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Systems and software engineering — Life cycle profiles for very small entities (VSEs) —

Part 5-6-4: Systems engineering guidelines for the generic Advanced profile

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*.

A list of all parts in the ISO/IEC 29110 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

0.1 Introduction to the ISO/IEC 29110 series

Very small entities (VSEs) around the world are creating valuable products and services. For the purpose of ISO/IEC 29110 series, a VSE is an enterprise, organization (e.g. government agency, non-profit organization), department or project having up to 25 people. Many VSEs develop and/or maintain systems and software components used in those systems, either as independent products or incorporated in the larger systems. Due to this a recognition of VSEs as suppliers of high-quality products is required.

VSEs around the world are creating valuable products and services. According to the World Bank, small and medium-sized enterprises (SMEs) account for about 90 % of enterprises worldwide. According to the Organisation for Economic Co-operation and Development (OECD), SMEs represent 99 % of all businesses and generate about 60 % of employment. Almost one person out of three is employed in a micro firm with less than 10 employees. The European Union reports that micro firms, with fewer than 10 persons, account for 93,5 % of all enterprises and small firms, with 10 to 49 employees, account for 5,5 % of all enterprises. The challenge facing OECD governments 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 conformity 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 the number of employees, expertise, budget and time, nor do they see a net benefit in establishing over-complex systems or software life cycle processes. To address some of these difficulties, a set of guidelines has been developed based on a set of VSE characteristics. The guidelines 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 the specifications of the ISO/IEC 29110 series.

The ISO/IEC 29110 series can be applied at any phase of system or software development within a life cycle. This series 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.

The ISO/IEC 29110 series is intended to be used with any life cycle such as waterfall, iterative, incremental, evolutionary or agile.

Systems, in the context of the ISO/IEC 29110 series, are typically composed of hardware and software components.

The ISO/IEC 29110 series, targeted by audience, has been developed to improve system or software and/or service quality, and process performance. Figure 1 describes the ISO/IEC 29110 series and positions the parts within the framework of reference.

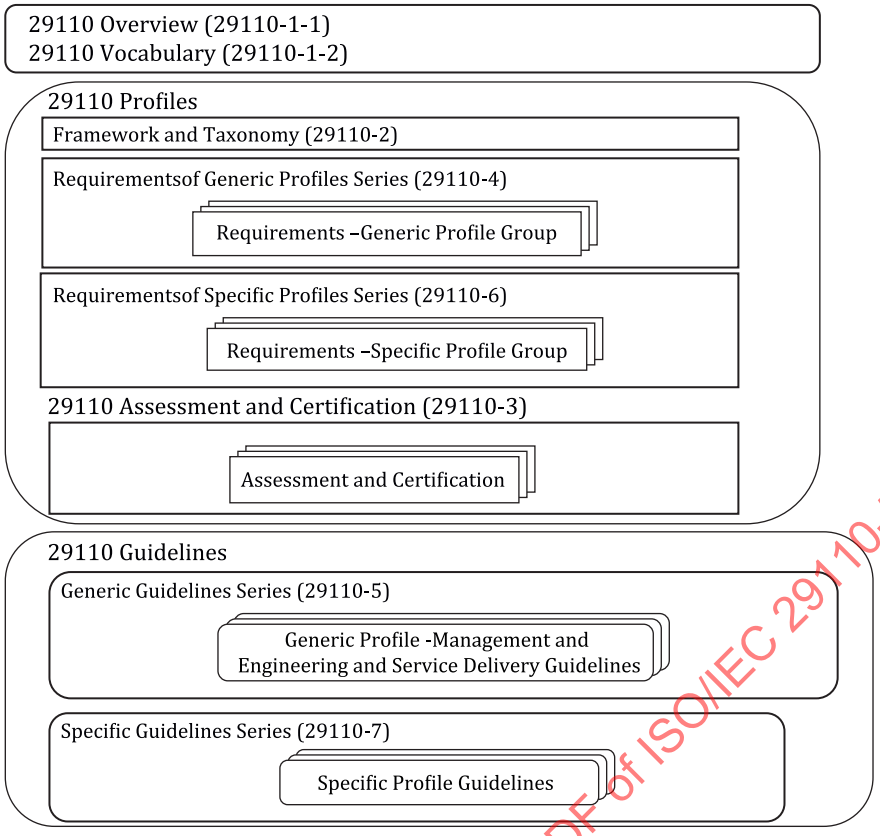


Figure 1 — The ISO/IEC 29110 series

ISO/IEC 29110-1-1 introduces processes, life cycle and standardization concepts, the taxonomy (catalogue) of ISO/IEC 29110 profiles and the ISO/IEC 29110 series. ISO/IEC 29110-1-1 also introduces the characteristics and needs of a VSE, and clarifies the rationale for specific profiles, documents, standards and guidelines. ISO/IEC 29110-1-2 defines the terms common to the ISO/IEC 29110 series. ISO/IEC 29110-1-1 and ISO/IEC 29110-1-2 are targeted at VSEs and their customers, assessors, standards producers, tool vendors and methodology vendors.

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, conformity, and 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 29110-2 is targeted at profile producers, tool vendors and methodology vendors.

ISO/IEC 29110-3 defines certification schemes, assessment guidelines and compliance requirements for process capability assessment, conformity assessments, 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, for example, 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 29110-3 is targeted at VSEs and their customers, assessors, accreditation bodies.

ISO/IEC 29110-4 provides the specifications for all generic profiles of the generic profile group that are based on subsets of appropriate standards elements. ISO/IEC 29110-4 is targeted at VSEs, customers, standards producers, tool vendors and methodology vendors.

ISO/IEC 29110-5 provides a management, engineering and service delivery guidelines for profiles of the generic profile group. ISO/IEC 29110-5 is targeted at VSEs and their customers.

ISO/IEC 29110-6 provides the specifications for specific profiles that are based on subsets of appropriate standards elements. ISO/IEC 29110-6 is targeted at VSEs, customers, standards producers, tool vendors and methodology vendors.

ISO/IEC 29110-7 provides a guideline for each profile of the specific profile group. ISO/IEC 29110-7 is targeted at VSEs and their customers.

If a new profile is needed, ISO/IEC 29110-4, ISO/IEC 29110-6, ISO/IEC 29110-7 or ISO/IEC 29110-5, or all, can be developed with minimal impact to existing documents.

These guidelines are oriented towards the management of more than one project in parallel with more than one work team.

0.2 Introduction to this document

This document has been developed using the management and engineering guidelines from the systems engineering Intermediate profile. Elements were added or modified (e.g. process, task, work product, role) to support VSEs involved in the development of more than one project in parallel with more than one work team.

This document is intended to be used with any process, technique and method that enhances the VSE's stakeholder satisfaction and productivity.

The Advanced profile is the fourth profile of a four-profile systems engineering roadmap (i.e. Entry, Basic, Intermediate and Advanced).

The outcomes and tasks are guidance, not requirements, for purposes of process assessment.

This document applies for the development of non-safety critical systems.

Using this document, a VSE can obtain benefits in the following aspects:

— systematic system definition and realization process is followed, that satisfies the acquirer needs and helps ensure quality work processes are followed;

— management and monitoring of more than one project in parallel with more than one work team;

— reuse of existing system components (e.g. code and document) in new projects;

— continuous measurement and evaluation of projects;

— continuous evaluation and improvement processes;

— continuous sustainability and growth;

— support to customers in the disposal of a current system and installation of a new system.

Once the system, developed by a VSE, has been accepted by their customers, the VSE can provide after delivery services by referring to ISO/IEC 29110-5-3.

To use this document, the VSE should ensure the following entry conditions:

— project needs and expectations are documented;

— feasibility of the project was performed;

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

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

In the context of systems engineering, that is the system definition and realization (SR) process, the group that is part of the VSE responsible for developing software elements that are part of the system, should use the management and engineering guidelines of the software engineering Advanced profile (ISO/IEC TR 29110-5-1-4).

To use this document, a VSE should be familiar with or have implemented ISO/IEC TR 29110-5-6-3, the systems engineering Intermediate profile, for their system development projects.

Systems and software engineering — Life cycle profiles for very small entities (VSEs) —

Part 5-6-4: Systems engineering guidelines for the generic Advanced profile

1 Scope

This document describes processes targeted at VSEs that want to sustain and grow as an independent competitive system development organization.

This document provides management and engineering guidelines for the systems engineering Advanced profile of the generic profile group.

This document is applicable to VSEs that do not develop critical systems and have little or no experience with systems engineering (SE) process planning and implementation using the ISO/IEC/IEEE 15288.

This document is also applicable to VSEs which are familiar with the management and engineering guidelines of the systems engineering Intermediate profile (ISO/IEC TR 29110-5-6-3) for their system development projects and are involved in the development of more than one project in parallel with more than one work team.

2 Normative references

This document has no normative references.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
Advanced profile
profile (3.14) targeted at VSEs which want to sustain and grow as a *system* (3.19) and/or software development organization

[SOURCE: ISO/IEC 29110-1-2:2024, 3.3, modified — "competitive system" has been changed to "system".]

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

EXAMPLE Contract, memorandum of agreement.

[SOURCE: ISO/IEC/IEEE 15288:2023, 3.4]

3.3
acquirer
stakeholder (3.18) 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, purchaser or internal/ organizational sponsor.

[SOURCE: ISO/IEC/IEEE 15288:2023, 3.1]

3.4
Basic profile
profile (3.14) targeted at VSEs developing a single product by a single work team

[SOURCE: ISO/IEC 29110-1-2: 2024, 3.18]

3.5
business objective
strategy designed by senior management to ensure an organization's continued existence and enhance its profitability, market share, and other factors influencing the organization's success

[SOURCE: ISO/IEC/IEEE 24765:2017, 3.444]

3.6
conditional process
process that may be mandatory under some specified conditions, may be optional under other specified conditions, and may be out of scope or not applicable under other specified conditions

Note 1 to entry: These are to be observed if the specified conditions apply.

[SOURCE: ISO/IEC TR 29110-5-1-3:2017, 3.3]

3.7
critical system
product that is essential to the operation of a business or organization, whose sustained failure would result in significant business impacts e.g. loss of revenue or loss of reputation

3.8
disposed system
system (3.19) 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 life cycle of the system. This includes all aspects of the system throughout its life until the day *users* (3.24) depose of the system and the external enterprises complete the handling of the disposed system products.

3.9
enabling system
system (3.19) that supports a system-of-interest during its life cycle stages but does not necessarily contribute directly to its function during operation

EXAMPLE Production-enabling system, which is required when a system-of-interest enters the production stage.

Note 1 to entry: Each enabling system has a life cycle of its own. This document is applicable to each enabling system when, in its own right, it is treated as a system-of-interest.

[SOURCE: ISO/IEC/IEEE 15288:2023, 3.15]

3.10
Entry profile
profile (3.14) targeted at start-up VSEs (i.e. VSEs who started their operation less than 3 years) and/or at VSEs working on small projects (e.g. project size of less than 6 person-months)

[SOURCE: ISO/IEC 29110-1-2:2024, 3.42]

3.11
generic profile group
profile (3.14) group applicable to VSEs (very small entities) that do not develop *critical systems* (3.7) or software products

[SOURCE: ISO/IEC 29110-1-2:2024, 3.45]

3.12
Intermediate profile
profile (3.14) targeted at VSEs involved in the development of more than one project in parallel with more than one work team

[SOURCE: ISO/IEC 29110-1-2:2024, 3.51]

3.13
operator
individual or organization that performs the operations of a *system* (3.19)

Note 1 to entry: The role of operator and the role of *user* (3.24) 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 15288:2023, 3.24]

3.14
profile
subset of appropriate standards' processes and their outcomes, activities and tasks combined to accomplish a particular function

Note 1 to entry: The base standards used to develop profiles for VSEs are ISO/IEC/IEEE 12207, ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 15289.

3.15
process purpose
high-level objective of performing the process and the likely outcomes of effective implementation of the process

[SOURCE: ISO/IEC/IEEE 24774:2021, 3.12]

3.16
process outcome
observable result of the successful achievement of the *process purpose* (3.15)

[SOURCE: ISO/IEC/IEEE 24774:2021, 3.11]

3.17
small and medium enterprise
SME
enterprise which employs fewer than 250 persons

[SOURCE: ISO/IEC 29110-1-2:2024, 3.92]

3.18
stakeholder
individual or organization having a right, share, claim, or interest in a *system* (3.19) or in its possession of characteristics that meet their needs and expectations

[SOURCE: ISO/IEC/IEEE 12207:2017, 3.1.59, modified — EXAMPLE and note 1 to entry have been removed.]

3.19
system
arrangement of parts or elements that together exhibit a stated behaviour or meaning that the individual constituents do not

Note 1 to entry: A system is sometimes 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" is substituted simply by a context-dependent synonym, e.g., aircraft, though this potentially obscures a system principles perspective.

Note 3 to entry: A complete system includes all of the associated equipment, facilities, material, computer programs, firmware, technical documentation, services and personnel required for operations and support to the degree necessary for self-sufficient use in its intended environment.

[SOURCE: ISO/IEC/IEEE 15288:2023, 3.46]

3.20
systems engineering management plan
SEMP
top level technical plan for managing the *systems* (3.19) engineering effort which defines how the technical aspects of the project will be organized, structured, and conducted and how the systems engineering processes will be controlled to provide a product that satisfies *stakeholder* (3.18) requirements

[SOURCE: ISO/IEC/IEEE 24748-4:2016, 4.14]

3.21
system-of-interest
SOI
system (3.19) whose life cycle is under consideration

[SOURCE: ISO/IEC/IEEE 15288:2023, 3.48]

3.22
system structure
decomposition of a *system-of-interest* (3.21) into a set of interacting *systems* (3.19) and system elements

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

3.23
trade-off
decision-making actions that select from various requirements and alternative solutions on the basis of net benefit to the *stakeholders* (3.18)

3.24
user
individual or group that interacts with a *system* (3.19) or benefits from a system during its utilization

Note 1 to entry: The role of user and the role of *operator* (3.13) are sometimes vested, simultaneously or sequentially, in the same individual or organization.

[SOURCE: ISO/IEC/IEEE 15288:2023, 3.53]

3.25
work breakdown structure
WBS
deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables

Note 1 to entry: The WBS can be an output or an input.

[SOURCE: ISO/IEC/IEEE 26511:2018, 3.1.42, modified — The abbreviated term and note 1 to entry have been added.]

4 Conventions and abbreviated terms

4.1 General

Conventions for naming, diagramming, describing and defining profiles are defined in ISO/IEC 29110-2-1.

4.2 Naming, diagramming and definition conventions

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

Process name – process identifier, followed by its abbreviation in parentheses "( )".

Process purpose – the high-level objectives and results expected of the effective implementation of the process. The implementation of the process should provide tangible benefits to the stakeholders.

Process outcomes - the process outcomes are identified by the abbreviation of the process name, followed by the letter "O" and a consecutive number, for example PM.O1, SR.O2.

Input work products – work 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. Input work products are identified by the abbreviation of the process name.

Output work products – work products generated by the process and its corresponding destination, which can be another process or an external entity to the project, such as an acquirer. Output work products are identified by the abbreviation of the process name.

Internal work products – work products generated (i.e. output work product) and consumed (i.e. input work product) by the process. Internal work products are identified by the abbreviation of the process name. An internal work product is not reviewed or approved by the customer.

All work products' names begin with capital letters. Some work products have one or more states attached to the work product name surrounded by square brackets "[ ]" and separated by",". The work product state may change during the process execution. See Clause 13 for the alphabetical listing of the work products, its descriptions, possible states and the source of the work product. The source can be another process or an external entity to the project, such as the acquirer.

Roles involved – names and abbreviation of the functions to be performed by project team members. Several roles may be performed 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 shown as a two-column table. See Clause 12 for the alphabetical list of the roles 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 work products. The directional or bidirectional thick arrows indicate the major flow of information between processes or activities. The thin directional arrows indicate the input or output work products. The notation used in the diagrams does not imply the use of any specific process life cycle.

Activity – a set of cohesive tasks. A task is a requirement, recommendation, or permissible action, intended to contribute to the achievement of one or more outcomes 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 outcomes surrounded by parenthesis "( )". For example, PM.01 project planning (contributes to PM.O1, PM.O5, PM.O6, and PM.O7) means that the activity PM.01 project planning contributes to the achievement of the listed outcomes: 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.

Task description - Each task description begins with an active verb (e.g. assign, test) and is followed by an object (e.g. review the project plan). 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 tables 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.01.01, PM.01.02, and so on. A few numbered items are added to provide additional information intended to assist the understanding or use of tasks.

— Input work products – work products needed to execute the task.

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

NOTE 1 A conditional task is executed if its associated work product (e.g. software user documentation) is required by the customer and listed in the delivery instructions. A conditional task statement is preceded with this text: " x) Conditional task". A work product associated to a conditional task is identified as an 'optional' work product.

Organizational repository – list of work products to be saved in organizational repository; the configuration management strategy should be applied to some of them.

NOTE 2 Tables used in process description are for presentation purpose only. The tables are not prescribing a waterfall approach.

NOTE 3 The term 'Advanced' is using a capital 'A' to indicate an ISO/IEC 29110 profile (e.g. Advanced profile) while the term 'advanced' is used when referring to something modern and highly developed.

4.3 Notation used to document new processes, additions and modifications to the processes of the Intermediate profile

The Advanced profile has been designed to build upon the processes of the Intermediate profile such that, when moving from the Intermediate profile to the Advanced profile, a VSE should only add to its existing Intermediate profile processes the new processes (e.g., outcomes, activities, tasks, roles and work products) described in this document.

Since, in the Advanced profile, there are additions and modifications to the Intermediate profile processes, this document has been written such that it will be easy for a VSE to identify these additions and modifications. The project management (PM) and system definition and realization (SR) processes, of the Intermediate profile, have been complemented with additional outcomes, tasks and work products in a context where a VSE is conducting more than one project in parallel with more than one work team. The following notation is used to highlight the addition/deletion/modification to the Intermediate profile:

— added text:

  — is underlined;

  — except for the added new processes of the Advanced profile;

— deleted/modified text is struck out.

The Advanced profile has one new process that is not in the Intermediate profile: system transition and disposal process (SYTD).

The purpose of the system transition and disposal process is to move the system, in an orderly and planned manner, into the operational status. In this way, the system is functional and operable in the operational environment of the customer to end the existence of a system element or system for a specified intended use. At this time, the customer can appropriately handle, replace, or retire elements, by properly attending to critical disposal needs (e.g. per an agreement, per organizational policy, or for environmental, safety, security aspects).

The SYTD process is a conditional process. It is executed if a VSE is required, in the agreement (e.g. statement of work), to install and/or dispose of a system at the customer operational environment. If this is the case, this process is included in the scope of an audit or an assessment.

To facilitate the identification of additional abbreviations, roles and work products of the SYTD process of the Advanced profile, these items are underlined. To facilitate reading, the SYTD process has not been underlined.

The Advanced profile terminology has been aligned with ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 15289. The following terms of old standards have been replaced with the new terms:

— "Statement of work", "agreement" and "contract" have been replaced with "agreement";

— work products are identified with a unique code WP.XX where XX is a sequential number in Clause 10. These codes have not been used in the descriptions of activities and tasks to facilitate readability.

4.4 Abbreviated terms

ACQ	acquirer
AM	acquisition management
CUS	customer
DES	designer
DEV	developper
PO	purchase order
PM	project management
PJM	project manager
PROM	proposal manager
SBS	system breakdown structure
SDD	system design document
SEMP	systems engineering management plan
SMART	specific, measurable, accepted, realistic and traced
SR	system definition and realization
STK	stakeholder
SUP	supplier
SW	software
SYS	systems engineer
SYTD	system transition and disposal
TM	technical management
TCM	technical manager

TPM	technical performance management
VSE	very small entity
V&V	verification and validation
V&VE	verification and validation engineer
WP	work product
WT	work team

5 Systems thinking

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

Systems thinking allows for a better understanding of the systems as a whole: Systems thinking is used to broaden the perspective to larger environments by considering the entire life cycle 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 should clearly understand these relationships before defining a solution.

The “system” perspective enables the design of an optimized system to consider all needs and constraints. This perspective also helps to invent new solutions to meet existing needs or in some cases create new needs.

For this document, systems thinking should be considered when understanding the system to be designed so that, when identifying the requirements, all stakeholders’ needs are 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 of the parts.

6 Overview

This document provides the following processes: technical management, acquisition management, project management, systems definition and realization and system transition and disposal. These processes integrate tasks selected from ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 15289. Annex A provides information about deployment packages (DPs) which will facilitate the implementation of these processes.

In the Entry, Basic, and Intermediate profiles of the generic profile group, the boundary between the VSE, its business environment, and its work product were naturally vague, since everyone was focused on one work product.

Table 1 illustrates the four-stage systems engineering roadmap. The 1st column on the left lists the 2 processes of the ISO/IEC TR 29110-5-6-1 Entry profile. The list of processes of the Basic profile of the 2nd column is incrementally built from the left column, so that the processes for the 2nd column are all the ones from the Entry profile plus new tasks and new work products. The list of the processes of the Intermediate profile of the 3rd column is the process in the second column plus two new processes. The list of process of the Advanced profile of the 4th column is the process in the 3rd column plus one new process.

Table 1 — Systems engineering four-stage roadmap

ISO/IEC TR 29110-5-6-1 Entry profile	ISO/IEC TR 29110-5-6-2 Basic profile	ISO/IEC TR 29110-5-6-3 Intermediate profile	ISO/IEC 29110-5-6-4 Advanced profile
— Software implementation — Project management	Processes of ISO/IEC TR 29110-5-6-1 with additional tasks and: — Conditional process: Acquisition management	Processes of ISO/IEC TR 29110-5-6-2 and: — Technical management	Processes of ISO/IEC TR 29110-5-6-3 and: — Conditional process: Software transition and disposal process

With the Advanced profile, the VSE may have more than one project ongoing at a time. With the potential need for more workers, a difficult but necessary boundary should be defined. That boundary differentiates between what the VSE should do to survive in its business environment and what the VSE actors should do to fulfil the different agreements (engagement) undertaken by the VSE.

The purpose of the technical management (TM) process is to cover more business areas than those pertaining exclusively to the management of the individual projects and systems engineering. This includes the efforts required to define, design, produce, qualify, and deliver a project to the customer, thus assuring the continued operation of the VSE. Technical management identifies business opportunities that fit within the organizational goals and resources (e.g. human, knowledge and material) of the VSE. Technical management then consults with the subject matter experts, project management, and systems engineering resources, on the feasibility of the proposed opportunity by the VSE. The same is true with the proposed agreement, where the technical management will help ensure the feasibility and validity of the proposed agreement, arising from the interpretation of the request for proposal (RFP) or business opportunity. The result is the formal acceptance of the agreement into the project to help ensure the viability of the VSE (until then no official project exists).

The purpose of the project management (PM) process is to establish and carry out, in a systematic way, the tasks of the system definition and realization process, while conforming to the project's objectives for the expected quality, time, cost, and risks.

The purpose of the system definition and realization (SR) process is the systematic performance of the analysis, design, construction, integration, verification, and validation activities for a new or modified system, according to the specified requirements.

The purpose of the acquisition management (AM) process is to obtain work products (e.g. material, software), work services, or both, required by the VSE. The execution of the AM process is only required if a work product/service should be obtained from a supplier by the VSE, i.e. a conditional process.

The purpose of the system transition and disposal (SYTD) process is to move the system, in an orderly, planned manner, into the operational status such that the system is functional and operable in the customer's operational environment. At the end of the need or intended use of the system element or system, the appropriate replacement or disposal of the product will be properly attended to, to include any critical disposal needs (e.g. per an agreement, per organizational policy, or for environmental, safety, and security aspects).

The processes are interrelated (see Figure 2). The arrow connecting the AM and SYTD processes to the other processes and the process itself are dashed arrows to indicate that these 2 processes are conditional processes.

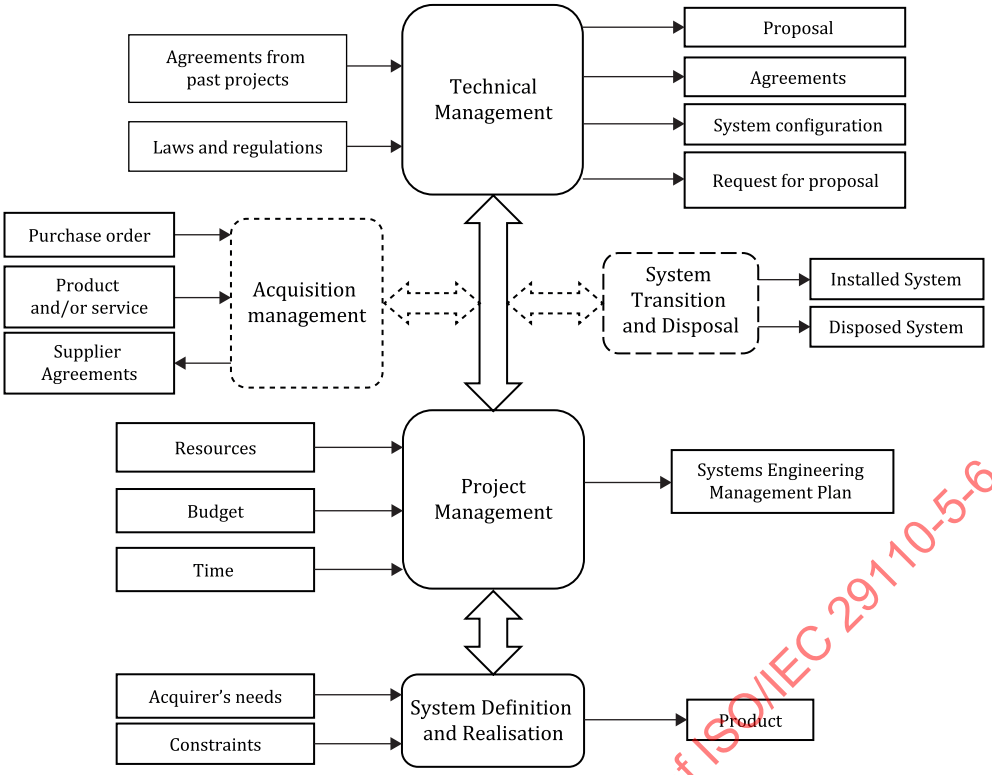


Figure 2 — Advanced profile processes

7 Technical management (TM) process

7.1 TM process purpose

The purpose of the technical management process is to identify opportunities, evaluate all in-place agreements or requests from customers for fit with organizational objectives and resources, obtain and provide the VSE with the necessary resources to perform all projects, monitor, and evaluate all projects, conduct lessons learned to improve the VSE, protect its intellectual property, and protect the security of its assets and information items.

This document is intended to be used by a VSE to establish processes to implement any development approach or methodology (e.g. agile, evolutionary, incremental, test-driven development) based on the VSE or project needs.

7.2 TM process outcomes

TM.O1. Initiate and sustain suitable projects that fit with the organizational goals and resources (e.g. human, knowledge and material) to meet the business objectives of the VSE.

TM.O2. Provide to the customer the work product that meets the agreed requirements.

TM.O3. Provide the VSE with necessary human resources and to maintain their competencies, consistent with business needs.

TM.O4. Provide an enabling infrastructure and services to all projects to support the VSE and the project objectives throughout the life cycle.

TM.O5. Collect and analyse measures with VSE actors to internally disseminate the results as lessons and to institutionalise them as lessons learned for all projects.

TM.O6. Protect the intellectual property and the security of the assets and information items of the VSE.

TM.O7. Establish and maintain current an organizational repository, to capture, maintain history, and disseminate the projects' relevant documentation, including TM input and output work products.

TM.O8. Provide structure for all projects evaluations, critiques and mentoring, if required, to deliver to the acquirer a system of defined quality, in time, and on cost.

7.3 TM roles involved

The roles involved in the TM process are:

— technical manager;

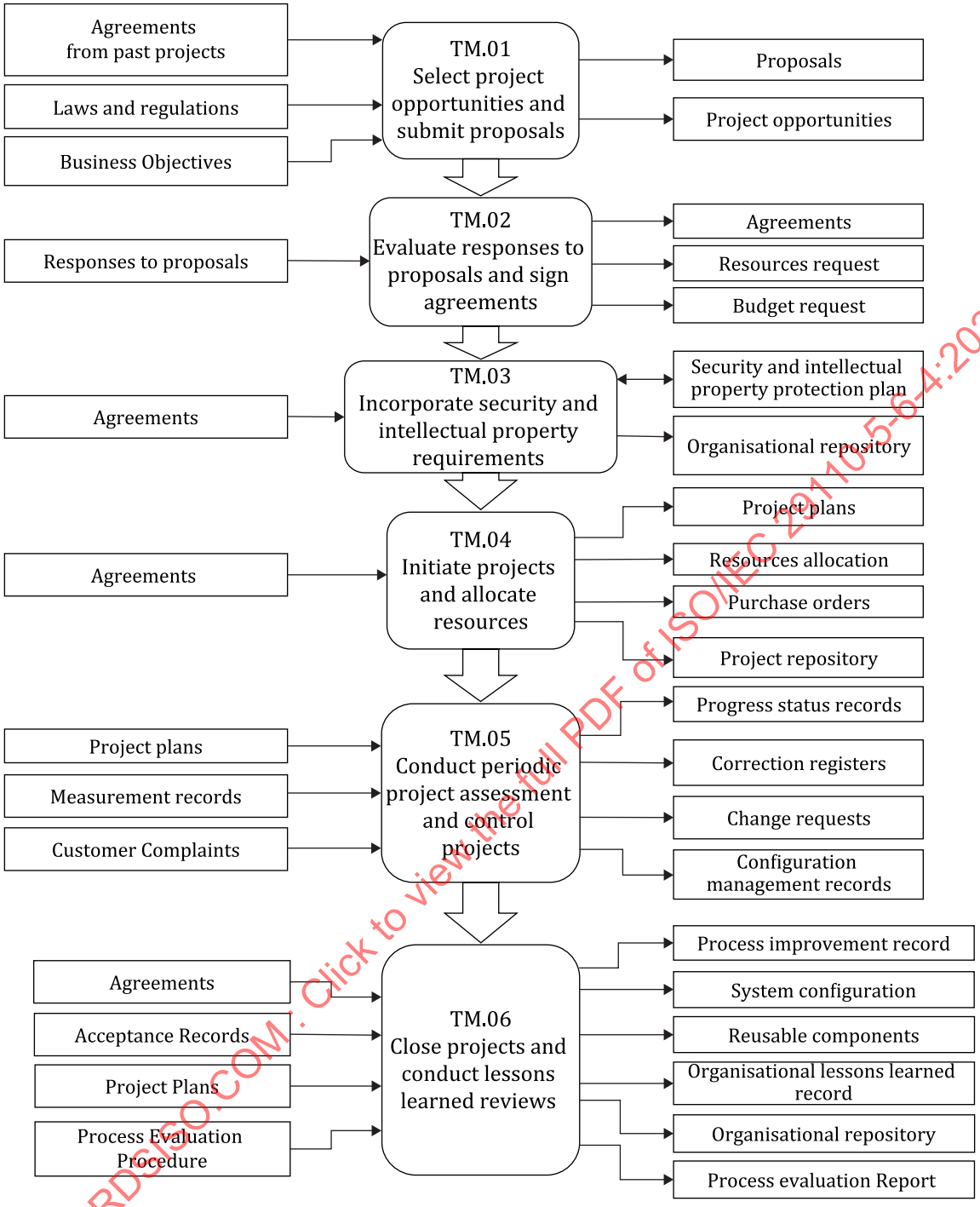
— project manager;

— customer.

7.4 TM process description

7.4.1 TM diagram

Figure 3 shows the flow of information between the technical management process activities including the most relevant work products and their relationships.



NOTE 1 All the feedback lines are not all displayed to facilitate readability.

NOTE 2 A few input WPs have been produced by other processes (e.g. PM) during the execution of a specific project.

Figure 3 — Technical management process diagram

7.4.2 TM activities

7.4.2.1 General

The technical management process has the following activities.

— TM.01. Select project opportunities and submit proposals.

— TM.02. Evaluate responses to proposals and sign agreements.

— TM.03. Incorporate security and intellectual property requirements.

— TM.04. Initiate projects and allocate resources.

— TM.05. Conduct periodic project assessment and control projects.

— TM.06. Close projects and conduct lessons learned reviews and institutionalised them.

7.4.2.2 TM.01 Select project opportunities and submit proposals (contributes to TM.O1)

This activity describes the tasks and information items needed to document project opportunities and proposals sent to potential customers.

The activity provides:

— project opportunities;

— proposals submitted to potential customers.

TM.01 task list is given in Table 2.

Table 2 — TM.01 task list

Role	Task list	Input work products	Output work products
TCM PJMs	TM.01.01 Document project opportunities. 1) Agreements (e.g. contracts) from past projects can be used to document the project opportunities.	Business objectives [approved] Project opportunities [updated] Agreements [approved]	Project opportunities [initiated]
TCM PJMs	TM.01.02 Select project opportunities.	Project opportunities [updated] Request for proposal [published] Laws and regulations	Project opportunities [approved]
TCM PJMs SYS	TM.01.03 Prepare and approve proposals. 1) A proposal is prepared by a PJM during the execution of the AM process for a specific project. 2) Proposals can be developed using the proposal template in the work product description section of this document.	Project opportunities [approved] Proposal [received]	Proposal [approved]
TCM PJMs	TM.01.04 Submit proposals to potential customers.	Proposal [approved]	Proposal [submitted]

7.4.2.3 TM.02 Evaluate responses to proposals and sign agreements (contributes to TM.O1)

This activity involves the evaluation of the responses to proposals submitted by customers, the negotiation and signature of agreements with customers. Once an agreement is signed, a project manager is assigned to the project and the project manager creates its project plan.

The activity provides:

— request for proposal(s);

— agreements.

TM.02 task list is given in Table 3.

Table 3 — TM.02 task list

Role	Task list	Input work products	Output work products
TCM	TM.02.01 Evaluate all responses to proposals from potential customers and prepare agreements for the accepted proposals.	Proposals [submitted] Responses to proposals	Agreement [initiated]
TCM CUS	TM.02.02 Negotiate, finalize and sign all agreements with customers.	Agreement [initiated]	Agreement [signed]
TCM PJMs	TM.02.03 Approve projects and assign project managers to develop project plans and resources requests. 1) Project opportunities are updated (if applicable). 2) Project plans are developed according to the planning activity of the PM process.	Agreement [approved]	Project opportunities [updated]

7.4.2.4 TM.03 Incorporate security and intellectual property requirements (contributes to TM.06)

This activity documents the tasks and information items needed to develop and implement security of its assets and information items, and the protection of the intellectual property of the VSE.

The activity provides:

— security and intellectual property protection plan;

— organizational repository to store assets and information items securely.

TM.03 task list is given in Table 4.

Table 4 — TM.03 task list

Role	Task list	Input work products	Output work products
TCM	TM.03.01 Develop a security and intellectual property protection plan. 1) The plan includes preventing infringements in the use of intellectual property of a third party and dealing with security issues of its assets and information.	Agreement [signed]	Security and intellectual property protection plan [initiated]
TCM PJMs	TM.03.02 Review and approve the security and intellectual property protection plan.	Security and intellectual property protection plan [initiated]	Security and intellectual property protection plan [approved]
TCM PJMs	TM.03.03 Implement the security and intellectual property protection plan.	Security and intellectual property protection plan [approved]	Security and intellectual property protection plan [implemented]
TCM	TM.03.04 Establish and maintain an organizational repository. 1) The repository should protect the security and intellectual property of the VSE and its customers.	Security and intellectual property protection plan [approved]	Organizational repository [established]

7.4.2.5 TM.04 Initiate projects and allocate resources (contributes to TM.03, TM.04, TM.07)

This activity is initiated with the approval of project plans and the resources requests. Human resources are allocated to projects. If work products or services should be acquired, purchase orders are approved. An organizational repository is established.

The activity provides:

— approved project plans;

— approved resources requests;

— approved purchased orders;

— human resource record.

TM.04 task list is given in Table 5.

Table 5 — TM.04 task list

Role	Task List	Input work products	Output work products
TCM PJMs	TM.04.01 Review and approve all project plans, budget allocations and resource requests. 1) Assign required human resources and other resources to project (e.g. work team, computer facilities). 2) Human resource record is developed.	Agreements [approved] Project plans [initiated] Resources requests [initiated]	Project plans [approved] Resources requests [approved] Budget [approved] Human resource record [approved]
TCM PJMs	TM.04.02 Obtain resources and train project team members if needed.	Resources requests [approved] Human resource record [approved]	Resources obtained and trained Human resource record [updated]
TCM PJMs	TM.04.03 Decide if work products or services should be acquired from suppliers and/or services to be acquired. 1) If a work product or a service should be acquired, a purchase order is initiated. 2) If a work product (e.g. software component) or a service should be acquired from supplier(s), use the acquisition management process of this document.	Project plans [approved]	Purchase orders [initiated]
TCM PJMs	TM.04.04 Approve all purchase orders to obtain work products or services from suppliers. 1) Purchase orders are approved by the project plan execution activity of the PM process.	Purchase orders [initiated]	Purchase orders [approved]

7.4.2.6 TM.05. Conduct periodic project assessment and control projects (contributes to TM.02, TM.06)

This activity evaluates the performance of all the plans against documented commitments. The information items needed to perform this activity are the outputs of the project assessment and control activity of the PM process.

The activity provides:

— progress status record;

— correction register;

— change request.

TM.05 task list is given in Table 6.

Table 6 — TM.05 task list

Role	Task list	Input work products	Output work products
TCM PJMs	TM.05.01 Evaluate all projects progress with respect to the project plans, comparing: — actual tasks against planned tasks; — actual results against established project objectives; — actual resource allocation against planned resources; — actual cost against budget estimates; — actual time against planned schedule; — actual risk against previously identified; — Identify deficiency in knowledge or training.	Project plans [approved] Customer complaints [published]	Progress status records [evaluated]
TCM PJMs	TM.05.02 Establish actions to correct deviations or problems and identified risks. 1) Concerning the accomplishment of the plan, as needed, document them in correction register and track them to closure.	Progress status records [evaluated]	Correction register [initial]
TCM PJMs	TM.05.03 Identify changes to requirements or project plans or both. 1) To address major deviations, potential risks or problems concerning the accomplishment of the plan, document them in change requests and track them to closure.	Progress status records [evaluated]	Change requests [initiated]
TCM	TM.05.04 Record and report the status of the items and modifications.	Configuration management strategy [initiated]	Configuration management records [initiated]

7.4.2.7 TM.06. Close projects and conduct lessons learned reviews (contributes to TM.O1, TM.O5)

This activity formalizes, at the organizational level, the project closure activity of the PM process, by delivering the work products to the customers. organizational lessons learned reviews are performed using the output of the project closure activity of the PM process. Process improvement opportunities are documented, implemented, and reusable components are identified and stored in the organizational repository.

The activity provides:

— acceptance record;

— delivery instructions signed by customer;

— product;

— organizational lessons learned;

— process improvement record;

— reusable components;

— updated organizational repository.

TM.06 task list is given in Table 7.

Table 7 — TM.06 task list

Role	Task list	Input work products	Output work products
TCM PJMs CUS	TM.06.01 Formalize the completion of the projects according to the delivery instructions. 1) As established in the project plans, providing acceptance support and getting the acceptance record signed from the customers. 2) The delivery instructions have been produced by the PM process of a specific project. The document is used as an input, no changes are done to this WP.	Agreements [approved] Acceptance records [initiated] Delivery instructions [signed] Product [delivered internally]	Acceptance records [signed] Delivery instructions [signed] Product [accepted]
TCM PJMs	TM.06.02 Perform the evaluation of processes. 1) The processes of the VSE are evaluated to identify weaknesses and propose improvements.	Process evaluation procedure [approved|	Process evaluation record [published]
TCM PJMs	TM.06.03 Conduct a lesson learned review of all projects. 1) Lessons learned are analysed to identify improvements to processes, work products, and prioritise them in the improvement record. 2) The business objectives are updated if necessary. 3) A few input WPs (e.g., meeting records) have been produced during the execution of a project.	Agreements [approved] Business objectives [approved) Project plans [approved] Meeting records [published] Customer complaints [published] Project lessons learned record [approved] Measurement records [published]	Organizational lessons learned record [approved] Process improvement record [approved] Business objectives [updated)
TCM PJMs	TM.06.04 Implement selected improvements.	Process improvement record [approved]	Process improvement record [implemented]
TCM PJM	TM.06.05 Identify reusable components from project repositories and store them in the organizational repository.	Product [accepted] Project repositories [baselined]	Organizational repository [updated] — Reusable components
TCM PJM	TM.06.06 Update the organizational repository.	Product [accepted] Project repositories [baselined]	Organizational repository [updated]

7.4.2.8 Incorporation to the organizational repository

The work products to be saved in organizational repository are:

— organizational objectives;

— project opportunities;

— proposal;

— agreement;

— project plan;

— acceptance record;

— security and intellectual property protection plan;

— organizational lessons learned record;

— process improvement record;

— meeting record;

— purchase order;

— reusable components;

— resource request;

— human resource record.

8 Project management (PM) process

8.1 PM process purpose

The purpose of the project management process is to establish and carry out, in a systematic way, the tasks of the system definition and realization project. This supports compliance with the project's objectives in the expected quality, time, and cost, within the acceptable risks.

The PM process of the Basic profile has been complemented with additional objectives, tasks, and work products in a context where a VSE is conducting more than one project with more than one work team. In addition, new tasks have been added to the PM process of the Basic profile to improve the management of projects. It also carries out administrative tasks relating to the storage, handling, protection and delivery of work products and configuration items.

This document is intended to be used by the VSE to establish processes to implement any development approach or methodology (agile, evolutionary, incremental, test-driven development, etc.) based on the VSE or project needs.

8.2 PM process outcomes

PM.O1. The project plan, the approved VSE proposal and commitments, are reviewed and accepted by both the acquirer, the organizational management, 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 made when project targets are not achieved. Closure of the project is achieved when the acquirer acceptance documented in the product acceptance record is completed. The system is disposed of in accordance with the agreement.

PM.O3. Change requests are addressed when submitted. Changes to system requirements are analysed and evaluated by the project team for cost, schedule, risks, and technical impacts.

PM.O4. Review meetings with the work team, the acquirer, and suppliers are held. Reviews of work products of activities are conducted, and the agreements are registered and tracked.

PM.O5. A risk management approach is developed. Risks are identified, analysed, prioritized, and monitored as they develop during the conduct of the project. Resources to manage the risks are determined.

PM.O6. A project configuration management strategy is developed. Configuration items (CI) are identified, defined, and baselined. Modifications and releases of the CI are controlled and made available to the customer and work team. The status of the CI and modifications are recorded and reported; the completeness and consistency of the CI is ensured; the storage, handling, and delivery of the CI are controlled.

PM.O7. Quality assurance is performed to provide assurance that the PM process and work products conform to the technical management goals and resources (e.g. human, knowledge, and material), ensuring that the cost, schedule, and risks support the viability of the VSE.

NOTE The implementation of quality assurance is conducted through the performance of the verifications, validations, and review tasks, performed in the project management and system definition and realization processes.

PM.O8. A disposal management approach is developed, with the acquirer, to support the disposal of the system at the end of its use.

8.3 PM roles involved

The roles involved in the PM process are:

— project manager;

— acquirer;

— customer;

— designer;

— systems engineer;

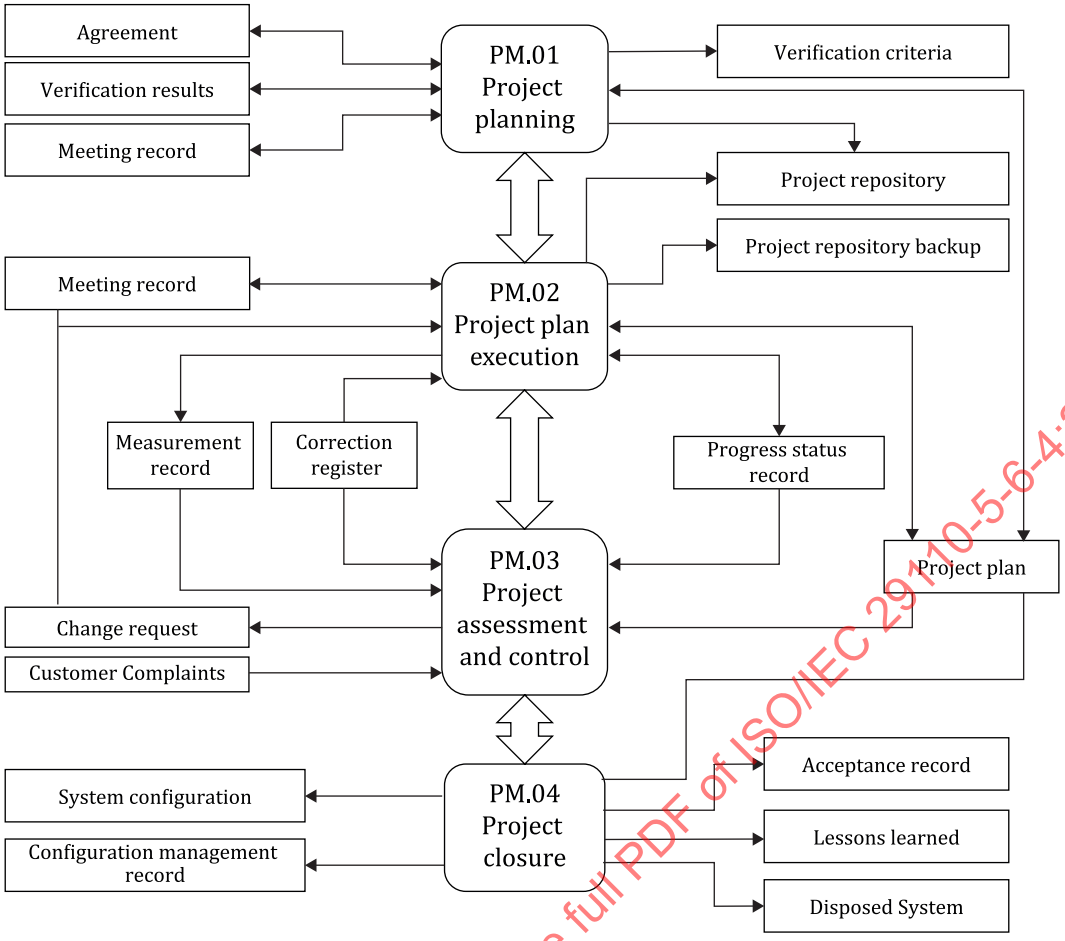
— technical leader;

— stakeholder.

8.4 PM process description

8.5 PM diagram

Figure 4 shows the flow of information between the project management process activities including the most relevant work products and their relationship.



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

Figure 4 — Project management process

8.5.1 PM activities

8.5.1.1 General

The project management process has the following activities:

— PM.01 Project planning;

— PM.02 Project plan execution;

— PM.03 Project assessment and control;

— PM.04 Project closure.

8.5.1.2 PM.01 Project planning (contributes to PM.01, PM.05, PM.06, PM.07)

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

— reviewed request for proposal (RFP) and its agreement and the tasks needed to provide the agreement deliverables;

— system breakdown structure (SBS), to provide the list of system and system elements of the project;

— project life cycle planning, 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 configuration management strategy;

— project repository to store, handle and deliver controlled work products and document versions and baselines.

The task list for PM.01 is given in Table 8.

Table 8 — PM.01 task list

Role	Task List	Input work products	Output work products
PJM SYS	PM.01.01 Review the request for proposal (RFP). 1) ISO/IEC 20246 defines work product reviews.	Request for proposal [received]	Request for proposal [approved or rejected]
PJM ACQ	PM.01.02 Define with the acquirer the delivery Instructions of each one of the deliverables specified in the agreement. 1) For drafting a project plan, see ISO/IEC/IEEE 16326.	Request for proposal [approved]	Project plan [initiated] — Delivery instructions
PJM DES	PM.01.03 Define the system breakdown structure that represents the relationship between the system and its system elements. 1) The system boundaries should be defined. 2) This task is iterative, as the system breakdown structure (SBS) is based on the system design document (SDD). 3) The SDD is preliminary, and all system elements hierarchy are not necessarily completely defined. 4) The SBS is updated while the SDD is progressively completed.	System design document	Project plan [initiated] — System breakdown structure
PJM WT	PM.01.04 Select a product life cycle and define milestones, according to the agreement.	Project plan [initiated] — System breakdown structure	Project plan [initiated] — Milestones
PJM SYS	PM.01.05 Identify the specific tasks to be performed to produce the deliverables and their system elements identified in the agreement.	Project plan [initiated] — System breakdown structure	Project plan [initiated] — Tasks

Table 8 *(continued)*

Role	Task List	Input work products	Output work products
	1) Include tasks in the SR process along with verification, validation, and reviews with acquirer/other stakeholders and work team tasks to develop quality of work products. 2) Identify the tasks to perform the Delivery Instructions. Document the tasks. 3) This task is performed in parallel with the creation of the SEMP.		
PJM	PM.01.06 Establish the estimated duration to perform each task.	Project plan [initiated] — Tasks	Project plan [initiated] — Estimated duration
PJM	PM.01.07 Identify and document the resources: human, material, equipment, tools, and standards, including the required training (competencies) of the work team, to perform the project. 1) Include in the schedule the dates when resources and training will be needed.	Project plan [initiated]	Project plan [initiated] — Resources
PJM	PM.01.08 Establish the composition of work team assigning roles and responsibilities according to the resources.	Project plan [initiated] — Resources	Project plan [initiated] — Composition of work team
PJM	PM.01.09 Assign estimated start and completion dates to each task, to create the schedule of the project tasks. 1) Consider the assigned resources, sequence, and dependency of the tasks. 2) Define milestones of the project (e.g., end of phases, payments, deliveries)	Project plan [initiated] — Tasks — Estimated duration — Composition of work team	Project plan [initiated] — Schedule of the project tasks — Milestones
PJM	PM.01.10 Calculate and document the project estimated effort and cost. 1) Using available in-house metrics or acquire commercial work estimation tool.	Project plan [initiated] — Schedule of the project — Tasks — Resources	Project plan [initiated] — Estimated effort and cost
PJM	PM.01.11 Identify and document a risk management approach and the risks which may affect the project.	All elements previously defined	Project plan [initiated] — Risk management approach
PJM	PM.01.12 Identify and document a disposal management approach.	Request for proposal [approved] Agreement [reviewed]	Project plan [initiated] — Disposal management approach
PJM	PM.01.13 Document the configuration management strategy in the project plan. 1) Identify the configuration items (CI). 2) Define the applicable configuration status. 3) Define the tasks and actors to manage the changes and the configuration.	Project plan [initiated] — System breakdown structure (SBS)	Project plan [initiated] — Configuration management strategy

Table 8 *(continued)*

Role	Task List	Input work products	Output work products
PJM	PM.01.14 Include system description, scope, objectives, deliverables, and reference to the RFP and agreement in the project plan.	Request for proposal [approved] Agreement [reviewed]	Project plan [initiated] — System description — Scope — Objectives — Deliverables — Reference to the agreement
PJM	PM.01.15 Generate the project plan integrating the elements previously identified and documented.	All elements previously defined	Project plan [initiated] — Reference to the agreement — Objectives — System description — Scope — System breakdown structure — Tasks — Deliverables — Estimated duration — Resources — Composition of work team — Milestones — Schedule of the project task — Estimated effort and cost — Risk management approach — Configuration management strategy — Delivery instructions — Disposal management approach
PJM WT	PM.01.16 Verify and obtain approval of the project plan.	Project plan [initiated]	Verification record [published]

Table 8 *(continued)*

Role	Task List	Input work products	Output work products
	1) All project plan elements are viable and consistent. 2) The results found are documented in a verification record and corrections are made until the document is approved by PJM.		Project plan [verified]
PJM ACQ STK	PM.01.17 Review and accept the project plan. 1) Acquirer and other stakeholders review and accept the project plan, making sure that the project plan elements match with the request for proposal and the agreement.	Project plan [verified]	Project plan [approved] Meeting record [signed]
PJM	PM.01.18 Prepare resource requests. 1) Resource requests are approved the TM process.	Project plan [approved]	Resource request [initiated]
PJM	PM.01.19 Establish the project repository using the configuration management strategy.	Project plan [approved] — Configuration management strategy	Project repository [established]
PJM WT	PM.01.20 Assign tasks to the work team members related to their role, according to the current project plan.	Project plan [approved] — Tasks	Project plan [approved] — Tasks

8.5.1.3 PM.02 Project plan execution (contributes to PM.02, PM.03, PM.04, PM.05, PM.07)

This 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), acquirer (ACQ), and stakeholders (STK);

— ensured safekeeping of the project organizational repository, and its recovery if necessary.

The task list for PM.02 is given in Table 9.

Table 9 — PM.02 task list

Role	Task List	Input work products	Output work products
PJM WT	PM.02.01 Monitor the project plan execution and record actual data in progress status record.	Project plan [approved]	Progress status record [evaluated]

Table 9 *(continued)*

Role	Task List	Input work products	Output work products
ACQ PJM STK	PM.02.02 Analyse and evaluate the change request for cost, schedule, and technical impact. 1) Change request can be initiated externally by the acquirer and other stakeholders, or internally by the work team. 2) Update the project plan, if the accepted change affects agreements with acquirer and stakeholders.	Change request [submitted] Project plan [approved]	Change request [evaluated]
PJM WT	PM.02.03 Conduct revision meetings with the work team, identify problems, review risk status, record agreements and track them to closure. 1) If an artefact should be purchased, review and issue the purchase order (PO) developed in activity SR.03 to acquire the artefact. 2) The purchase order is an optional WP.	Project plan [approved] Progress status record [evaluated] Correction register Meeting record Purchase order [initiated]	Meeting record [updated] Purchase order [approved]
PJM ACQ STK WT	PM.02.04 Conduct revision meetings with the acquirer, stakeholders, record agreements and track them to closure. 1) Change request is initiated by acquirer, and other stakeholders, or is initiated by work team, which affects the acquirer, stakeholders should be negotiated to reach acceptance of both parties. 2) If necessary, update the project plan according to new agreement with acquirer and other stakeholders.	Project plan [approved] Progress status record [evaluated] Change request [evaluated] Meeting record [signed]	Meeting record [updated] Change request [agreed] Project plan [updated]
PJM WT	PM.02.05 Perform configuration management of work products. 1) According to the configuration management strategy, manage configuration of the different artefacts of the project. 2) Product is generated as planned. 3) Changes (e.g. architecture, requirements) and/or project plan are developed to address major deviations, potential risks or problems concerning the accomplishment of the project. 4) Change requests on baselined artefacts are initiated and analysed impacts (e.g. technical cost, quality) before change approval by PJM.	Project plan [updated] Stakeholders' requirements specifications [validated] System requirements specifications [validated] System elements requirements specifications [validated]	Product [published] Change request [submitted]

Table 9 *(continued)*

Role	Task List	Input work products	Output work products
	5) Changes are tracked to their closure. 6) Concept of operation is an optional WP.	— System design document — System — Bought, built or reused system elements (HW, HW+SW) — Bought, built or re-used Software Elements — V&V plan — V&V integration procedure — Integration record — Verification record — Validation report — System operation guide — System user manual — System maintenance document — System training specifications — Change request [agreed] — Progress status Record [evaluated]	
PJM	PM.02.06 Manage project repository. 1) Project repository is updated at each new product change. 2) Backup and recovery testing are performed, according to the configuration management strategy.	Project plan [updated] — Configuration management strategy Product [published] Project repository	Project repository [updated] Project repository back-up
PJM	PM.02.07 Perform project repository recovery using the project repository backup, if necessary.	Project repository back-up	Project repository [recovered]

8.5.1.4 PM.03 Project assessment and control (contributes to PM.02)

This activity evaluates the performance of the plan against documented commitments. The activity provides:

— evaluation of actual plan performance and progress against targets;

— identification and evaluation of 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.

The task list for PM.03 is given in Table 10.

Table 10 — PM.03 task list

Role	Task List	Input work products	Output work products
PJM WT	PM.03.01 Evaluate project progress with respect to the project plan, comparing: — Actual tasks against planned tasks — Actual results against established project Objectives — Actual resource allocation against planned Resources — Actual cost against budget estimates — Actual time against planned schedule — Actual risk against previously identified risks	Project plan [approved] Progress status record [evaluated] Customer complaints [published]	Progress status record [evaluated]
ACQ PJM	PM.03.02 Obtain approval from the acquirer about the changes to the requirements or to the project plan. 1) Conditional task: This task is not executed if there is no change to the requirements or to the project plan.	Progress status record [evaluated] Change request [initiated] Correction register [initiated] Agreement [approved]	Change request [approved] Meeting record [approved]
PJM WT	PM.03.03 Establish and execute actions to treat deviations or problems and identified risks concerning the accomplishment of the plan as needed. 1) Document actions in correction register and track them to closure.	Project plan [approved] — Risk management approach Progress status record [evaluated]	Correction register [initiated] — Rational of deviation correction actions

Table 10 *(continued)*

Role	Task List	Input work products	Output work products
PJM WT	PM.03.04 Elaborate or update the justification document of the project. 1) Record the reasons of needs. 2) Record issues, hypothesis, architecture trade-off studies and decisions of the project. 3) Keep track of meetings and decisions. 4) Regroup or reference the verification and validation records in the justification document (if appropriate or needed). 5) Establish traceability between the rational and the related systems engineering work products.	Correction register [initiated] — Rationale of deviation correction actions System design document [updated] — System functional architecture — System physical architecture Traceability matrix [updated] Meeting record [signed] Validation records [published — Stakeholders' requirements Specifications — System requirements specification — Product delivery — System user manual — System Verification records [published] — Project plan — Stakeholders' requirements specifications — System requirements specifications — System design document	Justification document [initiated] — Justification of choices and decisions — Functional architecture trade-offs — Physical architecture trade-offs

Table 10 *(continued)*

Role	Task List	Input work products	Output work products
		— V&V plan — V&V procedure — System — System operation guide — System user manual — Product delivery — Product	

8.5.1.5 PM.04 Project closure (contributes to PM.O2, PM.O8)

This activity provides the project's lessons learned, documentation and work products in accordance with agreement requirements. The activity provides:

— delivery of the work product as specified in the delivery instructions;

— support of acquirer and stakeholders work product acceptance in accordance with the delivery instructions;

— completion of the project and signing of the acceptance record.

— lessons learned;

— execution of the disposal management approach.

The task list for PM.04 is given in Table 11.

Table 11 — PM.04 task list

Role	Task List	Input work products	Output work products
PJM ACQ	PM.04.01. Formalize the completion of the project. 1) According to the delivery Instructions established in the project plan, providing acceptance support and getting the product acceptance record signed.	Project plan [approved] — Delivery instructions Product [delivered]	Product acceptance record [approved] Product [accepted]
PJM WT	PM.04.02 Conduct lessons learned on the completed project.	Project plan [approved] Progress status record [evaluated]	Project lessons learned record [published]
PJM WT	PM.04.03 Update project repository.	Product [accepted] Project repository [updated]	Project repository [baselined]
PJM WT	PM.04.04 Execute the disposal management approach.	Project plan [approved]	Disposed system

8.5.1.6 PM incorporation to project repository

The work products to be saved in the project repository are:

— project plan;

— change request;

— product acceptance record;

— meeting record;

— correction register;

— progress status record;

— project lessons learned record;

— purchase order;

— verification record;

— validation record;

— delivery instructions;

— justification document;

— product.

After the incorporation, configuration management strategy should be applied to the project plan.

9 System definition and realization (SR) process

9.1 SR process 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 document is intended to be used by the VSE to establish processes to implement any development approach or methodology (for example agile, evolutionary, incremental, test-driven development) based on the VSE or project needs.

9.2 SR process outcomes

SR.O1. Tasks of the activities are performed through the accomplishment of the current project plan.

SR.O2. Acquirer's needs are analysed for coherence, correctness, validation and, approved by the acquirer, baselined and communicated.

SR.O3. System requirements are defined, analysed for coherence, correctness, verifiability, and approved by the acquirer. The needs should also be baselined and communicated.

SR.O4. The system architectural design is developed and baselined. It describes the system elements and internal and external interfaces of them. Coherence and traceability to system requirements are established.

NOTE 1 System architecture and detailed design can be performed separately, according to the project schedule.

SR.O5. System elements defined by the design are produced or acquired. Verification methods are defined and performed to verify the coherence with the requirements and the design. Traceability to the requirements and design are established.

SR.06. System elements are integrated. Defects encountered during integration are corrected and coherence with and traceability to system architecture are established.

SR.07. A product, as agreed in the project plan, includes the engineering artefacts as integrated, baselined, and stored in the project repository. The need for changes to the product are detected and related change requests are initiated.

SR.08. Verification and validation tasks of all required work products are performed using a defined criterion to achieve consistency among output and input work products in each activity. Defects are identified, corrected and recorded; records are stored in the verification/validation records.

NOTE 2 It's not the intention that all verification activities and work products are made available to the acquirer and other stakeholders. Verifications are performed by individuals that have organizational freedom, authority, to permit objective evaluation, and to initiate, effect, resolve, and verify problem resolution. In the best process, every verification and validation task is witnessed by an "independent witness", to help ensure that the evaluation is objective.

9.3 SR roles involved

The roles involved in the SR process are:

— acquirer;

— systems engineer;

— designer;

— developer;

— V&V engineer;

— project manager;

— stakeholder;

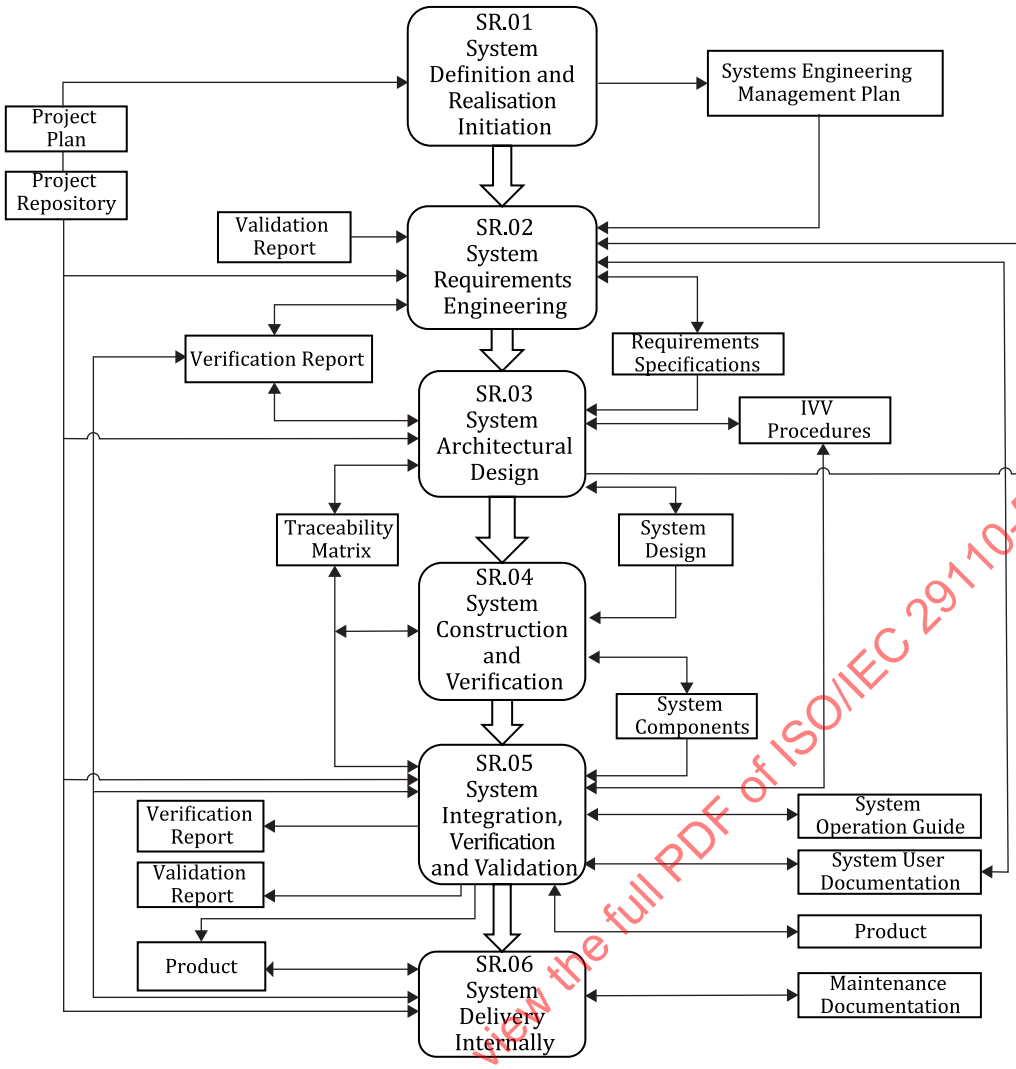
— supplier;

— work team.

9.4 SR process description

9.4.1 SR diagram

Figure 5 shows the flow of information between the system definition and realization process activities including the most relevant work products and their relationship.



NOTE 1 All the feedback lines are not all displayed to facilitate readability.

NOTE 2 The process illustrated in this figure is intended to be used with any life cycle such as waterfall, iterative, incremental, evolutionary or agile.

Figure 5 — System definition and realization process

9.4.2 SR activities

9.4.2.1 General

The system definition and realization process has the following activities:

— SR.01 System definition and realization initiation;

— SR.02 System requirements engineering;

— SR.03 System architectural design;

— SR.04 System construction and verification;

— SR.05 System integration, verification, and validation;

— SR.06 Product delivery.

9.4.2.2 SR.01 System definition and realization initiation (contributes to SR.O1)

This activity helps ensure that the project plan established in project planning activity, is committed to by the work team. The activity provides:

— review of the project plan by the work team to determine task assignment;

— a commitment to project plan by the work team and project manager;

— a systems engineering management plan (SEMP);

— an established implementation environment.

The task list for SR.01 is given in Table 12.

Table 12 — SR.01 task list

Role	Task List	Input work products	Output wok products
PJM WT	SR.01.01 Review the current project plan with the work team members. 1) Review to achieve a common understanding and get their engagement with the project. 2) ISO/IEC 20246 defines work product reviews	Project plan [approved]	Project plan [reviewed]
PJM SYS	SR.01.02 Define, in cooperation with the PJM, the technical activities and develop the systems engineering management plan (SEMP).	Project plan [reviewed]	Systems engineering management plan [initiated]
PJM WT	SR.01.03 Define the data model of the project. 1) The entities to manage in the project (e.g., requirement, system element, V&V plan, V&V procedure, integration record, verification record, validation record), their properties (e.g., maturity, version, target release) and their relation (e.g., satisfy, allocated to, verify, validate) to the project are defined.	Project plan [reviewed]	Data model [initiated]
PJM WT	SR.01.04 Set or update the implementation environment.	Project plan [reviewed] Data model [initiated]	Implementation environment [implemented]

9.4.2.3 SR.02 System requirements engineering (contributes to SR.O2, SR.O6, SR.O7)

This activity elicits and analyses the acquirer and other stakeholders' requirements, including legal and/or regulatory requirements. It establishes the agreed system requirements. In parallel to the architectural design activities, it establishes system element requirements. The activity provides:

— work team review of the project plan to determine task assignment;

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

— specification of 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;

— establishment and update of the traceability between stakeholders, system, and system elements requirements;

— establishment and update of the coverage of requirements by V&V artefacts;

— configuration management of system requirements engineering work products as agreed in the configuration management plan.

The task list for SR.02 is given in Table 13.

Table 13 — SR.02 task list

Role	Task List	Input work products	Output work products
SYS ACQ STK	SR.02.01 Elicit acquirer and other stakeholders' requirements and analyse system context. 1) Identify and consult information sources of requirements (e.g. acquirer, users, stakeholders, previous systems, documents), agreement, concept documents, previous system description, etc. 2) 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 3) Generate or update the * concept of operations that describes the way the system works from the operator's perspective. 4) Identify and analyse requirements to: 5) Specify 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 6) Resolve conflicting, duplicate, and out-of-scope stakeholder requirements Generate or update the stakeholders' requirements specifications.	Project plan [approved] — Tasks Agreement [reviewed] Systems engineering management plan [initiated]	Stakeholders' requirements specifications [initiated] Systems engineering management plan [reviewed]
PJM WT	SR.02.02 Verify the stakeholders' requirements specifications with PJM. 1) Obtain work team agreement on the stakeholder requirements specifications.	Stakeholders' requirements specifications [initiated]	Stakeholders' requirements specifications [verified] Verification record [published] — Stakeholders' requirements specifications
SYS	SR.02.03 Document the traceability between the requirements defined in the agreement and the software requirements specification.	Agreement [baselined]	Traceability matrix [initiated]

Table 13 *(continued)*

Role	Task List	Input work products	Output work products
PJM SYS ACQ STK	SR.02.04 Validate the stakeholders' requirements specifications with the acquirer and other stakeholders. 1) Obtain acquirer and stakeholder agreement on the stakeholder requirements specifications.	Stakeholders' requirements specifications [verified]	Stakeholders' requirements specifications [validated] Validation record [published] — Stakeholders' requirements specifications
SYS DES	SR.02.05 Elaborate system requirements and interfaces. 1) Define the system boundary. 2) Define interface requirements between the system and its environment. 3) Interface requirements are included in system requirements specifications. Separate specification document can be established. 4) Define system requirements, system design constraints and interface requirements with external entities/actors using the SMART (i.e. specific, measurable, accepted, realistic and traced) criteria: — Specific - without ambiguity, using consistent terminology, simple and at the appropriate level of detail — Measurable - quantify or at least suggest an indicator of progress — Achievable - possible for the system to exhibit that requirement under the given conditions. — Realistic - state what results can realistically be achieved, given available resources — Traceable - trace (forwards and backwards) a requirement from its conception through its specification to its subsequent design, implementation and test 5) Define the external functions ensured by the system (black box). 6) Define reuse constraints. 7) Define the applicable requirements and constraints to the system. 8) Generate or update the system requirements specifications.	Stakeholder requirements specifications [validated]	System requirements specifications [initiated]
DES SYS	SR.02.06 Elaborate system elements requirements specifications and the system interfaces specifications.	System requirements specifications [initiated]	System elements requirements specifications [initiated]

Table 13 *(continued)*

Role	Task List	Input work products	Output work products
	1) System element requirements are generally elaborated in parallel with the system functional and physical architectural design activity (see activities SR.03.01 and SR.03.03). 2) Allocate system requirements to System elements using 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, such that it can be traced to a specific parent system requirement. 3) Refine, as necessary, external interface requirements and identify internal interface requirements between system elements. 4) Generate or update system element requirements specifications for elements defined in the system design document. 5) Interface requirements are included in system elements requirements specifications. Separate specification document can be established. 6) System element requirements become needs and expectations inputs of the system elements implementation.		System interfaces specifications [initiated]
PJM WT	SR.02.07 Verify and obtain work team agreement on the system and system elements requirements specifications. 1) 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 (DES) — can be verified and validated (V&V) — fall within cost and schedule constraints of the project. 2) The results found are documented in a verification record and corrections are made until the document is approved by PJM. 3) If documents are under configuration management, identify and characterize the impact of the change and initiate, if necessary (i.e. change approved) a change request.	System requirements specifications [initiated] System elements requirements specifications [initiated]	System requirements specifications [verified] Verification record [published] Systems elements requirements specifications [validated] Change request (if needed)
ACQ STK	SR.02.08 Validate that system requirements specifications satisfies stakeholders' requirements specifications.	System requirements specifications [verified]	System requirements specifications [validated]

Table 13 *(continued)*

Role	Task List	Input work products	Output work products
SYS	1) The results found are documented in a validation record and corrections are made until the document is approved by the SYS.	Stakeholders' requirements specifications [validated]	Validation record [published]
SYS DES	SR.02.09 Update traceability matrix between requirements. 1) According to the data model defined in SR.01.02, 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.	Traceability matrix [initiated] Stakeholder requirements specifications [validated] System requirements specifications [validated] System elements requirements specifications [validated] System elements requirements specifications [validated]	Traceability matrix [updated]
SYS V&VE	SR.02.10 Establish or update the V&V plan and V&V Procedures for the System verification and validation. 1) Traceability is established between V&V plan and the specified requirements, between V&V procedures and V&V plan. 2) Verification is the confirmation, through the provision of objective evidence that specified requirements have been fulfilled. Methods of verification are: inspection, review, simulation, and test. 3) Validation is the confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled. 4) The V&V plan can be a standalone document or be part of the quality assurance document.	System requirements specifications [validated] System elements requirements specifications [validated] Stakeholders' requirements specifications [validated]	V&V plan [published] V&V procedures [published] Traceability matrix [updated]

9.4.2.4 SR.03 System architectural design (contributes to SR.03, SR.06, SR.07)

This activity transforms the system requirements to the system functional and physical architecture. The activity provides:

— work team review of the project plan to determine task assignment;

— design of the system functional architecture and associated interfaces;

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

— work team review of the system requirements specifications;

— functional and physical design verified and defects corrected;

— verified V&V plan (verification, validation, qualification) and verification procedures;

— traceability between the functional architecture definition and the system requirements; traceability between the physical architecture definition, the system elements, and the functional architecture definition;

— design of work products placed under configuration management.

The task list for SR.03 is given in Table 14.

Table 14 — SR.03 task list

Role	Task List	Input work products	Output work products
DES	SR.03.01 Document or update the functional system design. 1) The functional architecture is reviewed with the internal functions of the system and their relations (interfaces), by analysing: — The system requirements — The external functions of the system (black box) 2) Define the internal functions and interfaces. 3) Identify the artefacts to reuse. Decide whether to make, buy, or reuse. 4) Review the purchase order (PO) for the artefact to be purchased. 5) Define in parallel the system elements requirements and interface requirements. 6) A purchase order is documented if a work product has to be purchased by the VSE. The purchase order is an optional WP.	Project plan [approved] — Tasks System requirements specifications [validated] Traceability matrix [updated]	System design document [initiated] — System functional architecture Purchase order [initiated]
SYS DES	SR.03.02 Make trade-offs of the system functional architecture. 1) Make trade-offs among the different possible functional architectures relative to the requirements. Update the justification document and establish traceability with the requirements as defined in the PM process. 2) Functional architecture can be done in a model-based environment and generated as a document. 3) Trade-off is used here as a product name of a decision-making action recorded within a justification document.	System design document [initiated] — System functional architecture Justification document [initiated]	Justification document [updated] — System functional architecture trade-offs Traceability matrix [updated]

Table 14 *(continued)*

Role	Task List	Input work products	Output work products
DES	SR.03.03 Document or update the physical system design. 1) The physical architecture is elaborated by: — analysing the system requirements (e.g. non-functional requirements allocated directly the system elements) — analysing the functional architecture and allocating internal functions to system elements — identifying system elements to reuse. 2) The artefacts to reuse are identified. Decide whether to make, buy, or reuse. 3) Conditional task: Elaborate the purchase order for the artefact to be purchased. 4) The design is analysed as needed to demonstrate it can satisfy system requirements (e.g., maintainability, reliability, security, safety, integrity, usability). 5) The physical and functional interfaces (external and internal) are elaborated between system elements. In parallel define the interface requirements. 6) A purchase order is documented if a work product has to be purchased by the VSE. The purchase order is an optional WP.	System requirements specifications [validated] System design document [initiated] — System functional architecture	System design document [initiated] — System physical architecture Purchase order [initiated]
SYS DES	SR.03.04 Make trade-offs of the system physical architecture. 1) Trade-offs are made among the different possible physical architectures relative to the requirements and the functional architecture. 2) The justification document is updated and traceability with the requirements is established. 3) Physical architecture can be done in a model-based environment and generated as a document. 4) Traceability matrix is updated 5) Trade-off is used here as a product name of a decision-making action recorded within a justification document.	System design document [initiated] — System functional architecture — System physical architecture Justification document [updated|	Justification document [updated] — System physical architecture trade-offs Traceability matrix [updated]

Table 14 *(continued)*

Role	Task List	Input work products	Output work products
SYS DES DEV	SR.03.05 Verify and obtain approval of the system design. 1) Verify correctness of system design, its feasibility and consistency with their system requirements specifications. 2) Use the traceability matrix to verify the adequate satisfaction of system requirements. The results found are documented in a verification record and corrections are made until the document is approved by DES. 3) If system design is under configuration 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 Traceability matrix [updated] System requirements specifications [validated]	Verification record [published] — System design document System design document [validated] Change request (if needed) Traceability matrix [updated]
DES SYS	SR.03.06 Establish or update the integration plan and integration procedures for system integration. 1) Define or update the V&V plan and V&V procedures based in the system design and the system elements requirements specifications. 2) Establish traceability between V&V plan and the specified requirements; establish traceability between V&V procedures and V&V plan.	System elements requirements specifications [validated] System design document [validated]	V&V plan [published] V&V procedures [published] Traceability matrix [updated]
SYS	SR.03.07 Document the system user manual or update the current one, if appropriate. 1) The system user manual can be initiated in a preliminary version from the system requirements specifications, concept of operation (if available). 2) The concept of operations is an optional WP. 3) Conditional task. System user manual is developed if it is listed in the delivery instructions. 4) The "System [verified]" WP comes from the activity SR.05. 5) The system user manual is an optional WP.	System requirements specifications [validated] System design document [validated] System [verified]	System user manual [preliminary]
SYS ACQ STK	SR.03.08 Verify and obtain approval of the system user manual if appropriate.	System user manual [preliminary]	Verification record [published]

Table 14 *(continued)*

Role	Task List	Input work products	Output work products
	1) Verify consistency of the system user manual with the system. 2) Demonstrate the use of the system with its user manual. 3) The results found are documented in the verification record and corrections are made until the document is approved by ACQ and STK. 4) Conditional task. System user manual is developed if it is listed in the delivery instructions. 5) The system user manual is an optional WP.		— System user manual Validation record [published] — System user manual System user manual [verified]

9.4.2.5 SR.04 System construction and verification (contributes to SR.04, SR.06, SR.07)

This activity involves physical construction and/or software construction and verification of elements. 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:

— 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 verified;

— software system elements to be developed and verified;

— traceability between hardware construction, software construction, and physical architecture.

The task list for SR.04 is given in Table 15.

Table 15 — SR.04 task list

Role	Task List	Input work products	Output work products
DEV	SR.04.01 Construct or update software system elements. 1) Software construction can be performed according to the ISO/IEC TR 29110-5-1-4.	Project plan [approved] — Tasks System elements requirements specifications [validated]	Bought, built or reused software system elements Software system elements [initiated]
DEV	SR.04.02 Construct or update hardware system elements.	Project plan [approved] — Tasks	Bought, built, or reused system elements (HW, HW+SW)

Table 15 *(continued)*

Role	Task List	Input work products	Output work products
	1) 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, and production). 2) 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 [initiated]	System elements (HW, HW+SW) [initiated]
DEV DES SYS	SR.04.03 Verify that the system elements satisfy their system elements specifications. 1) Perform incoming acceptance verification of system elements in accordance with: — the project plan; — the system design document; — the system elements requirements specifications; — the applicable verification procedures. 2) 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 reused system elements (HW, HW+SW) Project plan [approved] System design document [validated] System elements requirements specifications [validated] V&V procedures [verified] Software system elements [initiated] System elements (HW, HW+SW) [initiated]	Bought, built, or reused system elements (HW, HW+SW) [verified] Bought, built, or reused system elements (HW, HW+SW) [rejected]
DEV	SR.04.04 Correct the defects found until successful verification (reaching exit criteria) is achieved.	Bought, built, or reused system elements (HW, HW+SW) [rejected]	Bought, built, or reused system elements (HW, HW+SW) [accepted]

9.4.2.6 SR.05 System integration, verification, and validation (contributes to SR.05, SR.06, SR.07)

This activity helps ensure that the integrated system elements (e.g. hardware, hardware + software) satisfy the system requirements. The activity provides:

— work team review of the project plan to determine task assignment;

— understanding of V&V plan and procedures and the integration environment;

— integrated system elements, corrected defects and documented results;

— documented and verified operational and system user documentation;

— verified system baseline.

The task list for SR.05 is given in Table 16.

Table 16 — SR.05 task list

Role	Task List	Input work products	Output work products
DES SYS DEV V&VE	SR.05.01 Verify V&V plan and V&V procedures. 1) Consistency between system requirements specifications, system design, V&V plan, and V&V procedures is verified. 2) The results found are documented in a verification record.	Project plan [approved] — Tasks — V&V plan V&V procedure System requirements specifications [validated] System design document [validated]	Verification record [published] — V&V plans — V&V procedures V&V plan [verified] V&V procedures [verified]
V&VE DES SUP	SR.05.02 Integrate the system using system elements (HW, HW+SW). 1) The interfaces according to V&V plan and V&V procedures for integration testing are verified. 2) The results found are documented in the integration record.	System design document [validated] System elements requirements specifications [validated] Traceability matrix [updated] Bought, built or reused system elements (HW, HW +SW) [accepted] V&V procedures [verified] — Integration procedures	System [integrated] Integration record [published]
V&VE SYS	SR.05.03 Verify the system against its requirements. 1) The results found are documented in a verification record. 2) The acceptance of the system is prepared.	System requirements specifications [validated] Traceability matrix [updated] V&V procedures [verified]	System [verified] Verification record [published]
V&VE SYS ACQ	SR.05.04 Validate the system against its stakeholders' requirements. 1) The system is accepted by ACQ.	Stakeholders' requirements specifications [validated] Traceability matrix [updated] V&V procedures [verified] System [verified]	System [validated] Validation record [published] Product acceptance record — System [approved]

Table 16 *(continued)*

Role	Task List	Input work products	Output work products
WT	SR.05.05 Correct the defects found and retest to detect faults introduced by the modifications.	System [validated] Verification record [published] Validation record V&V procedures [verified]	System [corrected] Validation record [published]
SYS DES	SR.05.06 Document the system operation guide or update the current guideline if appropriate. 1) Conditional task. System operation guide is developed if it is listed in the delivery instructions. 2) The system operation guide is an optional WP.	System [verified]	System operation guide [preliminary]
SYS ACQ STK	SR.05.07 Verify and obtain approval of the system operation guide, if appropriate, verify consistency of the system operation guide with the system. 1) The results are documented in a verification record. 2) Conditional task. System operation guide is developed, if it is listed in the delivery instructions. 3) The system operation guide is an optional WP.	System operation guide [preliminary]	Verification record [published] — System operation guide System operation guide [verified]

9.4.2.7 SR.06 Product delivery (contributes to SR.O6, SR.O7)

This activity provides the integrated system (i.e. product) to the acquirer and other stakeholders. The activity provides:

— work team review of the project plan to determine task assignment;

— verified system maintenance document;

— delivery of the product and applicable system documentation, in accordance with the delivery instructions.

The task list for SR.06 is given in Table 17.

Table 17 — SR.06 task list

Role	Task List	Input work products	Output work products
PJM WT	SR.06.01 Review work product. 1) ISO/IEC 20246 defines work product reviews.	System elements [initiated] Project plan [accepted] — Delivery instructions	Product acceptance record [published] — Product
SYS DES	SR.06.02 Document the system maintenance document or update the current one(s).	Project plan [approved] — Tasks assigned Product	System maintenance document [initiated]
SYS DES	SR.06.03 Identify training needs and develop system training specifications, in accordance with the project plan. 1) The system training specifications is an input to develop the system and maintenance training enabling systems.	System requirements specifications [validated] System user manual [verified]	System training specifications [initiated]
PJM SYS DES STK ACQ	SR.06.04 Verify and obtain approval of the system maintenance document and system training specifications. 1) Verify consistency of system maintenance document with system requirements specifications. 2) Verify consistency of system training specification with system requirements specifications. 3) Validate the system training specifications and system maintenance document with the acquirer and the other stakeholders. 4) The results are documented in a verification record and corrections are made until the document is approved by PJM and maintenance, as a stakeholder.	System maintenance document [initiated] System training specifications [initiated]	Verification record [published] — Product record Product [approved] System maintenance document [approved] System training specifications [validated]
PJM ACQ	SR.06.05 Perform product delivery. 1) Support delivery of training to acquirer and other stakeholders including: — Training-the-trainer — Support to pilot training classes 2) In case of hardware/software upgrades, support transition from previous to the new system, according to the 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 disposing of it.	Project plan [approved] — Tasks on product delivery assigned — Delivery instructions Product [approved] System [validated]	Product [delivered]
PJM	SR.06.06 Transition to manufacturing and in-service/after-sales Support.	Product [delivered]	Product acceptance record [published]

9.4.2.8 SR incorporation to the project repository

The work products to be saved in the project repository is provided are:

— implementation environment;

— stakeholders' requirements specifications;

— system requirements specifications;

— system elements requirements specifications;

— system operation guide;

— system design document;

  — system functional architecture;

  — system physical architecture;

— justification document;

— system functional architecture trade-offs;

— system physical architecture trade-offs;

— V&V plan;

— V&V procedures;

— traceability matrix;

— bought, built, or reused system elements (HW, HW+SW);

— system;

— systems engineering management plan;

— system user manual;

— system maintenance document;

— system training specifications;

— verification record;

— validation record;

— product;

— product acceptance record;

— product specification.

After the incorporation, the configuration management should be applied to: system requirements specifications, system design, traceability matrix, V&V plan and V&V procedure, system elements (hardware, hardware + software, software), system, system operation guide, system user documentation, maintenance and training documentation.

10 Acquisition management process (AM)

10.1 AM process purpose

The purpose of acquisition management process is to obtain the work products (e.g. material, software) and/or services that satisfy the need expressed by the VSE.

This process, a conditional process, should be executed if a VSE requires work products or services from an external supplier. If this is the case, this process is included in the scope of an audit or an assessment.

10.2 AM process outcome

— AM.O1. Obtain the work product (e.g. material, software) and/or service that satisfies the needs expressed by the VSE.

10.3 AM roles involved

The roles involved in the AM process are:

— Technical manager

— Project manager

— Supplier

10.4 AM process description

10.4.1 AM diagram

Figure 6 shows the flow of information between the acquisition management process activities including the most relevant work.

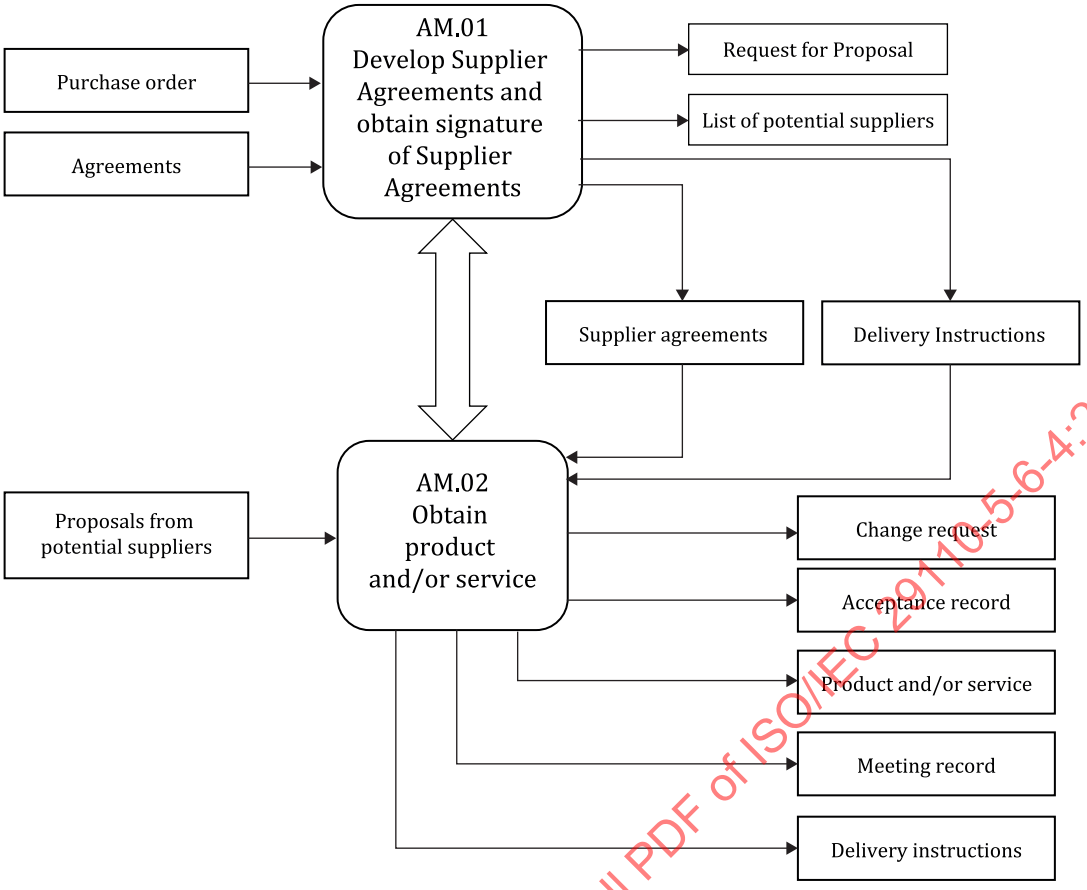


Figure 6 — Acquisition management process

10.4.2 AM activities

10.4.2.1 General

The acquisition process has the following activities:

— AM.01 Obtain approval of purchase orders and supplier agreements;

— AM.02 Obtain products and/or services.

10.4.2.2 AM.01 Obtain approval of purchase orders and supplier agreements (contributes to AM.O1)

This activity helps ensure that the work products (e.g. material, software) and/or services that satisfy the need expressed by the VSE are obtained.

The activity provides:

— approved purchase order(s);

— approved supplier agreement(s).

The task list for AM.01 is given in Table 18.

Table 18 — AM.01 task list

Role	Task list	Input work products	Output work products
PJM TCM	AM.01.01 Obtain approval of purchase order(s) from TCM. 1) A purchase order has been initiated in activity SR.03.	Agreement [approved] Purchase order(s) [initiated]	Purchase order(s) [approved]
PJM	AM.01.02 Develop, using the approved purchase order(s), the supplier agreement and the delivery instructions. 1) For example, a purchase order describes a work product or a service.	Purchase order(s) [approved]	Supplier agreement [initiated] Delivery instructions [initiated]
PJM TCM	AM.01.03 Obtain approval from TCM of the supplier agreement and the delivery instructions.	Supplier agreement [initiated] Delivery instructions [initiated]	Supplier agreement [approved] Delivery instructions [approved]
PJM TCM	AM.01.04 Identify and select supplier(s) and document/update potential suppliers on the list of potential suppliers. 1) The list of potential suppliers is developed using past agreements.	Agreements [approved]	Selected supplier(s) List of potential suppliers [updated]
PJM TCM SUP	AM.01.05 Obtain signature of the supplier agreement and the delivery instructions by the supplier. 1) The supplier agreement is signed by TCM and supplier. 2) The delivery instructions are signed by the TCM and the supplier.	Supplier(s) agreement [approved] Delivery instructions [approved]	Supplier(s) agreement [signed] Delivery instructions [signed]

10.4.2.3 AM.02 Obtain products or services or both (contributes to AM.01)

This activity helps ensure that the work products or services that satisfy the need expressed in the supplier(s) agreement is or are obtained.

The activity provides:

— products and/or services required by the supplier agreement;

— acceptance record;

— delivery instruction.

The task list for AM.02 is given in Table 19.

Table 19 — AM.02 task list

Role	Task list	Input work products	Output work products
PJM SUP	AM.02.01 Monitor the supplier agreement(s) such that specified constraints, such as cost, schedule, and quality are met. 1) If needed, document a change to the supplier agreement(s) in a change request. 2) Document any issue in meeting record. 3) Meeting records are signed by PJM and supplier(s).	Supplier agreement(s) [signed] Delivery instructions [approved]	Meeting record [signed] Change request [submitted]
PJM TCM SUP	AM.02.02 Accept supplier deliverable(s) specified in the supplier agreement(s) and delivery instructions. 1) Open items in meeting records are described and signature of the supplier of the acceptance record is obtained. 2) If the work product/service does not meet the acceptance criteria, PJM produce meeting record to document the issue(s). 3) Meeting records are signed by PJM and supplier(s).	Supplier agreement(s) [signed] Delivery instructions [approved] Meeting record [signed]	Acceptance record [signed] Meeting record [signed] Product/service [accepted] or [pending acceptance]
PJM TCM SUP	AM.02.03 Track open item(s) in a satisfactory conclusion to the VSE and the supplier(s). 1) Supplier(s) and PJM sign the acceptance record and update the list of potential suppliers.	Supplier agreement(s) [signed] Delivery instructions [approved] Product/service [pending acceptance] Meeting record [signed] Acceptance record [signed] List of potential suppliers [initiated]	Product/service [accepted] Acceptance record [signed] List of potential suppliers [updated]

10.4.2.4 AM incorporation to the project repository

The work products to be saved in the project repository are:

— purchase order;

— supplier agreement;

— delivery instructions;

— acceptance record;

— meeting record;

— product/service (from suppliers);

— list of potential suppliers.

11 System transition and disposal process (SYTD)

11.1 SYTD process purpose

The first purpose of the system transition and disposal (SYTD) process is to move the system in an orderly, planned manner into the operational status such that the system is functional and operable in the operational environment of the customer. The second purpose is to end the existence of a system element or system, by appropriately handling the replacement or retirement of elements, and to properly attend to identified critical disposal needs (e.g. per an agreement, per organizational policy, or for environmental, safety, and security aspects).

The disposal of the system encompasses the termination of services and disposal of system elements, stored data, media, firmware, information items, and associated hardware elements that will not be reused or transitioned to another system.

The SYTD process is a conditional process that should be executed if a VSE is required to in the agreement. If this is the case, the SYTD process is included in the scope of an audit or an assessment.

11.2 SYTD process outcomes

SYTD.O1. Plan the installation of the system minimizing security risks, disruption, and downtime.

SYTD.O2. Install and test the system in the target environment.

SYTD.O3. Plan the disposal of the system, minimizing security risks and disruption.

SYTD.O4. Remove system from its operational environment.

11.3 SYTD roles involved

The roles involved in the SYTD process are:

— project manager;

— customer;

— team leader;

— work team.

11.4 SYTD process description

11.4.1 SYTD diagram

Figure 7 shows the flow of information between the system transition and disposal process activities including the most relevant work products and their relationship.

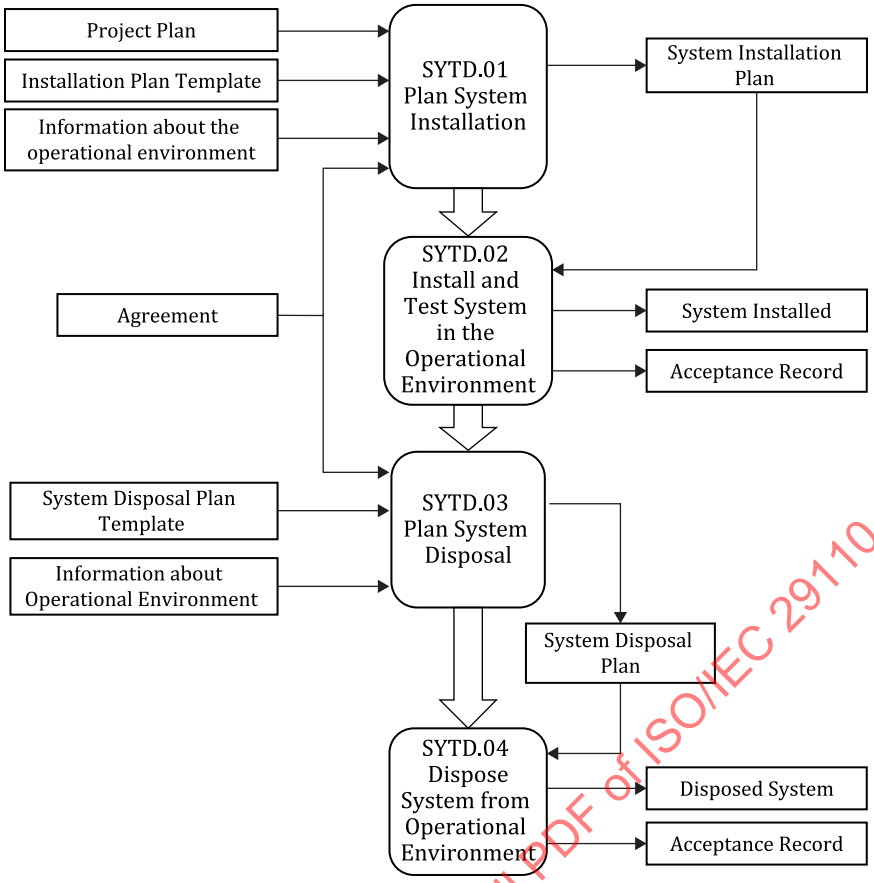


Figure 7 — System transition and disposal process

11.4.2 SYTD activities

11.4.2.1 General

The system transition and disposal process has the following activities:

— SYTD.01 Plan system installation;

— SYTD.02 Install and test the system in the operational environment;

— SYTD.03 Plan system disposal;

— SYTD.04 Dispose the system from operational environment.

11.4.2.2 SYTD.01 Plan system installation (contributes to SYTD.01)

This activity ensures that the VSE has developed and obtained approval from the customer of a system installation plan. The activity provides:

— approved system installation plan.

The task list for SYTD.01 is given in Table 20.

Table 20 — SYTD.01 task list

Role	Task List	Input work products	Output work products
PJM CUS TL	SYTD.01.01 Obtain from customer the information required to install the system in the selected operational environment.	Agreement [approved] Project plan [approved] — Delivery instructions	System disposal plan [initiated] — Description of the operational environment
PJM TL	SYTD.01.02 Document the system installation plan using the delivery instructions. 1) The delivery instructions, as an element of the project plan, was approved by the customer. 2) Tasks, schedule, composition of WT, resources, installation, and information security risks are documented in the installation plan. 3) System transition plan is the most significant one. It answers the question of how to move to the new system with the lowest issues and cost while maintaining the customers service and cutover process. Whether the new system will be mirrored, ghosted, or just swapped out. 4) Roll back should be considered and if so, a roll back plan should be done and agreed to. These will drive the project plan for transitioning and include the installation plan. 5) System assurance should be considered.	Agreement [approved] System disposal plan [initiated] — Description of the operational environment Project plan [approved] — Delivery instructions	System installation plan [initiated] — Description of the operational environment — tasks — Composition of WT — Estimated effort — Estimated cost — Schedule — Resources — Risks — Cutover plan — Rollback plan — New system assurance plan — Ghost, mirror or cutover
PJM CUS	SYTD.01.03 Review the system installation plan with customer. 1) ISO/IEC 20246 defines work product reviews.	System installation plan [initiated]	System installation plan [reviewed]
PJM CUS	SYTD.01.04 Obtain approval of the system installation plan from the customer.	System installation plan [reviewed]	System installation plan [approved]

11.4.2.3 SYTD.02 Install and test system in the operational environment (contributes to SYTD.02)

The system is installed and tested in the operational environment of the customer and, the customer has approved the installation. The activity provides:

— system installed in the operational environment;

— system tested in the operational environment;

— acceptance record signed by the customer.

The task list for SYTD.02 is given in Table 21.

Table 21 — SYTD.02 task list

Role	Task List	Input work products	Output work products
PJM TL WT	SYTD.02.01 Install system in the operational environment of the customer.	System installation plan [approved]	System [installed]
TL WT	SYTD.02.02 Test the system in the operational environment of the customer.	System [installed]	System [verified]
PJM CUS	SYTD.02.03 Obtain approval of installation of system from the customer.	System [tested]	Acceptance record [approved]
PJM TL	SYTD.02.04 Collect documents and store in the project repository.	System installation plan [approved] Acceptance record [approved]	Project repository [updated]

11.4.2.4 SYTD.03 Plan system disposal (contributes to SYTD.03)

This activity ensures that the VSE has developed and obtained approval from the customer of a system disposal plan (or retirement plan). The activity provides:

— system disposal plan.

The task list for SYTD.03 is given in Table 22.

Table 22 — SYTD.03 task list

Role	Task List	Input work products	Output work products
PJM TL CUS	SYTD.03.01 Obtain from customer information about the operational environment of the system to be disposed. 1) Information about the operational environment of the customer is documented.	Agreement [approved]	System disposal plan [initiated] — Description of the operational environment of the customer
PJM TL CUS	SYTD.03.02 Document with customer constraints on disposal of the system.	System disposal plan [initiated] — Description of the operational environment of the customer	System disposal plan [initiated] — Description of the operational environment of the customer — Disposal constraints
PJM TL	SYTD.03.03 Document the system disposal plan.	System disposal plan [initiated]	System disposal plan [initiated]

Table 22 *(continued)*

Role	Task List	Input work products	Output work products
	1) Tasks, schedule, composition of WT, resources, installation, and information security risks are documented in the system disposal plan.	— Description of the operational environment of the customer — Disposal constraints agreement	— Description of the operational environment of the customer — Disposal constraints tasks — Composition of WT — Estimated effort — Estimated cost — Schedule — Resources — Risks
PJM CUS	SYTD.03.04 Obtain approval to access the customer operational environment.	System disposal plan [initiated] — Description of the operational environment of the customer — Disposal constraints tasks — Composition of WT — Estimated effort — Estimated cost — Schedule — Resources — Risks	System disposal plan [initiated] — Description of the operational environment of the customer — Disposal constraints tasks — Composition of WT — Estimated effort — Estimated cost — Schedule — Resources — Risks — Access to operational environment of the customer granted
PJM TL	SYTD.03.05 Review the disposal plan with the customer. 1) ISO/IEC 20246 defines work product reviews.	System disposal plan [initiated]	System disposal plan [reviewed]
PJM CUS	SYTD.03.06 Obtain approval of the disposal plan from the customer.	System disposal plan [reviewed]	System disposal plan [approved]

11.4.2.5 SYTD.04 Dispose the system from operational environment (contributes to SYTD.O4)

The system is disposed from the operational environment of the customer. The activity provides:

— disposed system;

— acceptance record.

The task list for SYTD.04 is given in Table 23.

Table 23 — SYTD.04 task list

Role	Task List	Input work products	Output work products
TL WT CUS	SYTD.04.01 Deactivate the selected system to prepare it for disposal.	System disposal plan [approved]	System [deactivated]
TL WT CUS	SYTD.04.02 Remove the deactivated system from the operational environment of the customer.	System [deactivated]	System [disposed]
PJM CUS	SYTD.04.03 Obtain acceptance of completed disposed system from the customer.	System [disposed]	Acceptance record [approved]
PJM TL	SYTD.04.04 Collect documents and store in the project repository.	System disposal plan Acceptance record [approved]	Project repository [updated]

11.4.2.6 SYTD Incorporation to the project repository

The work products to be saved in the project repository are:

— system installation plan;

— delivery instructions;

— acceptance record (of installed system);

— system disposal plan;

— acceptance record (of disposed system).

12 Roles

Table 24 provides an alphabetical list of the roles and suggested competencies description.

Table 24 — Roles

	Role	Competency
1.	Acquirer	The acquirer is the stakeholder's representative. He is responsible for the acquisition of the system. The acquirer is internal or external to the supplier organization. Acquisition of a work product involves, 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 has knowledge of the stakeholders' processes and ability to explain the stakeholders' requirements. The acquirer fills the role in the organization that receives the work product or service. In some context the acquirer is the end user of the system. The acquirer should have the authority to approve the requirements and their changes. The stakeholder includes user representatives to help ensure that the operational environment is addressed. Knowledge and experience in the application domain.
2.	Designer	Knowledge and experience in the architecture design. Knowledge of the revision techniques. Knowledge and experience in the planning and performance of integration tests. Knowledge of the editing techniques. Experience on the system development and maintenance.
3.	Developer	Knowledge in fabrication and development (HW, SW) Knowledge and experience in the application domain
4.	V&V engineer	Knowledge of the agreement, the requirements and design Knowledge in inspection, peer review, simulation, and review techniques Knowledge in testing techniques and trackability
5.	Project manager	Leadership capability with experience making decisions, planning, personnel management, delegation, supervision, finances, and system development.
6.	Stakeholder	Stakeholders are actors that have an interest in the system, all along its life cycle, such as representatives of users, users, maintainers, security, trainers, regulatory bodies, suppliers. The stakeholder has the knowledge of the stakeholder (e.g. manufacturer, maintainer, tester, logistic) processes and ability to explain the stakeholder requirements. The stakeholder (representative) should have the authority to approve the requirements and their changes. The stakeholder (representative) should have knowledge and experience in the application domain.
7.	Supplier	Supplier of a system element of the system: hardware, software, or hardware with software.

Table 24 *(continued)*

	Role	Competency
8.	Systems engineer	Knowledge and experience eliciting, specifying, and analysing the requirements. Knowledge in designing user interfaces and ergonomic criteria. Knowledge of the revision techniques. Knowledge of the requirements authoring. Knowledge of the business domain. Experience on system development, integration, operation, and maintenance. Experience on the system development and maintenance.
9.	Technical manager	Knowledge of the VSE strategy Knowledge of the VSE projects Knowledge of the budget information Knowledge of the VSE processes
10.	Work team	Knowledge and experience according to their roles on the project: SYS, DES, DEV and V&V. Knowledge on the standards used by the acquirer and/or by the VSE.

13 Work product description

13.1 States of work products

Table 25 provides an alphabetical list and a definition of the states of work products.

Table 25 — Definition of states of work products

Name of state	Definition of states
Approved	An authorized stakeholder has checked that a work product is ready for delivery and has provided a sign-off for the work product.
Assigned	A task has been assigned to the work team members related to their role.
Baselined	A work product has been approved and uploaded in the repository.
Cancelled	A planned work product or an element of a work product has been deleted from the project plan.
Completed	A work product is considered complete.
Corrected	Defect(s) identified in a work product has(ve) been removed
Deleted	A planned work product or an element of a work product has been deleted from the baseline.
Delivered	A work product or a set of work products, that has been approved by the customer or authorized stakeholders, has(ve) been delivered to the customer
Established	A tool, an environment or a project repository is operational.
Evaluated	A work product or an element of a work product that has been verified and validated.
Implemented	Code has been written to implement the requirement, and the requirement's corresponding design elements have been traced into the code.
Initiated	The workflow for a work product has been initiated.
Postponed	A work product or an element of a work product is planned for implementation in a later release.
Preliminary	A work product that has not yet been submitted for approval.
Published	A work product has been approved and uploaded in the repository. The work product is a stable base for further development.
Recovered	A work product stored in a repository was successfully restored
Rejected	A work product or an element of a work product that has not been approved

Table 25 *(continued)*

Name of state	Definition of states
Reviewed	A work product was presented to the authorized customer or stakeholder(s) as applicable for comment
Updated	A new version of a work product has been produced and stored in a repository.
Validated	A work product was evaluated to confirm, through the provision of objective evidence, that it will fulfil its requirements for its intended use and was approved by authorized stakeholders(s)
Verified	A work product was evaluated (e.g. via test, review) to confirm, through the provision of objective evidence, that it fulfils its specified applicable requirements.

13.2 Description of work products

Table 26 and Table 27 provide descriptions of the input, output and internal process work products, its descriptions, possible states, and the source of the work products. The source can be another process or an external entity to the project, such as the customer.

Work product items in the following tables are based on ISO/IEC/IEEE 15289 information items with some exceptions.

Information items may be combined or subdivided, consistent with the project, service, or processes, phases, and stakeholder needs by a VSE.

The work product states give information to the project team about the type of work (tasks) already done on the work product (e.g. evaluated, verified, tested, and baselined). This information can be used to start the next tasks that can use the work product as an input. Some work products have no state assigned because they are only informative, and they do not change the content (e.g. acceptance record, correction register, project repository backup, and verification/validation record).

Table 26 lists the work products of the Intermediate profile.

Table 27 lists the work products added for the Advanced profile.

Work products (WPs) are identified with a unique code WP.XX where XX is a sequential number. These codes have not been used in the descriptions of activities and tasks to facilitate readability.

A work product is available on the media identified in the project plan. As an example, a work product can be available as a paper document, as an item of an email, or as an item of an electronic tool.

Table 26 — Work product descriptions of the Intermediate profile

Work product identification	Name	Description – WP common to the Intermediate profile	Source
WP.01	Agreement	Describes the mutual acknowledgement of terms and conditions under which a working relationship is conducted. EXAMPLE Contract, memorandum of agreement. It may have the following characteristics:	Technical management

Table 26 *(continued)*

Work product identification	Name	Description – WP common to the Intermediate profile	Source
		— identifies customer requirements (functional and non-functional); — identifies time frame for delivery; — identifies budget and resources provided by both parts; — identifies what is to be purchased; — identifies any warranty information; — identifies any copyright and licensing information; — identifies acceptance criteria (e.g., delivery instructions); — identifies change management and problem resolution procedures; — identifies the role of the customer; — provides evidence of review and approval by authorised signatories. The applicable states are: initiated, approved, and updated.	
WP.02	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 V&V facilities; — Impact to operations of the existing system(s) defined; — Impact to associated documentation defined; — Criticality of the request, date needed. The applicable states are: submitted, evaluated, approved, and rejected.	System definition and realization Project management
WP.03	Concept of operation	User-oriented document that describes a system's operational characteristics from the end user's viewpoint. It may have the following characteristics:	System definition and realization Project management

Table 26 *(continued)*

Work product identification	Name	Description – WP common to the Intermediate profile	Source
		— Statement of the goals and objectives of the system — Strategies, tactics, policies, and constraints affecting the system — Organizations, activities, and interactions among participants and stakeholders — Clear statement of responsibilities and authorities delegated — Specific operational processes for fielding the system — Processes for initiating, developing, maintaining, and retiring the system The applicable states are: initiated and approved.	
WP.04	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 for deviation correction action. The applicable states are: initial and published.	Project management
WP.05	Configuration management record	Documents the configuration and status of the system and associated documentation. It may have the following characteristics: — a list of the approved configuration; — status of proposed changes to the configuration; — implementation status of approved changes; — “as delivered” product. The applicable states are: initiated and updated.	System definition and realization
WP.06	Human resource record	Personnel and training information for human resources. It may have the following characteristics:	Technical management

Table 26 *(continued)*

Work product identification	Name	Description – WP common to the Intermediate profile	Source
		— Human resource register: — personal data; — education; — experience; — competency — roles assigned; — training. — Training plan/record description of the training activities. It may have the following characteristics: — courses, workshops, mentoring, on-the-job training, etc.; — calendar (planned and actual information); — trainers; — logistics. The applicable states are: updated and approved.	
WP.07	Integration approach	Describes the approach used to integrate the software and hardware components to obtain the system. One approach is a global integration (big-bang integration) where all the software and hardware elements are assembled in only one step. Another approach is to integrate hardware and software components as they become available. Other known approaches are top-down integration, risk driven integration (i.e. most critical components are integrated first) and bottom-up integration. It may have the following characteristics: — the order for assembling the implemented hardware and software components, based on the priorities of the system requirements and architecture definition, focusing on the interfaces; — regression strategy; — minimisation of integration time, cost, and risks. NOTE For more information about different integration approaches, see reference to the related V&V procedures — Date — Place — Duration — Verification checklist — Passed items of integration — Failed items of integration — Pending items of integration: not run, partial execution — Defects identified during integration	System definition and realization

Table 26 *(continued)*

Work product identification	Name	Description – WP common to the Intermediate profile	Source
		The applicable state is: verified and approved.	
WP.08	Justification document	The justification document contains all the justifications of choices, decisions (e.g. trade-offs), results of integration, verification and validation. This document is updated progressively during the development of the system. It can be used to justify the compliance for certification or qualification. The applicable states are: initial and updated.	System definition and realization
WP.09	List of products or services to be acquired	List the products or services to be acquired from the supplier(s). It may have the following characteristics: — software component(s); — hardware component(s); — service(s); — potential supplier(s); — delivery Instructions. The applicable state is: initiated	Technical management
WP.10	List of potential suppliers	List potential suppliers that can provide the product or service required. It may have the following characteristics: — product(s) required; — service(s) required; — potential supplier(s). The applicable states are: initiated and updated.	Acquisition management
WP.11	Measurement record	Records measurements collected during the execution of the tasks. It may have the following characteristics: — Process measures EXAMPLE effort (person-hour), estimation accuracy (e.g. estimated/actual start and end dates), estimated cost, cost of rework, productivity. — Work product measures EXAMPLE for software: quality (number of defects), size (number of requirements, number of pages, number of lines of code, number of function points). — EXAMPLE for hardware: quality (number of defects), technical data package (number of requirements, technical drawings, product specification, verification (testing) procedure(s). NOTE For more information about measuring process, see the ISO/IEC/IEEE 15939. The applicable state is: published.	All processes

Table 26 *(continued)*

Work product identification	Name	Description – WP common to the Intermediate profile	Source
WP.12	Organizational lessons learned record	A lesson learned meeting is conducted after each project has been completed. The objective is to capture and document the organizational knowledge gained after the project has been completed and closed to improve the performance of the VSE. The information from the following documents can be used when performing a lesson learned review: — Organizational management plan; — Business objectives; — Project plans; — Progress status records; — Correction register; — Meeting records. It may have the following characteristics: — potential causes of problems; — recommendations to improve the performance of VSE and projects such as quality, estimates, schedule. The applicable state is: approved.	Technical management
WP.13	Organizational repository	Electronic container to store organizational documents such as processes and work products. It may have the following capabilities: — storage and retrieval; — content browsing; — listing of contents, with description of attributes; — sharing and transfer of work products between affected groups; — effective controls over access; — work products description maintenance; — to recover archived versions of work products; — to report work products status. The organizational repository may contain — agreement; — agreements with customers; — agreements with suppliers; — reusable components; — organizational lessons learned; — project work products; — human resource records; — project released products. The applicable states are: established and updated.	Technical management