TECHNICAL REPORT

ISO/IEC TR 29110-5-6-1

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Systems and software engineering — Lifecycle profiles for Very Small Entities (VSEs) —

Part 5-6-1:
Systems engineering — Management and engineering guide: Generic profile group: Entry profile

Ingénierie des systèmes et du logiciel - Ingénierie des systèmes - Profils de cycle de vie pour très petits organismes (TPO) - Partie 5-6-1: —

Partie 5-6-1: Guide d'ingénierie et de gestion - Profil d'entrée

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*.

ISO/IEC 29110 consists of the following parts, under the general title *Systems and software engineering — Lifecycle profiles for Very Small Entities (VSEs)*:

The full list of parts of ISO/IEC 29110 is available here.

Introduction

Very Small Entities (VSEs) around the world are creating valuable products and services. For the purpose of ISO/IEC 29110, a Very Small Entity (VSE) is an enterprise, an organization, a department or a project having up to 25 people. Since many VSEs develop and/or maintain system and software components used in systems, either as independent products or incorporated in larger systems, a recognition of VSEs as suppliers of high quality products is required.

According to the Organization for Economic Co-operation and Development (OECD) SME and Entrepreneurship Outlook report (2005) "Small and Medium Enterprises (SMEs) constitute the dominant form of business organization in all countries world-wide, accounting for over 95 % and up to 99 % of the business population depending on country". The challenge facing governments and economies is to provide a business environment that supports the competitiveness of this large heterogeneous business population and that promotes a vibrant entrepreneurial culture.

From studies and surveys conducted, it is clear that the majority of International Standards do not address the needs of VSEs. Implementation of and conformance with these standards is difficult, if not impossible. Consequently VSEs have no, or very limited, ways to be recognized as entities that produce quality systems/system elements including software in their domain. Therefore, VSEs are excluded from some economic activities.

It has been found that VSEs find it difficult to relate International Standards to their business needs and to justify the effort required to apply standards to their business practices. Most VSEs can neither afford the resources, in terms of number of employees, expertise, budget and time, nor do they see a net benefit in establishing over-complex systems or software lifecycle processes. To address some of these difficulties, a set of guides has been developed based on a set of VSE characteristics. The guides are based on subsets of appropriate standards processes, activities, tasks, and outcomes, referred to as Profiles. The purpose of a profile is to define a subset of International Standards relevant to the VSEs' context; for example, processes, activities, tasks, and outcomes of ISO/IEC/IEEE 12207 for software; and processes, activities, tasks, and outcomes of ISO/IEC/IEEE 15288 for systems; and information products (documentation) of ISO/IEC/IEEE 15289 for software and systems.

VSEs can achieve recognition through implementing a profile and by being audited against ISO/IEC 29110 specifications.

The ISO/IEC 29110 series of International Standards and Technical Reports can be applied at any phase of system or software development within a lifecycle. This series of International Standards and Technical Reports is intended to be used by VSEs that do not have experience or expertise in adapting/tailoring ISO/IEC/IEEE 12207 or ISO/IEC/IEEE 15288 standards to the needs of a specific project. VSEs that have expertise in adapting/tailoring ISO/IEC/IEEE 12207 or ISO/IEC/IEEE 15288 are encouraged to use those standards instead of ISO/IEC 29110.

ISO/IEC 29110 is intended to be used with any lifecycle such as: waterfall, iterative, incremental, evolutionary or agile.

The ISO/IEC 29110 series, targeted by audience, has been developed to improve system or software and/or service quality, and process performance (see Table 1).

Table 1 — ISO/IEC 29110 target audience

ISO/IEC 29110	Title	Target audience
Part 1	Overview	VSEs and their customers, assessors, standards producers, tool vendors and methodology vendors
Part 2	Framework and taxonomy	Profile producers, tool vendors and methodology vendors Not intended for VSEs
Part 3	Assessment guide	VSEs and their customers, assessors, accreditation bodies
Part 4	Profile specifications	VSEs, customers, standards producers, tool vendors, and methodology vendors
Part 5	Management and engineering guide	VSEs and their customers

If a new profile is needed, ISO/IEC 29110-4 and ISO/IEC TR 29110-5 can be developed with minimal impact to existing documents.

ISO/IEC TR 29110-1 defines the terms common to the ISO/IEC 29110 series. It introduces processes, lifecycle and standardization concepts, the taxonomy (catalogue) of ISO/IEC 29110 profiles, and the ISO/IEC 29110 series. It also introduces the characteristics and needs of a VSE, and clarifies the rationale for specific profiles, documents, standards, and guides.

ISO/IEC 29110-2 introduces the concepts for systems and software engineering profiles for VSEs. It establishes the logic behind the definition and application of profiles. For standardized profiles, it specifies the elements common to all profiles (structure, requirements, conformance, assessment). For domain-specific profiles (profiles that are not standardized and developed outside of the ISO process), it provides general guidance adapted from the definition of standardized profiles.

ISO/IEC TR 29110-3 defines certification schemes, assessment guidelines and compliance requirements for process capability assessment (ISO/IEC 33xxx), conformity assessments (ISO/IEC 17xxx), and self-assessments for process improvements. ISO/IEC 29110-3 also contains information that can be useful to developers of certification and assessment methods and developers of certification and assessment tools. ISO/IEC 29110-3 is addressed to people who have direct involvement with the assessment process, e.g. the auditor, certification and accreditation bodies and the sponsor of the audit, who need guidance on ensuring that the requirements for performing an audit have been met.

ISO/IEC 29110-4-m provides the specification for all profiles in one profile group that are based on subsets of appropriate standards elements. Profile groups cover the following domains: systems engineering, software engineering and service delivery.

ISO/IEC TR 29110-5-m-n provides a management and engineering guide for each profile in one profile group.

The future ISO/IEC TR 29110-6-x provides management and engineering guides not tied to a specific profile.

This part of ISO/IEC 29110 provides an implementation management and engineering guide for the Entry Profile of the Generic Profile Group specified in ISO/IEC 29110-4-6. The Entry Profile is targeted at start-up VSEs (i.e. VSEs who started their operation less than three years) and/or at VSEs working on small project (e.g. project size of less than six person-months).

Figure 1 describes the International Standards (IS) and Technical Reports (TR) of ISO/IEC 29110 and positions the parts within the framework of reference. Overview, assessment guide, management and engineering guide are available from ISO as freely available Technical Reports (TR). The Framework document, profile specifications and certification schemes are published as International Standards (IS).
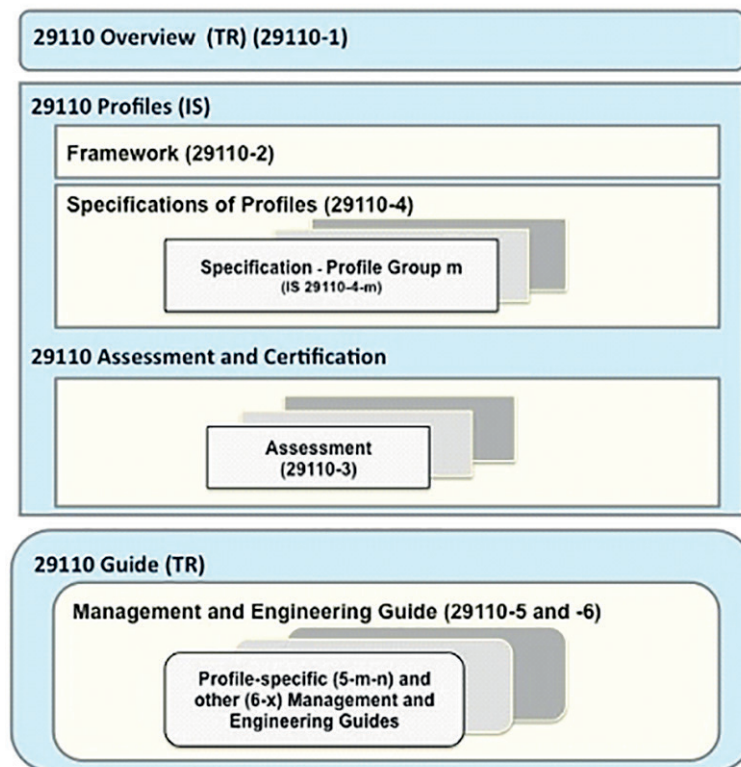
Figure 1 — ISO/IEC 29110 series

Systems and software engineering — Lifecycle profiles for Very Small Entities (VSEs) —

Part 5-6-1:
Systems engineering — Management and engineering guide: Generic profile group: Entry profile

1 Scope

1.1 Fields of application

This part of ISO/IEC 29110 is applicable to Very Small Entities (VSEs). VSEs are enterprises, organizations, departments or projects having up to 25 people. The lifecycle processes described in the set of International Standards (IS) and Technical Reports (TR) are not intended to preclude or discourage their use by organizations bigger than VSEs.

This part of ISO/IEC 29110 provides the management and engineering guide to the Entry Profile described in ISO/IEC 29110-4-6 through Project Management and System Definition and realization processes. This part of ISO/IEC 29110 is a standalone guide; it is not intended for a VSE to use the standardized profile to implement this part of ISO/IEC 29110.

This part of ISO/IEC 29110 applies for non-critical systems development projects. The system development should fulfil the project requirements and the system description.

Using this part of ISO/IEC 29110, a VSE can obtain benefits in the following aspects:

— an agreed set of project requirements (technical part of contract) and expected products are agreed by the Acquirer;

— a disciplined management process, that provides project visibility and corrective actions of project problems and deviations, is performed;

— a systematic System Definition and Realization process, that satisfies Acquirer needs and ensures quality products, is followed.

VSEs developing software that is part of a larger system and for standalone software products and services are encouraged to use the management and engineering guide of the Entry Profile (ISO/IEC TR 29110-5-1-1).

1.2 Target audience

This part of ISO/IEC 29110 is targeted at VSEs who do not develop critical systems and do not have experience with Systems Engineering (SE) process planning and implementation using ISO/IEC/ IEEE 15288.

It is intended to be used with any processes, techniques and methods that enhance the VSE's Stakeholders satisfaction and productivity.

2   Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 29110-2, *Systems and software engineering — Lifecycle profiles for Very Small Entities (VSEs) — Part 2: Framework*

3   Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC IS 29110-2 and the following apply.

3.1
acquirer
stakeholder that acquires or procures a product or service from a supplier

Note 1 to entry: Other terms commonly used for an acquirer are buyer, customer, owner, or purchaser.

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.1]

3.2
agreement
mutual acknowledgment of terms and conditions under which a working relationship is conducted

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.4]

3.3
critical system
items (e.g., functions, parts, software, characteristics, processes) having significant effect on the product realization and use of the product, including safety, performance, form, fit, function, producibility, service life, etc., that require specific actions to ensure they are adequately managed

EXAMPLE   Critical items include safety critical items, fracture critical items, mission critical items, key characteristics, etc.

[SOURCE: AS/EN/JIS Q 9100:2009]

3.4
disposed system
system that has been transformed (i.e., state change) by applying the disposal process

Note 1 to entry: A systems approach considers the total system and the total lifecycle of the system. This includes all aspects of the system and the system throughout its life until the day users depose of the system and the external enterprises complete the handling of the disposed system products.

[SOURCE: ISO/IEC/IEEE 15288:2015, modified]

3.5
operator
individual or organization that performs the operations of a system

Note 1 to entry: The role of operator and the role of user can be vested, simultaneously or sequentially, in the same individual or organization.

Note 2 to entry: An individual operator combined with knowledge, skills and procedures can be considered as an element of the system.

Note 3 to entry: An operator may perform operations on a system that is operated, or of a system that is operated, depending on whether or not operating instructions are placed within the system boundary.

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.26]

3.6
Small and Medium Enterprise
SME
enterprise which employ fewer than 250 persons

[SOURCE: OECD 2005, modified]

3.7
system
combination of interacting elements organized to achieve one or more stated purposes

Note 1 to entry: A system may be considered as a product or as the services it provides.

Note 2 to entry: In practice, the interpretation of its meaning is frequently clarified by the use of an associative noun, e.g., aircraft system. Alternatively, the word "system" may be substituted simply by a context-dependent synonym, e.g., aircraft, though this may then obscure a system principles perspective.

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.46]

3.8
trade-off
decision-making actions that select from various requirements and alternative solutions on the basis of net benefit to the stakeholders

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.51]

3.9
user
individual or group that interacts with a system or benefits from a system during its utilization

Note 1 to entry: The role of user and the role of operator are sometimes vested, simultaneously or sequentially, in the same individual or organization.

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.52]

3.10
system structure
decomposition of a system of interest into a set of interacting systems and system elements

Note 1 to entry: The system structure is described in a System Breakdown Structure (SBS).

[SOURCE: ISO/IEC/IEEE 15288:2015]

3.11
work breakdown structure
WBS
hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables

[SOURCE: ISO/IEC/IEEE 24765:2010, 3.3330, modified]

4   Symbols and abbreviated terms

4.1   Naming, diagramming, and definition conventions

The following process structure description and notation are used to describe the processes.

Name — process identifier, followed by its abbreviation in brackets "( )".

Purpose — general goals and results expected of the effective implementation of the process. The implementation of the process should provide tangible benefits to the stakeholders. The purpose is identified by the abbreviation of the process name.

Objectives — specific goals to ensure the accomplishment of the process purpose. The objectives are identified by the abbreviation of the process name, followed by the letter "O" and a consecutive number, for example PM.O1,SR.O2, etc.

Input Products — products required to perform the process and its corresponding source, which can be another process or an external entity to the project, such as the Acquirer. Identified by the abbreviation of the process name and showed as two column table of product names and sources.

Output Products — products generated by the process and its corresponding destination, which can be another process or an external entity to the project, such as Acquirer or Organizational Management. Identified by the abbreviation of the process name and showed as two column table of product names and destinations.

Internal Products — products generated and consumed by the process. Identified by the abbreviation of the process name and showed as one column table of the product names.

All products' names are printed in cursive and initiate with capital letters. Some products have one or more statuses attached to the product name surrounded by square brackets "[ ]"and separated by ",". The product status may change during the process execution. See Clause 10 for the alphabetical list of the products, its descriptions, possible statuses and the source of the product. The source can be another process or an external entity to the project, such as the Acquirer.

Rectangle boxes — the rectangle boxes following the description of processes objectives make the correspondence with ISO/IEC/IEEE 15288 standard.

Roles involved — names and abbreviation of the functions to be performed by project team members. Several roles may be played by a single person and one role may be assumed by several persons. Roles are assigned to project participants based on the characteristics of the project. The role list is identified by the abbreviation of the process name and showed as two column table. See Clause 9 for the alphabetical list of the roles, its abbreviations and required competencies description.

Diagram — graphical representation of the processes. The large round-edged rectangles indicate process or activities and the smaller square-edged rectangles indicate the products. The directional or bidirectional thick arrows indicate the major flow of information between processes or activities. The thin directional or bidirectional arrows indicate the input or output products. The notation used in the diagrams does not imply the use of any specific process lifecycle.

Activity — a set of cohesive tasks. Task is a requirement, recommendation, or permissible action, intended to contribute to the achievement of one or more objectives of a process. A process activity is the first level of process workflow decomposition and the second one is a task. Activities are identified by process name abbreviation followed by consecutive number and the activity name.

Activity Description — each activity description is identified by the activity name and the list of related objectives surrounded by brackets "( )". For example PM.1 Project Planning (PM.O1, PM.O5, PM.O6, PM.O7) means that the activity PM.1 Project Planning contributes to the achievement of the listed objectives: PM.O1, PM,O5, PM,O6 and PM,O7. The activity description begins with the task summary and is followed by the task descriptions table. The task description doesn't impose any technique or method to perform it. The selection of the techniques or methods is left to the VSE or project team.

Tasks description table contain four columns corresponding to

— Role — the abbreviation of roles involved in the task execution.

— Task — description of the task to be performed. Each task is identified by activity ID and consecutive number, for example PM.1.1, PM.1.2, and so on.

— Input Products — products needed to execute the task.

— Output Products — products created or modified by the execution of the task.

Incorporation to *Project Repository* — list of products to be saved in *Project Repository*; the *Version Management Strategy* has to be applied to some of them (see 7.7.2 and 8.7.2). It is useful as a checklist for project manager and technical leader.

NOTE   Tables used in process description are for presentation purpose only.

4.2   Abbreviated terms

The following abbreviations are used in this document:

AGR   Agreement

DEV   Developer

HW   Hardware

IVV   Integration, Verification, Validation

PM   Project Management

PJM   Project Manager

SDD   System Design Document

SE   Systems Engineering

SEP   Systems Engineering Plan

SR   System Definition and Realization

SMART   Specific, Measurable, Achievable, Relevant and Traceable

SME   Small and Medium Enterprise

STK   Stakeholder

SUP   Supplier

SW   Software

VSE   Very Small Entity

WBS   Work Breakdown Structure

WP   Work Product

5   Systems Thinking

The traditional approach to solve a problem is called Cartesian. This approach focuses on dividing a problem into smaller parts and, once resolved each part, the whole problem is solved. This approach, however, has limitations because you can lose insight of the whole system. To overcome this limitation, there is the System Thinking, which analyses and observes the system as a whole and identifies the interrelationships among the parts that compose it and also with the system environment (e.g. enabling systems).

System Thinking allows for a better understanding of the systems as a whole: System Thinking is used to broaden the perspective to larger environments by considering the entire lifecycle of the system and the different possible applications of the system. Systems can be immersed in different environments and multiple relationships will emerge. Every project has a context in which the system is embedded.

Thus a system is not only composed of software and hardware, but is always part of a larger operation, often involving people and other systems. The designer must clearly understand these relationships before defining a solution.

The "system" perspective enables to design of an optimized system taking into account all needs and constraints. This perspective also helps to invent new solutions to meet existing needs or in some cases create new needs.

For the purpose of this part of ISO/IEC 29110, System Thinking should be considered particularly when understanding the system to be designed so that, when identifying the requirements, all the stakeholders must be considered as well as the context in which the system should operate. Following this approach, when deploying the requirements in smaller modules, it will help ensure effective integration the parts.

6 Overview

The Entry Profile Management and Engineering Guide is targeted at start-up VSEs (i.e. VSEs who started their operation less than three years) and/or at VSEs working on small project (e.g. project size of less than six person-months). The project may fulfill an external or internal contract. The internal contract between the project team and its Acquirer need not be explicit.

The Entry profile is the first systems engineering profile of the Generic profile group. The Entry profile is defined for the case when more flexible and more light-weight system engineering process is needed than the Basic profile scope, e.g. for the case when user-risk is very low, using period is very short. The main simplifications of Entry profile against the Basic profile concern the Systems Engineering Management Plan, the disposal Management approach and a lightweight program management approach.

The Guide provides Project Management and System Definition and Realization processes which integrate practices based on the selection of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 15289 standards elements. Annex A provides information about Deployment Packages which will facilitate the implementation of these processes.

This part of ISO/IEC 29110, is intended to be used by the VSE to establish processes to implement any development approach or methodology including, e.g., agile, evolutionary, incremental, test driven development, etc. based on the VSE organization or project needs.

Using the Guide, VSE can obtain benefits in the following aspects:

— a set of project requirements (technical part of the contract) and expected products are agreed with the Acquirer;

— a disciplined management process, that provides project visibility and corrective actions of project problems and deviations, is performed;

— a systematic System Definition and Realization process, that satisfies Acquirer needs and ensures quality products, is followed.

To use the Guide the VSE needs to fulfill the following entry conditions:

— project *Needs and Expectations* are documented;

— feasibility of the project was performed before its start;

— project team, including project manager and system engineer, is assigned and trained;

— goods, services, and infrastructure to start the project are available.

The purpose of the Project Management (PM) process is to establish and carry out in a systematic way the *Tasks* of the system development, which allows complying with the project's *Objectives* in the expected quality, time and cost.

The purpose of the System Definition and Realization process is the systematic performance of the analysis, design, construction, integration, verification, and validation activities for new or modified system according to the specified requirements.

Both processes are interrelated (see Figure 2).
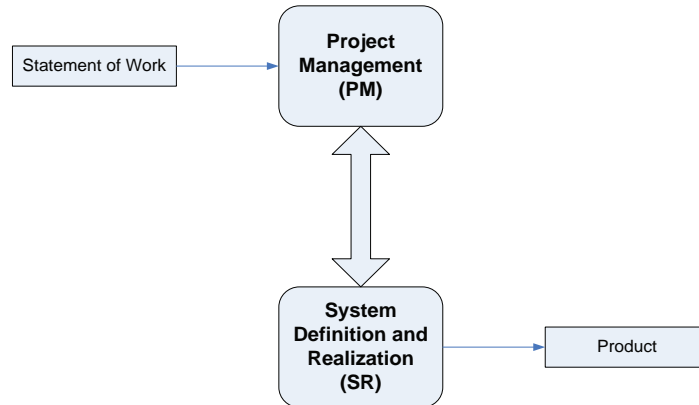
Figure 2 — Entry profile guide processes (diagram notation is explained in 4.1)

PM process uses the Acquirer's *Agreement* to elaborate the *Project Plan*. If there is no Agreement available from the Acquirer, the Project Manager (PJM), in collaboration with the Work Team, has to clarify the basis to develop the Agreement. The PM project assessment and control tasks compare the project progress against the *Project Plan* and actions are taken to eliminate deviations or incorporate changes to the *Project Plan*. The PM project closure activity ensures delivery of *the product (new or modified product)*, produced by SR (System Definition and Realization) process, and gets the Acquirer's acceptance to formalize the end of the project. A *Project Repository* is established to save the work products and to control its versions during the project.

The execution of the SR process is done according to the *Project Plan*.

The Acquirer provides an *Agreement* (AGR) as an input to Project Management process and receives *Products* as a result of System Definition and Realization process execution (see Figure 2).

7   Project Management (PM) process

7.1   PM purpose

The purpose of the Project Management process is to establish and carry out in a systematic way the *Tasks* of the system development project, which allows complying with the project's *Objectives* in the expected quality, time and costs.

This part of ISO/IEC 29110 is intended to be used by the VSE to establish processes to implement any development approach or methodology including, e.g., agile, evolutionary, incremental, test driven development, etc. based on the VSE organization or project needs.

7.2   PM objectives

PM.O1. The *Project Plan*, the *Agreement* (AGR) and commitments are reviewed and accepted by both the Acquirer and the Project Manager. The *Tasks* and *Resources* necessary to complete the work are sized and estimated.

PM.O2. Progress of the project is monitored against the *Project Plan* and recorded in the *Progress Status Record.* Corrections to remediate problems and deviations from the plan are taken when project targets are not achieved. Closure of the project is performed to get the Acquirer acceptance documented in the *Acceptance Record.*

PM.O3. *Change Requests* are addressed through their reception and analysis. Changes to system requirements are evaluated by the project team for cost, schedule, risks and technical impact.

PM.O4. Review meetings with the Work Team and the Acquirer, suppliers are held. Agreements are registered and tracked.

PM.O5. A *Risk Management Approach* is developed. Risks are identified, analysed, prioritized, and monitored as they develop and during the conduct of the project. Resources to manage the risks are determined.

PM.O6. A *Product Management Strategy* is developed. Items of *Product* are identified, defined and baselined. Modifications and releases of the items are controlled and made available to the Acquirer and Work Team. The storage, handling and delivery of the items are controlled.

PM.O7. Quality Assurance is performed to provide assurance that work products and processes comply with the *Project Plan* and *System Requirements Specifications*.

NOTE   The implementation of the Quality Assurance is through the performance of the verifications, validations and review *Tasks* performed in Project Management and System Definition and Realization processes.

PM.O8. A *Disposal Management Approach* is developed to end the existence of a system entity.

7.3   PM input products

Table 2 — PM input products

Name	Source
Agreement	Acquirer
All deliverables from SR	Work Team
Change Request	Acquirer, Stakeholders
	Work Team
	Suppliers

7.4   PM output products

Table 3 — PM output products

Name	Destination
Project Plan	System Definition and Realization
Product Acceptance Record	Organizational Management
Project Repository	System Definition and Realization
Meeting Record	Acquirer, Stakeholders
System Configuration	Acquirer, Stakeholders
	System Definition and Realization
	Suppliers
Disposed System	Acquirer, Stakeholders
	Suppliers

7.5   PM internal products

Table 4 — PM internal products

Name
Change Request
Correction Register
Justification Document
Meeting Record
Progress Status Record
Project Repository
Product Acceptance Record

7.6   PM roles involved

Table 5 — PM roles involved

Role	Abbreviation
Acquirer, Stakeholders	STK
Project Manager	PJM
Work Team (System Engineer, Designer)	WT

7.7   PM diagram

The following diagram shows the flow of information between the Project Management Process activities including the most relevant work products and their relationship.
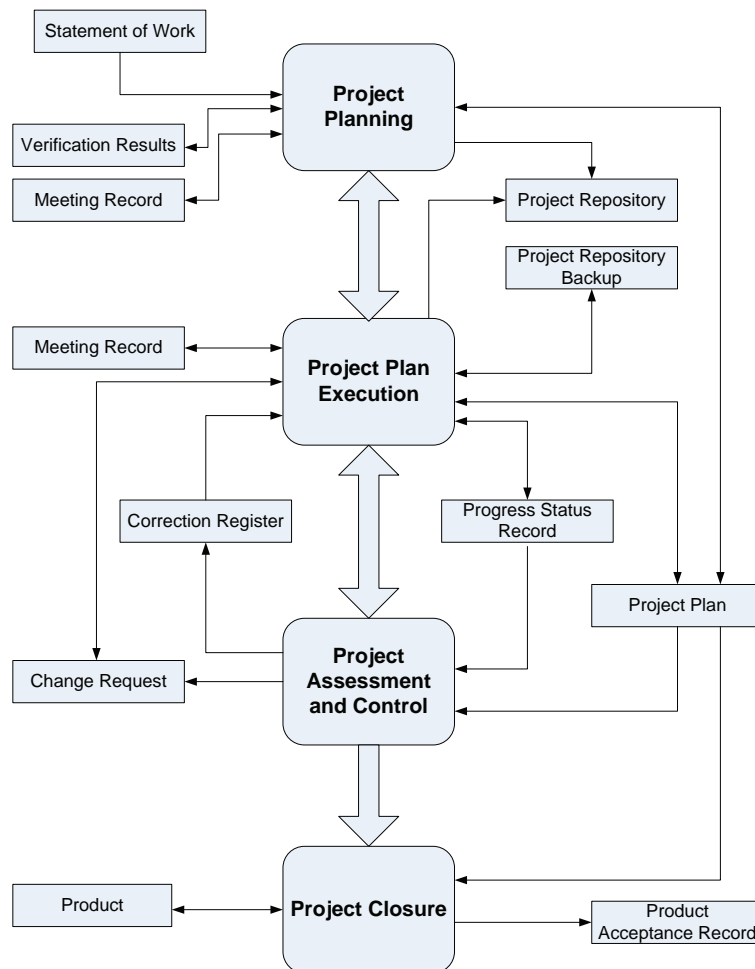
Figure 3 — Project Management process diagram

NOTE   All the feedback lines are not all displayed to facilitate readability.

7.7.1   PM activities

The Project Management Process has the following activities:

— PM.1 Project Planning;

— PM.2 Project Plan Execution;

— PM.3 Project Assessment and Control;

— PM.4 Project Closure.

7.7.1.1   PM.1 project planning, (PM.O1, PM.O5, PM.O6, PM.O7)

The Project Planning activity documents the planning details needed to manage the project. The activity provides:

— Reviewed *Agreement* (AGR) and the *Tasks* needed to provide the contract *Deliverables.*

— System Breakdown Structure (SBS), to provide the list of system and system elements of the project.

— Project lifecycle, including task dependencies and duration.

— Project quality assurance strategy through verification and validation of work products/*Deliverables*, Acquirer, Stakeholders and Work Team reviews.

— Work Team, Acquirer and other Stakeholders roles and responsibilities.

— Project *Resources* and training needs.

— Estimates of effort cost and schedule.

— *Risk Management Approach*.

— *Disposal Management Approach.*

— *Change Control Process* and *Version Management* strategy.

— *Project Repository* to store, handle and deliver controlled product and document versions and baselines.

Table 6 — PM.1 task list

Role	Task List — PM.1	Input products	Output products
PJM WT	PM.1.1 Review the *Agreement*.	Agreement	Agreement *[reviewed]*
PJM STK	PM.1.2 Define with the *Acquirer* the *Delivery Instructions* of each one of the *Deliverables* specified in the *Agreement.*	Agreement *[reviewed]*	Project Plan — Delivery Instructions
PJM WT	PM.1.3* Define the boundary of the system of interest. If during design activities, the System of Interest is decomposed into System Elements, define the boundaries for each of these System Elements and identify scope of responsibilities. *(Optional if the VSE acts as a supplier to a system integrator). If the VSE acts as a supplier to a system integrator) If the VSE acts as a supplier to a system integrator)	System Design Document	Project Plan — List of System Elements
PJM WT	PM.1.4* Select a product lifecycle according to the Agreement. *(Optional if the VSE acts as a supplier to a system integrator).	Project Plan — List of System Elements	Project Plan — Product lifecycle
PJM	PM.1.5 Establish the *Composition of Work Team* assigning roles, responsibilities and work products according to the *Resources.*	Project Plan — List of System Elements	Project Plan — Composition of Work Team
PJM	PM.1.6 Define milestones of the project (e.g. end of phases, payments, deliveries, …)	Project Plan — Composition of Work Team	Project Plan — Milestones
PJM	PM.1.7 Identify the *Risks* which may affect the project. Establish a list of Risks that may affect the Project. Define for each Risk possible scenarios, frequency of occurrence and the impact.	All elements previously defined	Project Plan — List of Risks for the Project
PJM	PM.1.8 Document the *Version Management Strategy* in the *Project Plan.* Define the versioning strategy of inputs/outputs of the development process	List of System Elements	Project Plan — Version Management Strategy

Table 6 *(continued)*

Role	Task List — PM.1	Input products	Output products
PJM	PM.1.9 *Include System Description, Scope, Objectives, Deliverables*, and reference to the *AGR* in the *Project Plan*.	Agreement *[reviewed]*	Project Plan — System Description — Scope — Objectives — Deliverables — Reference to the AGR
PJM	PM.1.10 Generate the *Project Plan* integrating the elements previously identified and documented.	All elements previously defined	Project Plan — Objectives — System Description — Scope — List of System Elements — Product lifecycle — Deliverables — Composition of Work Team — Milestones — List of Risks — Version Management Strategy
PJM WT	PM.1.11 Verify and obtain approval of the *Project Plan.* Verify that all *Project Plan* elements are viable and consistent	Project Plan	Project Plan Verification Report Project Plan *[verified]*
PJM STK STK	PM.1.12 Review and accept the *Project Plan.* Acquirer and other Stakeholders review and accept the *Project Plan*, making sure that the *Project Plan* elements match with the *Agreement.*	Project Plan *[verified]*	Meeting Record Project Plan *[accepted]*
PJM	PM.1.13 Establish the *Project Repository* using the *Version Management Strategy*.	Project Plan — Version Management Strategy	Project Repository

7.7.1.2   PM.2 project plan execution (PM.O2, PM.O3, PM.O4, PM.O5, PM.O7)

The Project Plan Execution activity implements the documented plan on the project. The activity provides:

— *Progress Status Record* of the project updated.

— Analysed and evaluated change requests to the plan impacting cost, schedule and technical requirements.

— Approved changes to the plan.

— Reviews and agreements with the Work Team (WT), and Stakeholders (STK).

— Back up of the *Project Repository*, and its recovery if necessary.

Table 7 — PM.2 task list

Role	Task List — PM.2	Input products	Output products
PJM WT	PM.2.1 Monitor the *Project Plan* execution and record actual data in *Progress Status Record.*	Project Plan	Progress Status Record
STK PJM STK	PM.2.2 Analyse and evaluate the *Change Request* for cost, schedule and technical impact. The *Change Request* can be initiated externally by the Acquirer and other Stakeholders, or internally by the Work Team. Update the *Project Plan*, if the accepted change affects agreements with Acquirer and Stakeholders. *Change Request*, which affects those agreements, needs to be negotiated by both parties (see PM.2.4).	Change Request Project Plan *[accepted]*	Change Request *[evaluated]*
PJM WT	PM.2.3 Conduct revision meetings with the Work Team, identify problems, review risk status, record agreements and track them to closure.	Project Plan *[accepted]* Progress Status Record Correction Register Internal Meeting Record	Internal Meeting Record *[updated]*
PJM STK WT	PM.2.4 Conduct revision meetings with the Acquirer, Stakeholders, record agreements and track them to closure. *Change Request* initiated by Acquirer, and other Stakeholders, or initiated by Work Team, which affects the Acquirer, Stakeholders needs to be negotiated to reach acceptance of both parties. If necessary, update the *Project Plan* according to new agreement with Acquirer and other stakeholders.	Project Plan *[accepted]* Progress Status Record Change Request *[evaluated]* External Meeting Record	External Meeting Record *[updated]* Change Request *[agreed]* Project Plan *[updated]*

Table 7 *(continued)*

Role	Task List — PM.2	Input products	Output products
PJM WT	PM.2.5 Perform version management According to the version management strategy, manage in version the different artifacts of the project. Generate the configuration of the Product. Identify changes (e.g. architecture, requirements) and/or *Project Plan* to address major deviations, potential risks or problems concerning the accomplishment of the project. Initiate Change Requests on baselined artifacts and analyse impacts (technical cost, quality) before change approval by PJM. Track the changes to closure.	— Project Plan — Stakeholders Requirements Specification — Concept of Operations — System Requirements Specification — System Elements Requirements Specification — System Design Document — System — Bought, built or re-used System Elements (HW, HW+SW) — Bought, built or re-used Software Elements — IVV Plan — Integration Procedures — Verification Procedures — Validation Procedures — Integration Report — Verification Report — Validation Report — System Operation Guide — System User Manual — System Maintenance Document — System Training Material — Change Request *[agreed]* — Progress Status Record *[evaluated]*	Product
PJM	PM.2.6 Manage Project Repository Update Project Repository at each new System Configuration. Perform backup and recovery testing according to the *Version Management Strategy*.	Project Plan *[updated]* — Version Management Strategy Product Project Repository	Project Repository *[updated]* Project Repository Backup

Table 7 *(continued)*

Role	Task List — PM.2	Input products	Output products
PJM	PM.2.7 Perform *Project Repository* recovery using the *Project Repository Backup*, if necessary.	Project Repository Backup	Project Repository *[recovered]*

7.7.1.3   PM.3 project assessment and control (PM.O2)

The Project Assessment and Control activity evaluates the performance of the plan against documented commitments. The activity provides the following:

— evaluation of actual plan performance and progress against targets;

— identified and evaluated significant cost, schedule and technical performance deviations and problems;

— review of project risks and identification of new risks;

— documented change requests, appropriate corrective action defined, and changes tracked to closure.

Table 8 — PM.3 task list

Role	Task List — PM.3	Input Products	Output Products
PJM WT	PM.3.1 Evaluate project progress with respect to the *Project Plan*, comparing: — actual results against established project *Objectives* — actual cost against budget estimates — actual time against planned schedule — actual risk against previously identified	Project Plan [*updated*] Progress Status Record	Progress Status Record [*evaluated*]
PJM WT	PM.3.2 Establish and execute actions to treat deviations or problems and identified risks concerning the accomplishment of the plan, as needed, document them in *Correction Register* and track them to closure.	Project Plan — List of Risks Progress Status Record [*evaluated*]	Correction Register — Rational of deviation correction actions

7.7.1.4   PM.4 project closure (PM.O2, PM.O8)

The Project Closure activity provides the project's documentation and products in accordance with contract requirements. The activity provides the following:

— delivery of the product as specified in the *Delivery Instructions*;

— support of Acquirer and Stakeholders product acceptance in accordance to *Delivery Instructions*;

— completion of the project and sign of the *Acceptance Record;*

— execution of the *Disposal Management Approach.*

Table 9 — PM.4 task list

Role	Task List — PM.4	Input	Output
PJM STK	PM.4.1. Formalize the completion of the project according to the *Delivery Instructions* established in the *Project Plan,* providing acceptance support and getting the *Product Acceptance Record* signed.	Project Plan — Delivery Instructions Product [*delivered*] System [*delivered*]	Validation Report — Product Acceptance Record Product [*accepted*]
PJM WT	PM.4.2 Update *Project Repository.*	Product *[accepted]* Project Repository *[updated]*	Project Repository *[baselined]*

7.7.2   PM incorporation to *Project Repository*

The list of products to be saved in *Project Repository*. After the incorporation, *Version Management Strategy* has to be applied to *Project Plan.*

Table 10 — PM repository products

Product
Project Plan
Change Request
Acceptance Record
Meeting Record
Correction Register
Progress Status Record
Verification Report
Validation Report

8   System Definition and Realization (SR) process

8.1   SR purpose

The purpose of the System Definition and Realization process is the systematic performance of the specification of system/system element, analysis, design, construction, integration and verification/validation activities for new or modified system according to the specified requirements.

This part of ISO/IEC 29110 is intended to be used by the VSE to establish processes to implement any development approach or methodology including agile, evolutionary, incremental, test driven development, based on the VSE or project needs.

8.2   SR objectives

SR.O1. *Tasks* of the activities are performed through the accomplishment of the current *Project Plan*.

SR.O2. System requirements are defined, analysed for correctness and testability, approved by the Acquirer, baselined and communicated.

SR.O3. The System architectural design is developed and baselined. It describes the *System elements* and internal and external interfaces of them. Consistency and traceability to system requirements are established.

NOTE   System architecture and detailed design can be performed separately according to the project schedule.

SR.04. System elements defined by the design are produced or acquired. Acceptance tests are defined and performed to verify the consistency with requirements and the design. Traceability to the requirements and design are established.

SR.05. System elements are integrated. Defects encountered during integration are corrected and consistency and traceability to *System Architecture* are established.

SR.06. A *System Configuration*, as agreed in the Project Plan, and that includes the engineering artifacts is integrated, versioned and stored at the *Project Repository*. Needs for changes to the *Product* are detected and related change requests are initiated.

SR.07. Verification and Validation *Tasks* of all required work products are performed using a defined criterion to achieve consistency among output and input products in each activity. Defects are identified, and corrected; records are stored in the *Verification/Validation Reports*.

It's not the intention that all verification activities and work products are made available to the acquirer and other stakeholders. Verifications should be performed by individuals that have organizational freedom, authority, to permit objective evaluation, and to initiate, effect, resolve and verify problem resolution.

8.3 SR input products

Table 11 — SR input products

Name	Source
Project Plan	Project Management
Project Repository	Project Management

8.4 SR output products

Table 12 — SR output products

Name	Destination
All deliverables from SR	Project Management

8.5 SR internal products

Table 13 — SR internal products

Name
Verification Report

8.6 SR roles involved

Table 14 — SR roles involved

Role	Abbreviation
Developer	DEV
IVV Engineer	IVV
Project Manager	PJM
Stakeholder, Acquirer	STK
Supplier	SUP
Work Team (System Engineer, Designer)	WT

8.7 SR diagram

Overview SR diagram

The following diagram shows the flow of information between the System Definition and Realization Process activities including the most relevant work products and their relationship.
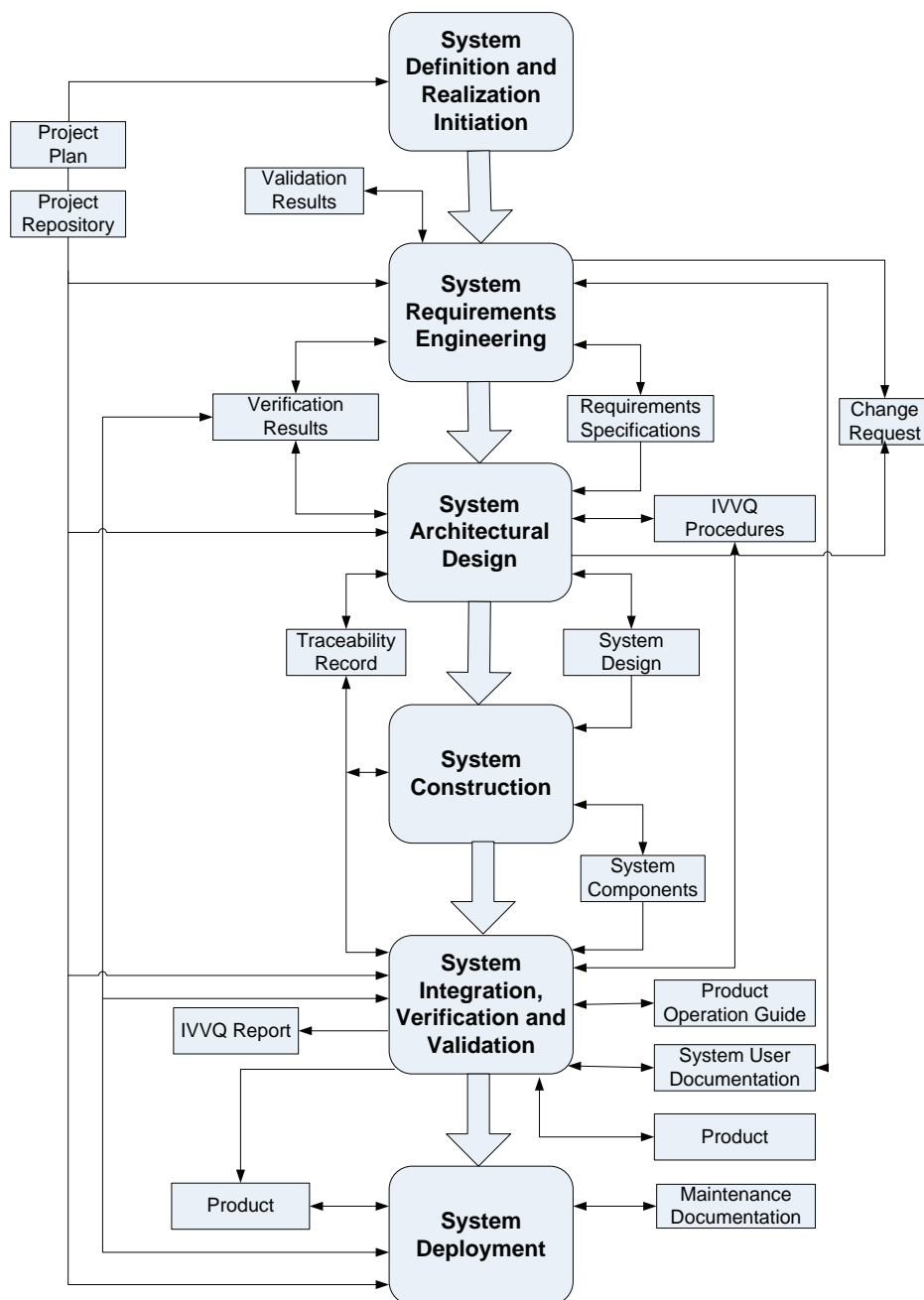
Figure 4 — System definition and realization process diagram

NOTE   All the feedback lines are not all displayed to facilitate readability.

8.7.1   SR activities

The System Definition and Realization Process has the following activities:

—   SR.1 System Definition and Realization Initiation;

— SR.2 System Requirements Engineering;

— SR.3 System Architectural Design;

— SR.4 System Construction;

— SR.5 System Integration, Verification and Validation;

— SR.6 Product Delivery.

8.7.1.1   SR.1 system definition and realization initiation (SR.01)

The System Definition and Realization Initiation activity ensures that the *Project Plan* established in Project Planning activity is committed to by the Work Team. The activity provides the following:

— review of the *Project Plan* by the Work Team to determine task assignment;

— commitment to *Project Plan* by the Work Team and Project Manager;

— an established implementation environment.

Table 15 — SR.1 task list

Role	Task List — SR.1	Input Products	Output Products
PJM WT	SR.1.1 Revise the current *Project Plan* with the Work Team members in order to achieve a common understanding and get their engagement with the project.	Project Plan	Project Plan [*reviewed*]
PJM WT	SR.1.2 Define the data model of the project Define the entities to manage in the project (e.g. requirement, *system element*, *IVV plan*, *IVV procedure*, *IVV result*), their properties (e.g. maturity, version, target release) and their relation (e.g. satisfy, allocated to, verify, validate).	Project Plan [*reviewed*]	Data Model
PJM WT	SR.1.3 Set or update the implementation environment.	Project Plan [*reviewed*] Data Model	Implementation environment

8.7.1.2   SR.2 system requirements engineering (SR.02, SR.06, SR.07)

The System Requirements Engineering activity elicits and analyses the Acquirer and other Stakeholders' requirements, including legal and/or regulatory requirements. It establishes the agreed system requirements. In parallel of the architectural design activities, it establishes System Element requirements. The activity provides the following:

— work Team review of the *Project Plan* to determine task assignment;

— elicitation, analysis and specification of Acquirer and other stakeholders' requirements;

— specification and agreement on the System requirements;

— specification of system elements' requirements;

— verification of implemented system against System and System elements requirements;

— validation of Stakeholder, System and System Elements requirements;

— validation of implemented system against Stakeholder requirements;

— establish and update the traceability between Stakeholders, System, System Elements requirements;

— establish and update the coverage of Requirements by IVV artifacts;

— version management of System Requirements Engineering products as agreed in the Version Management Plan.

Table 16 — SR.2 task list

Role	Task List — SR.2	Input Products	Output Products
WT STK	SR.2.1 Elicit acquirer and other stakeholders requirements and analyse system context**.** Identify and consult information sources of requirements (Acquirer, users, stakeholders, previous systems, documents, etc.): Agreement, Concept documents, previous System description, etc. Analyse the context of use of the system with acquirer and other stakeholders: — Identify the stakeholders — Define the concepts of use of the system — Define scenarios, business processes Identify and analyse requirements to — Determinate the scope and system boundary, — If applicable, identify the strengths and weaknesses of the previous system — Ensure that the Stakeholder requirements are complete and consistent — Elicit missing Stakeholder requirements Resolve conflicting, duplicate and out-of-scope Stakeholder requirements Generate or update the *Stakeholders' Requirements Specification.*	Agreement [*reviewed*]	Stakeholders Requirements Specification
PJM WT	SR.2.2 Verify the *Stakeholders Requirements Specifications* with PJM Obtain Work Team agreement on the *Stakeholder Requirements Specification.*	Stakeholders Requirements Specification	Stakeholders Requirements Specification [*verified*] Stakeholders Requirements Specification Verification Report
PJM WT STK	SR.2.3 Validate the *Stakeholders Requirements Specification* with the Acquirer and other stakeholders Obtain Acquirer and Stakeholder agreement on the *Stakeholder Requirements Specification.*	Stakeholders Requirements Specification [*verified*]	Stakeholders Requirements Specification [*validated*]

Table 16 (continued)

Role	Task List — SR.2	Input Products	Output Products
WT	SR.2.4 Elaborate System Requirements Specification and Interfaces Define the system boundary. Define interface requirements between the System and its environment. NOTE Interface requirements can be included in *System Requirements Specification* or in a dedicated document *System Interface Specification.* Define System requirements, System design constraints and interface requirements with external entities/actors using the SMART criteria: Specific, Measurable, Accepted, Realistic and Traced. Define the external functions ensured by the system (black box). Define reuse constraints. Define the applicable requirements and constraints to the system Generate or update the *System Requirements Specification*	Stakeholder Requirements Specification	System Requirements Specification System Interface Specification
WT	SR.2.5 Elaborate *System Elements Requirements Specifications* and the *System Elements Interfaces Specifications* NOTE System Element requirements are generally elaborated in parallel with the System Functional and Physical Architectural Design Activity (see Activities SR.3.1 and SR.3.3) Allocate System requirements to System elements in conformity with the functional and physical architecture and decompose requirements so that System element requirements are distinctively and clearly defined. Elaborate System element requirements derived from the System architectural design but that cannot be traced to a specific parent System requirement Refine as necessary external interface requirements and identify internal interface requirements between System Elements. Generate or update a *System Element Requirements Specification* for each System Element defined in the System Design Document. *NOTE interface requirements can be included in System Elements Requirements Specifications or established in dedicated document: System Element Interface Specification.* *NOTE System elements requirements become needs and expectation in input of the system elements implementation.*	System Requirements Specification System Design Document	System Elements Requirements Specifications System Elements Interfaces Specifications

Table 16 (continued)

Role	Task List — SR.2	Input Products	Output Products
PJM WT	SR.2.6 Verify and obtain Work Team (WT) agreement on the *System and System Elements Requirements Specifications* Ensure with WT that requirements are SMART. In particular: — are precise, concise, non-ambiguous — are consistent (in the same specification, with input specifications) — are properly traced — can be implemented (WT) — can be verified and validated (IVV) — fall within cost and schedule constraints of the project (PJM)	System Requirements Specification System Elements Requirements Specification	System Requirements Specification Verification Report System Requirements Specifications *[verified]* Systems Elements Requirements Specifications *[validated]*
STK WT	SR.2.7 Validate that System *Requirements Specification* satisfies *Stakeholders Requirements Specifications*.	System Requirements Specification [*verified*] Stakeholders Requirements Specifications [*validated*]	System Requirements Specification Validation Report System Requirements Specification [*validated*]
WT	SR.2.8 Define or update traceability between Requirements According to the *data model* defined in SR.1.2, at each level of decomposition of the system, define or update traceability between: — System requirements, interface requirements and their parent stakeholder's requirements — System elements requirements, interface requirements and their parent system requirements.	Stakeholder Requirements Specification [*validated*] System Requirements Specification [*validated*] System Elements Requirements Specifications [*validated*]	Requirements Traceability Matrix
WT IVV	SR.2.9 Establish or update the *IVV plan* and *Verification, Validation Procedures* for the System verification and validation. Establish traceability between IVV Plan and the specified Requirements, between Verification or Validation Procedures and IVV Plan Verification is the confirmation, through the provision of objective evidence, that specified requirements have been fulfilled. Methods of verification are: inspection, review, simulation, test. Validation is the confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled NOTE *The IVV plan can be a single or separate document*	System Requirements Specification [*validated*] Stakeholders Requirements Specification [*validated*]	IVV plan Verification Procedures Validation Procedures

8.7.1.3   SR.3 system architectural design (SR.O3, SR.O6, SR.O7)

The System Architectural activity transforms the system requirements to the system Functional and physical architecture. The activity provides the following:

— work team review of the *Project Plan* to determine task assignment;

— design the system Functional architecture and associated interfaces;

— design the system physical architecture and associated interfaces, allocation of the Functional to the physical architecture;

— work team review of the System *Requirements Specification*;

— *Functional and physical Design* verified and defects corrected;

— verified *IVV Plan (Integration, Verification, validation, Qualification) and Verification Procedures*;

— traceability between the Functional architecture definition and the System Requirements and between the physical architecture definition, the System Elements and the Functional architecture definition.

Table 17 — SR.3 task list

Role	Task List — SR.3	Input Products	Output Products
WT	SR.3.1 Document or update the *Functional System Design.* Elaborate the Functional architecture with the internal functions of the system and their relations (interfaces), by analyzing: — The System Requirements — The external functions of the system (black box) Define the internal functions and interfaces. Identify the artifacts to reuse. Decide whether to make, buy or reuse. Define in parallel the System elements requirements and interface requirements	Project Plan — Tasks [*assigned*] System Requirements Specification [*validated*]	System Design Document: — System Functional Architecture
WT	SR.3.2 Make trade-offs of the *System Architectures* Make trade-offs among the different architectures — Functional architectures relative to the requirements. — Physical architectures relative to the requirements and the Functional architecture Update the *Justification Document* and establish traceability with the requirements as defined in PM. Generate or update the Traceability Matrix. Architectures can be done in a model based environment and generated as a document. Note Trade-offs is used here as a product name of a recording decision-making action within a *Justification Document*	System Design Document: — System Functional Architecture — System Physical Architecture	Justification Document — System Functional architecture trade-offs — System physical architecture trade-offs

Table 17 (continued)

Role	Task List — SR.3	Input Products	Output Products
WT	SR.3.3 Document or update the Physical System Design. Elaborate the physical architecture by: — analyzing the System Requirements (e.g. non functional requirements allocated directly the System Elements) — analyzing the Functional Architecture and allocating internal functions to System Elements — Identifying System Elements to reuse. Identify the artifacts to reuse. Decide whether to make, buy or reuse. Analyse the design as needed to demonstrate it can satisfy System Requirements (e.g. maintainability, reliability, security, safety integrity, usability, etc.). Elaborate the physical and functional interfaces (external and internal) between System Elements. Define in parallel the interface requirements.	System Requirements Specification *[validated]* System Design Document: — System Functional Architecture	System Design Document: — System Physical Architecture
WT DEV	SR.3.4 Verify and obtain approval of the *System Design.* Verify correctness of *System Design*, its feasibility and consistency with their System *Requirements Specification*. Use the *Requirements Traceability Matrix* to verify the adequate satisfaction of System Requirements. If System Design is under Version management, identify and characterize the impact of the change and initiate if necessary (i.e. change approved) a *Change Request.*	System Design Document — System Functional Architecture — System Physical Architecture Requirements Traceability Matrix System Requirements Specification *[validated]*	System Design Document *[validated]*
WT	SR.3.5 Establish or update *the Integration plan and Integration Procedures* for System integration. Define or update the *Integration Plan and Procedures* based in the System Design and the *System Elements Requirements Specification* Establish traceability between IVV Plan and the specified Requirements, between Integration Procedures and Plan.	System Elements Requirements Specification *[validated]* System Design Document *[validated]*	Integration plan Integration Procedures Requirements coverage matrix
WT	SR.3.6 Document the *System User Manual* or update the current one, if appropriate. NOTE The *System User Manual* can be initiated in a preliminary version from the *System Requirements Specification*, *Concept of Operation* are available. *(Optional)	Concept of Operations System Requirements Specification System Design Document System *[verified]*	* System User Manual
WT STK	SR.3.7 Verify and obtain approval of the * *System User Manual,* if appropriate Verify consistency of the System *User Manual* with the System. Demonstrate the use of the System with its *User Manual.* *(Optional)	* System User Manual System *[verified]*	* System User Manual *[verified]*

8.7.1.4 SR.4 system construction (SR.O4, SR.O6, SR.O7)

The System Construction involves Physical Construction and/or Software Construction.

The Software Construction develops the software elements of the system from the *System Design.*

The Hardware Construction develops the Hardware system elements from the *System Design*, that include (or not) software elements. The activity provides the following:

— Work Team review of the *Project Plan* to determine task assignment.

— Work Team review of the Physical *Design.*

— *Hardware System Elements* to be developed and tested.

— *Software System Elements* to be developed and tested.

— Traceability between Hardware *Construction, Software Construction* and *Physical Architecture,*

Table 18 — SR.4 task list

Role	Task List — SR.4	Input Products	Output Products
DEV	SR.4.1 Construct or update Software System Elements. Software Construction could be performed according to the ISO/IEC TR 29110-5-1-1.	System Elements Requirements Specifications [*validated*]	Bought, built or re-used Software System Elements Software System Elements data
DEV	SR.4.2 Construct or update Hardware System Elements. Buy, build or re-use the Hardware System Elements identified in the *System Design Document* and in accordance with the *Project Plan* with regards to fabrication stages (i.e. prototyping, first article, pre-series, series production etc.) In case of Hardware System Elements with software, integrate the Software System Elements into the Hardware System Elements.	System Design Document [*validated*] System Elements Requirements Specifications [*validated*] Software System Elements Software System Elements data	bought, built or re-used System Elements (HW, HW+SW) System Elements data (HW, HW+SW)
DEV WT	SR.4.3 Verify that the *System Elements* satisfy their *System Elements Specification* Perform in-coming acceptance verification of System Elements in accordance with: — the *Project Plan* — the *System Design Document* — the *System Elements Requirements Specification* — the applicable *Verification Procedures.* NOTE For Hardware System Elements that include software, this task includes the verification of the integration of the software into the hardware System Elements.	Bought, built or re-used System Elements (HW, HW + SW) Project plan [*accepted*] System Design Document [*validated*] System Elements Requirements Specifications [*validated*] Verification procedures [*verified*]	Bought, built or re-used System Elements (HW, HW+SW) [*verified*] Bought, built or re-used System Elements (HW, HW+SW) [*rejected*]
DEV	SR.4.4 Correct the defects found until successful verification (reaching exit criteria) is achieved.	Bought, built or re-used System Elements (HW, HW+SW) [*rejected*]	Bought, built or re-used System Elements (HW, HW+SW) [*accepted*]

8.7.1.5   SR.5 system integration, verification, and validation (SR.05, SR.06, SR.07)

The System Integration and verification, validation activity ensures that the integrated System Elements (e.g. Hardware, Hardware + Software) satisfy the system requirements. The activity provides the following:

— work team review of the *Project Plan* to determine task assignment;

— understanding of *IVV plan and Procedures* and the integration environment;

— integrated *System Elements*, corrected defects and documented results;

— documented and verified operational and system user documentations;

— verified system baseline.

Table 19 — SR.5 task list

Role	Task List — SR.5	Input Products	Output Products
WT DEV IVV	SR.5.1 *Verify IVV plan and IVV* Procedures. Verify consistency among System Requirements Specification, System Design and IVV plan and Verification Procedures.	IVV plan Integration Procedures Verification Procedures Validation Procedures System Requirements Specification [*validated*] System Design Document [*validated*]	IVV plan [*verified*] Integration Procedures [*verified*] Verification Procedures [*verified*] Validation Procedures [*verified*]
IVV WT SUP	SR.5.2 Integrate the System using *System Elements* (HW, HW+SW) Verify the interfaces according to IVV plan and *Integration Procedures* for integration testing. The results found are documented in an *Integration Report.*	System Design Document [*validated*] System Elements Requirements Specifications [*validated*] Requirements Coverage Matrix bought, built or re-used System Elements (HW, HW+SW) [*accepted*] Integration Procedures [*verified*]	Integration Report System [*integrated*]
IVV WT	SR.5.3 Verify the System against its Requirements The results found are documented in a *Verification Report.* Prepare the acceptance of the system.	System Requirements Specifications [*validated*] Requirements Coverage Matrix Verification Procedures [*verified*]	System [*verified*] System Verification Report
IVV WT STK	SR.5.4 Validate the System against its Stakeholders Requirements Accept the System by STK.	Stakeholders Requirements Specification [*validated*] Requirements Coverage Matrix Validation Procedures [*verified*] System [*verified*]	System [*validated*] System Validation Result Product Acceptance Report

Table 19 *(continued)*

Role	Task List — SR.5	Input Products	Output Products
WT	SR.5.5 Correct the defects found and re-test to detect faults introduced by the modifications.	System [*verified*] System [*validated*] System Verification Report System Validation Report Verification Procedures [*verified*] Validation Procedure [*verified*]	System [*corrected*] System Verification Report [*defects eliminated*] System Validation Report *[defects eliminated]*

8.7.1.6   SR.6 product delivery (SR.O6, SR.O7)

The Product Delivery activity provides the integrated System (i.e. Product) to the Acquirer and other stakeholders. The activity provides the following:

— work team review of the *Project Plan*;

— verified System *Maintenance Document*;

— delivery of the system product and applicable system documentation in accordance with the *Delivery Instructions*.

Table 20 — SR.6 task list

Role	Task List — SR.6	Input Products	Output Products
PJM WT	SR.6.1 Review configuration of the Product to be delivered	System elements	Product Acceptance Report
WT	SR.6.2 Document the *System Maintenance Document* and *System Operation Guide* or update the current one(s). *(Optional)	System Configuration	System Maintenance Document *System Operation Guide
WT	SR.6.3 Identify training needs and develop System User and Maintenance Training Curriculum and Material in accordance with the *Project Plan*. NOTE The *System Training Material* is an input to develop the System and Maintenance training enabling systems.	System Requirements Specification [*validated*] System User Manual [*verified*]	System Training Material

Table 20 (continued)

Role	Task List — SR.6	Input Products	Output Products
PJM WT STK	SR.6.4 Verify and obtain approval of the System maintenance and operation documentation. Verify consistency of System *Maintenance Document* with *System Requirements Specification*. Verify consistency of System Training Material *with System Requirements Specification*. Validate the *System Training Material* and *System Maintenance Document* with the acquirer and the other stakeholders Verify consistency of the *System Operation Guide* with the System. The results found are documented in a *Verification Report* and corrections are made until the document is approved by PJM and maintenance as a stakeholder (STK). *(Optional)	System Maintenance Document System Training Material *System Operation Guide	Product Delivery Verification Report Product Delivery Validation Report System Maintenance Document [verified] System Training Material [verified] *System Operation Guide [verified]
PJM STK	SR.6.5 Perform delivery Support delivery of training to Acquirer and other Stakeholders including: — Training-the-trainer — Support to pilot training classes In case of Hardware/Software upgrades, support transition from previous to new system, according to Project Plan including; — Legacy data conversion/transfer — System transition provisions such as interim/bridge System or System Elements — Replaced/obsolete hardware/software/data "sun setting", archiving or disposal	Project Plan — Tasks on Product delivery assigned — Delivery Instructions Product *System [validated]*	Product [*delivered*] Product [*delivered*]
PJM	SR.6.6 Transition to Manufacturing and In-service/After-sales Support.	Product [*delivered*]	

8.7.2 SR incorporation to the *Project Repository*

The list of products to be saved in the *Project Repository*. After the incorporation, the *Configuration Management* has to be applied to: System *Requirements Specifications, System Design, Traceability Matrix, IVV Plan and Procedures, System Elements (Hardware, Hardware + Software, Software), System, System Operation Guide, System User Documentation, Maintenance and Training Documentation*.

Table 21 — SR repository products

Product
Implementation Environment
Stakeholders Requirements Specification
System Requirements Specification
System Elements Requirements Specification
System Operation Guide

Table 21 *(continued)*

Product
System Design Document
— *System Functional Architecture*
— *System Physical Architecture*
System Functional Architecture Trade-offs
System Physical Architecture Trade-offs
IVV plan
Integration Procedures
Requirements Coverage Matrix
Requirements Traceability Matrix
Verification Procedures
Validation Procedures
Bought, built or re-used System Elements (HW, HW+SW)
System
System User Manual
System Maintenance Document
System Training Material
Verification Reports
Validation Reports
System Configuration

9 Roles

This is an alphabetical list of the roles, its abbreviations and suggested competencies description. All role names are printed in roman and abbreviated with capital letters. This list is showed as a four-column table for presentation purpose only.

Table 22 — Roles

	Role	Abbreviation	Knowledge and competency
1.	Developer	DEV	Skills in implementation & development (HW, SW)
			Knowledge and experience in the application domain
2.	IVV Engineer	IVV	Skills in simulation or testing techniques
			Knowledge of the Requirements, Design
			Knowledge in inspection, peer review, simulation, and review techniques
3.	Project Manager	PJM	Leadership capability with experience making decisions, planning, personnel management, delegation and supervision, finances and system development.

Table 22 *(continued)*

	Role	Abbreviation	Knowledge and competency
4.	Stakeholder, Acquirer	STK	Stakeholders are actors that have an interest in the system, all along its lifecycle, such as, representatives of users, users, maintainers, security, trainers, regulatory bodies, suppliers.
			STK should have Knowledge of the Stakeholder (e.g. manufacturer, maintainer, tester, logistic) processes and ability to explain the Stakeholder requirements.
			The Acquirer is the Stakeholders representative. He is responsible for the acquisition of the System.
			The acquirer may be internal or external to the supplier organization. Acquisition of a product may involve, but does not necessarily require, a legal contract or a financial transaction between the acquirer and supplier. In some context the Acquirer is the end user of the system. The Acquirer is the role of the organization that receives the product or service. In some context the Acquirer is the end user of the system.
			The acquirer should have skills in Needs elicitation, knowledge of main stakeholders application domains
			The Acquirer must have the authority to approve the requirements and their changes.
			The Stakeholders includes user representatives in order to ensure that the operational environment is addressed.
5.	Supplier	SUP	Supplier of a System Element of the system: hardware, software, hardware with software.
6.	Work Team	WT	The work team includes System Engineers (SYS), Designers (DES) roles.
			SYS:
			Skills and experience eliciting, specifying and analyzing the requirements.
			Knowledge in designing user interfaces and ergonomic criteria.
			Knowledge of the revision techniques.
			Skills in requirements authoring.
			Knowledge of the business domain
			Experience on system development, integration, operation and maintenance
			Experience on the system development and maintenance.
			DES:
			Skills and experience in the architecture design.
			Skills in requirements authoring.
			Knowledge of the revision techniques.
			Knowledge and experience in the planning and performance of integration tests.
			Experience on the system development and maintenance.
			Knowledge on the standards used by the Acquirer and/or by the VSE.

10 Product description

This is an alphabetical list of the input, output and internal process products, its descriptions, possible states and the source of the product. The source can be another process or an external entity to the project, such as the Acquirer. This list is showed as a four-column table for presentation purpose

only. ISO/IEC/IEEE 15289 definitions of Information Products were used to develop the Product Descriptions of Table 23.

The product status gives the information to the project team about the type of work (tasks) already done on the product (for example: evaluated, verified, tested, baselined). This information can be used to start next tasks which can use the product as an input. Some products have no status assigned because they are only informative and they do not change the content (for example: Acceptance Record, Correction Register, Project Repository Backup, Verification/Validation Results).

Table 23 — Product Descriptions

	Name	Description	Source
1.	*Change Request*	Identifies a *System*, or documentation problem or desired improvement, and requests modifications. It may have the following characteristics: — Identifies purpose of change — Identifies request status , — Identifies requester contact information — Impacted system(s), system element(s) — Impacted IVV facilities — Impact to operations of existing system(s) defined — Impact to associated documentation defined — Criticality of the request, date needed The applicable statuses are: draft, submitted, approved, rejected, postponed, in study	System Definition and Realization Project Management
2.	*Correction Register*	Identifies activities established to correct a deviation or problem concerning the accomplishment of a plan. It may have the following characteristics: — Identifies the initial problem — Defines a solution — Identifies corrective actions taken — Identifies the ownership for completion of defined actions — Identifies the open date and target closure date — Contains a status indicator — Indicates follow up actions — Includes rational of deviation correction action	Project Management
3.	*Data Model*	Defines the properties and relations between entities of a project. It may include: — Requirements — Functions — System elements — IVV plans — IVV results — Justification elements	Project Management
4.	*Implementation Environment*	The environment and tools (software and hardware) required to specify, design, develop, integrate, verify, validate, manage the configuration and deploy the system.	System Definition and Realization

Table 23 *(continued)*

	Name	Description	Source
5.	*Integration Report*	Document the integration execution. It may include the record of: — Reference to the related IVV procedures — Date — Place — Duration — Verification check-list — Passed items of integration — Failed items of integration — Pending items of integration: not run, partial execution — Defects identified during integration	System Definition and Realization
6.	*IVV Plan*	Elements needed to integrate, verify and validate the system. It may be a single documents with dedicated paragraphs or separate documents (Integration plan, verification plan, validation plan, qualification plan) *IVV Plan* may include: — Identifies the IVV activities regarding the System Requirements: inspection, reviews, simulation, test items — Identifies the System integration strategy regarding the System Elements Requirements and interfaces. — Environmental constraints — Requirements for IVV means — Special procedural requirements	System Definition and Realization
7.	*IVV Procedure*	Elements to execute the IVV activities. It may be a single documents with dedicated paragraphs or separate documents (Integration procedure, verification procedure, validation procedure, qualification procedure) IVV Procedures may include: — Purpose of the IVV procedure — Reference to the IVV plan — Defines the prerequisites — Defines procedure steps including the step number, the required action and the expected results The applicable statuses are: verified, accepted, updated, and reviewed.	System Definition and Realization
8.	*Justification Document*	The justification document contains all the justifications of choices, decisions (e.g. trade-offs).	System Definition and Realization

Table 23 *(continued)*

	Name	Description	Source
9.	*Meeting Record*	Records the agreements established with Acquirer and/or Work Team. It may have the following characteristics: — Purpose of meeting — Attendees — Date, place held — Reference to previous minutes — What was accomplished — Identifies issues raised — Any open issues — Agreements — Next meeting, if any. The applicable status is: updated.	Project Management
10.	*Product Acceptance Record*	Documents the Acquirer acceptance of the *Deliverables* of the project. It may have the following characteristics: — Record of the receipt of the delivery — Identifies the date received — Identifies the delivered elements — Records the verification of any Acquirer acceptance criteria defined — Identifies any open issues (if applicable) — Signed by receiving Acquirer	Project Management
11.	*Product*	A uniquely identified and consistent set of system elements including: — *Stakeholders Requirements Specification System Requirements Specification* — *System Elements Requirements Specification* — *System Design Document* — *Traceability Matrices (includes Requirements traceability matrix, Requirements coverage matrix)* — *System Elements* — *System* — *Bought, built or re-used System Elements* — *IVV Plan* — *Integration Procedures* — *Verification Procedures* — *Validation Procedures* — *Verification Report* — *Validation Report* — *System Operation Guide* — *System User Manual* — *System Maintenance Document* The main applicable statuses are: delivered and accepted.	System Definition and Realization

Table 23 *(continued)*

	Name	Description	Source

12.	*Project Plan*	Presents how the project processes and activities will be executed to assure the project's successful completion, and the quality of the deliverable system. It Includes the following elements which may have the characteristics as follows:
		
		— Reference to the *AGR*
		
		— *System Description*
		
		  — Purpose
		
		  — General Acquirer requirements
		
		— *Scope* description of what is included and what is not
		
		— *Objectives* of the project
		
		— *Deliverables* –items to be delivered to Acquirer
		
		— *Product lifecycle*
		
		— *List of System Elements*
		
		— *Composition of Work Team (roles, responsibilities and work products)*
		
		— *Milestones*
		
		— *List of Risks*
		
		— *Version Management Strategy*
		
		  — Version management tool and mechanisms identified
		
		  — Version identification and control defined
		
		  — Backup and recovery mechanisms defined
		
		  — Storage, handling and delivery (including archival and retrieval) mechanisms specified
		
		— *Change control process* to manage the changes based on impact studies using traceability and change control boards.
		
		— *Delivery Instructions*
		
		— Elements required for system release identified (i.e., hardware, software, documentation, etc.)
		
		— Delivery requirements
		
		  — Sequential ordering of *Tasks* to be performed
		
		  — Applicable releases identified
		
		  — Identifies all delivered *System Elements* with version information
		
		  — Identifies any necessary backup and recovery procedures
		
		The applicable statuses are: verified, accepted, updated and reviewed.
			Project Management

Table 23 *(continued)*

	Name	Description	Source
13.	*Project Repository*	Container to store project work products and deliveries. It may have the following characteristics: — Stores project work products — Stores released *Deliverables* products — Storage and retrieval capabilities — Ability to browse content — Listing of contents with description of attributes — Sharing and transfer of work products between affected groups — Effective controls over access — Maintain work products descriptions — Recovery of archive versions of work products — Ability to report work products status — Changes to work products are tracked to *Change Requests* The applicable statuses are: recovered and updated.	Project Management
14.	*Project Repository Backup*	Repository used to backup the *Project Repository* and, if necessary, to recover the information.	Project Management
15.	*Progress Status Record*	Records the status of the project against the *Project Plan*. It may have the following characteristics: — Status of actual *Tasks* against planned *Tasks* — Status of actual results against established *Objectives*/ goals — Status of actual resource allocation against planned *Resources* — Status of actual cost against budget estimates — Status of actual time against planned schedule — Status of actual risk against previously identified — Record of any deviations from planned *Tasks* and reason why. The applicable status is: evaluated.	Project Management

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Table 23 *(continued)*

	Name	Description	Source

16.	*Stakeholders Requirements Specification*	Defines the acquirer and other stakeholder's requirements.
		
		It may be in a single document with all stakeholders explicitly identified or in separate documents.
		
		It may have the following characteristics:
		
		— Introduction — general description of *the main goals; needs and expectations*
		
		— Requirements description:
		
		   — Regulation
		
		   — Capabilities
		
		   — Performances
		
		   — Scenarios, Concepts of operations
		
		   — User interface
		
		   — Interfaces
		
		   — Reliability
		
		   — Maintenance
		
		   — Interoperability
		
		   — Constraints
			System Definition and Realization

17.	*Agreement*	Description of work to be done related to *System* development. It may Include:
		
		— *System Description (Needs and expectations)*
		
		   — Purpose
		
		   — Acquirer and stakeholders requirements
		
		   — Constraints (regulation, imposed solutions…)
		
		— *Scope* description of what is included and what is not
		
		— *Objectives* of the project
		
		— *Deliverables* list of products to be delivered to Acquirer
		
		The applicable status is: reviewed.
		
		It could be part of a contract between the Acquire and the Supplier
			Project Management

18.	*System*	Combination of interacting elements organized to achieve one or more stated purposes*.*	System Definition and Realization

Table 23 *(continued)*

	Name	Description	Source

19.	*System Design Document*	Textual and/or graphical information, model on the *System* structure (solution). This structure may include the following parts:
		
		Functional Architecture:
		
		— Identifies the required *Internal Functions*
		
		— Identifies the relationship between *Internal Functions*
		
		— Consideration is given to any required:
		
		  — *System* performance characteristics
		
		  — Functional and human interfaces
		
		  — Security characteristics
		
		Physical Architecture:
		
		— Provides hardware design
		
		— Identifies the required *Physical Elements*
		
		— Identifies the allocation of *Internal Functions to Physical Elements*
		
		— Provides format of input / output interfaces: physical interfaces, functional data through physical interfaces.
		
		— Defines the format of required data structures
		
		The applicable statuses are: verified and baselined.
			System Definition and Realization

20.	*System Element*	A product, that is part of a system, and that can be implemented to fulfill specified requirements. Examples: hardware, hardware with software, software, data, humans, processes (e.g. processes for providing service to users), procedures (e.g., operator instructions), facilities, materials, and naturally occurring entities (e.g., water, organisms, minerals), or any combination	System Definition and Realization
21.	*System Elements Requirements Specifications*	Defines the system elements requirements that satisfy the system requirements according to the system Functional and physical architecture. Interfaces resulting from the system Functional and physical architecture may be defined within the *System Elements Requirements Specifications* or in separate document. Each requirement is uniquely identified and is written in conformity with the SMART criteria (i.e. Specific, Measurable, Achievable, Relevant and Traceable). The applicable statuses are: verified, validated and baselined.	

Table 23 *(continued)*

	Name	Description	Source
22.	*System Mainte-nance Document*	Defines the requirements and operations to maintain the system. It may have the following characteristics: — Maintenance Strategy: Accounts for the system's technical availability, replacements for system elements and logistical support, maintenance personnel training and staff requirements — Maintenance Enabling System Requirements — Requirements for any system needed to enable maintenance of the system-of-in-terest need to be developed — Maintenance Constraints on Design — Any constraints on the design arising from the maintenance strategy — Maintenance Procedure — Maintenance Report — Including documentation of the mainte-nance activity results, reporting of failures and recommendations for action, and failure and lifetime performance data. This report also documents any required procedure or system changes that should be accomplished as part of on-going configuration man-agement activities.	System Definition and Realization
23.	*System Operation Guide*	Contains the necessary information to install and manage the *System*. It may have the following characteristics: — Criteria for operational use — A description of how to operate the product including: — operational environment required — supporting tools and material (e.g. system user manuals) required — possible safety warnings — start-up preparations and sequence — frequently asked questions (FAQ) — sources of further information and help to operate the product — Certification and safety approvals — Warranty and replacement instructions — It should be written in terms that the personnel responsible for the operation can understand. The applicable statuses are: verified and baselined.	System Definition and Realization

Table 23 *(continued)*

	Name	Description	Source
24.	*System Require-ments Specification*	Defines the system requirements that satisfy the stakeholders' requirements. It may have the following characteristics: — Introduction — general description of the *System* and its use within the *Scope* of the Acquirer business; — Requirements description: — Functionality — established needs to be satisfied by the System when it is used in specific conditions. Functionality must be adequate, accurate and safe — User interface — definition of those user interface characteristics that allow to understand and learn the *system* easily so the user be able to perform his/her *Tasks* efficiently including the interface exemplar description — External interfaces — definition of interfaces with other system, software or hardware — Reliability — specification of the system execution level concerning the maturity, fault tolerance and recovery — Efficiency — specification of the system execution level concerning the time and use of the *Resources* — Maintenability — degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers. — Portability — description of the *System* characteristics that allow its transfer from one place to other — Design and construction limitations/constraints "–Interoperability — capability for two or more systems or *System Elements* be able to change information each other and use it — Reusability — feature of any product/sub-product, or a part of it, so that it can be used by several users as an end product, in the own system development, or in the execution of other system products — Legal and regulative — needs imposed by laws, regulations, etc. Each requirement is uniquely identified and is written in conformity with the SMART criteria (i.e. Specific, Measurable, Achievable, Relevant and Traceable). The applicable statuses are: verified, validated and baselined.	System Definition and Realization
25.	*System Training Material*	Describes the requirements and operation to train the users, maintainers, and support personnel of a system to accomplish required tasks at any point in the system lifecycle (transition, use, maintenance, disposal). The applicable statuses are: verified, validated and baselined.	System Definition and Realization

Table 23 *(continued)*

	Name	Description	Source
26.	*System User Manual*	Describes the way of using the *System* based on the user interface. It may have the following characteristics: — User procedures for performing specified *Tasks* using the *System* — Installation and de-installation procedures — Brief description of the intended use of the *System*: a user-oriented document that describes a system's operational characteristics from the end user's viewpoint (the concept of operations) — The supplied and required *Resources* — Needed operational environment — Availability of problem reporting and assistance — Procedures to access and exit the *System* — Lists and explains *System* commands and system-provided messages to the user — As appropriate for the identified risk, it includes warnings, cautions, and notes, with corrections — It includes troubleshooting and error correction procedures. It is written in terms understandable by users. The applicable statuses are: preliminary, verified and baselined.	System Definition and Realization
27.	*Traceability Matrix*	Documents the relationship between engineering and IVV artifacts according to the data model. It includes: — Requirements traceability matrix — Requirements coverage matrix The applicable statuses are: verified, baselined and updated.	System Definition and Realization
28.	*Validation Report*	Documents the validation execution. It may include the record of: — Reference to the related IVV procedures — Date — Place — Duration — Validation check-list — Passed items of validation — Failed items of validation — Pending items of validation: not run, partial execution — Defects identified during validation	System Definition and Realization

Table 23 *(continued)*

	Name	Description	Source
29.	*Verification Report*	Documents the verification execution. It may include the record of: — Reference to the related IVV procedures — Date — Place — Duration — Verification check-list — Passed items of verification — Failed items of verification — Pending items of verification: not run, partial execution — Defects identified during verification	System Definition and Realization

11 System tools requirements

11.1 System tools requirements overview

System tools that could be used to perform process activities.

11.2 Project management process

Table 24 — Project management tools

Activity	Resource list
Project Planning Project Plan Execution Project Assessment and Control Project Closure	Tool allowing document, manage and control the *Project Plan.* Tool allowing Project scheduling, tasks definition, resources and cost management. Tool allowing the measurement of the project execution Tool to manage project configuration and changes.

11.3 System definition and realization process

Table 25 — System definition and realization tools

Activity	Resource list
System Definition and Realization Initiation System Requirements Engineering System Design System Integration System Verification Product Delivery	Requirements Engineering tool allowing elicitation, definition, management and traceability of requirements through the system lifecycle (including exchanges with suppliers)
	Design tool allowing definition of the Functional and physical architecture, definition of interfaces and traceability to the Requirements (including modeling tools).
	Tools allowing integration, verification, validation, qualification of the system.
	Tool to manage defects within a configuration management process
	Tools allowing training the stakeholders in the delivery phase to the use and maintenance of the system.
	Tools for documentation management.
System Construction	Construction Tools allowing developing the products of the system (hardware, software).

Annex A
(informative)

Systems engineering deployment packages

In order to facilitate the implementation, by VSEs, of a Profile, a set of Deployment Packages are available. A deployment package is a set of artifacts developed to facilitate the implementation of a set of practices, of the selected framework, in a VSE. But, a deployment package is not a complete process reference model. Deployment packages are not intended to preclude or discourage the use of additional guidelines that VSEs find useful.

The elements of a typical deployment package are: technical description, relationships with ISO/IEC 29110, key definitions, detailed description of processes, activities, tasks, steps, roles, products, template, checklist, example, references and mapping to standards and models, and a list of tools. The mapping is only given as information to show that a Deployment Package has explicit links to Part 5, ISO standards, such as ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 15289, or models such as the CMMI-DEV®[1] developed by the Software Engineering Institute. Hence by deploying and implementing a package, a VSE can see its concrete step to achieve or demonstrate coverage to Part 5. Deployment Packages are designed such that a VSE can implement its content, without having to implement the complete framework at the same time. The table of content of a system engineering deployment package is illustrated in Table A.1.

Table A.1 — Table of Content of a systems engineering deployment package

1.   Technical Description

      Purpose of this document

      Why this Topic is important?

2. Definitions

3. Relationships with ISO/IEC 29110

4. Overview of Processes, Activities, Tasks, Roles and Products

5. Description of Processes, Activities, Tasks, Steps, Roles and Products

      Role Description

      System Description

      Artifact Description

6. Template(s)

7. Example(s)

8. Checklist(s)

9. Tool(s)

10. References to other Standards and Models (e.g. ISO 9001, ISO/IEC/IEEE 15288, CMMI-DEV®)

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[1]   CMMI-DEV® is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

11. References

12. Evaluation form

For the Entry Profile, a set of Systems Engineering Deployment Packages are available, at no cost, on the Internet,

a)   Project Management, and

b)   System Definition and Realization.

Annex B

(informative)

Mapping between the objectives of ISO/IEC/TR 29110-5-6-1 and ISO/IEC/IEEE 15288:2015

B.1 General

B.2 and B.3 present the mapping between the objectives of ISO/IEC/TR 29110-5-6-1 and ISO/IEC/IEEE 15288:2015.

B.2 Correspondence with project management process

PM.O1. The *Project Plan*, the *Agreement* and commitments are reviewed and accepted by both the Acquirer and the Project Manager. The *Tasks* and *Resources* necessary to complete the work are sized and estimated.

6.3.1 Project planning process

a)   *Objectives and plans are defined.*

d)   *Plans for the execution of the project are activated.*

6.3.7 Measurement process

a)   *Information needs are identified.*

[ISO/IEC/IEEE 15288:2015, 6.3.1, 6.3.7]

PM.O2. Progress of the project is monitored against the *Project Plan* and recorded in the *Progress Status Record.* Corrections to remediate problems and deviations from the plan are taken when project targets are not achieved. Closure of the project is performed to get the Acquirer acceptance documented in the *Acceptance Record.*

6.3.2 Project assessment and control process

a) Performance measures or assessment results are available.

f) Affected stakeholders are informed of project status;

g) Corrective action is defined and detected when project achievement is not meeting planned targets.

j) Project objectives are achieved.

6.3.7 Measurement process

c) Required data are collected and stored.

d) The data is analysed and the results interpreted.

e) Information items provide objective information that support decisions.

6.1.1 Acquisition Process

e) A product or service complying with the agreement is accepted.

6.4.9 Verification Process

e) Objective evidence that the realized product fulfils the requirements, architecture and design is provided.

> *6.3.3 Decision management process*
>
> *d) The resolution, decision rationale and assumptions are defined.*
>
> *[ISO/IEC/IEEE 15288:2015, 6.3.2, 6.3.7, 6.1.1, 6.4.9, 6.3.3]*

PM.O3. *Change Requests* are addressed through their reception and analysis. Changes to system requirements are evaluated by the project team for cost, schedule, risks and technical impact.

> *6.3.5 Configuration management process*
>
> *d) Changes to items under configuration management are controlled.*
>
> *[ISO/IEC/IEEE 15288:2015, 6.3.5]*

PM.O4. Review meetings with the Work Team and the Acquirer, suppliers are held. Agreements are registered and tracked.

> *6.4.9 Verification process*
>
> *c) The system or system element is verified*
>
> *f) Verification results and anomalies are identified.*
>
>
> *6.3.8 Quality assurance process*
>
> *d) Results of evaluations are provided to relevant stakeholders.*
>
> *e) Incidents are resolved.*
>
> *[ISO/IEC/IEEE 15215:2008, 6.4.9, 6.3.8]*

PM.O5. A *Risk Management Approach* is developed. Risks are identified, analysed, prioritized, and monitored as they develop and during the conduct of the project. Resources to manage the risks are determined.

> *6.3.4 Risk Management Process*
>
> *a) Risks are identified.*
>
> *c) Risks are analysed.*
>
> *e) Risks are evaluated to assess changes in status and progress in treatment.*
>
> *[ISO/IEC/IEEE 15288:2015, 6.3.4]*

PM.O6. A *Product Management Strategy* is developed. Items of *Product* are identified, defined and baselined. Modifications and releases of the items are controlled and made available to the Acquirer and Work Team. The storage, handling and delivery of the items are controlled.

> *6.3.5 Configuration management process*
>
> *a) Items requiring configuration management are managed.*
>
> *d) Configuration status information is available.*
>
> *f) System releases and deliveries are controlled and approved.*
>
> *[ISO/IEC/IEEE 15288:2015, 6.3.5]*

PM.O7. Quality Assurance is performed to provide assurance that work products and processes comply with the *Project Plan* and *System Requirements Specifications*.

NOTE   The implementation of the Quality Assurance is through the performance of the verifications, validations and review *Tasks* performed in Project Management and System Definition and Realization processes.

> *6.3.8 Quality assurance process*
>
> *a) Evaluations of the project's products, services, and processes are performed, consistent with quality management policies, procedures, and requirements.*
>
> *d) Results of evaluations are provided to relevant stakeholders.*
>
> *e) Incidents are resolved.*
>
> *[ISO/IEC/IEEE 15288:2015, 6.3.8]*

PM.O8 A *Disposal Management Approach* is developed to end the existence of a system entity.

> *6.4.14 Disposal process*
>
> *a) Disposal constraints are provided as inputs to requirements, architecture, design, and implementation.*
>
> *d) The environment is returned to its original or an agreed state.*
>
> *[ISO/IEC/IEEE 15288:2015, 6.4.14]*

B.3   Correspondence with system definition and realization process

SR.O1. *Tasks* of the activities are performed through the accomplishment of the current *Project Plan*.

> *6.3.1 Project planning process*
>
> *d) Plans for the execution of the project are activated.*
>
> *[ISO/IEC/IEEE 15288:2015, 6.3.1]*

SR.O2. System requirements are defined, analysed for correctness and testability, approved by the Acquirer, baselined and communicated.

> *6.4.2 Stakeholder needs and requirements definition process*
>
> *b) Required characteristics and context of use of capabilities and concepts in the lifecycle stages, including operational concepts, are defined.*
>
> *c) Constraints on a system are defined.*
>
> *d) Stakeholder requirements are defined.*
>
> *6.4.3 System requirements definition process*
>
> *b) System requirements (functional, performance, process, non-functional, and interface) and design constraints are defined.*
>
> *d) The system requirements are analysed.*
>
> *f) Traceability of system requirements to stakeholder requirements is developed.*
>
> *6.3.5 Configuration management process*
>
> *b) Configuration baselines are established.*
>
> *c) Changes to items under configuration management are controlled.*
>
> *d) Configuration status information is available.*
>
> *[ISO/IEC/IEEE 15288:2015, 6.4.2, 6.4.3, 6.3.5]*

SR.O3. The System architectural design is developed and baselined. It describes the *System elements* and internal and external interfaces of them. Consistency and traceability to system requirements are established.

6.4.4 Architectural design process

e) Concepts, properties, characteristics, behaviors, functions, or constraints that are significant to architecture decisions of the system are allocated to architectural entities.

f) System elements and their interfaces are identified.

k) Traceability of architecture elements to stakeholder and system requirements is developed.

h) An architectural basis for processes throughout the lifecycle is achieved.

6.4.7 Implementation process

a) An architectural basis for processes throughout the lifecycle is achieved.

[ISO/IEC/IEEE 15288:2015, 6.4.4, 6.4.7]

NOTE   System architecture and detailed design can be performed separately according to the project schedule.

SR.O4. System elements defined by the design are produced or acquired. Acceptance tests are defined and performed to verify the consistency with requirements and the design. Traceability to the requirements and design are established.

6.4.7 Implementation process

b) A system element is realized.

c) A system element is packaged and stored.

[ISO/IEC/IEEE 15288:2015, 6.4.7]

SR.O5. System elements are integrated. Defects encountered during integration are corrected and consistency and traceability to *System Architecture* are established.

6.4.8 Integration process

a) Integration constraints that influence system requirements, architecture, or design, including interfaces, are identified.

d) A system composed of implemented system elements is integrated.

[ISO/IEC/IEEE 15288:2015, 6.4.8]

SR.O6. A *System Configuration*, as agreed in the Project Plan, and that includes the engineering artifacts is integrated, versioned and stored at the *Project Repository*. Needs for changes to the *Product* are detected and related change requests are initiated.

6.1.2 Supply process

d) A product or service is provided

f) Responsibility for the acquired product or service, as directed by the agreement, is transferred.

6.3.6 Information management process

a)   Information to be managed is identified.

c)   Information is obtained, developed, transformed, stored, validated, presented, and disposed of.

f)   Information is available to designated stakeholders.

[ISO/IEC/IEEE 15288:2015, 6.1.2, 6.3.6]

SR.O7. Verification and Validation *Tasks* of all required work products are performed using a defined criterion to achieve consistency among output and input products in each activity. Defects are identified, and corrected; records are stored in the *Verification/Validation Reports*.

6.4.9 Verification process

a) Constraints of verification that influence the requirements, architecture, or design are identified.

d)   Data providing information for corrective action is reported.

e)   Objective evidence that the realized system satisfies the system requirements architecture and design is provided.

f) Verification results and anomalies are identified.

6.4.11 Validation process

a) Validation criteria for stakeholder requirements are defined.

d) The system or system element is validated.

f) Validation results and anomalies are identified.

g) Objective evidence that the realized system or system element satisfies stakeholder needs is provided.

[ISO/IEC/IEEE 15288:2015, 6.4.9, 6.4.11]

Bibliography

[1]   AS/EN/JIS Q. 9100—Quality Management Systems— Requirements for Aviation, Space and Defense Organizations. International Aerospace Quality Group, 2009

[2]   ISO/IEC/IEEE 15288:2015, *Systems and software engineering — System life cycle processes*

[3]   ISO/IEC/IEEE 12207:2015, *Systems and Software Engineering—Software Life Cycle Processes*

[4]   ISO/IEC/IEEE 15289:2015, *Systems and software engineering — Content of life-cycle information items (documentation)*

[5]   ISO/IEC TR 29110-1[2]), *Systems and Software Engineering — Lifecycle profiles for Very Small Entities (VSEs) — Part 1: Overview*

[6]   ISO/IEC 29110-2:2011, *Software engineering — Lifecycle profiles for Very Small Entities (VSEs) — Part 2: Framework and taxonomy*

[7]   ISO/IEC TR 29110-3:2011, *Software engineering — Lifecycle profiles for Very Small Entities (VSEs) — Part 3: Assessment guide*

[8]   ISO/IEC TR 29110-5-1-2:2011, *Software Engineering — Lifecycle profiles for Very Small Entities (VSEs) — Part 5-1-2: Management and engineering guide: Generic profile group: Basic profile, 2011*

[9]   LAPORTE C.Y., FANMUY G., PTACK K. *The Development of Systems Engineering International Standards and Support Tools for Very Small Enterprises*, in: Proceedings INCOSE International Symposium, Rome (Italy), July 9-12, 2012

[10]   OECD. SME and Entrepreneurship Outlook, 2005 Edition. Organization for Economic Co-Operation and Development, Paris, 2005

[11]   PYSTER A., & OLWELL D. eds. 2013. *Guide to the Systems Engineering Body of Knowledge (SEBoK),* version 1.1, Hoboken, NJ: The Trustees of the Stevens Institute of Technology. www.sebokwiki.org/

[12]   SYSTEMS ENGINEERING HANDBOOK A Guide for System Life Cycle Processes and Activities. John Wiley & Sons, Fourth Edition, 2015

[13]   ISO/IEC/IEEE 20246:—, *Software and Systems Engineering — Work Product Reviews*[3])

[14]   ISO/IEC 29110-4-6, *Systems and software Engineering — Lifecycle profiles for Very Small Entities (VSEs) — Part 4-6: Systems engineering — Profile specifications: Generic profile group*[4])

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