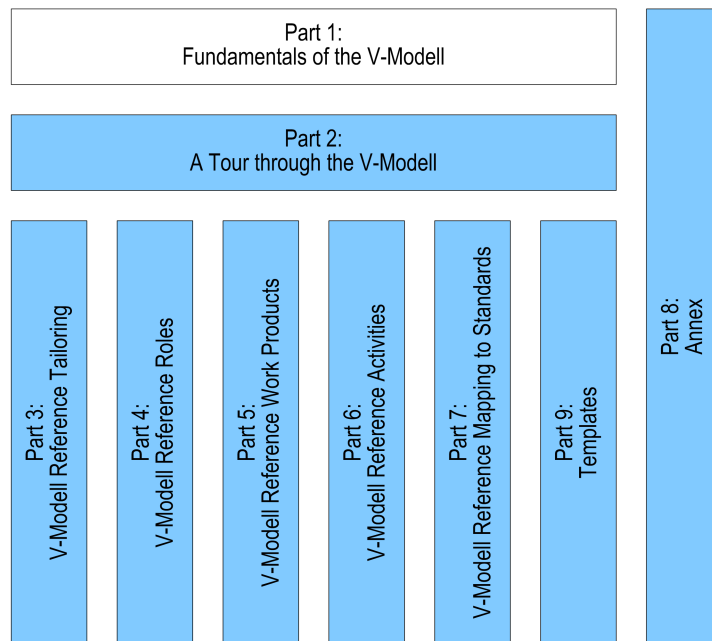




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V-Modell[®] XT



Part 1: Fundamentals of the V-Modell

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1 Introduction

The V-Modell is a model for planning and realizing Projects. The V-Modell improves project transparency, project management and the probability of success by specifying concrete approaches with the respective results and responsible roles. The V-Modell XT described hereafter is an advance 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 approach 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 further 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 Execution Strategies and Decision Gates. In addition, the interaction between various V-Modell Projects 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 management, execution and control. This in turn requires interaction between various management mechanisms, like project management, quality assurance, configuration management, 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 guidance for the actual processing of the project task. This application guidance covers system development projects, the roles and functions of acquirers and suppliers in these projects, and the development of an organization-specific 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 a product template.

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 required project cooperation between acquirer and supplier is also 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 the possibility of falling back on standardized and proven 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 Basis

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, the Federal Office of Defense Technology and Procurement, 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), 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 (KBSt Volume 27/1)
 - Part 2: Supplements with Regard to Authorities (KBSt Volume 27/2)
 - Part 3: Collection of Manuals (KBSt Volume 27/2)
- Methods Standard (AU 251)
- Functional Tool Requirements (AU 252)

2.2 Successor

In 1997, the V-Modell 97 was completed; since then it has not been updated. Therefore, it does 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, the V-Modell today is 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, the Federal Office of the Bundeswehr for Information Management and Information Technology, A5, 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 Compliant to the V-Modell approach:

Minimization of Project Risks

The V-Modell improves project transparency and plannability 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

A standardized process model 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 replicable. This reduces the acquirers's 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 will be 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.
- The question as to whether the user should develop the overall system or buy a standard product is not covered. However, the V-Modell supports the use of off-the-shelf products as integral system elements of projects of the supplier.
- The placing of no-bid subcontracts is not supported by the V-Modell .
- During the Implementation 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 Leader 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:

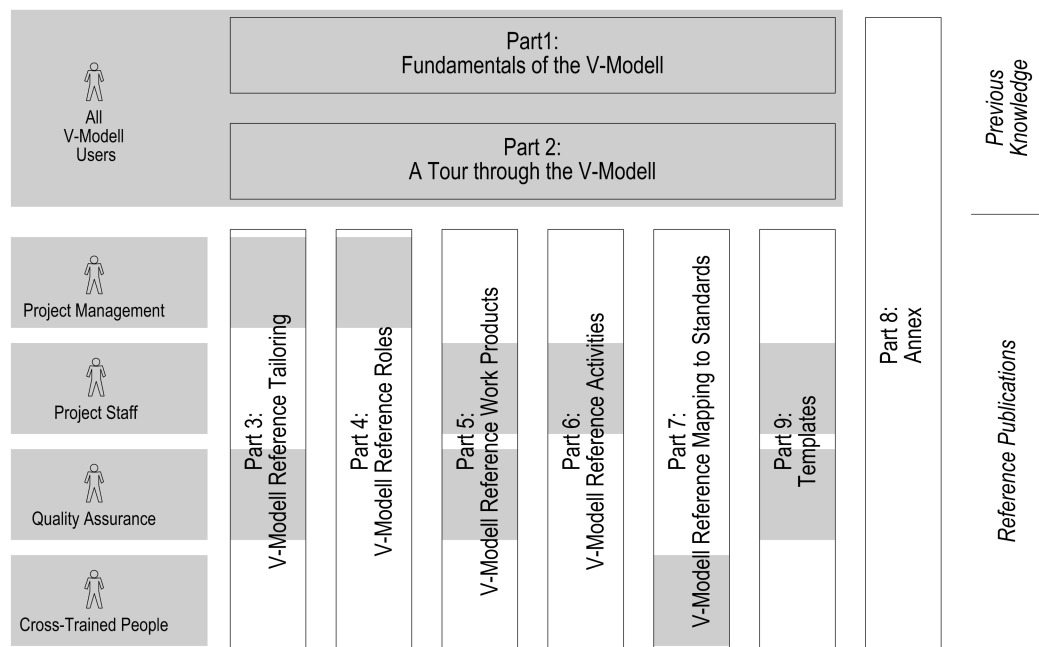


Figure 1: Target Groups of the V-Modell Sections

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.

A fundamental knowledge of the first two parts is the prerequisite for the successful application of the V-Modell in a project. The following sections 3 to 6 are V-Modell References. A V-Modell reference is a specific view of the contents of the V-Modell. The V-Modell user is not required to read these V-Modell References before starting a project. The V-Modell References and the sections 8 and 9 can be used as reference work during project .

Section 3: V-Modell Reference Tailoring

The V-Modell Reference Tailoring describes the 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 included in 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 product groups, 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 managers and inspectors of V-Modell products.

Section 6: V-Modell Reference Activities

The V-Modell Reference Activities includes all activity groups, activities and subactivities of the V-Modell in accordance with the hierarchical activity model. In particular, it describes the processing of the specific subactivities 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 adapted 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 which other standards are covered 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 advance 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 products and intermediate results should 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 Projects follow the same pattern. Depending on some characteristics, the projects can be classified and subdivided into Project Types.

In order to ensure that the V-Modell can be employed simply and without significant effort, sequence frames - the so-called Project Execution Strategies - are predefined for various Project Types. 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 Products which have to be developed within the scope of the task, the Activities required for developing the individual products and the Roles included in the products are specified. The individual process modules are self-contained. Dependencies and interrelations between the process modules are defined explicitly.

The project type does not only define the process modules to be used but also the project realization strategy to be applied. A Project Execution Strategy corresponds to a sequence of decision gates. A Decision Gate indicates a Project Progress Stage in the project sequence 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 and decision gates 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.

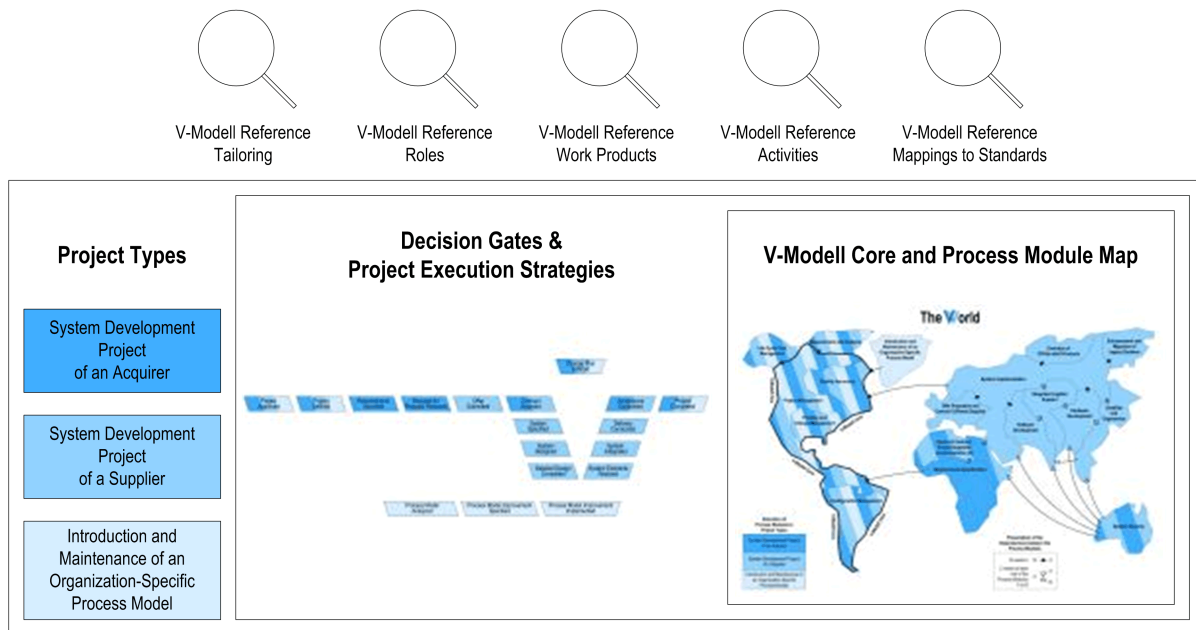


Figure 2: Overall Structure of the V-Modell and Presentation Based on the Point of View

The elements described up to now are the actual contents of the V-Modell, which are complemented by so-called mappings to standards. A mapping to a standard 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, an application of the Mapping to CMMI® and the Mapping to ISO 15288 to the V-Modell. For users, who have up to now processed their projects in accordance with other regulations, procedures or standards, the mappings to standards facilitate the change to the V-Modell.

During a project, various persons and groups of persons deal with the individual 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 management. At a later stage of the project, project management and 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 References, which correspond exactly to these points of view. Thus, the V-Modell Reference Tailoring especially describes the development 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 follows the same stereotype pattern. Depending on the Project Characteristics, project variants can be classified and subdivided into Project Types. This classification of project variants will be described briefly in the following paragraphs.

The most important project characteristics used for classifying V-Modell projects are the Subject of the Project and the Project Role. The Subject of the Project of a V-Modell project is either the development of a System or of an Organization-Specific Process Model. The Project Role is occupied either by the Acquirer or the Supplier and designates the position of a V-Modell project as compared to other projects.

Each project role implies a specific point of view with regard to the system development project and includes several specific project tasks.

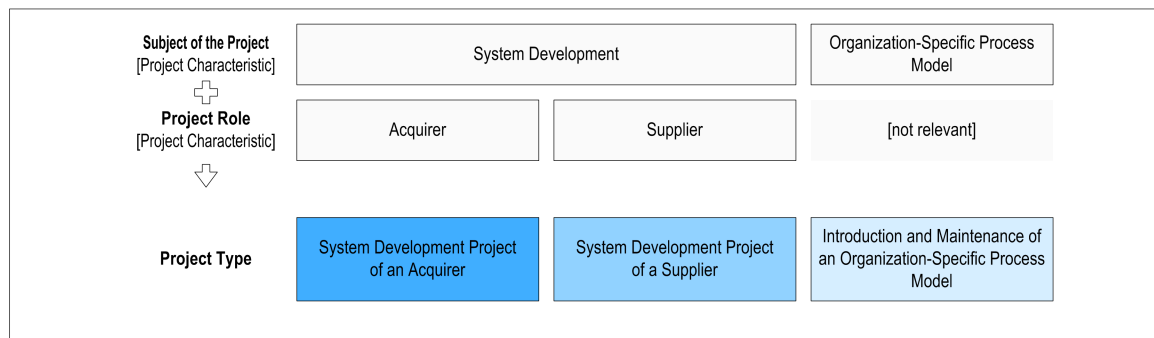


Figure 3: Classification of Projects and Subdivision into Project Types

As shown in →Figure 3 the following project types are specified based on the most important project characteristics:

- System Development Project of an Acquirer
- System Development Project of a Supplier
- Introduction and Maintenance of an Organization-Specific Process Model

In the following paragraphs, the color identification of these project types will be used for allocating process modules, project execution strategies and decision gates. The selection of a project type is the first step for determining "what" has to be done in a project.

3.3 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 is a concrete task which may occur within the scope of a V-Modell project. As shown schematically in →Figure 4 a process module encapsulates the Work Products, Activities and Roles, which are relevant for the fulfillment of this task and thus belong together with regard to contents, e.g., the contents of project management or software development.

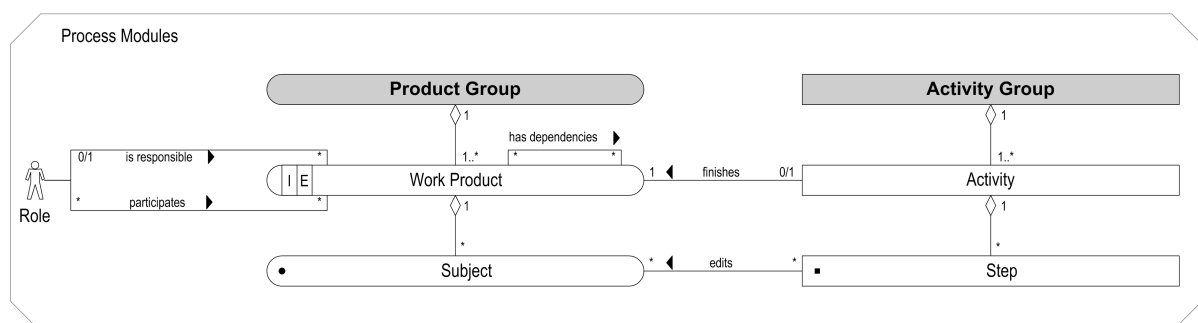


Figure 4: Process Modules and their Components

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

The results and interim results to be developed are designated as Work Products. The entirety of all products is structured in a hierarchical manner, by integrating products which belong together with regard to contents into Product Groups. In addition a complex product may be subdivided into several Subjects.

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 is specified explicitly as Initial Product or as External Product. 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.

Every product developed within the scope of the respective V-Modell project will be completed by exactly one Activity. The methods for processing the individual products are specified in the Activities. 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 are integrated into Activity Groups. In addition, activities may be subdivided into sub-activities. A Sub-Activity is comparable to a work instruction which shall be executed completely and includes one or several subjects.

In addition to products and activities, a process module includes roles. 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.

3.4 V-Modell Core and Process Module Map

As already mentioned, the mandatory and optional Process Modules are specified for every Project Type . 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 concrete V-Modell Project are selected and specified in accordance with the specifications of the Project Type .

The V-Modell Core ensures a minimum project execution quality: in every project Compliant to the V-Modell, the basic management mechanisms as defined in the Process Modules of the V-Modell Core shall be used. As shown in [Figure 5](#) the Process Modules of the V-Modell Core include Project Management, Quality Assurance , Configuration Management and Problem and Change Management.

In addition, 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 and multiproject acquisition and evaluation of parameters.

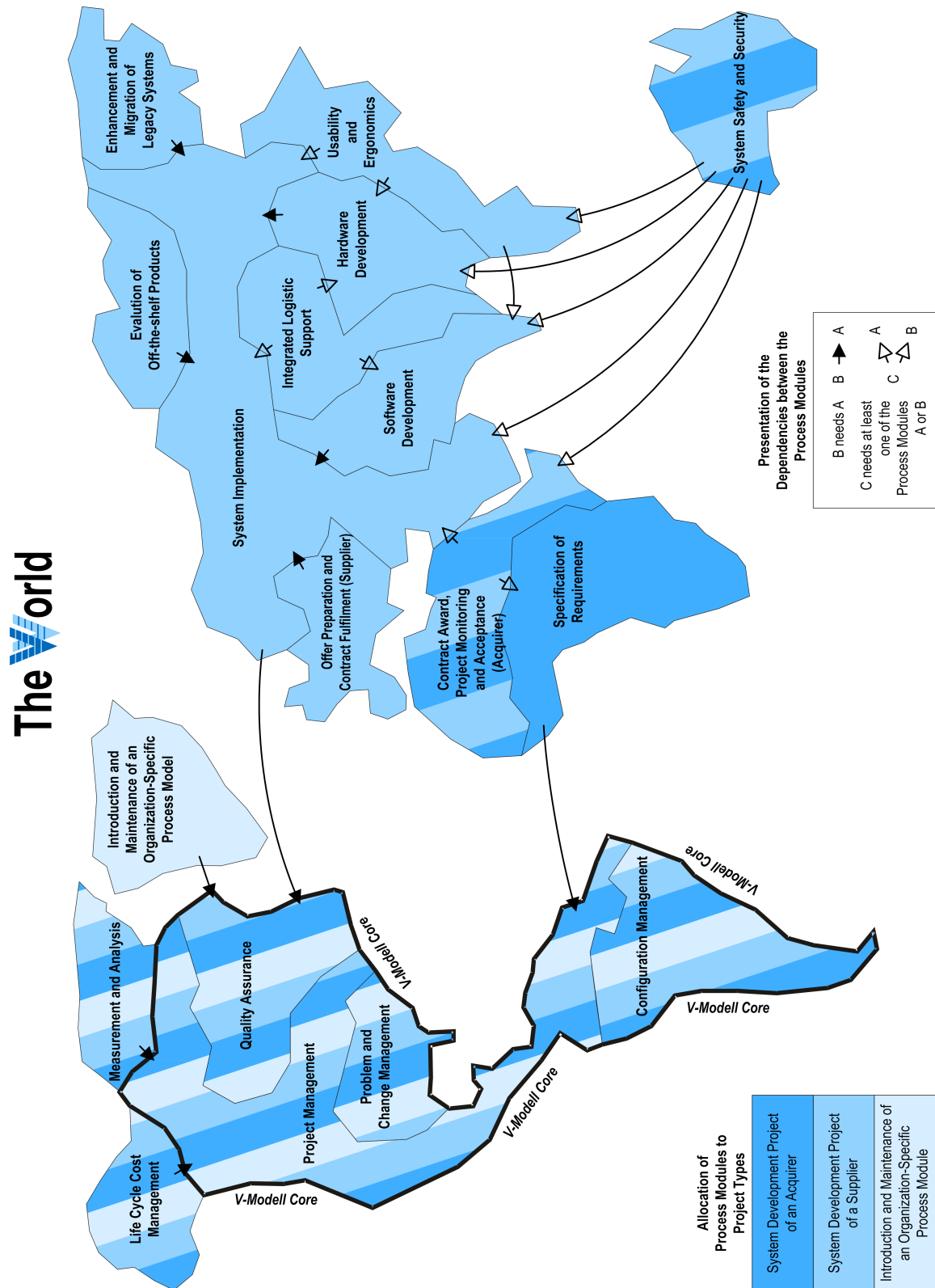


Figure 5: Process Module Map

In addition, every Project Type includes additional Process Modules which are specific for this project type, as shown in →Figure 5 . The project type System Development Project of an Acquirer includes the process modules Specification of Requirements, System Safety and Security and Contract Award, Project Monitoring and Acceptance (Acquirer).

The process modules System Safety and Security and Contract Award, Project Monitoring and Acceptance (Acquirer) can also be used for awarding subcontracts in the project type System Development Project of a Supplier. For this project type, the System Development is the central process module, which is complemented by the process modules Hardware Development, Software Development, Integrated Logistic Support, Enhancement and Migration of Legacy Systems, Evaluation of Off-the-Shelf Products and Usability and Ergonomics. The individual process modules of the V-Modell will be described in detail in the V-Modell Reference Tailoring.

3.5 Project Execution Strategies

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 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 the projects, an ordered project life cycle must be developed. For this purpose, the V-Modell provides the user with a catalog including the so-called project execution strategies. A Project Execution Strategy defines a basic framework for the ordered and replicable execution of a project.

The V-Modell offers at least one suitable project execution strategy for every Project Type. Based on the Project Characteristic System Life Cycle Section, the project execution strategy suitable for a project of a specified type can be determined. →Figure 6 shows the presently available project execution strategies in dependence on the System Life Cycle Sections.

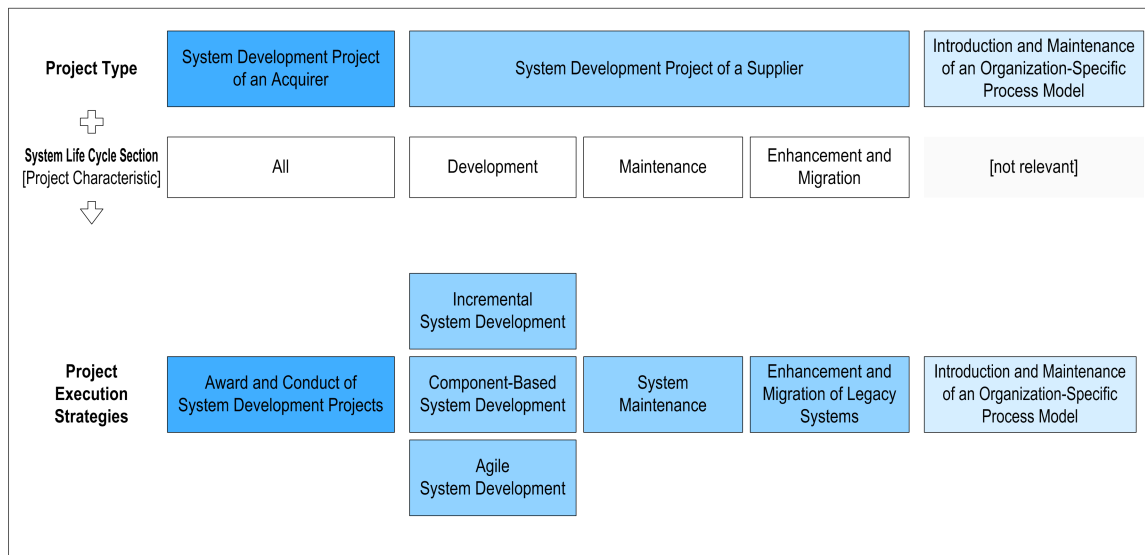


Figure 6: Allocation of Project Execution Strategies to Project Types

In the current version of the V-Modell, various project execution strategies are only available for supplier system development projects. Additional project execution strategies may be added (see paragraph →Introduction and Maintenance of an Organization-Specific V-Modell).

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

3.6 Decision Gates

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

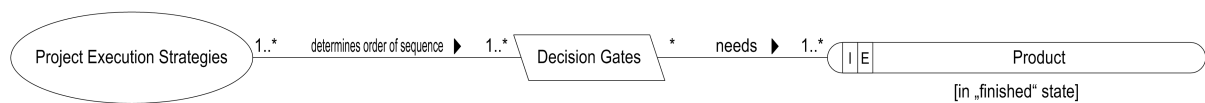


Figure 7: Project Execution Strategy, Decision Gates and Products

→Figure 8 shows all Decision Gates planned in the V-Modell. The different colors indicate in which Project Types and in which project execution strategies the individual decision gates are used.

The decision gates Project Approved, Project Defined, Change Plan Defined and Project Completed are used in all project types and, thus, also in all project execution strategies. The project type System Development Project of an Acquirer includes the additional decision gates Requirements Specified, Request for Proposal Released, Contract Awarded and Acceptance Completed.

The decision gates Contract Awarded and Acceptance Completed are also included in the project type System Development Project of a Supplier. Together with the decision gate Offer Submitted, they provide the interface to the user. The actual system development is indicated by the decision gates System Specified, System Designed, Detailed Design Completed, System Elements Realized, System Integrated and Delivery Conducted.

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 available in detail.

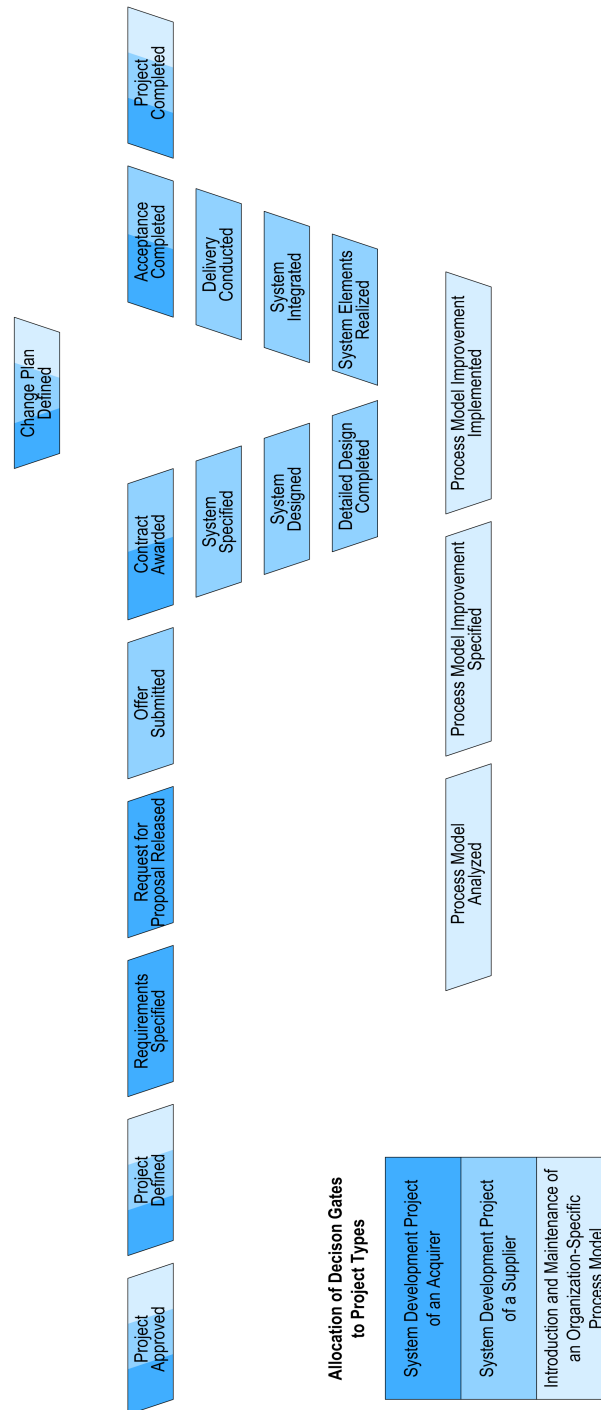


Figure 8: Decision Gates of the Project Execution Strategies

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

3.7 Overview of Basic Concepts

An important principle of the V-Modell is the target-oriented and result-oriented approach. 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.

- Project Execution Strategies and Decision Gates 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 and processed and completed professionally during the project progression.

The target and result orientation of the V-Modell avoids unnecessary activities which are not oriented towards a result. Activities and sub-activities 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 specification of the project type, the applicable process modules and project execution strategies. The detailed adaptation of the V-Modell to the level of the products to be developed and activities 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](#)).

As shown in →[Figure 9](#), the project is first characterized by a list with specified Project Characteristics. The result of this characterization is the Application Profile. The figure shows the project characteristics Subject of the Project and Project Role, which are only a part of the total of 9 project characteristics specified in an application profile. The complete application profile automatically determines the project type and, thus, the selection of mandatory Process Modules and Project Execution Strategies. If the Tailoring Result provides a selection of several project execution strategies, the V-Modell User selects one or a combination of these strategies (Static Tailoring).

→[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 of an Acquirer with six mandatory and three optional process modules and a corresponding project execution strategy were selected (currently the project assistant is only in german language available).

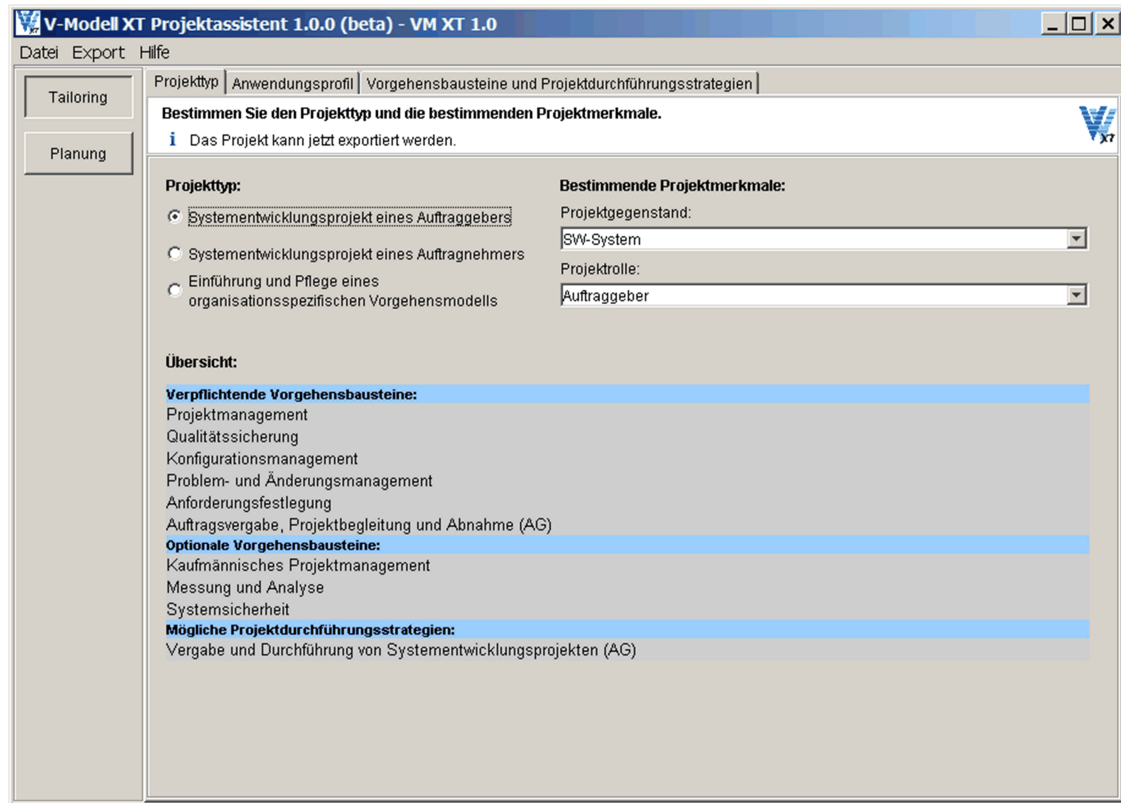


Figure 9: Tailoring of a V-Modell

The selection of process modules can be extended manually as required. However, the process module dependencies must be taken into account. The final determination of the project type and the corresponding selection of process modules and project execution strategy shall be documented in the Project Manual. The reasons for the selection of a specific application profile, project execution strategies and the use of additional process modules shall 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 project execution strategies relevant for his/her project.

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 shall 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 shall 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 shall be determined, funds allocated and framework conditions specified. This will be documented in the Project Progress Decisions 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, shall 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 to be used will be determined. This project execution strategy specifies the sequence of the project progress stages to be achieved during the project. 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 requirements of the project to be executed. The project execution strategy only provides a general frame, which shall 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 Gates Requirements Specified , Request for Proposal Released , Contract Awarded and Acceptance Completed twice - once for the prototype and once for the proper system.

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

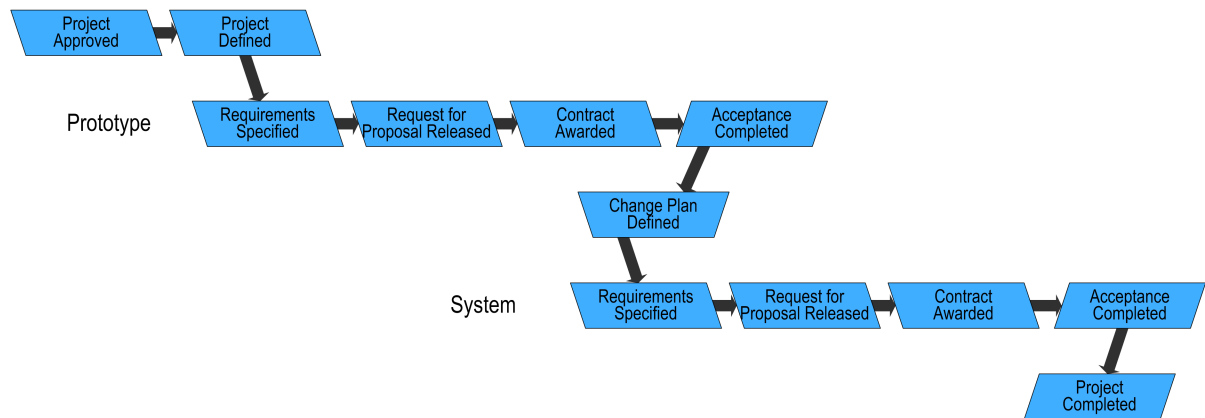


Figure 10: Project-Specific Development of the Project Execution Strategy

Thus, a basic frame for a detailed project planning and organization is specified. The decision gates of the project execution strategy specify 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 specified by the decision gates - together with the corresponding activities - can be integrated immediately into the project plan.

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 shall be reviewed continually and systematically, and difficulties shall be controlled 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.

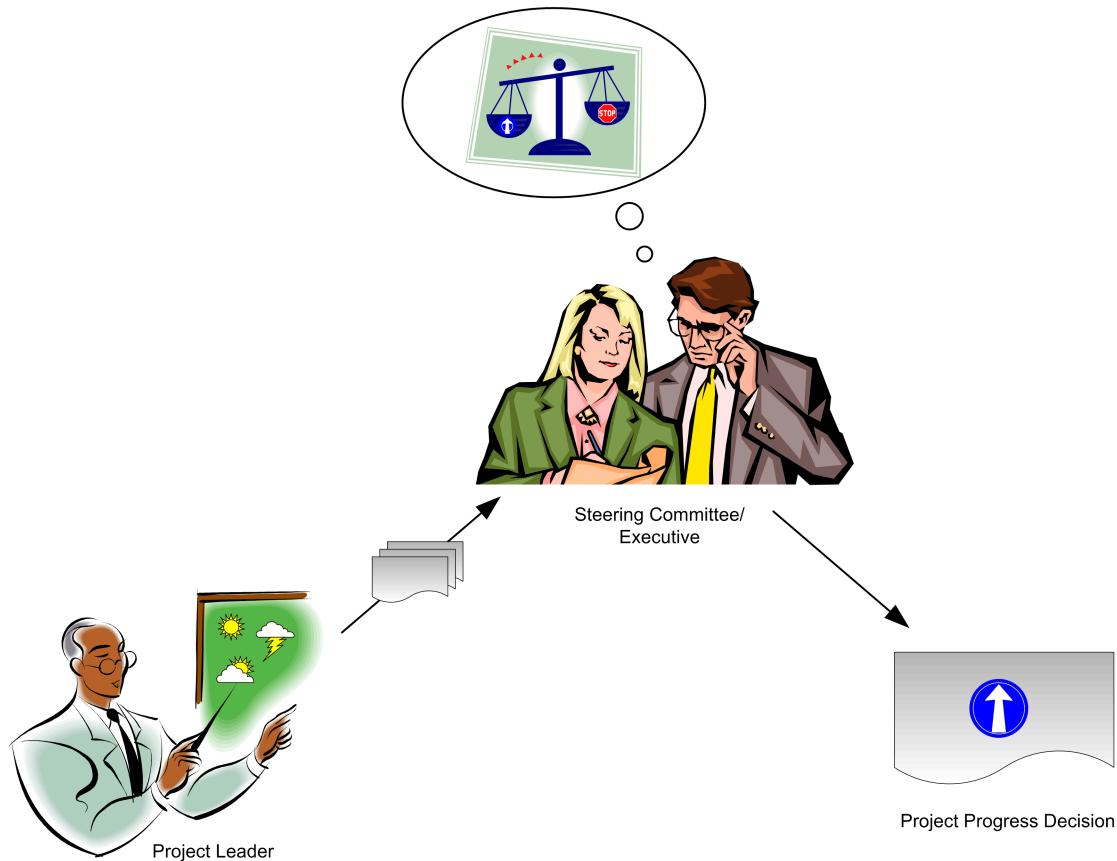


Figure 11: Decision Gates and Project Progress Decision

The decision gates indicate quality gates for deciding 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 will be made in the Steering Committee, which includes all key persons of the project, as shown in [Figure 11](#).

The decision will 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 formulate 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 decision gate shall be improved and submitted again, the project shall undergo a fundamentally new development or the project shall be cancelled.

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 progress stages, which permits an early initiation of appropriate countermeasures.

4.5 Quality Assurance and Product State Model

The development should ensure the quality of the project result by constructive and analytical quality assurance activities. The analytical quality assurance shall be executed 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 specifies 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 product has a Processing State. Potential processing 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.

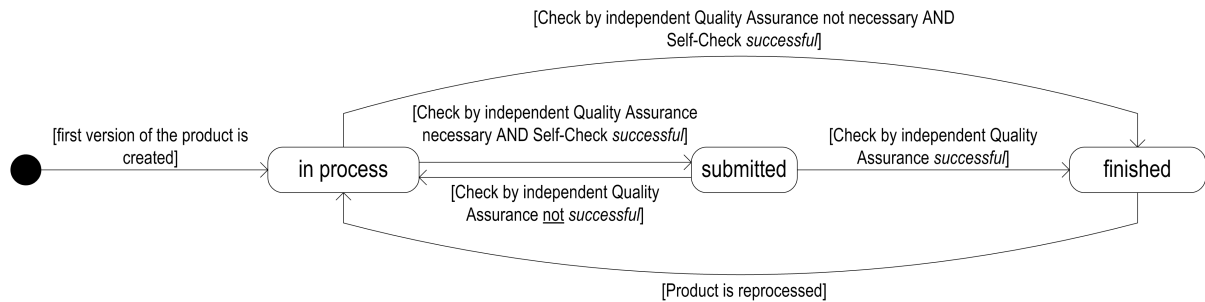


Figure 12: Product Processing Status Model

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-evaluation checks contents and form of the Work Product in accordance with the V-Modell specifications. In addition, the consistency with the contents of other products will be checked. This includes a check of all relevant product dependencies. 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.

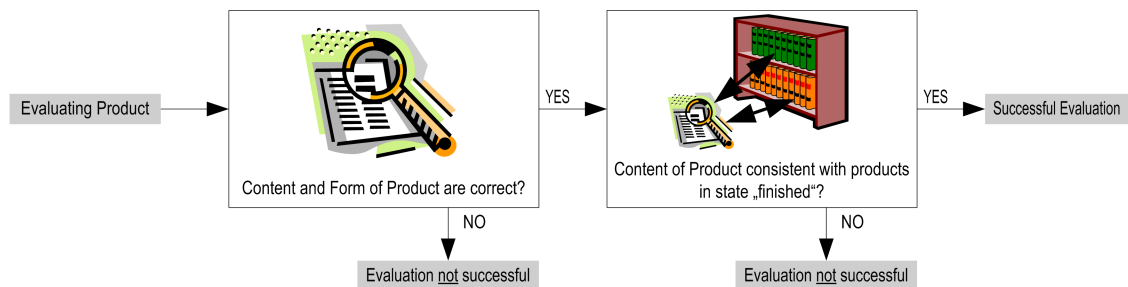


Figure 13: Evaluation Sequence

At first, a self-evaluation will always be executed as shown in →Figure 12 . As already described, this self-evaluation 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 concepts specify 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-evaluation 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-evaluation 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 have been violated, the persons responsible for these Work Products 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 Products 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 from the Product Library in a specific version and in their respective processing state - the so-called Product Versions.

Thus, the Configuration Management is intended to document the current and previous Product Configurations 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.

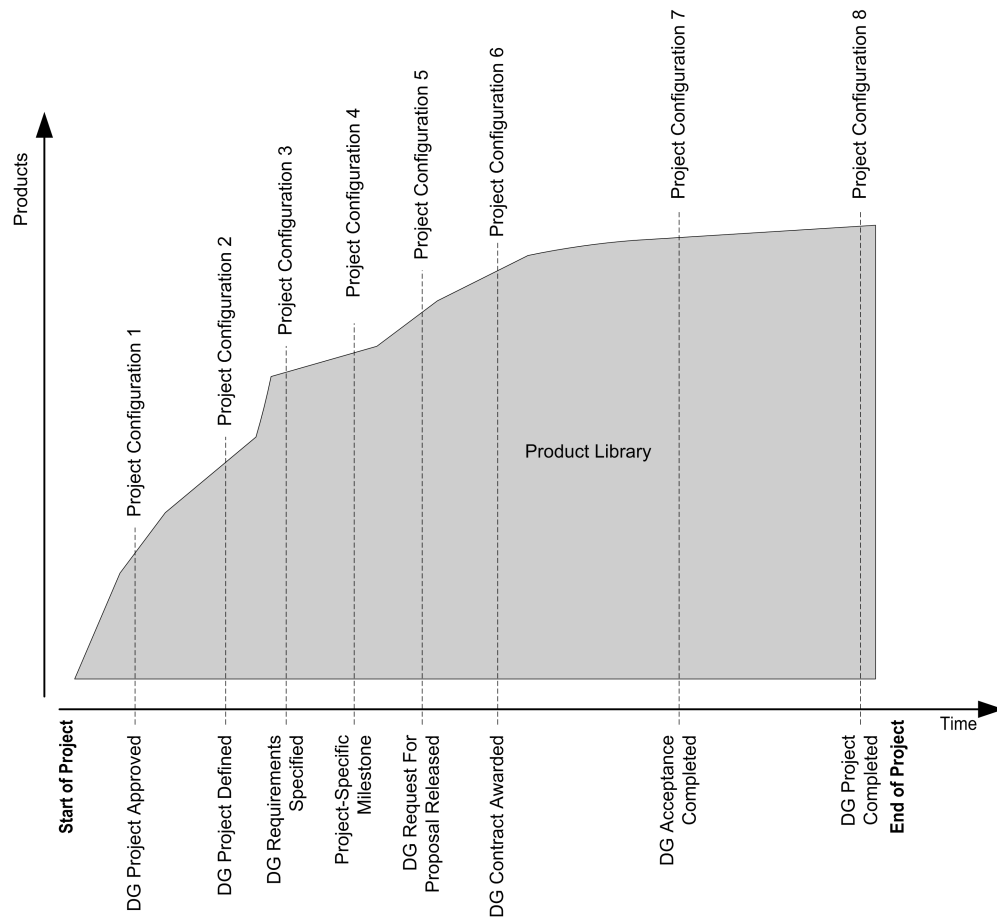


Figure 14: Decision Gates and Product Configurations

4.7 Problem and Change Management

During the entire project life cycle, products will be modified and changed. If a specified degree of completeness has been reached, it is necessary to follow product changes also formally. This formal problem and change management is specified in the Process Module Problem and Change Management. The procedure is developed specifically for each project in the Project Manual which particularly determines to which types of changes the formal problem and change management must be applied. 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 will be documented and evaluated and the further approach in the project will be decided. Appropriate 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 order and newly recognized dependencies. These problem reports and change requests will 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 for development projects. It supports the following three project types:

- System Development Project of an Acquirer
- System Development Project of a Supplier
- Introduction and Maintenance of an Organization-Specific Process Model

The [→Management Mechanisms of the V-Modell](#) presented in the previous chapter will be applied to each project type. During the development of the proper project result, specific procedures for executing the project as regards contents will be required. These procedures will be described in the following paragraphs.

5.1 Acquirer/Supplier Interface

According to the V-Modell, at least two V-Modell projects will be executed within the scope of system development: System Development Project of an Acquirer and System Development Project of a Supplier. The V-Modell provides specially adapted project execution strategies for these different project types (see paragraph Project Execution Strategies). [→Figure 15](#) shows an example for two of these different project execution strategies and the sequence of the corresponding Decision Gates.

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 proper V-Modell Project, will be 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 specifications for 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.

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 appropriately 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.

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.

If the system development project of the acquirer exceeds a certain magnitude, it should be subdivided into appropriate subprojects. 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.

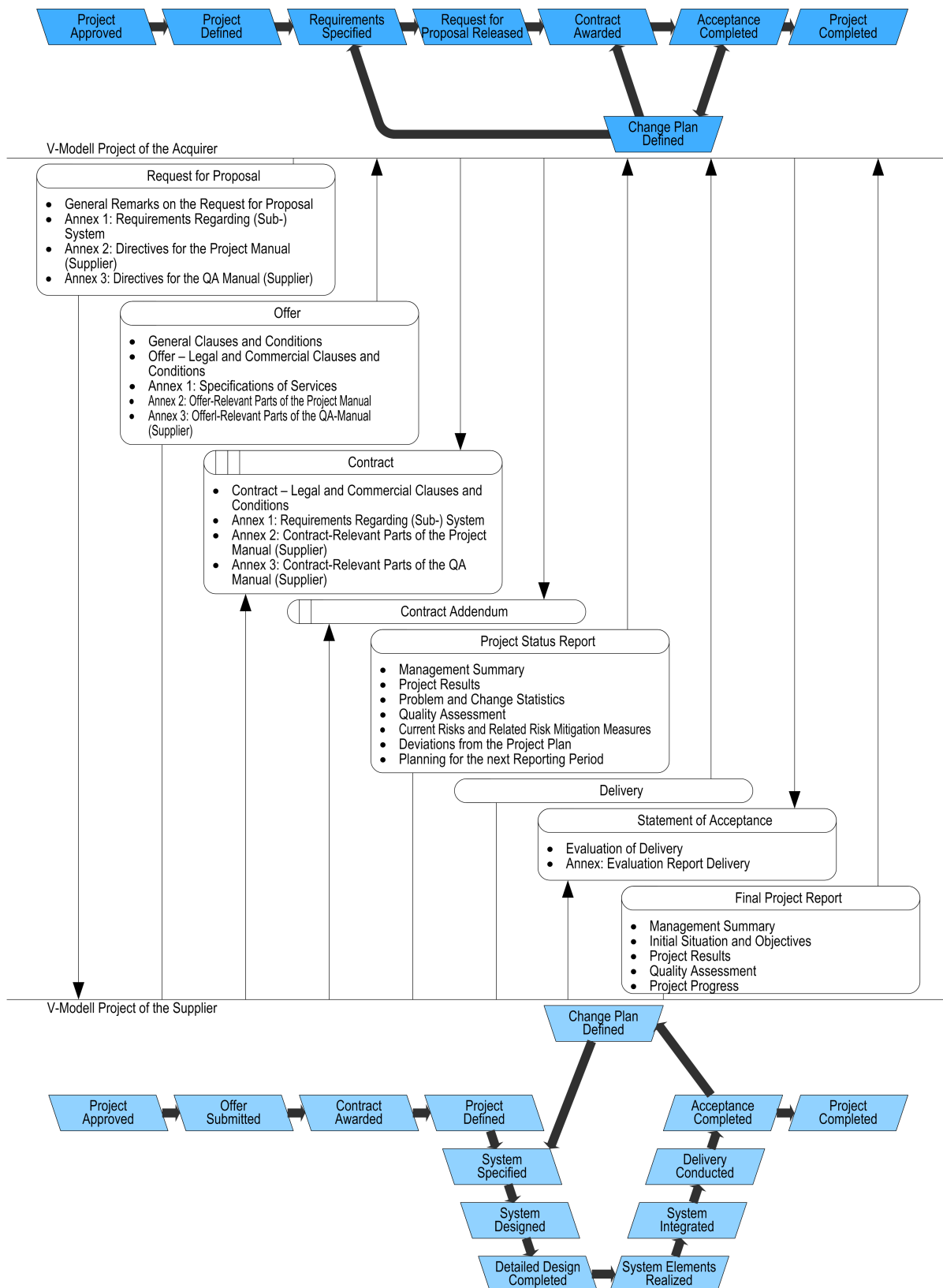


Figure 15: Acquirer/Supplier Interface

5.2 System Development

The system development includes the development of the System to be prepared and the development of the Enabling Systems required in various system life cycles. For the development, the system is subdivided hierarchically into smaller units until a realization is possible. It is subdivided hierarchically into Segments, Hardware Units, Software Units, External Units, Hardware Components, Software Components, Hardware Modules and 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 model and permits a complete tracing of the requirements. Every step secures the requirements of the higher System Elements, designs the subdivision process, specifies the realization of the System Elements and finally assigns the requirements 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 Modules, the more complex System Elements, and finally the system will be System Integrated . As shown in [Figure 16](#) , verification and validation are ensured at every design level.

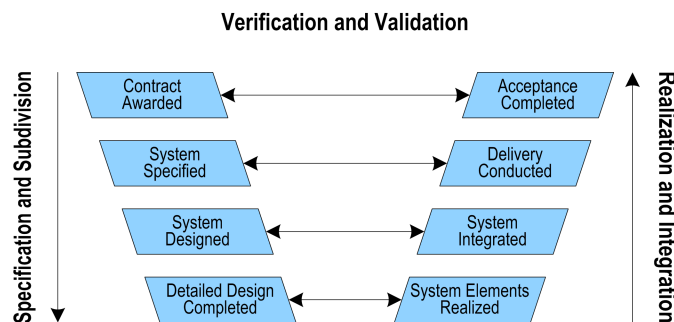


Figure 16: System Development Structure

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 shall be applied to the organization-specific adaptation of the V-Modell. The V-Modell will be adapted to the organization, specified in detail and complemented by specific organization processes.(see [Further Development of the V-Modell](#)).

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 will be submitted to the V-Modell Change Conference (Äko - Änderungskonferenz). The Äko decides whether the changes and upgradings will be integrated into V-Modell. Changes and upgradings can only affect Process Modules, Project Execution Strategies, Decision Gates, Project Characteristics 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 shall be executed by a special review and coordination process with the V-Modell Users within the scope of an updating project.

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