrating into Software Unit, Aktivity: Integrating into Software Component
Activity SE 8 - System Integration	Aktivity: Integrating into System, Aktivity: Integrating into Segment, Aktivity: Defining In-Service Documentation, Aktivity: Preparing Repair Documentation
Activity SE 9 - Transition to Use	Aktivity: Preparing Logistic Support Specification
Product SE - User Requirements	Product: Overall System Specification, Product: Requirements Specification, Product: Safety and Security Analysis, Product: Requirements Specification Overall Project
Product SE - Data Catalog	Product: Database Design
Product SE - Implementation Documents	Product: Software Implementation, Integration and Evaluation Concept, Product: System Implementation, Integration and Evaluation Concept
Product SE - User Manual Information	Product: In-Service Documentation
Product SE - Operation Manual Information	Product: In-Service Documentation
Product SE - Diagnosis Manual Information	Product: Repair Documentation
Product SE - Integration Plan	Product: Software Implementation, Integration and Evaluation Concept, Product: System Implementation, Integration and Evaluation Concept
Product SE - Interface Description	Product: Software Specification, Product: System Specification, Product: External Unit Specification, Product: External Software Module Specification

Product SE - Interface Overview	Product: Software Architecture, Product: System Architecture
Product SE - Other Operational Information	Product: Training Documentation, Product: Logistic Support Concept, Product: Maintenance Documentation, Product: Spare Parts Catalog
Product SE - SW Architecture	Product: Software Architecture
Product SE - SW Design	Product: Software Specification
Product SE - Software Problem and Change Concept	Process module: Problem and Change Management, Projekt type variant: Project (Acquirer) Including System Maintenance, Product: Logistic Support Concept
Product SE - System Architecture	Product: System Architecture, Product: Safety and Security Analysis
Product SE - Technical Requirements	Product: Software Specification, Product: System Specification, Product: External Unit Specification, Product: External Software Module Specification

2.5.5 Manual Collection

The Manual collection of the V-Modell 97 includes explanations of various topics. The manuals are to assist in the work with the V-Modell. Accordingly they do not have the character of a regulation.

The individual manuals may be mapped on different parts of the V-Modell XT. Beyond that, the HW Manual - Building of Hardware may be assigned to the »Process Module »Hardware Development. The manuals "SEC - Application of V-Modell and ITSEC" and "SI - Security and Criticality" are mapped in the V-Modell XT by the process module »Safety and Security. The manual "SZ - Scenarios" corresponds in the V-Modell XT to the »Project Execution Strategy for system development.

The manuals "FAO - Meeting the Minimum IT Requirements of the FAO by the V-Modell" and "BPR - Connection between Business Process Reengineering and V-Modell" cannot be mapped on the V-Modell XT. Mapping of the manual "RE - Reverse Engineering" was not examined.

Element of the standard	Is fulfilled by
HW Manual - Hardware development	Process module: Hardware Development

ISO Manual - The V-Modell in an ISO and AQAP Environment	Convention Mapping: Mapping to ISO 15288, Convention Mapping: Mapping to AQAP-150

OOS Manual - Making Allowances for Object-Oriented Languages	Process module: Software Development

R Manual - Role Concept in the V-Model	V-Modell Part: V-Modell Reference Roles

SEC Manual - Application of V-Modell and ITSEC	Process module: Safety and Security

SI Manual - Security and Criticality	Process module: Safety and Security

SZ Manual - Scenarios	Chapter: Project Type Variants

T Manual - Tailoring and Project-Specific V-Modell	V-Modell Part: V-Modell Reference Tailoring

UMF Manual - Integration of the V-Modell into its Environment	V-Modell Part: Fundamentals of the V-Modell

3 List of Figures

Part 8: Annex

V-Modell® XT

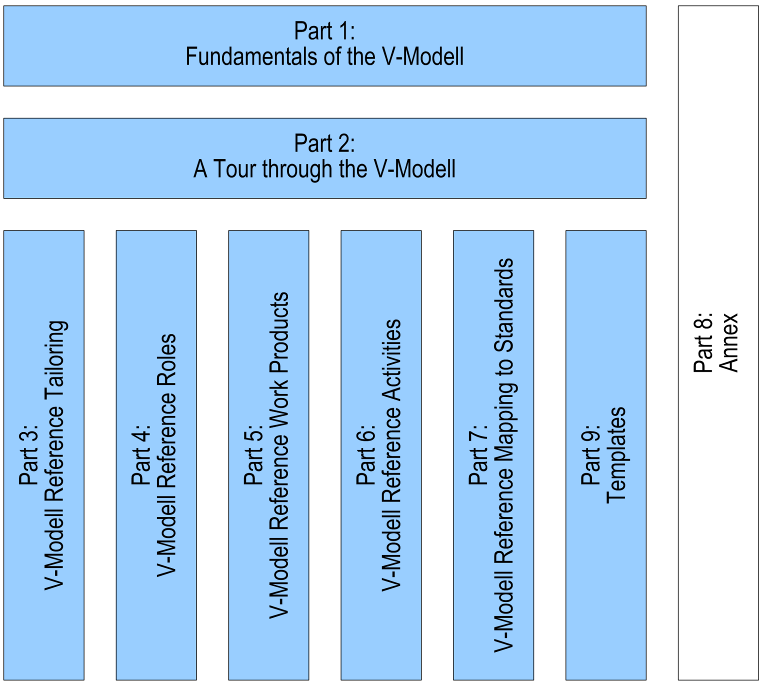

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Table of Contents

1 Method References

1.1 Business Process Modeling

Usage

Determining Requirements

Reference

BG03

Purpose

The objectives of business process modeling include the specification and optimization of business processes. For business process modeling the following methods may be used:

Business Process Optimization

In a business process the goals of third parties (such as acquirers, citizens etc.) are to be achieved, who therefore are to be made to "stakeholders" in the process. Essential characteristics of a business process are

- acquirer orientation (this means also the internal "acquirers" of the administration) and
- that a payoff (for the acquirers and the organization itself) is achieved.

There are two fundamentally different approaches to business process optimization:

- the radical method of Business (Process)Reengineering (BPR) according to Hammer and Champy
- and the gentler approach of the continuous improvement process (CIP).

Business Reengineering

Business Reengineering according to Hammer and Champy is a fundamental rethinking and radical redesign of companies or essential business processes. In this context "fundamental" means that the question "what and why" has to be put before the question "how". Also the reorganization is to apply not only to certain sectors, but to the whole company or at least to the main business processes. "Radical" means for Hammer and Champy principally "to start from scratch" and that existing processes and structures have to be fundamentally called into question. The approach offers important ideas, methods and "food for thought", which are or may also be of importance in all other forms of (company) reorganization.

Continuous Improvement Process (CIP)

The theory on which the CIP is based is the European version of the so-called "Japanese Way" (KAIZEN). It describes a systematic approach to the identification and elimination the waste of resources and to the improvement of the work processes and the work environment. According to the German saying "Der Weg ist das Ziel " ("The way is the goal"), CIP focuses on continuing small improvements of the business processes instead of a fundamental innovation or reorganization. This distinguishes CIP from BPR. The thing that it has in common with the BPR, and thus the novelty compared to traditional organizational processes, however, is its process orientation and thus the departure from function-oriented thinking.

The approach of the CIP is neither revolutionary nor radical, but was shaped on the basis of many years' experience. In this respect the approach is considerably more practical than that of the BPR and takes into account to a greater degree the problems occurring during the reorganization of company processes.

Use Case Modeling

See paragraph "Use Case Modeling" in method reference »Requirements Analysis.

1.2 Cost-Benefit Analysis

Usage

Performing Life Cycle Cost Calculation

Reference

Röt01

Purpose

The »Cost-Benefit Analysis does not evaluate the profit to be gained from a measure, but compares the monetary benfit with the costs of the measure. Therefore, the cost-benefit analysis should be used for projects which are not focussed on gaining a profit. This is the case in the public sector, non-profit enterprises and internal projects.

The cost-benefit analysis examines and evaluates the economic effectiveness of projects in advance. The results are the basis for the selection of the projects which enable the respective organizational unit to pursue their strategic goals most effectively.

Cost-Effectiveness Considerations

IT cost-effectiveness considerations (cost-effectiveness considerations for information technology projects) can be used to evaluate and document IT projects and to present them in a project portfolio. Each project is tested on a criteria catalog. The cost-effectiveness considerations distinguish between two kinds of cost-effectiveness: monetary cost-effectiveness and cost-effectiveness in a broader sense.

In this concept the monetary cost-effectiveness is the result of the costs and benefits that can be quantified in monetary values. When compiling the costs and benefits, the net present value method is taken as a basis to adequately take into account the chronological sequence of the accrouing costs and benefits. In the cost-effectiveness considerations, the monetary criteria are subdivided for this process into two groups. The first group includes criteria concerning the the development costs and development benefits. These are normally non-recurring costs and accrue prior to the introduction of a IT project, and they are strictly speaking the capital investments that are paid in and out. In this process the monetary benefit is generated mostly from the savings when the previous procedure is replaced. The second group of criteria are the criteria related to operating costs and benefits. They usually accrue after the introduction of the IT project in the form of running costs and benefits and have to be determined for the period of the expected service life. The standard period assumed in the cost-effectiveness considerations is five years.

For many IT projects it is often not possible to furnish proof of cost-effectiveness in a narrower sense. Therefore the cost-effectiveness considerations provide not only an examination according to the net present value method, but in addition also an evaluation for which the utility analysis is used. In this process two evaluation areas are formed, the urgency values and the qualitative-strategic values.

1.3 Database Modeling

Usage

Preparing Database Design

Reference

KE04

Purpose

- the representation of entity types, relation types and cardinalities with accordingly different graphical symbols, and
- the indication of the names of all entity types and relation types in the diagram.

Database modeling consists of several submethods: **ER Modeling** In Entity Relationship Modeling („ER Modeling“) within the scope of a specified terms of reference a »Data Model is prepared that is based in general only on technical factors and the view of the users and not on the realization of the IT system. The aim of ER Modeling is to describe the objects that are represented by data in an information processing system and their mutual relations. The ER Model is prepared in a top-down approach where in each design step more detailed and refined structures emerge. For the description of ER Modeling, the ER diagram is used. An ER diagram mainly consists of the following

Data Navigation Modeling

The method "Data Navigation Modeling" is used to generate a database-management-oriented (DBMS) data structure from an entity-relationship-model (ER Model). Data Navigation Modeling is helpful in particular for the generation of powerful hierarchical and network-like database structures.

Normalization

The aim of "normalization" is the formation of data structures (entity types with attributes) so that specific regularities, so-called normalization rules, are observed, which have, among other things, the following effects:

- Elimination of redundancies,
- Elimination of anomalies that may occur when inserting, deleting or modifying data in data structures.

1.4 Design Verification

Usage

Preparing Hardware Architecture, Preparing Software Architecture, Preparing System Architecture, Performing and Evaluating Safety and Security Analysis

Reference

THE03

Purpose

The aim of the design verification is to furnish a mathematically exact proof that the refined specification continues to meet the requirements of the initial specification. It uses the tools of formal logic to verify that a formal specification (refined specification) is a refinement of the initial specification and that also it meets all requirements for the initial specification. A specification is refined by a further detailing and concretization of the statements and conditions.

For the design verification the following methods may be used:

Software Architecture Analysis Method (SAAM)

SAAM is one of the simpler methods for scenario-based architecture evaluation, which was the first to be published. SAAM is suitable for the testing of software architectures with regard to quality attributes (qualitative requirements), such as

- Modifiability,
- Portability,
- Growth Potential,
- Performance,
- Reliability,

but also for the evaluation of the functionality (functional requirements) of a software architecture. In a SAAM evaluation basically scenarios are developed, prioritized and assigned to those parts of the software architecture to be tested that are affected by them. This may be sufficient to indicate problems in the architecture.

Architecture Tradeoff Analysis Method (ATAM)

ATAM is used to review the design decisions of the architecture. It is checked whether the design decisions satisfactorily support the requirements concerning quality. Risks and compromises included in the architecture are identified and documented.

The process includes two phases. In the first phase the necessary components are presented. Then the architecture is checked and analyzed. In the second phase it is tested whether the analysis and the test were correct and complete. Then the results are summed up.

1.5 Estimation Models

Usage

Performing Life Cycle Cost Calculation, Performing an Estimation

Reference

BF04, Bur03

Purpose

Estimation models form the basis of an »Estimation that is as objective and realistic as possible. The method that is used is to guarantee a traceable, reliable and accurate »Estimation of the Scope and »Estimation of Effort .

At first, the estimation objects must be specified and characterized as accurately as possible. On the basis of the structuring of the project in clear subtasks, the criteria for the impact on the estimation have to be determined and evaluated. This concerns product, project, personnel and technological characteristics. There is a large number of estimation models; however, hardly any of these models is universally valid, i. e. applicable to a variety of projects, systems and companies and at the same time sufficiently reliable and accurate for each of these fields of application.

In the following, some usual methods will be described briefly:

Estimation Formulas

The effort of an estimation object will be calculated by means of formulas that are based on empirical values.

- **Function Point Analysis**: This method breaks the software system to be examined down into its functional structure. The transactions (inputs, outputs, or queries) and files (external or internal data inventory) of each function shall be counted. Afterwards, a function value shall be determined based on the complexity of the individual functions. Based on learning curves, the effort can be derived from this function values, taking into account defined influencing factors.
- **COCOMO**: COCOMO is employed in the field of software developments and derives the effort of an estimation object from the estimated scope and defined influencing factors by means of a formula.
- **PRICE**: PRICE comprises a collection of estimation methods which can not only be employed in the software sector, but also in the hardware sector. The software variant is similar to COCOMO.

Expert Estimation

In this method, scope and effort of the estimation objects shall be estimated by experts. In the »Estimation of the Scope, estimation objects are derived from the »Product Structure of the project to be examined, in the estimation of effort, they are derived from the project structure. In every expert estimation, the 4-eyes principle should be observed, i.e., the person responsible for the estimation object estimates scope and effort and coordinates this with an experienced expert.

A special and widely used form of the expert estimation is the **Closed Estimation Meeting**, which is conducted with the participation of 3 to 7 experienced estimators. These experts will estimate scope and effort of the estimation objects independently, discuss the causes of larger deviations and agree on a joint estimation value. Signficant assumptions, like risks or degree of reuse of the estimation object, shall be documented. In a final discussion, the settling of open questions shall be specified. It is also possible to decide that the estimation values will be verified by a plausibility check, e.g., COCOMO or the Function Point Method. In a Closed Estimation Meeting, the accuracy of the estimation largely depends on the experience of the participating estimators. Thus, it is very important to select the suitable category of persons.

Percentage Method

The Percentage Method determines the effort for individual phases and activities by means of a projection based on average or recommended portions - the so-called empircal values - of the overall effort. For example, 3 percent of the overall effort of the development project will be required for configuration management. The Percentage Method is only suitable for rough estimations.

1.6 Evaluation Process

Usage

Preparing Requirements Evaluation, Performing Market Survey for Off-the-Shelf Products, Performing Make-or-Buy Decision, Peparing Criteria Catalog for Assessment of Offers

Reference

Kon96, Schw04, Wil75, Wan02, PD99, LMTC01, AF02

Purpose

Within the framework of IT projects, there is an increasing demand for procedures that permit a qualitative and quantitative evaluation of specifications – like the »Requirements Specification, the »Evaluation of Off-the-Shelf Products, or the »Overall System Specification – based on transparent and repeatable criteria. In the course of the past 10 years, some standard modules have been developed for this purpose.

Weighted Scoring Model (WSM)

One of these standard modules is the Weighted Scoring Model (WSM) [»Schw04]. In a first step, this model defines assessment criteria, which are then weighted in accordance with their significance for the overall system (e.g., essential, very important, important, nice-to-have, or 10, 7, 5, or 3 points). In the evaluation, the model will assign scores to the individual criteria, e.g., 70 % degree of fulfilment. The total weighted scores are obtained by multiplying the score with the weights of the individual criteria, e.g., 70 % * 7 points = 4.9 points. The total of all evaluated criteria indicates the weighted score of the subject to be evaluated. The result can than be compared with the results of the other points. In addition, minimum scores may be defined, which lead to appropriate consequences for the overall project (e.g. if the weighted scoring for off-the-shelf products shows that the acquisition of these products is no realistic possibility, the development of individual products is the only way).

Analytic Hierarchy Process (AHP)

A similar procedure is the AHP procedure, which is also based on a decision matrix. The criteria are arranged in hierarchy levels in accordance with their relevance, and the scores can be calculated from pair-wise comparisons (cf. »Kon96 et al.).

Both methods, but particularly the AHP, pose the risk that the overall model becomes inconsistent due to wrong weightings, thus loosing its informative value. The complexity of the model should be limited - also considering the effort connected with the evaluation.

Special Case: COTS Software

The evaluation of standard software and standard software components is intended to develop and apply comparison methods and criteria, which permit the evaluation and selection of off-the-shelf products. The subject has been discussed at international level since approx. 1990. Since that time, the commercial use of IT has no longer aimed primarily at individual system developments, but at the use and integration of standard applications.

Transaction Cost Analysis

The subject was first developed for industrial production, but was soon also transferred to the IT sector: Is it more economic and effective, to produce a sub-product or end product within the enterprise or to purchase it from a third party? For this purpose, the transaction cost theory (TCT) [»Wil75, »Wan02] was developed, which at first evaluates the assets based on their *specificity* for the respective process: the more specific an asset is, the more recommendable is the production within the enterprise, and the less specific an asset is, the more sensible is the purchase from third parties. Second, the approach evaluates the *uncertainties*, the risks, followed by the *frequency* of use and the *reputation* of the supplier. These are the criteria for the decision as to whether the asset should be produced within the enterprise or purchased from a third party.

Meanwhile, numerous models have been developed, which propagate a combination of different evaluation processes [for a small selection, refer to »Kon96, »PD99, »LMTC01, »AF02].

1.7 Fault/Reliability Analysis

Usage

Preparing Hardware Architecture, Preparing Hardware Specification, Performing Logistic Calculations and Analyses, Performing and Evaluating Safety and Security Analysis

Reference

Sta95, Ebe02

Purpose

The objective of the »Fault/Reliability Analysis is the identification of faults and the checking of the reliability of a system. For the fault/reliability analysis the following methods may be used:

Failure Mode Analysis (FMEA/FMECA)

FMEA/FMECA is a methodical integrated part of system development and quality assurance. It is used to increase the functional reliability and the reliability of »Work Products or processes and to minimize the impact of faults. In addition to the functional and physical impact, this includes also the life cycle costs (warranty or courtesy costs, maintenance concept, product liability).

Within the framework of the analysis, a team of experienced experts from different disciplines will discuss possible failure modes, their causes, their effects and importance to the project for each individual technical or functional structural element.

Fault Tree Analysis

The fault tree analysis (according to the German standard DIN 25424) is a proven multi-purpose analysis method. It is used for modeling the functional system and quantifying the reliability of the system. Starting with the "undesired event" (system failure), the functions/failure modes of the components and the actions required to operate a system are determined "top down". The result is the Boolean model (the fault tree) that is quantified by using reliability parameters.

Reliability Models

A reliability model serves for the identification, compaction and verification of reliability requirements. Based on the user-oriented requirements and the operational environment, the system has to be described by the model completely or adaptively.

The reliability model should not only be able to provide information about the achievement of the quality targets of the users, but also about the related criteria and the intermediate objectives that have to be achieved (increase in reliability) and the impact of technical changes.

Reliability Prediction of Electronic Equipment (MIL-HDBK 217)

For many years, MIL-HDBK-217 has been a standard method for reliability prediction. The handbook includes a number of empirically developed failure rate models that are based on historical component part failure rates for a broad range of component types. Models are available for practically all electric/electronic parts and also for some electromechanical parts. All models predict reliability in relation to failures per million operating hours and assume an exponential distribution (constant failure rate) that permits the addition of failure rates in order to determine higher equipment reliabilities. The handbook includes two prediction models (the component load technique and the component counting technique) and takes into account 14 different work environments, such as attached to the ground or observed on-board. Typical factors for determining the component failure rate include a temperature factor, a performance factor, a load factor, a quality factor and an environmental factor in addition to the basic failure rate.

1.8 Logistic Support Analysis

Usage

Performing Logistic Calculations and Analyses

Reference

MIL-STD 1388-1A

Purpose

The Logistic Support Analysis (LSA) is an iterative and goal-directed analysis process that accompanies the development in real time and a systematic sequence of individual analysis tasks with the following objectives:

- Recording logistic product characteristics and the logistic product environment,
- Influencing the product development to realize and guarantee the required logistic product characteristics,
- Determining the personnel and capital resources.

The inputs for the LSA are:

- Technical documentation, such as mechanical and electrical engineering documents (for example circuit diagrams, internal wiring and assembly diagrams),
- Basic material data, such as bills of material, information about components and bought-out components (e. g. manufacturer, price, size, weight, order number), components with a long lead time or similar characteristics (e. g. single source components), prices of all parts (form components to the complete equipment),
- If necessary, additional required special tooling for manufacturing, testing, troubleshooting and repair, information about dismantling and assembly, results of reliability, fault analysis and security and safety analysis that also require input from the development process.

The method of the Logistic Support Analysis is defined in MIL-STD 1388-1A/2B.

1.9 Process Analysis

Usage

Performing a Process Model Assessment, Preparing Hardware Implementation, Integration and Evaluation Concept, Evaluating Process, Preparing Evaluation Specification Process

Reference

Kne03, Car02, CMMI®, SPICE, DW88, Lev86, MIL-STD 1629A, EFQM, ISO DIS 10011, MIL-STD 1521 B, IEEE-STD 1028-1988, ANSI-Norm N45, Sta95, Car93, Car98, Phi86

Purpose

Process analysis is the evaluation of organization-specific processes, the identification of faults and deficiencies in the development process and the determination of deviations from given standards, guidelines and approaches. Process analysis may be carried out with the following methods:

Assessment Methods:

The assessment method is used to evaluate processes in an organization. For this purpose various assessment models and methods may be used, such as:

1. »V-Modell XT Assessment
2. »V-Modell XT Compliance Test
3. **CMMI®:** »CMMI® (**C** apability **M**aturity **M**odel **I**ntegration) is an improved version of the Capability Maturity Model that combines various other frameworks prepared by the Software Engineering Institute. CMMI® allows not only to support software development processes, but is also related to risk management and structured decision-making. It also permits the effective integration of human capability aspects within the software development.
4. **SPICE (ISO 15504):** The »SPICE (**S**oftware **P**rocess **I**mprovement **C**apability d**E** termination) project is an international initiative for the development of a software process assessment standard. Approximately 40 countries participated actively in the development of this standard, which was headed by the Working Group 10 at ISO (ISO/IEC JTC1/SC7/WG10). The SPICE project is subdivided into six phases that are connected with each other: project initialization, product development, testing, product revision, knowledge and technology transfer, conclusion. The standard includes process evaluation, process improvement and performance evaluation. The primary goals of the standard are to further predictable product

quality, to make improvements so that maximum productivity is achieved, to further a replicable software process and continuous process improvement through periodic consistency checks.

5. **EFQM:** The »EFQM -Methodology (**E**uropean **F**oundation of **Q**uality **M**anagement) is used for the evaluation of a company as a whole. EFQM may be used to evaluate processes, but it provides mostly qualitative and not quantitative information. In the EFQM method also interfaces to not development-relevant business processes are evaluated. A self-check is made by the persons in charge of the businesses. The objective is to identify strengths and improvement potentials through improvement measures and a new self-check after, for example, one year. The EFQM methodology originated from the TQM concept (**T**otal **Q**uality **M**anagement). It forces people to consider the company as a whole, takes as a basis a generally accepted business excellence model and offers a generally accepted measure of effectiveness, for example a possibility to make Europe-wide comparisons.

Defect Causal Analysis:

The Defect Causal Analysis is a method that records faults of the product and deficiencies in the preparation process immediately after their occurrence and tests them systematically for their causes. This results in suggestions for corrective measures concerning the process and its environment. The suggested measures are reviewed by the management and their implementation is initiated. After their implementation the measures are tested and their effectiveness is measured. Successful measures will lead to process improvements that are introduced on a broad basis.

Categories of failure causes are:

- Communication problems (e. g. the responsibilities/tasks in the project/team are not clearly defined, points of contact not available because people are absent (vacation, extension training), inadequate communication between participating groups (software/software, software/hardware, development/acquirer, multi-site development),
- Implementation problems (tools, time management),
- Lack of orientation, lack of knowledge (e. g. the design is not understood, knowledge of the programming language is lacking),
- Procedural problems (e. g. the process is not suited for the product, there is a lack of mechanisms for the processing of change requests, etc.)
- Problems caused by unplanned extensions.

Audit:

The objective of the audit is to determine deviations from specified standards, guidelines and approaches when carrying out activities. The task of an audit is in particular to point to possibilities for improvement. The audit is based on the principle that a team led by a audit team leader checks and evaluates on the basis of defined evaluation criteria how the activities are carried out. For tests and evaluations, human faculty of judgment and the interview technique are used. Depending on the extent of the test it is sufficient to have the audit performed not by a team but by an individual person.

FMEA/FMCEA:

For the description of FMEA/FMCEA, see »Fault/Reliability Analysis.

1.10 Project Planning and Control

Usage

Preparing Commercial Project Status Report, Planning Project

Reference

Bal00, Röt01, PMI

Purpose

The objective of project planning and control is the definition of projects and to monitor their progress towards a specific goal. Project planning and control may be performed with the following methods:

Gantt Chart and Network Planning Technique

The goal of the network planning technique is to schedule activities and at the same time take into account their dependencies. "Dependency" means for example that an activity may start only when another activity is finished.

As a notation for project plans, the "Gantt chart" is used. Gantt charts exist in different forms, as a so-called Meta Potential Method, as Program Evaluation and Review Technique or as Critical Path Method. These different notations are integrated by modern project planning tools.

As a basis for time scheduling, the network planning technique offers varying calculation methods: When entering the dependencies of the activities on each other, the durations of the activities and the earliest and latest project starting and end dates, it is for example possible to calculate critical paths. Critical paths consist of activities that depend on each other and whose delay will lead to an overall delay of the project.

Milestone Trend Analysis

A Milestone Trend Analysis (MTA) illustrates graphically the changed assessment of planned values at the various reporting times and the changed ratio between planned and actual values.

Earned Value Method

The "Earned Value Method" graphically presents a comparison between planned and actual values of the schedule and cost situation related to the progress of the work in a project. It combines performance progress measurement methods with cost tracking and time control.

In the EVV diagram three different views of the project progress are compared with each other:

- Planned value: Budget value of the planned performance,
- Actual Value: Actual value of the performance provided,
- Performance: Budget value of the performance provided.

From this parameters the value variance (actual value minus performance) and the performance variance (planned value minus performance) on a key day are determined.

Cost-Benefit Analysis

See the description of »Cost-Benefit Analysis .

1.11 Prototyping

Usage

Preparing Software Architecture, Preparing System Architecture, Preparing System Specification

Reference

Geb02, Mac99

Purpose

Prototyping is a method for testing or refining new systems, programs or information management systems. For this purpose a model of the system to be tested is developed and used for tests or studies.

When in rapid succession again and again slightly improved prototypes are planned and not much time is spent on planning a "perfect" prototype, people are talking of so-called **"Rapid Prototyping"** .

In **Explorative Prototyping** a prototype is developed as a means of communication ("showpiece prototype"). In a direct exchange of views with the user, the prototype is then used to refine, complete and clarify user requirements.

1.12 Requirements Analysis

Usage

Determining Requirements, Preparing External Hardware Module Specification, Preparing Logistic Support Specification, Preparing External Software Module Specification, Preparing External Unit Specification, Preparing Overall System Specification, Preparing System Specification

Reference

Rup04, Coc00

Purpose

The objective of the analysis of requirements is the identification, description and quality assurance of requirements. For the analysis of requirements the following methods may be used:

Use Case Modeling

The objective of this method is to collect and present the functional requirements for a system from the point of view of external operating units ("actors"). The requirements have to be described in the form of use cases. A use case may be concretized in a number of scenarios. External operating units (for example staff, »Project Leader or administrator) represent roles that may be played by actual persons, machines, computer tasks or other systems.

A use case will be initiated by an operating unit, and its description will contain the dialogs or interactions between this operating unit and the system that are "required" to work on a task. For the description of the interactions a sequence of actions and events is defined that are triggered by the initiating operating unit, the system or other operating units. Only those actions or events have to be defined that are visible from the point of view of the operating unit, but not details that describe how the system is intended to work internally.

The »System Specified use cases represent as a whole the application-oriented functional requirements for the system. For a complete description, if possible all identified use cases should be specified in this form.

Interview Technique

One possibility for the identification of the requirements is the interview technique. It is used to question future users in a specified and formalized process. It is assumed that with this interview technique it is possible to form different groups and to inquire about utilization potentials that are difficult to quantify, that are quantifiable and that are supplementary. For such an approach the involvement and active cooperation of all areas concerned is absolutely necessary for the quantification of the utilization potentials. Although it is possible to assume in advance fictitious values when this cooperation is lacking, those values subsequently may be questioned very easily by the affected areas. A defined interview method is the "Structured Hierarchical Interviewing for Requirement Analysis" (SHIRA), which sets in very early. SHIRA tries to understand the concrete meaning of product attributes, such as "simple", "innovative", "controllable" or "impressive", for a possible software product.

Dialog Design Modeling

The aim of "Dialog Design Modeling" is to model the structure of a user dialogue with screen masks, leaving the layout of the screen masks out of consideration. The masks may only be typified (the type may be for example an input mask).

System Behavior Models

The aim of the preparation of system behavior models is to use a model to specify the requirements for the dynamic behavior of a system considering in particular the influence of (external) events on the system and possible concurrencies within the system. This model is used in particular for the alignment with the requirements of the user and the exact definition with regard to completeness, unambiguity etc.

Cost-Benefit Analysis for Requirements

In the analysis of requirements often a cost-benefit analysis for the prioritization of the requirements is made. This is an analysis with the goal to make a recommendation whether the expected benefit of the realization of an requirement will justify the expected costs. This makes it easier to eliminate requirements of lesser importance.

Use of facilitation techniques

Sometimes, an unconventional approach is necessary in order to successfully deal with the heterogeneity of the stakeholders participating in the elicitation of requirements. Facilitation techniques serve the purpose of enabling the develompent of unusual creative ideas. However they are not suited to elicit detailed descriptions of the precise behaviour of a system. Albeit facilitation techniques can serve to overcome obstacles which the own way of thinking and the missing familiarity with someone elses thinking can pose to the elicitation of requirements.

The following facilitation techniques may be apt depending on the situation:

- Brainstorming,

- Brainstorming paradox (results, which are not to be achieved, are collected),
- 6-3-5 method (Brainstorming in writing: 6 participants develop 6 ideas each, these are distributed until each participant has posessed each card once),
- Change of perspective (each participant considers the problem from a different previously defined perspective),
- Walt Disney method (the participants are classified into the groups dreamer/visionary, realist and critic),
- Bionic/biosociation (finding of proper associations to the problem and discussion of solution possibilities for the analogon).

Use of observation techniques

The user has the most knowledge of how tasks of his daily work can be tackled. Nevertheless it happens often that the user - consciously or unconsciously - does not provide suitable descriptions of his activities. Observation techniques are used to give the requirements engineer an insight into the world of the user. These techniques may be very time consuming, but they offer the potential for the requirements engineer to really understand the tasks the user has to cope with and thus for the requirements engineer to phrase his own requirements to support these tasks.

The following observation techniques may be used:

- Field observation (the requirements engineer observes the user in his daily work),
- Apprenticing (the requirements engineer learns the tasks of the user and applies them).

1.13 Review

Usage

Evaluating Document, Preparing Evaluation Specification Document, Preparing Software Implementation, Integration and Evaluation Concept, Integrating into Logistic Support Documentation

Reference

FW90, Bal00

Purpose

A **Review** is a scheduled, critical, systematic and documented content check of the results of the work at the end of defined work steps. The Review is characterized by a defined approach that is put down in writing. In the review testing is performed on the basis of defined specifications (e. g. reference documents, evaluation criteria). In the test tools (such as forms and checklists) are used, and the results of the review are evaluated and documented in a protocol. CMMI® calls for so-called **Peer Reviews**. Those are reviews performed by peers, i. e. knowledgeable colleagues.

The goals of the Reviews are:

- Checking results on the basis of objective evaluation criteria,
- Detecting and eliminating faults in the results of the work at an early stage,
- Ensuring compliance with guidelines, standards and other specifications,

- Avoiding that work performed in earlier phases is repeated,
- Minimizing the costs of the elimination of faults,
- Obtaining »Measurement Data Types for the evaluation of the quality of results and the process,
- Disclosing deficiencies in the development process,
- Gaining experience so that in the future faults can be avoided.

The Review starts with preliminary work that includes an introductory meeting (depending on the method) and the preparation of the review meeting (e. g. selection of the date and the location). Then the Review is performed in accordance with a previously defined procedure. The faults and suggestions for improvement for the review object (e. g. document, code, drawing or process) that were documented during the review are worked over by the author of the review object. Then the review object may be released.

The following requirements apply to the review procedures that are to be used:

- The schedule, the individual steps and the »Roles and their tasks have been defined and described.
- All steps that have to be performed have been planned and the persons in charge and the evaluation criteria have been determined.
- The results of the Review are recorded, the fault data and expenditures are documented and analyzed.

There are some basic review procedures that vary in their structure and schedule and in the roles (including tasks) that are used:

- In the "**Comment Technique" procedure** (for example an opinion) the review is performed separately by the »Inspectors; there is no meeting.
- In **"Meeting Technique" procedures**, such as a walkthrough, peer review or one-to-one talk, the faults found during the preparation are discussed in the meeting.
- In **Inspections**, such as intensive inspection of code or documents, the contents of the objects to be tested are systematically discussed.
- In **"Combined Procedures"** different procedures from written comments and the review meeting are combined.

Review Methods:

Inspection or Walkthrough

The walkthrough is a formalized review technique with defined approach and role allocation in the review meeting. The objective of the review procedures inspection and walkthrough is to identify existing faults or fault-prone situations and to measure quality. The object of the review procedure is the source text of the program (in connection with the specification), the document or the drawing.

A walkthrough is recommended for objects of high complexity or with a high fault density. The number of persons participating in the review may be between three and seven. A larger number of participants usually requires additional efforts that are not matched by an additional benefit in the form of a larger number of detected faults; also tight moderation of a meeting with eight or more participants is no longer possible.

A walkthrough or an inspection of a document, a code or a drawing is performed mostly in a team of about four persons. In addition to the developer, this team includes one moderator and some experts. The developer explains the program logic statement by statement or the document sentence by sentence. The team members ask questions and identify faults. The recommended duration of a meeting is approximately two hours.

One-to-One Talk

The one-to-one talk is a special form of the walkthrough; by limiting the participation to only two persons the effort required for the review is to be kept small. However, to ensure an intensive review and that if possible all faults are found, in this technique the functions to be performed and the sequential steps are specified in concrete terms and on top of that, with the reader, a special function is provided. Because of the smaller number of persons, however, it is possible that important experience and know-how of those staff members who are not involved may be lost.

Combined Procedures

In those cases in which as many participants as possible are to be involved in the review, which, however, would exceed the planned maximum number of participants in one meeting, a combination of two review techniques is practical. This is for example the case if the review object has to be considered from many different points of view or if it affects a large number of authorities.

The combination includes, firstly, written comments provided by staff members who cannot or are not to take part in the meeting in connection with a walkthrough and, secondly, a walkthrough. In a first phase the review object is checked by all possible participants in order to seek as many comments as possible. This is followed by a walkthrough in which only selected staff members (for example those who are primarily affected by the review object) or those staff members who are available at the time of the meeting will take part.

1.14 RFP Support

Usage

Assessing and Selecting Offers, Preparing Request for Proposal, Determining RFP Concept, Peparing Criteria Catalog for Assessment of Offers

Reference

UfAP IV

Purpose

An important method, in particular in the public sector, is »UfAB III ("Unterlage für die Ausschreibung und Bewertung von IT-Leistungen" (Document for the » Request for Proposal and for the Evaluation of IT Services)). This method supports the public »Purchaser in the procurement of IT equipment and services. It represents a standard for a standardized evaluation of »Offers. With the help of this document an objective, transparent and reconstructible evaluation of IT offers, be it software, hardware or other services, is possible.

It describes the process and the necessary contents of the RFP and evaluation of offers for all EU and national procedures.

1.15 Simulation

Usage

Evaluating System Element

Reference

Sch03, Hof97

Purpose

The goal of a simulation is to indicate system behavior from dynamic aspects. The dynamic effects are generated respectively estimated by including an operational scenario or a sequence of events in the model. The use of the simulation method is in particular practical for the evaluation of the following characteristics:

- Fulfillment of quality requirements,
- Response behavior for specific input data,
- Use of the CPU,
- Storage use/capacity,
- Fulfillment of operational/operating period constraints,
- Man-Machine interaction and response behavior.

1.16 System Analysis

Usage

Preparing External Hardware Module Specification, Preparing Hardware Specification, Preparing Logistic Support Specification, Preparing External Software Module Specification, Preparing Software Specification, Preparing External Unit Specification, Preparing Overall System Specification, Preparing System Specification

Reference

BRL99, You92, Mor99

Purpose

The objective of the system analysis is the identification, modeling and evaluation of systems. The following methods may be used:

Object-oriented Analysis (OOA)

For the OOA, resources of the UML method family may be used:

1. Use Case Modeling

The objective of this method is to identify and describe the functional requirements for a system made from the point of view of external operating units ("actors"). The requirements have to be described in the form of use cases. A use case may be put into more concrete terms in a number of scenarios. External operating units (for example staff, the »Project Leader or the administrator) represent »Roles that may be played by actual persons, machines, computer tasks or other systems.

2. Class/Object Modeling

This method is used for object-oriented system development, which requires the modeling of classes, associated attributes and operations and the relations between the classes. It is the task of class modeling to determine the static class structure in class models. With regard to the design of a system, a class is statical and defines the structure and behavior of similar objects. Objects have to be modeled as instances of classes.

In object-oriented development, class/object modeling may be used both in the analysis and in the design phase. In the analysis phase, the class structures and the object structures have to be modeled from the point of view of the user in order to express what a system does. In the design, these structures have to be refined, and it has to be determined how things are done by the system.

In class modeling, attributes have to be used to model identifying, descriptive and referencing information in a class. The development results may be refined using additional modeling options, such as for example determining the visibility, allocating role names, assigning constraints, describing derived attributes and using higher order relations.

Class modeling concepts may also be used to define the statical aspects of interfaces of classes and subsystems and their application. Those parts of classes (attributes, operations) or subsystems (classes, relations) that are defined as interfaces may be marked once again in separate interface models.

3. Interaction Modeling

This method is used for object-oriented system development. The objective is to use interaction models to describe interactions between objects and their order. Interactions may be used to express the occurrence of events or the exchange of messages. The method may be used for formalizing scenarios (succession of events and the related system behavior) and for modeling the dynamic sequence of operations. In this process sequence diagrams are used to concentrate on modeling and visualizing the sequence-oriented order of the interactions between objects. For a more detailed modeling of the relations of the interactions and in order to place emphasis on the software structure, mainly interaction graphs ("collaboration diagrams") are used. During the modeling of the interactions, the time required for communication is not directly considered; it is possible, however, to model time limits. Concurrencies can be modeled. Development results may be refined by modeling signatures, synchronous and asynchronous sequences, time, sequence and synchronization conditions, branchings, iterations and recursions and by generating and deleting objects.

4. Activtiy Diagrams

Activity diagrams may be used as a concretization of the use cases by applying activity diagrams to use cases, thus describing dependencies, concurrent processes and decision/branching points. Activity diagrams also may be used as a special kind of state diagram, which shows exclusively activities and transitions between those activities. An activity is assigned to a state and represents a continuing internal action.

5. State Modeling

The objective of state modeling in the field of object-oriented system development is to model the dynamic behavior of a system. The most important area of application is the modeling of the dynamic behavior of objects of significant, event-controlled classes. Such classes usually specify "active" objects.

The behavior of the objects of a class has to be abstracted as a life cylcle and is modeled in a state model. The state model is to define all states that an object may take on, the possible state transitions, the events that may effect state transitions, the conditions that have to be fulfilled in addition to the events so that a state transition can occur, and the actions that have to be taken because of state transitions.

The states are used to determine data values that may assumed by the attributes of an object of a class and possible connections with other objects. The state transition that occurs for an object of a class in a concrete situation is unambiguously defined by the current state of the object, the event that occurred and specified conditions.

In a state model, a path represents a sequence of events. It must be possible to model scenarios that are frequently used during the analysis to formulate desired sequences of events on the paths of the specified state models.

Struktured Analysis (SA)

The structured analysis consists of the combination of the following methods:

1. Data Flow Modeling

The objective of "data flow modeling" is to specify the functional structure of a system by the combined examination of functions and data. In this process the data flows form the interfaces between the functions. Data flow modeling abstracts from the physical conditions of a planned system.

In a top-down approach, more and more detailed levels of the future systems will be specified. The starting point is a layout diagram ("context diagram") that shows only the system's data flows from and to its environment. When refining the data flow model, the functions identified in the functional hierarchy are refined with the help of a data flow diagram of the corresponding level.

A data flow diagram of a specific hierarchical level may be described as an interplay between processes that are connected via data flows. A refinement of the data is always carried out in coordination with the corresponding refinement of the functional hierarchy. When modeling the data flows, it is important to find a logical internal structure of the planned system, which is stable and independent of design decisions and hardware factors.

2. Functional Modeling

The objective of functional modeling is to break down a system step-by-step, starting with the view on the main functions of the system over the intermediate levels down to the elementary function level. At each level abstraction from details of the next lower level is performed. Together the subfunctions yield completely the function that was broken down (functional hierarchy).

Formal Specification

The formal specification is a specification that follows strict rules. A distinction is made between two classes of formal specifications: the abstract specification (which is neutral with regard to the implementation, reflects a black box view and is an algebraic specification) and the model-based specification, in which the change of the state of the system is described on the basis of one or more operations (an example of this is the Z specification). The objective of a formal specification is a short and accurate description with the possibility to translate it directly into code. It is desirable to be able to verify the system so that faults can be detected and to have a proof for the correctness of the program on the basis of the specification. The disadvantage of a formal specification is its difficult and costly preparation, which is mastered only by a few developers or project leaders, and the fact that it is impossible to understand for the acquirer (i. e. it cannot be used as a basis for communication) and that it is limited to some functional requirements (e. g. mathematical calculations). Sine it seems to be hardly possible to realize a purely formal specification, a mixture of formal and semi-formal or informal specification is the optimum solution. It should be used for everything that can be formally specified. The remainder will be handled with a different specification variant.

1.17 System Design

Usage

Preparing Software Architecture, Preparing System Implementation, Integration and Evaluation Concept, Preparing System Architecture

Purpose

»System Design may be specified

- object-oriented,
- function-oriented or
- formally.

Object-Oriented Specification

In the object-oriented design methods the same methods from the family of UML methods may be used as in the »System Analysis.

Function-Oriented Specification

The "Structured Design" method is mainly used in connection with the structured analysis. This method dates from the seventies and is today mostly still used for maintaining legacy systems. A structured design is a design method that leads to a software architecture consisting of functional process modules. The structure of the architecture is a tree or an acyclic network, which is described with the help of structure diagrams. This method is used both for the preliminary design and the detailed design of software. In the preliminary design, the objective of this method is to structure both the higher control sequences and the actual processing functions in the form of a process module hierarchy.

Formal Specification

The formal specification is described in the section »System Analysis.

1.18 Test

Usage

Preparing Hardware Implementation, Integration and Evaluation Concept, Preparing Software Implementation, Integration and Evaluation Concept, Preparing System Implementation, Integration and Evaluation Concept, Preparing Evaluation Specification System Element, Evaluating System Element, Integrating into Logistic Support Documentation

Reference

Bal00, Tha02

Purpose

The objective of the test is to detect faults and to prove that specified requirements have been met.

A distinction is made between various structural tests, **White Box Tests** and **Black Box Tests**.

In structural testing tests, the internal structure is known during the tests. In this context, an important »Role is played by the coverage, which indicates how intensively the structure was tested.

Black box tests are performed without knowing the internal structure with regard to the requirements. They have different objectives and include various test types, such as:

- Functional Test,
- Volume Test,
- Stress and Performance Test,
- Resources Test,
- Recovery Test,
- Usability Test,
- System Test,
- RegressionTest.

2 Tool References

2.1 Change Request Management

Usage

Deciding on Changes, Maintaining Change Status List, Assessing Problem Report/Change Request, Preparing Problem Report/Change Request

Purpose

- record problem reports and change messages,
- classify problem reports and change messages according to urgency and impact,
- describe the state and state of fault processing (change control and state reporting).

Tools for supporting the change request management are toFrequently change request management tools are combined with configuration management tools, but sometimes they may also be separate.

2.2 CM Tool

Usage

Managing Product Library, Managing Product Configuration, Preparing Software Implementation, Integration and Evaluation Concept, Preparing System Implementation, Integration and Evaluation Concept

Purpose

In the daily routine of a project, transparency and traceability are crucial requirements. For this purpose »CM Tools are used. This means that, during the whole lifetime of the software product, it is must be possible to permanently keep track of and to control its structure and components. In the simplest case, a file system is used for this purpose. More practical, however, is the use of special tools that support orderly filing. It must be possible to identify connections and differences between earlier configurations and the current configuration at any time with the help of the CM tool. Furthermore, it has to be ensured with the help of the CM tool that it is always possible to access both the current version and previous versions. There are some open source CM management tools, but the majority of these tools is proprietary.

Typical characteristics of CM systems are:

- Version tracking,
- Variant tracking,
- Build management,
- Change management and dependency tracking,
- Bug tracking,
- Documentation tracking, distribution tracking etc.

2.3 Compiler

Usage

Preparing Software Implementation, Integration and Evaluation Concept

Purpose

A compiler is a computer program that converts a program written in a source language into a semantically equivalent program in a target language. Usually this is the translation of a source text written by a programmer in a programming language into assembler language or computer language.

As a rule, a compiler does not generate a finished program that can be directly executed, but an object file. One or more object files may be connected with a link program for an executable program, even if they were generated in different languages or even by an assembler. Compilation is a single event, i. e. it does not have to be repeated for each run of the program, because the "translation" is stored.

2.4 Construction/Simulation

Usage

Preparing External Hardware Module Specification, Preparing Hardware Architecture, Preparing Hardware Specification, Preparing Hardware Implementation, Integration and Evaluation Concept, Preparing External Software Module Specification, Preparing System Implementation, Integration and Evaluation Concept, Integrating into Logistic Support Documentation, Performing and Evaluating Safety and Security Analysis

Purpose

CAE/CAD tools for logic circuit design usually have the following functions:

- Design of a circuit in the form of a circuit diagram,
- Verification of the function,
- Simulation under different tolerance conditions,
- Generation of package and component libraries,
- Conversion of the circuit diagram to a layout,
- Manufacturing of exposure masks for production,
- Derivation of data that are important to production, such as parts lists and test plans.

Related to this is the design of programmable building blocks, such as gate arrays, GALs and other types of Programmable Logic Devices (PLDs). Programs for finite element analysis simulations have to be referred to as a special case of CAD development.

2.5 GUI Tools

Usage

Preparing Style Guide for Man-Machine Interface

Purpose

Software ergonomics deals with the aspects of the design of user interfaces (Graphical User Interface, in short GUI). With the help of the GUI tool, the graphical user interface of a software, the man-machine interface, is designed. GUI design characterizes what the user of the software sees, i. e. what goes beyond its simple functioning. In this context special attention is paid to human perception and information processing. During the GUI design, the user interface is planned and tested. This development stage includes the definition of user actions (the possible actions of the users), the representation of the system functionality and the feedback.

2.6 Integrated Development Environment

Usage

Preparing External Hardware Module Specification, Preparing Hardware Specification, Preparing External Software Module Specification, Preparing External Unit Specification, Preparing Overall System Specification, Preparing System Implementation, Integration and Evaluation Concept, Preparing System Specification, Developing Migration Concept

Purpose

An integrated development environment is a universal platform for the development and testing of software. Usually the terms Integrated Design Environment and Integrated Development Environment (both abbreviated IDE) are used. IDEs may be combined functionally to a group and usually include the following components:

- Text Editor,
- Compiler and/or Interpreter,
- Linker/Binder,
- Testing Aid (Debugger).

In most cases IDEs have a common database and make it possible to work under a coherent graphical user interface. This allows it to automate frequently occurring work steps, and it is no longer obvious when there is a change in the individual program (for example between editor/compiler/linker or debugger/editor). Furthermore, more comprehensive IDEs may have additional useful components, such as version management, project management or the option of an easy generation of GUIs.

2.7 Modeling Tool

Usage

Preparing External Hardware Module Specification, Preparing Hardware Architecture, Preparing Hardware Specification, Preparing Hardware Implementation, Integration and Evaluation Concept, Preparing Logistic Support Specification, Preparing External Software Module Specification, Preparing Software Architecture, Preparing Software Specification, Preparing External Unit Specification, Preparing Overall System Specification, Preparing System Implementation, Integration and Evaluation Concept, Preparing System Architecture, Preparing System Specification

Purpose

Modeling is a central task in many areas of software technology, such as when determining requirements, structuring application domains and developing software and process architectures. It is supported by modeling tools that model the methods with an emphasis on the UML-based modeling techniques or the conventionally structured methods.

Modeling tools may be part of an integrated development environment (IDE) or a pure stand-alone modeling tool.

Graphic modeling tools make it possible to design simulation models on the screen even without extensive knowledge of details and initially without relationships described in formulas. In this process, the model is generated interactively on the screen as a network of effects by taking symbols for the elements, state variables, incremental values, functions and constants from a palette and linking them on the screen with the mouse, using the drag-and-drop method.

2.8 Project Planning

Usage

Preparing Logistic Support Concept, Planning Project, Performing an Estimation

Purpose

- the monitoring of milestones,
- project control by way of work orders and
- quantitative project planning and control (expenditures, costs and time, planned/actual comparison).

Project planning tools support the scheduling of activities that have to be carried out and their dependencies as well as the resource planning. In addition, the following aspects may be supported:

2.9 Requirements Management

Usage

Determining Requirements, Preparing External Hardware Module Specification, Preparing Hardware Specification, Preparing Logistic Support Specification, Preparing External Software Module Specification, Preparing External Unit Specification, Preparing Overall System Specification, Preparing System Implementation, Integration and Evaluation Concept, Preparing System Specification

Purpose

In the course of a project it is necessary to record new requirements, to import them if required from other documents and to change and to manage them. When there is a large number of requirements, only a tool-based management is possible. The requirements management tools should perform the following tasks:

- Recording the requirements;
- Building up and managing requirements structures (e. g. hierarchical and loose structures, reference to the appropriate test requirement);
- Refining the requirements;
- Managing the history;
- Tracking requirements (for example to determine whether the requirement has already been processed or how long it took to process the requirement),
- Analyzing and tracing the requirements (e.g. to design objects and evaluation cases),
- Supporting the impact analysis (how large will be the expenditure in case of a change in the requirement and what additional requirements will be affected by that),
- Database-supported requirements management, if possible in several database platforms,
- »Determining Requirements attributes (including for example priority, processing state, implementation costs, action officer).

2.10 Test Tool

Usage

Preparing Hardware Implementation, Integration and Evaluation Concept

Purpose

A test is a demonstration, which can be repeated any time, that a software product has the required functions and performance and that it complies with the agreed interfaces. The tools are used to support process module, integration and system testing. They are to support both black and white box tests and have (more or less) the following characteristics:

- Test planning,
- Test design,
- Test case definition,
- Test case archiving,
- Test execution,

- Test reports,
- Test management.

This includes the execution of the following types of tests:

- Functional test,
- Interface test,
- Performance test,
- GUI tests,
- Safety and security tests,
- Regression test.

3 Glossary

Acquirer	The user is understood to be the acquirer in a contract, i. e. the recipient of a »Work Product provided by the »Supplier (DIN EN ISO 8402).
Acquirer/Supplier Interface	The »Acquirer/Supplier Interface describes explicitly which »Work Products are exchanged between the user and the supplier V-Modell project. These products are called »Interface Products.
Activity	A distinction is made between the »Activity Type and the »Activity Instance. In the context of the V-Modell the term Activity generally denotes an »Activity Type.
Activity Group	see »Discipline.
Activity Instance	An »Activity Instance is understood to be the concrete form of an »Activity Type, for example the realization of a certain software unit.
Activity Structure	The term »Activity Structure is understood to be the quantity of »Activity Instance of a project and their relations.
Activity Type	An »Activity Type (in the following briefly called "activity") describes »Activity Instance that may be executed during a development process. Activities are part of exactly one »Discipline and thus always assigned to a »Process Module. Each »Work Product is assigned to an activity by which it is processed. Thus activities modify products. Product used only as an input for an activity are not explicitly assigned to an activity. When a product is finished, it is in the »Product State »Finished, and the finishing conditions assigned to the product apply. Activities are further subdivided in sub-activities.
Advanced V-Modell	See »V-Modell, Advanced.
Application Profile	An »Application Profile indicates the values adopted for the individual »Project Characteristics in concrete projects. On the basis of this application profile an initial »Tailoring is performed.
Component-Based Development	see »Development, Component-Based.
Consistency State	A »Work Product assumes one of the two consistency states Consistency Checked or Consistency Unclear. This state is assigned to the product depending on whether the conditions defined within the framework of a »Product Dependency are fulfilled.
Content-Related Product Dependencies	See »Product Dependencies, Content-Related.

Contributor
The term Contributor describes those roles whose consultation is absolutely necessary for the processing of a »Work Product.

Data Protection
The purpose of data protection is to protect the individual against his right to privacy being impaired through the handling of his personal data. (Reference: Bundesdatenschutzgesetz (Federal Data Protection Act)).

Decision Gate
At a »Decision Gate a decision is made whether a »Project Progress Stage is reached. This decision is made on the basis of the »Finished »Work Products defined for the decision gate.
The order in which the decision gates have to be passed through in a project is determined in the »Project Execution Strategy.

Degree of Risk
Within the framework of risk management, the »Degree of Risk is the »Risk Damage weighted with the »Risk Probability.
Degree of Risk = Risk Probability * Risk Damage

Development, Component-Based
The develoopment strategy »Component-Based Development is based on the idea that the new system will largely be developed by integrating existing system elements. A »System Element intended for integration (e.g. a segment or a hardware/software unit) has a clearly defined external interface, includes design and implementation and can be connected to other system elements. It is functionally and technically independent and has a certain size (i.e. economic value).
Generally a system element intended for integration must have the following characteristics:

- Availability of clear, accurately defined interfaces
- Communication with the environment (e.g. other components) exclusively via the defined interfaces
- Adaptation to certain application environments (Customizing) exclusively via the interfaces
- Realization specifications not visible for the user (Blackbox)

Development, Incremental Development strategy which at first defines the overall system in an »Overall System Specification . Afterwards, the system will be continually refined in accordance with the Divide & Conquer principle until the »Software Specification has been developed, which will then be implemented and integrated by means of a suitable »Software Architecture.

The Supplier designs, realizes and delivers the system in individual steps, which are also called »Increment. Each increment will be accepted individually by the Acquirer and laid down contractually in advance, or additional contracts on the development of complementing increments will be concluded. Before an increment will be delivered to the Acquirer, the Supplier may complete several internal iterations.

Within the framework of this development strategy, the Acquirer should avoid changes within one increment. Changes should be integrated into the following increment by means of change management procedures. The Supplier should be informed as soon as possible about important changes which may have a significant influence, e.g., on the architecture of the system. For the Acquirer, this approach has the advantage that he will have an early preliminary system which already realizes the basic functionalities of the entire system.

This development strategy is particulary suitable if the system requirements are regarded as relatively stable and the technological risks are rather low. It is possible to use off-the-shelf products, but the main portion of the system will be developed within the framework of the project.

Development, Prototypic The »Prototypic Development Strategy is based on the knowledge that it is frequently impossible to define the system requirements in advance. In addition, it ensures that nothing will be specified unless it has proven its feasibility. Therefore, this strategy is used particularly if the project includes realization risks. Changes of the requirements will be managed by the Problem and Change Management.

Another typical feature of this development strategy is the fact that the Acquirer is present at the site of the Supplier during the development. This enables the Acquirer to directly express his change proposals. The Supplier designs, realizes and delivers the system in individual steps, which is similar to the development strategy »Incremental Development. Each step will be accepted individually by the Acquirer. For the Acquirer, this approach has the advantage that he will have an early operable system which already realizes most important the basic functionalities. In addition, this strategy enables the Acquirer to give an early feedback, which minimizes the development risks of the Supplier.

Development Standards for IT Systems of the Federal Republic of Germany
See the »V-Modell.

Discipline
The »Work Products and »Activity of the »V-Modell are hierarchically structured. At the highest level are Disciplines. A Discipline is a grouping of a number of products that, with regard to contents, are closely connected with each other and of activities that prepare the respective products.
Examples of Disciplines include »Supply and Contracting and »System Design. Each Discipline is unambiguously assigned to one »Process Module.
Earlier V-Modell XT versions represented Disciplines by means of Product Groups and Activity Groups. This subdivision is no longer used.

Dynamic Tailoring
Dynamic »Tailoring is understood to be the tailoring activities that are carried out during the project duration to further adjust the list of the activities to be carried out and the products to be prepared, which is drawn up at the start of the project, to the project.

External Hardware Module
see »Hardware Module, External

External Product
See »Work Product, External.

External Software Module
see »Software Module, external

External Unit
The Product »External Unit comprises system elements which are not developed within the scope of the project. An »External Unit may be an off-the-shelf product, a unit furnished by the user, a re-usable system or segment developed in advance, an adjacent system or the result of a sub-contract. An external unit may comprise hardware and software portions.

Finished
Defines a »Product State of a »Work Product that is finished. For the term "finished" frequently also the term "released" or "valid". This product state is set in the »Product Library.

finishes
An »Activity finishes a »Work Product. An »Activity Instance is only finished, when the corresponding »Product Instance is in the »Product State »Finished.

Functional Safety
Functional safety comprises procedural or operational safety and the aspects of reliability, fault tolerance and correctness. This status depends on measures limiting the risk of a personal injury or material or immaterial damage to an acceptable level.

Generative Product Dependency
See »Product Dependency, Generative.

Hardware Element	The term »Hardware Element is a generic term which may designate all system elements beginning with the »Hardware Unit level in the hierarchy of »System Elements: »Hardware Unit, »Hardware Component, »Hardware Module, and »External Hardware Module.
Hardware Module, External	The product »External Hardware Module comprises system elements (»Hardware Modules , »Hardware Components) which are not developed within the scope of the project. An »External Hardware Module is a functional element which can be described autonomously. An external hardware module may be an off-the-shelf product, a unit furnished by the supplier, a re-usable component developed in advance, an adjacent system or the result of a sub-contract.
Increment	In the »Project Type Variant »Project (Acquirer) Including Development, Enhancement or Migration , the software/hardware item to be prepared will be developed by a step-by-step approach. The development is conducted in » Iterations, i.e., the steps will be developed successively. Since the contents of each »Increment is largely independent of the other increments, an operational »System will be available if a completed » Increment is delivered. An »Increment may be subject of an »Iteration.
Incremental Development	see »Development, Incremental.
Information Security	Information security describes the condition, which ensures the confidentiality, integrity, authenticity, and availability of information. This condition is achieved by suitable technical, personal, material (including structural) and organizational measures.
Initial Product	See »Work Product, Initial.
In Processing	Defines a »Product State of a »Work Product that is currently being processed. This product state is set in the »Product Library.
Integrity	Integrity is the state that excludes unauthorized and forbidden modifications of information and IT systems or components.
Interface between V-Modell Projects	See »Acquirer/Supplier Interface.
Interface Product	A »Work Product that is exchanged between the »V-Modell Projects of the »Acquirer and the »Supplier is called an »Interface Product. Interface products are defined in the »Acquirer/Supplier Interface.
Iteration	An »Iteration designates one system development cycle. An iterative approach leads to periodically recurring similar system development tasks, with the subject either chainging in each »Iteration (e.g. development of different sub-systems in successive »Increment s) or being refined in successive »Iterations (e.g. the step-by-step refinement and further development of systems).

Mapping to Standards

»Mapping to Standards represents the connection of the »V-Modell to current (quasi-) standards and regulations.
For this purpose, »Mapping to Standards relates the terms defined in the standard to the system of concepts of the V-Modell.

Measurement Data Type

Synonymous to: basic data, measurable quantities
Each measurement data type describes a measure that is directly determined (e. g. by counting faults, counting hours, measuring a duration) and that is entered as an actually measured value (measurement datum) in the determination of a »Metric.
Measurement data types

- are absolute values,
- are obtained by measurements on the project, product or process,
- may refer for example to times, phases, products or organizational areas.

»Measurement Data Types may also be "soft", i. e. they result from informal surveys and individual assessments, for example »Risk Probability low/medium/high.

Measurement Data Types

See »Measurement Data Types.

Method Reference

A »Method Reference describes a class of methods that may be used to carry out activities or prepare products.

Metric

Synonymous to: characteristic numbers
A »Metric describes a quantitative measure for a feature of a project, a »Work Product or a process.

- Metrics are derived from »Measurement Data Types or other metrics (e. g. formulas, percentages, comparisons).
- A measurement data type may also be a metric.

Organization-Specific Process Model

See »Process Model, Organization-Specific.

Process Compliant to the V-Modell

A process is said to be compliant to the V-Modell if it fulfills the quality requirements of the V-Modell XT with regard to description techniques, results and sequences. The expected results and the requirements posed on the sequences are determined by the V-Modell XT »Reference Model. The »V-Modell®XT Konformität is demonstrated within the framework of a »V-Modell XT Compliance Test.

Processed

A »Work Step processes a topic, i. e. it participates in its completion.

Process Model, Organization-Specific

The Organization-Specific Process Model is used to introduce, establish and continuously improve a process improvement method in an organization. The approach defined at this point is used in two situations:

1. During the initial introduction of organization-wide process descriptions and their implementation.
2. During repeated execution of an organization-wide process improvement program.

The continuous improvement process is based on the »V-Modell with all its subprocesses, »Work Products and Activities. Within the framework of the introduction of an Organization-Specific Process Model, the V-Modell may be adapted to the organization and also supplemented by the organization's own processes. The units that in this connection belong to the organization have to be determined at the start of the improvement project.

Process Module

The modular unit of the »V-Modell. The V-Modell consists of »Process Modules. Process Modules are also used to prepare a project-specific or »Organization-Specific Process Model.
A process module combines different activity process modules to a modular unit. Therefore also »Work Products are indirectly assigned to a process module, because these products are in turn unambiguously assigned to continuing activities or to finishing activities.

Process Module Map

In the »Process Module Map the dependencies of the individual »Process Modules are graphically visualized to give the user quickly a general idea.

Product Dependencies, Content-Related

A content-related product dependency describes the connection between several »Work Products with regard to contents. A »Content-Related Product Dependencies exists for example if a change of a »Work Product will entail a change of another product.

Product Dependency

A »Product Dependency describes a condition that two or more »Work Products have to meet to be consistent. A product dependency may exist both within a »Process Module and between products of different process modules.
A distinction is made between tailoring-related product dependencies, generative product dependencies, relevant product dependencies, structural product dependencies and content-related product dependencies.

Product Dependency, Generative

Based on an initial product, a generative product dependency describes a condition; when this condition occurs, a target product has to be generated.

Product Dependency, Relevant

A »Product Dependency is called relevant, if the »Work Products concerned have the state »Finished. Besides only those product dependencies are considered that are included in the selected »Process Modules.

Product Dependency, Structural	Structural product dependencies (also called structural dependencies) structure products and relate them to each other. Thus there is for example a structural dependency that states that a »Software Unit consists of »Software Components.
Product Dependency, Tailoring-Related	Tailoring Product Dependencies describe the relations of »Work Products to process modules that are relevant to »Tailoring. Thus for example the identification of hardware parts within the framework of system design entails the use of the »Process Module »Hardware Development.
Product Group	see »Discipline.
Product Instance	A Product Instance is understood to be a concrete occurrence of a product type, for example a specific document. Refer to »Product Type for an example.
Product State	»Work Products have a product state that may be changed by activities. A distinction is made between the three product states »In Processing, »Submitted and »Finished.
Product Structure	The term »Product Structure is understood to be the number of »Product Instances of a project and their relations.
Product Type	A Product Type generically describes »Product Instance that may emerge during a development process. Example: The product (more exact: Product Type) Meeting Document describes all meeting documents created within the project. A single minutes of a meeting document is a product instance of the product type Meeting Document.
Product Version	The Product Version is an identifyable and reproducable processing state of a product artefact. A Product Version has exactly one product state.
Project	According to »IPMA, a project is understood to be a singular entirety of coordinated activities with specific starting and end points that are carried out by a person or organization with the aim to achieve specific targets with regard to schedule, cost and performance.
Project Characteristic	A project is characterized by several »Project Characteristics. For the preparation of an »Application Profile, a value that has to be selected from a number of possible values is inserted into each Project Characteristic. Examples of Project Characteristics include »Security (Acquirer) or »Subject of the Project. The selected »Project Type and the selected »Project Type Variant determine if the »V-Modell User must assign a value to the respective Project Characteristic during the Tailoring process.
Project Compliant to the V-Modell	A project is said to be compliant to the V-Modell, if it includes at least the »Process Modules and »Work Products of the »V-Modell Core and if it takes into account each »Relevant Product Dependency during the development.

Project Execution Strategy	A »Project Execution Strategy defines a sequence in which the »Decision Gates relevant to the project have to be passed through. It is determined based on the selection of a »Project Type Variant and the assignment of all conditional »Project Characteristics.
Project Progress Stage	A »Project Progress Stage characterizes a particular time in the project at which a specific decision is made and thus a »Project Section is finished. Therefore a Project Progress Stage is always achieved when a »Decision Gate is successfully passed through.
Project Section	A »Project Section is the period of time between two successive »Decision Gates.
Project-Specific Adaptation of the V-Modell	See »Tailoring.
Project-Specific V-Modell	See »Tailoring Result.
Project Stage	A »Project Stage is the time interval between two (partial) deliveries by a supplier.
Project Type	In the V-Modell essentially a distinction is made between four different »Project Types: • System Development Project (Acquirer), • System Development Project (Supplier), • System Development Project (Acquirer/Supplier) - aquirer and supplier within the same organization (without contract), • Introduction and maintenance of an organization-specific process model. The Project Type also determines the minimum quantity of project characteristcs, which must be provided with a value during the Tailoring process.
Project Type Variant	A Project Type Variant shapes a »Project Type . In the Tailoring process, the selection of the Project Type Variant finally determines the selection of the »Process Module , »Project Characteristic and sequence of operations (components of the »Project Execution Strategy), which complement the Project Type.
Prototypic Development	see »Development, Prototypic.
Reference Model	The V-Modell XT Reference Model defines the minimum contents and relations required to ensure compliance, which must be covered by a process compliant to the V-Modell.
Relevant Product Dependency	See »Product Dependency, Relevant.
Residual Risk	In risk management the risk that remains after the implementation of appropriate preventive measures is called »Residual Risk.

Responsible Person

The term responsible is used for such »Role, which are responsible for the contents of a »Work Product and are liable for the decisions documentet within those products. Upon creation the responsible person assumes the main role in coordination and distribution of the necessary tasks and in tracing product state.
Responsible for an »External Product are those roles, which are responsible for the reception of the product and their further distribution within the Project.

Risk Class

»Risk Class es permit the priorization of potential risks. They are determined individually in an organization or a project. Risk classes facilitate the decision on whether and what measures are to be selected as a reaction to risks. Within the framework of risk management, risk classes are frequently based on the degree of risk and the project volume. Typical risk classes are for example:

- Tolerable: the degree of risk involved is less than 0.1 percent of the project volume,
- Undesirable: the degree of risk involved is larger than 0.1 percent and lesser than 1 percent of the project volume,
- Critical: the degree of risk involved is larger than 1 percent and lesser than 10 percent of the project volume,
- Catastrophic: the degree of risk involved is larger than 10 percent of the project volume.

Risk Damage

The »Risk Damage is the estimated damage connected with a risk in the project in case of damage. The possible damage is shown in monetary units (e. g. in T). Damage that cannot be estimated in monetary units (for example image loss) is to be monetarized to the maximum extent by using auxiliary quantities, e. g. image loss may lead to a drop in sales that can be expressed in monetary units.

Risk Probability

The »Risk Probability is the estimated probability of the occurrence of a risk.

Role

A role is a description of a number of tasks and responsibilities within the framework of a project and an organization.
By defining roles it is achieved that the »V-Modell is independent of the organizational and project-specific framework conditions. The assignment of organizational units and people to the roles is made at the start of a project.

Safety

See »Functional Safety.

Safety and Security

The term Safety and Security includes the terms functional safety (Safety), information security (Security) and data protection.
In this context Safety stands for procedural or operational safety and the aspects of reliability, fault tolerance and correctness. This status depends on measures limiting the risk of a personal injury or material or immaterial damage to an acceptable level.
On the other hand, Security describes the state that ensures the availability, integrity, authenticity and confidentiality of information when IT systems are used. This state results from IT measures and personal, material and organizational measures. In this context

- availability is the state that guarantees the required usability of information, IT systems and components;
- integrity is the state that excludes unauthorized and forbidden modifications of information and IT systems or components;
- authenticity is the state in which required or assured characteristics or features of information and physical connections can be both authentically identified by the user and proven to third parties;
- confidentiality is the state that excludes unauthorized collection or gathering of information.

The purpose of data protection is to protect the individual against his right to privacy being impaired through the handling of his personal data. (Reference: Bundesdatenschutzgesetz (Federal Data Protection Act)).

Safety and Security Level

A safety and security level is a level which is assigned to a unit considered (physical system/system element or logic function/functional chain) and provides a discrete measure

- for a potential hazard (towards the outside) for persons, environment or goods during the operation of or in case of a loss of availability (failure, non-accessibility, etc.) or malfunction of the respective unit considered and
- for the threat to the system (from the outside) during operation if the unit considered is attacked by espionage, sabotage, manipulation etc. in combination with the sensitivity (the value) of the information to be protected, which is handled (processed, transmitted, stored) by the unit considered.

In addition to the known hazards resulting from failures or malfunctions, the operation of a system alone may already pose a hazard: Due to their design and function, vehicles, rocket launchers or X-ray machines endanger operators, bystanders and environment even if they function properly.

The sensitivity of informationen can be specified by laws (Data Protection Act etc.) or official regulations (protection of classified material etc.) or result from business operations (e.g. account data in banks or insurance companies, patent administrations in a research enterprise). In any case, it is important to protect (high) material and immaterial values against (significant) risks (manipulation, misuse, espionage, etc.).

Security

See »Information Security .

Segment

A »Segment is an important part of a »System, presenting a hierarchy level below the »System itself. It is the realization of a part of the »System. »Segments may be subdivided hierarchically into additional »Segments.

Software Element

The term »Software Element is a generic term which may designate all system elements beginning with the »Software Unit level in the hierarchy of »System Elements: »Software Unit, »Software Component, »Software Module, and »External Software Module.

Software Module, external

The product »External Software Module comprises system elements (»Software Module , »Software Component) which are not developed within the scope of the project. An »External Software Module is a functional element which can be described autonomously. An external software module may be an off-the-shelf product, a unit furnished by the supplier, a re-usable component developed in advance, an adjacent system or the result of a sub-contract.

Static Tailoring

Static »Tailoring are the tailoring activities carried out during project initialization in order to draw up as soon as the projects starts a list that includes the activities to be carried out and the products to be prepared and that is clear and can be handled.

Structural Product Dependency	See »Product Dependency, Structural.
Sub-Acquirer	A »Supplier is called a »Sub-Acquirer if he himself awards parts of the subject matter of the contract as »Acquirer to a »Sub-Supplier in order to fulfill the »Contract with his »Acquirer.
Submitted	This defines a »Product State of a »Work Product that is submitted for evaluation through independet quality assurance. Depending on the results of the evaluation, the subsequent product state is set in the »Product Library.
Sub-Supplier	A »Sub-Supplier is the supplier in a contract, i. e. the organization that provides a »System Element or subsystem to the »Sub-Acquirer (DIN EN ISO 8402).
Supplier	A supplier is understood to be the supplier in a contract, i. e. the organization that provides the »Acquirer with a »Work Product (DIN EN ISO 8402).
System	The system is an integral whole with the capability to meet specified requirements or targets. It represents the subject matter of the order agreed between the acquirer and the supplier. The system consists of descriptions and/or realizations of hardware, software and/or logistic elements.
System Element	The term »System Element is a generic term which may designate all elements to be realized during »System Development. This may include »System, »Enabling System, »Segment, »External Unit, »Hardware Unit , »Software Unit, »Hardware Component, »Software Component, »Hardware Module, and »Software Module.
Tailoring	Beyond the literal meaning of the term itself, »Tailoring means in the context of the»V-Modell not only "cutting off" parts, but also "adapting" the V-Modell. Usually the V-Modell is adapted to a concrete project by adding »Process Modules. Adaptations within the process modules are to be considered exceptions to the rule. In addition to the selection of the process modules, the Tailoring process also determines the »Project Execution Strategy . The selection of the »Project Type and a »Project Type Variant determine the selection of the process modules and the project execution strategy. Depending on the progress of the project, a distinction is made between ● »Static Tailoring, i. e. Tailoring during the project initialization phase and ● »Dynamic Tailoring, i. e. Tailoring in the further course of the project.
Tailoring-Related Product Dependency	See »Product Dependency, Tailoring-Related.

Tailoring Result	The »Tailoring Result determines the »Process Modules that are to be used in the project. The Tailoring Result may be both a result of the static »Tailoring at the start of the project and a changed Tailoring Result caused by »Dynamic Tailoring during the execution of the project.
Test	Tests are regarded as special form of evaluation which evaluates the execution behavior of »Software Elements.
Test case	A test case is a special form of evaluation case intended to evaluate the execution behavior of »Software Element s.
Tool Reference	A »Tool Reference describes a class of tools that may be used for carrying out activities or preparing products.
Topic	A topic is unambiguously assigned to a »Work Product, which for its part may consist of any number of topics. A topic is content-related and complete in itself. The topics of a product have to be seen as a listing of the essential contents of the product. Topics are processed by »Work Step.
Topics	See »Topics.
Trigger	A »Trigger describes an event that triggers an »Activity. Triggers are used for example during the planning and execution of risk avoidance and risk reduction measures.
V-Modell	The V-Modell is a guideline for the planning and execution of development projects, which takes into account the whole life cycle of the system. In this process the V-Modell defines the results that have to be prepared in a project and describes the concrete approaches that are used to achieve these results. The V-Modell also defines the responsibilities of the individual participants in the project.

V-Modell, Advanced
For the maintenance and the further development of the »V-Modell a procedure is defined that consists of two stages. The V-Modell may be changed and extended in comparatively short intervals that are suitable for the short innovation cycles of information technology.
For this purpose accordingly to the preparation of an organization-specific process model an advanced V-Modell, respectively parts of an advanced V-Modell, is developed. These change proposals and suggestions for further development are submitted to the »V-Modell Change Conference (Änderungskonferenz des V-Modells (Äko)). »Äko then decides whether the changes are adopted in the V-Modell. In this process changes and extensions may only affect »Process Modules, Project Execution Strategies, »Decision Gates, »Project Characteristics and »Mapping to Standards.
Changes that go beyond these limits, such as changes to these »Fundamentals of the V-Modell, fall under the second stage of this procedure. Such changes have to be made in a separate review and coordination process together with the »V-Modell Users within the framework of an update project.

V-Modell Core
The »V-Modell Core forms the basis of each »Application Profile. It determines a number of »Process Modules that have to be used in each »Project Compliant to the V-Modell.

V-Modell Project
A »V-Modell Project is a project that is executed as »Project Compliant to the V-Modell .

V-Modell Reference
A V-Modell Reference defines a specific grouping of the contents of the »V-Modell. The descriptions and relations of the individual »Work Products, Activities, »Roles etc. do not change. However, they are regrouped within the framework of their dependencies and, if required, presented in a shortened form. Thus adapted presentations of the same contents can be provided for different application purposes.
V-Modell References are implemented in the printed version of the V-Modell in different parts of the V-Modell.

V-Modell User
Persons who are concerned with the execution of »V-Modell Projects, i. e. who are involved in V-Modell projects, are called »V-Modell Users.

V-Modell XT
The addendum "XT" to »V-Modell stands for "extreme tailoring" or for "extendable".

V-Modell XT Assessment
The V-Modell XT Assessment checks if a »Process Compliant to the V-Modell of an organization is really applied. Thus, it provides the practical part, which is not included in the »V-Modell XT Compliance Test. After successful completion of an assessment, the certificate "V-Modell XT Pur" (cf. »Zertifizierungsprogramm) will be awarded.

V-Modell XT Compliance Test	A V-Modell XT Compliance Test is intended to check the »V-Modell®XT Konformität of a process deviating from the (Standard) V-Modell XT. If the process is compliant to the V-Modell XT, it may be used - in consultation with the Acquirer - instead of the V-Modell XT in projects, for which the V-Modell XT is required. In the Compliance Test, a questionnaire is used in order to determine if the respective process fulfills the quality requirements of the V-Modell XT with regard to description techniques, results and sequences. The expected results and the requirements posed on the sequences are determined by V-Modell XT »Reference Model.
Weit e.V.	The Weit e.V. is a registered association. The main focus of this assosiation lies in the maintenance and further development of the V-Modell XT. The Weit e.V. was foundet in 2008 by the "Weit" development project partners. Members of the Weit e.V. consist of representatives of industry, government institutions and universities.
Work Package	A »Work Package is a project-specific grouping of activity models with regard to contents. For example, configuration management »Activity Instance may be grouped into a work package, because a detailed scheduling of these activity models may possibly not be necessary.
Work Product	A distinction is made between »Product Type and »Product Instance. The exact meaning of the term Work Product depends on the context it is used in. Not only the system to be developed, but also all documents, evaluation protocols, software modules, in short: All kinds of artefacts are named Product Type or even just Product within the context of the V-Modell XT.
Work Product, External	»Work Products (e.g. »External Unit, »External Hardware Module, or »External Software Module) that may be prepared outside the framework of the »V-Modell Project. The »V-Modell XT defines responsible »Role for external products, but it does not necessarily define participating roles and activities.
Work Product, Initial	The term »Initial Product stands for a »Work Product that has to be prepared in each case and exactly once.
Work Step	A Work Step belongs to exactly one »Process Module and is always assigned to an »Activity. Work Steps process »Work Products and »Topics. A Work Step is a description of how a task, which typically turns up in a project or an organization, has to be performed. Thus Work Steps are comparable with a work instruction that has to be executed fully for the processing of one or more product process modules.

4 Abbreviations

Äko	Änderungskonferenz des V-Modells (V-Modell Change Conference)
ANFE	Anforderungsfestlegung (»Specification of Requirements)
ANG	Delivery und Abnahme (AN) (»Delivery and Acceptance (Supplier))
AUF	Delivery und Abnahme (AG) (»Delivery and Acceptance (Acquirer))
BVB	Besondere Contractsbedingungen für die Beschaffung von DV-Leistungen (Special Contract Terms for the Procurement of DP Services)
COTS	Commercial off the shelf
DIN	Deutsche Industrienorm (German DIN Standard)
ERGO	Benutzbarkeit und Ergonomie (»Usability and Ergonomics)
EVB-IT	Ergänzende Contractsbedingungen für die Beschaffung von Informationstechnik bzw. informationstechnischen (Dienst-)Leistungen (Supplementing Contract Terms for the Procurement of Information Technology and Information Technology Services)
FP	Evaluierung von Fertigprodukten (»Evaluation of Off-the-Shelf Products)
FPGA	Field-Programmable Gate Array
GOTS	Government off the shelf
GWB	Gesetz gegen Wettbewerbsbeschränkungen (Act against Restraints of Competition)
HHM	Haushaltsmittel (budgetary funds)
HW	Hardware
HWE	HW-Entwicklung (»Hardware Development)
IEC	International Engineering Consortium
IPMA	International Project Management Association
ISO	International Organization for Standardization
IT	Information Technology
KM	Konfigurationsmanagement (»Configuration Management)
KPM	Kaufmännisches Projektmanagement (»Life Cycle Cost Management)
LOG	Logistikkonzeption (»Integrated Logistic Support)

MESS	Messung und Analyse (»Measurement and Analysis)
MIG	Weiterentwicklung und Migration von Altsystemen (»Enhancement and Migration of Legacy Systems)
OVM	Einführung und Pflege eines organisationsspezifischen Vorgehensmodells (»Introduction and Maintenance of an Organization-Specific Process Model)
PM	»Project Management
PROB	»Problem and Change Management
QS	Qualitätssicherung (»Quality Assurance)
SE	Systemerstellung (»System Development)
SI	Sicherheit (»Safety and Security)
SW	Software
SWE	Softwareentwicklung (»Software Development)
UfAB III	Unterlage für die Request for Proposal und Project Evaluation von IT-Leistungen (Teil III) (Document for the Tendering and Evaluation of IT Services (Part III))
VDE	Verband der Elektrotechnik Elektronik Informationstechnik (Association of German Electrical Engineers)
VgV	VergabeVerordnung (Regulation on the Award of Public Contracts)
VOB	Verdingungsordnung für Bauleistungen (Conditions Concerning Contracts for Public Works)
VOF	Verdingungsordnung für freiberufliche Leistungen (Conditions Concerning Contracts for Freelance Services)
VOL	Verdingungsordnung für Leistungen (Conditions Concerning Contracts for Professional Services)
WiBe 21	WiBe 21- Recommendation zur Durchführung von Analysis of Cost-Effectivenessen in der Bundesverwaltung, insbesondere beim Einsatz der IT (WiBe 21 Recommendation for Cost Effectiveness Considerations in the Federal Administration, in particular for the Use of IT)

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UfAP IV	Webseite: http://www.kbst.bund.de
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V-Modell®XT Konformität	V-Modell XT-Konformität (Compliance to the V-Modell XT)
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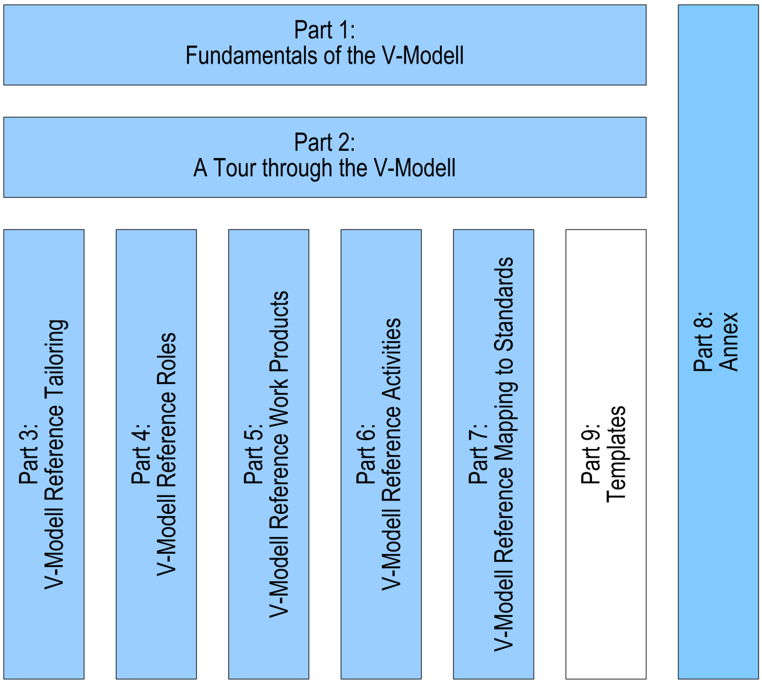
Zertifizierungsprogramm	Webseite des Zertifizierungsprogramms (Website of Certification Program)

Part 9: Templates

V-Modell® XT



This document was created based on:

Export templates	Version 1.3 English
Export environment	Version 2.1.3
V-Modell XT	V-Modell® XT Version 1.3

Table of Contents

1 Introduction

1.1 Objectives

The objective of this document is to illustrate the contents and the setup of the product templates that are available with the V-Modell and to provide an example of their use. This is to ensure that templates - also independently of the project - are uniformly used and completed.

1.2 Audience

The target group of this document are all members of a project staff who are responsible for products, contribute to the preparation of products or evaluation a product.

1.3 Contents and Structure

This document includes the following chapters:

»Basics about Product Templates

In this chapter information about the product templates in general is provided.

»Contents and Structure of Product Templates

In this chapter an example is used to explain how to handle product templates in order to use them for the preparation of concrete »Product Instances.

1.4 Nomenclature

For the understanding of this part it is absolutely necessary to make a distinction between the terms »Work Product/»Product Type and »Product Instance. In this context product templates are always »Templates for a specific product type.

2 Basics about Product Templates

This chapter provides answers to fundamental questions about product templates:

- What are product templates and for what purpose are they required?
- For which products do product templates exist?
- Where do you obtain product templates from?

2.1 Purpose

A product template is a RTF file that contains all relevant contents of the V-Modell with regard to a concrete »Product Type, e.g. product name, »Discipline, the responsible »Roles, the contributing roles, the description of products and subjects.Generally all information relevant to the preparation of a » Product Instance can be found in the »V-Modell Reference Work Products. The added value of product templates is based on the fact that this information is already incorporated into the corresponding file, e. g. all topics are already set up as points of a breakdown. Thus the member of the project staff is not required to use "Copy &Paste" to copy parts from the V-Modell reference, but can start with the work on the contents immediately after the file was opened. Also all product templates follow a standard layout.

2.2 Work Products without Templates

Most products of the V-Modell correspond to a document; thus also an appropriate product template is available. The other products for which no template exists are divided into the following classes:

System Elements

System Elements (e. g. »Hardware Module or »Software Module) are component groups or program codes.

External Interface Products

Products such as the contract exist both at the acquirer (as »Contract) and at the supplier (as »Contract (Acquirer)). However, they are of course not prepared twice, but exchanged (in the form of a file, letter, fax etc.) via the »Acquirer/Supplier Interface.

Product Library, »Delivery, etc.

There are additional products, such as the »Product Library or the delivery. Although these are prepared in the course of the project, they are neither documents nor part of the system.

2.3 How to get Product Templates

There are in principle two possibilities to use product templates.

Delivered Product Templates

The individual Word files are provided together with the V-Modell (i. e. on the V-Modell CD or on the V-Modell website »www.V-Modell-xt.de). Those are product templates that were not tailored to a concrete project, but contain the contents of the V-Modell completely. Thus in each product template for the project manual the topic »Safety and Security - Organization and Directives is included, regardless whether the »Process Module »Safety and Security was selected in the concrete project or not. In this case the product template has to be adapted to the concrete project by deleting the appropriate chapter.

Self-Generated Product Templates

Moreover, with the V-Modell there is also a tool available for the preparation of one's own project- or organization-specific product templates. It is thus possible to include in the product templates for example one's own project logos, organization-specific formattings or file storage information. Furthermore it is possible to adapt the product templates in accordance with the project-specific »Tailoring.

3 Contents and Structure of Product Templates

The following chapter describes the contents and the structure of the product templates delivered together with the V-Modell. To provide assistance to the user, the specifications from the V-Modell for the respective products were integrated into the products as hidden text.

3.1 Title Page

The Title Page contains the most important information about the » Product Instance. First of all these are the product name and the corresponding discipline, followed by additional information, which should be updated by the person responsible for the product when he prepares the product model for the first time, providing in particular the name of the person responsible for the product.

Project Name	MaPaROM		
Projektleader	Mr. Dr. M. Aurelius		
Responsible	Mr. P. Cato		System Architect
Prepared at	09.07.2004		
Last amended	14.06.2005 16:36		
Processing state	X	in process	
		presented	
		ready made	
Document clipboard	C:\Dokumente und Einstellungen\admin\Desktop\MaPaROMSysSpec-USys1SegementA.rtf		
V-Modell-XT Version	Version 1.1		

Figure 1: Example of a Title Page of a System Specification

3.2 Additional Product Information

This section of the product template contains further V-Modell-specific product information.

Under *Contributing* all roles can be found that may contribute to the preparation of a model of this product type. the names of the persons actually contributing to the preparation of the product model have to be listed according to the respective roles. Roles that may contribute, but are not involved in the preparation of the product model, have to be marked as "not involved". Roles that do not appear in the project because of the tailoring have to be deleted.

Under *Generation* all generative product dependencies that may be used to generate this product type can be found. Here a distinction has to be made between the following three cases:

1. The product is an »Initial Product or an »External Product. In this case there is no generative product dependency.

2. There is exactly one generative product dependency that may be used to generate this product type. In this case the file name of the source product model or the file names of the source product models have to be indicated.

3. There are several generative product dependencies that may be used to generate this product type. For the concrete product model, however, only exactly one dependency applies and all other generative product dependencies that do not apply have to be deleted. Then proceed as described under point 2.

Figure 2 and Figure 3 show the corresponding part in the delivered product template and an exemplary implementation in the project. The roles »Safety Manager and »Ergonomics Manager were deleted, since the corresponding »Process Module were not selected during »Tailoring. Although the roles "Developer for Logistics" and "Logistic Manager" may contribute, they actually did not do it. Since this »System Specification is a specification of a concrete »Segment in a »Enabling System that has to be developed, the corresponding »Generative Product Dependency were selected and all others were deleted.

Contributing	[not involved]	Inspector
	[not involved]	Logistics Developer
	[not involved]	System Security Manager
	[not involved]	Logistics Manager
	[not involved]	Ergonomics Manager
	[not involved]	System Integrator
Creation	Product range of segements in the Enabling System ● Enabling System Architecture [Filename] ● Implementation, Integration and Evaluation Concept Enabling System [Filename] Product range of segements in the System ● System Implementation, Integration and Evaluation Concept [Filename] ● System Architecture [Filename] Product range of the system ● Overall System Specification [Filename] Product range of the Enabling System ● Overall System Specification [Filename]	

Figure 2: The Section "Further Product Information" in a Product Template

Contributing	Mrs. A. Minor — Inspector [not involved] — Logistics Developer [not involved] — Logistics Manager Mr. G. Gracchus — System Integrator
Creation	Product range of segements in the Enabling System ● Enabling System Architecture SysArc-US1.rtf ● Implementation, Integration and Evaluation Concept Enabling System IIPK-USys1.rtf

Figure 3: The Section "Further Product Information" in a concrete Product Model

3.3 History of Change and Review List

To make it possible to trace the preparation of the document, careful maintenance of the *Change List* is important. Also the reviews of the documents have to be traceable. For this purpose a corresponding entry has to be made for each successful review that results in the document having the state »Finished. If the product is not identified in the »QA Manual under »Products to Be Evaluated as a product that has to be tested, the section *Evaluation List* may be deleted.

The exact guidelines for the development of entries to these tables are defined in the »Project Manual in chapter »Configuration Management - Organization and Directives.

Change catalog

Change			Changed Chapters	Description of Change	Author	State
Nr.	Date	Version				
1	09.07.04	1.1	all	Initial product creation	Cato	In process
2	10.07.04	1.2	4, 6	Non-Functional Requirements revised	Cato	In process
3	21.07.04	1.3	3	Interfaces revised	Gracchus	In process
4	24.07.04	1.4	---	---	Cato	presented
5	01.08.04	1.5	---	---	Minor	Ready-made
6	14.06.05	2.1	all	Revision according to change request 4711	Cato	In process

Evaluation catalog

The following table presents an overview from all evaluations – self-evaluations as well as evaluations from an independant quality assurance – of the present document.

Date	Evaluated version	Notes	Inspector	New product state
20.07.04	1.2	Self-evaluation not successful; revise Interfaces!	Cato	In process
24.07.04	1.3	Self-evaluation okay	Cato	presented
01.08.04	1.4	okay	Minor	Ready-made

Figure 4: »History of Change and Review List in a Sample Document

3.4 Introduction

Under *Introduction* the role this document plays in the project should be described. This includes the reasons for the existence of the document and what is to be achieved with the document.

3.5 Subjects

The individual topics of the project were inserted as separate chapters within the document and have to be processed accordingly. In this context it should be taken into consideration that some topics are defined in »Process Modules that were not selected for the project. Of course those topics have to be deleted. Also subchapters may be used to structure topics when they are edited.

3.6 Directives for Evaluating this Document

This part is intended only as information source and help for the editors and »Inspectors of the document. At this point it is once more put down in writing which dependencies as regards content exist between this product and other products. Those dependencies have to be checked before this »Product Instance can be transferred to the state "finished".

In this context it is highly important that this information is at »Product Type level. This means for example that it is not necessary to keep a »System Specification for a concrete »Segment consistent with all »Software Specifications prepared in the project, but only with the software specifications for the »Software Units in the segment concerned.