TECHNICAL REPORT

ISO/IEC TR 29110-5-6-3

First edition
2019-09

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

Part 5-6-3: Systems engineering: Management and engineering guide: Generic profile group: Intermediate profile

Reference number
ISO/IEC TR 29110-5-6-3:2019(E)

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Foreword

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

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see http://patents.iec.ch).

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

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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 29110 series can be found on the ISO website.

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.

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Introduction

Very Small Entities (VSEs) around the world are contributing to valuable products and services. For the purpose of ISO/IEC 29110 (all parts), a Very Small Entity (VSE) is an enterprise, an organisation, a department or a project having up to 25 people. Since many VSEs develop and/or maintain system elements and software components used in systems, or sold to be used by others, a recognition of VSEs as suppliers of high-quality products is required.

According to the Organization for Economic Co-operation and Development (OECD) SME and Entrepreneurship Outlook report (2005) 'Small and Medium Enterprises (SMEs) constitute the dominant form of business organisation in all countries world-wide, accounting for over 95 % and up to 99 % of the business population depending on country'. 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 conformance with these standards is difficult, if not impossible. Subsequently 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 often cut off 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 application of standards to their business practices. Most VSEs can neither afford the resources, in terms of number of employees, expertise, budget and time, nor do they see a net benefit in establishing systems or software lifecycle processes. To rectify some of these difficulties, a set of guides has been developed according to a set of VSE characteristics. The guides are based on subsets of appropriate standards processes, activities, tasks, and outcomes, referred to as profiles. The purpose of a profile is to define a subset of International Standards relevant to the VSEs' context; for example, processes, activities, tasks, and outcomes of ISO/IEC/IEEE 12207 for software; and processes, activities, tasks, and outcomes of ISO/IEC/IEEE 15288 for systems; and information products (documentation) of ISO/IEC/IEEE 15289 for software and systems.

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

The ISO/IEC 29110 series of standards and technical reports can be applied at any phase of system or software development within a lifecycle. 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 (all parts).

ISO/IEC 29110 (all parts) is intended to be used with any lifecycles 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. See Table 1.

Table 1 — ISO/IEC 29110 (all parts) target audience

The ISO/IEC 29110 series	Title	Target audience
ISO/IEC 29110-1	Overview	VSEs and their customers, assessors, standards producers, tool vendors and methodology vendors.

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Table 1 *(continued)*

The ISO/IEC 29110 series	Title	Target audience
ISO/IEC 29110-2	Framework for profile preparation	Profile producers, tool vendors and methodology vendors. Not intended for VSEs.
ISO/IEC 29110-3	Certification and assessment guidance	VSEs and their customers, assessors, accreditation bodies.
ISO/IEC 29110-4	Profile specifications	VSEs, customers, standards producers, tool vendors and methodology vendors.
ISO/IEC 29110-5	Management, engineering and service delivery guidelines	VSEs and their customers.
ISO/IEC 29110-6	Profile specifications	VSEs, customers, standards producers, tool vendors and methodology vendors.
ISO/IEC 29110-7	Specific profile guidelines	VSEs and their customers.

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

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

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

ISO/IEC 29110-3-m defines certification schemes, assessment guidelines and compliance requirements for process capability assessment, conformity assessments, and self-assessments for process improvements. ISO/IEC 29110-3-m 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-m is addressed to people who have direct involvement with the assessment process, e.g. the auditor, certification and accreditation bodies and the sponsor of the audit, who need guidance on ensuring that the requirements for performing an audit have been met.

ISO/IEC 29110-4-m provides the specification for all profiles in one profile group that are based on subsets of appropriate standards elements.

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

ISO/IEC 29110-6-m provides the specification for specific profiles that are based on subsets of appropriate standards elements.

ISO/IEC TR 29110-7-m provides a guide for each profile in the specific profile group.

This document provides a management and engineering guide for the systems engineering Intermediate profile of the generic profile group. This guide is oriented towards the management of more than one project in parallel with more than one work team.

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

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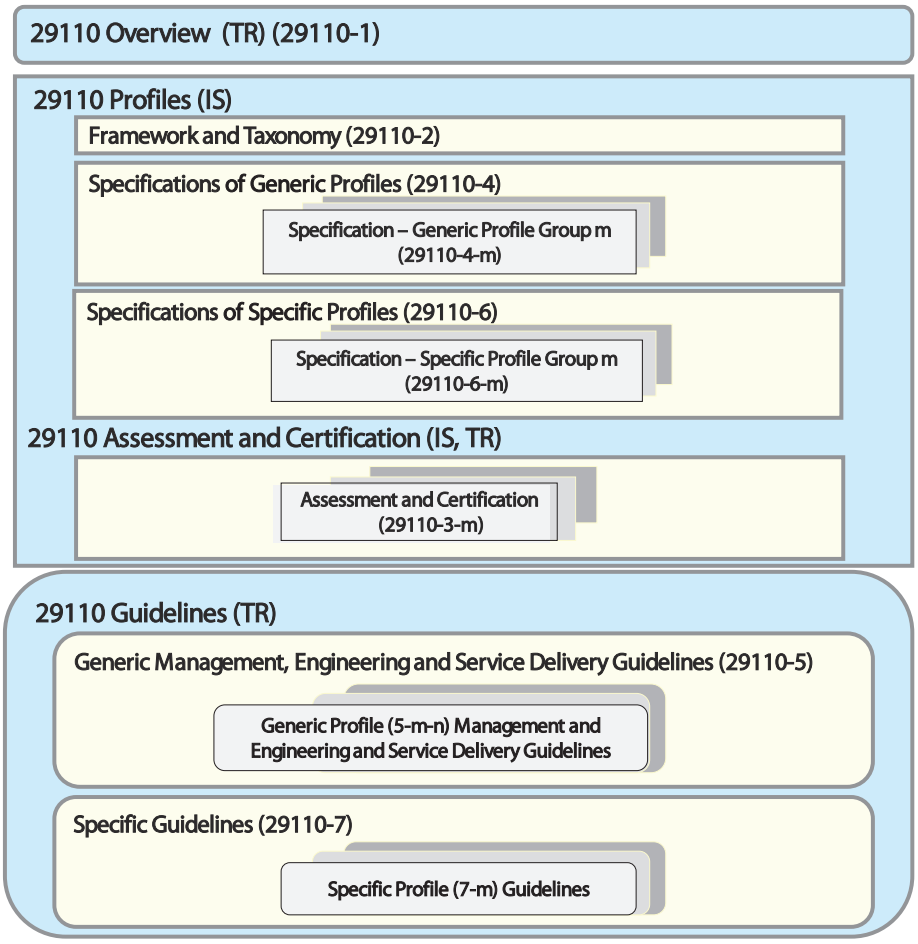

Figure 1 — The ISO/IEC 29110 Series

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

Part 5-6-3: Systems engineering: Management and engineering guide: Generic profile group: Intermediate profile

1 Scope

1.1 Fields of application

This document provides management and engineering guidance within the Intermediate profile for the Business Management, Project Management, System Definition and Realisation and Acquisition Management processes.

This document is applicable to Very Small Entities (VSEs). VSEs are enterprises, organisations, departments or projects having up to 25 people. The lifecycle processes described in the ISO/IEC 29110 series are not intended to preclude or discourage their use by organisations bigger than VSEs.

This document has been developed using the management and engineering guide from the systems engineering Basic 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 guide is oriented towards the management of more than one project in parallel with more than one work team.

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

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

— An agreed set of project requirements (technical part of contract) and expected work products are agreed by the Acquirer.

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

— A systematic System Definition and Realisation process, that satisfies Acquirer needs and helps ensure quality work products, is followed.

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

In the context of systems engineering, that is the System Definition and Realisation (SR) process, the group that is part of the VSE responsible for developing software elements that are part of the system are encouraged to use the management and engineering guide of the software engineering Intermediate profile (ISO/IEC TR 29110-5-1-3).

1.2 Target audience

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

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This document is also targeted to VSEs which are familiar with management and engineering guide of the systems engineering Basic profile (ISO/IEC TR 29110 5-6-2) for their system development projects and are 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 processes, techniques and methods that enhance the VSE's Stakeholder satisfaction and productivity.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 29110-2-1, *Software engineering — Lifecycle profiles for Very Small Entities (VSEs) — Part 2-1: Framework and taxonomy*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 29110-2-1 and the following apply.

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

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

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

3.1
agreement
mutual acknowledgement of terms and conditions under which a working relationship is conducted

EXAMPLE Contract, memorandum of agreement.

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

3.2
acquirer
stakeholder that acquires or procures a product or service from a supplier

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

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

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

Note 1 to entry: Examples of critical items include safety critical items, fracture critical items, mission critical items, key characteristics, etc.

Note 2 to entry: This definition is adapted from (AS/EN/JIS Q) 9100:2009.

3.4
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.

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

3.5
disposed system
system (3.10) that has been transformed (i.e. state change) by applying the disposal process

Note 1 to entry: A systems approach considers the total system and the total lifecycle of the system. This includes all aspects of the system and the system throughout its life until the day *users* (3.13) depose of the system and the external enterprises complete the handling of the disposed system products.

3.6
enabling system
system (3.10) that supports a *system-of-interest* (3.11) during its life cycle stages but does not necessarily contribute directly to its function during operation

EXAMPLE A configuration management system used to control software elements during software development.

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 15288:2015, 4.1.18, modified — The original EXAMPLE has been replaced with a new one.]

3.7
operator
individual or organization that performs the operations of a *system* (3.10)

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

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

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

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

3.8
systems engineering management plan
SEMP
systems engineering plan
top-level plan for managing the SE effort which, as such, defines how the project will be organized, structured, and conducted and how the total engineering process will be controlled to provide a product that satisfies stakeholder requirements

Note 1 to entry: This definition is adapted from INCOSE:2010.

3.9
small and medium enterprise
SME
enterprise which employs less than 250 persons

Note 1 to entry: This definition is adapted from OECD:2005.

3.10
system
combination of interacting elements organized to achieve one or more stated purposes

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

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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 15288:2015, 4.1.46]

3.11
system-of-interest
SOI
system (3.10) whose life cycle is under consideration in the context of this document

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.46, modified — The abbreviated term "SOI" has been added.]

3.12
trade-off
decision-making actions that select from various requirements and alternative solutions on the basis of net benefit to the stakeholders

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

3.13
user
individual or group that benefits from a *system* (3.10) during its utilization

Note 1 to entry: The role of user and the role of *operator* (3.7) are sometimes vested, simultaneously or sequentially, in the same individual or organization.

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.51, modified — The words "interacts with a system" have been removed.]

3.14
system structure
decomposition of a *system-of-interest* (3.11) into a set of interacting *systems* (3.10) and system elements
Note 1 to entry: The system structure is described in a System Breakdown Structure (SBS).

3.15
statement of work
SOW
document used by the *acquirer* (3.2) that includes the needs and expectations, the scope, objectives and deliverables

3.16
work breakdown structure
WBS
<Output/Input> 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: It organizes and defines the total scope of the project.

[SOURCE: ISO/IEC/IEEE 24765:2017, 3.4603, modified — The domain "<Output/Input>" has been added; Note 1 to entry has been added.]

4 Conventions and abbreviated terms

4.1 Naming, diagramming and definition conventions

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

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

Purpose — general goals and results expected of the effective implementation of the process. The implementation of the process should provide tangible benefits to the stakeholders.

Objectives — specific goals to help ensure the accomplishment of the process purpose. The objectives are identified by the abbreviation of the process name, followed by the letter "O" and a consecutive number, for example PM.O1, SR.O2, etc. Annex B presents a mapping between the objectives of this document and the base standards used to develop this profile.

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. They are identified by the abbreviation of the process name and showed as a two-column table of work product names and sources.

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 Acquirer or Organisational Management. They are identified by the abbreviation of the process name and showed as a two-column table of work product names and destinations.

Internal Work Products — work products generated and consumed by the process. They are identified by the abbreviation of the process name and showed as a one-column table of the work product names.

All work products' names are printed in italics and begin with capital letters. Some work products have one or more statuses attached to the work product name surrounded by square brackets "[ ]" and separated by ",". The work product status may change during the process execution. See Clause 12 for the alphabetical listing of the work products, its descriptions, possible statuses and the source of the work product. The source can be another process or an external entity to the project, such as the Acquirer.

Rectangle boxes — the rectangle boxes following the description of process objectives correspond to ISO/IEC/IEEE 15288.

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 showed as a two-column table. See Clause 11 for the alphabetical list of the roles, its abbreviations and required competencies description.

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

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

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

The tasks description table contains four columns corresponding to:

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

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— Task — description of the task to be performed. Each task is identified by activity ID and consecutive number, for example PM1.1, PM1.2, and so on.

— Input Work Products — work products needed to execute the task.

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

Organisational Repository — list of work products to be saved in *Organisational Repository*; the *Configuration Management Strategy* needs to be applied to some of them. It is useful as a checklist for project manager and technical leader.

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

4.2 Notation used to document new processes, additions and modifications to the Basic profile processes

The Intermediate profile is the third profile of a four-profile roadmap (i.e. Entry, Basic, Intermediate and Advanced). The Intermediate profile has been designed to build upon the processes of the Basic profiles such that, when moving from the Basic profile to the Intermediate profile, a VSE needs to add to its existing Basic profile processes the new processes (e.g. objectives, activities, tasks, roles and work products) described in this document.

Since, in the Intermediate profile, there are additions and modifications to the Basic 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 Realisation (SD) processes, of the Basic profile, have been complemented with additional objectives, 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 Basic profile:

— added text:

  — is underlined;

  — except for the processes of the Intermediate profile;

— deleted/modified text is struck out as follows: ~~the text is stroked out~~.

The Intermediate profile has two new processes that are not in the Basic profile: The Business Management (BM) process and a conditional process, the Acquisition Management (AM) process. The execution of the AM process is required only if a product/service needs to be obtained from an external Supplier by a VSE. To facilitate the identification of additional abbreviations, roles and work products of the BM and AM processes of the Intermediate profile, these items are underlined. To facilitate reading, the BM and AM processes have not been underlined.

The Intermediate 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:

— “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 12. These codes have not been used in the descriptions of activities and tasks in order to facilitate readability.

4.3 Abbreviated terms

The following abbreviations are used in this document:

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ACQ	Acquirer
AM	Acquisition Manager
BM	Business Manager
HW	Hardware
IVV	Integration, Verification and Validation
PO	Purchase Order
PM	Project Management
PJM	Project Manager
PROM	Proposal Manager
SE	System Engineering
SEM	System Engineering Management
SEMP	System Engineering Management Plan
SMART	Specific, Measurable, Accepted, Realistic and Traced
SME	Small and Medium Enterprise
SBS	System Breakdown Structure
SDD	System Design Document
SOW	Statement of Work
SR	System Definition and Realisation
STK	Stakeholder
SUP	Supplier
SW	Software
TPM	Technical Performance Management
VSE	Very Small Entity
WBS	Work Breakdown Structure
WP	Work Product

5 Systems Thinking

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

System Thinking allows for a better understanding of the systems as a whole: System Thinking is used to broaden the perspective to larger environments by considering the entire lifecycle of the system and

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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 needs to clearly understand these relationships before defining a solution.

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

For the purpose of this document, System Thinking should be considered when understanding the system to be designed so that, when identifying the requirements, all the stakeholders 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 the parts.

6 Overview

The Management and Engineering Guide of the Intermediate Profile applies to a Very Small Entity (VSE), i.e. enterprise, organisation, department, with more than one project having up to 25 people. The VSE is familiar with or have implemented the systems engineering Basic profile guide, i.e. ISO/IEC TR 29110-5-6-2, for their system development projects. It is possible that the VSE, being dedicated to software engineering find itself with systems engineering responsibilities. In this case the VSE should be familiar with or have implemented the software engineering Basic profile guide, i.e. ISO/IEC TR 29110-5-1-2, for their software development projects. The VSE efforts are dedicated to system development of non-critical systems. The projects may fulfil external or internal ~~contracts~~ agreements. The internal ~~contract~~ agreement between the project team and its Acquirer need not be explicit.

This document provides the following processes: Business Management, Acquisition Management, Project Management and, Systems Definition and Realisation. These processes integrate practices based on the selection of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 15289 standards elements. Annex A provides information about Deployment Packages which will facilitate the implementation of these processes.

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

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

— An in-place business management process maintains and improves the business relationship across different projects. Business management is making sure that the human resources, infrastructure and supportive equipment (H/W and S/W) are available, known and functional for more than one project at a time. The business management process helps ensure that each project satisfies Acquirer needs and provides quality work products.

— A set of project needs (Acquirer's needs) and a set of technical requirements (technical part of the agreement ~~contract~~) and expected work products as are agreed with the Acquirer.

— A disciplined project management process, to plan and execute more than one project at a time and that provides project visibility and control; coupled with corrective actions of project problems and deviations, is performed.

— A disciplined system engineering management process that defines systematic System Definition and Realisation processes, which satisfies Acquirer needs and helps ensure quality work products, is followed.

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

— project *Needs and Expectations* are documented;

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— feasibility of the project was performed before its start;

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

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

To use this document, a VSE needs to be familiar with or have implemented ISO/IEC TR 29110-5-6-2, the systems engineering Basic profile, for their system development projects.

In previous systems engineering profiles of the Generic profile group, the Entry and the Basic profiles, the boundary between the VSE, its business environment and its work product were naturally vague as everyone had to focus on one work product. With the Intermediate profile, the VSE now having more than one project and therefore in need of more VSE actors, a difficult but necessary boundary needs to be defined. That boundary differentiates between what the VSE needs to do to survive in its business environment and what the VSE actors need to bring to fruition the different *Agreements* (engagement) undertaken by the VSE.

The Business Management (BM) process is covering more business areas than those pertaining exclusively to the management of the individual projects and system engineering required to define, design, produce, qualify and deliver these projects, ensuring the perennity of the VSE. The Business Management having identified business opportunities that fit with the organisational goals and resources (human, knowledge and material), it then seeks with the Subject Matter Experts, project management and systems engineering resources, the feasibility of the proposed opportunities in the context of the VSE. The same is true with proposed *Agreements*, where the Business Management will help ensure the feasibility and validity of any proposed *Agreements* arising from the interpretation of the *Request for Proposal (RFP) or business opportunities*, bringing the formal acceptance of *Agreements* into projects to help ensure the perennity of the VSE (*Until then no official project exists*). In the same manner, the protection of its Intellectual Properties (IP), the security of its assets and information items, the safety of its human resources are inherent activities of an Entity and should be outside the scope of this ISO document.

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 Realisation process, while complying with the project's *Objectives* in the expected quality, time, cost and risks.

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

The purpose of the Acquisition Management (AM) process is to obtain work products or services or both required by the VSE. The execution of the AM process is only required if a work product/service needs to be obtained from a supplier by the VSE, i.e. a conditional process.

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

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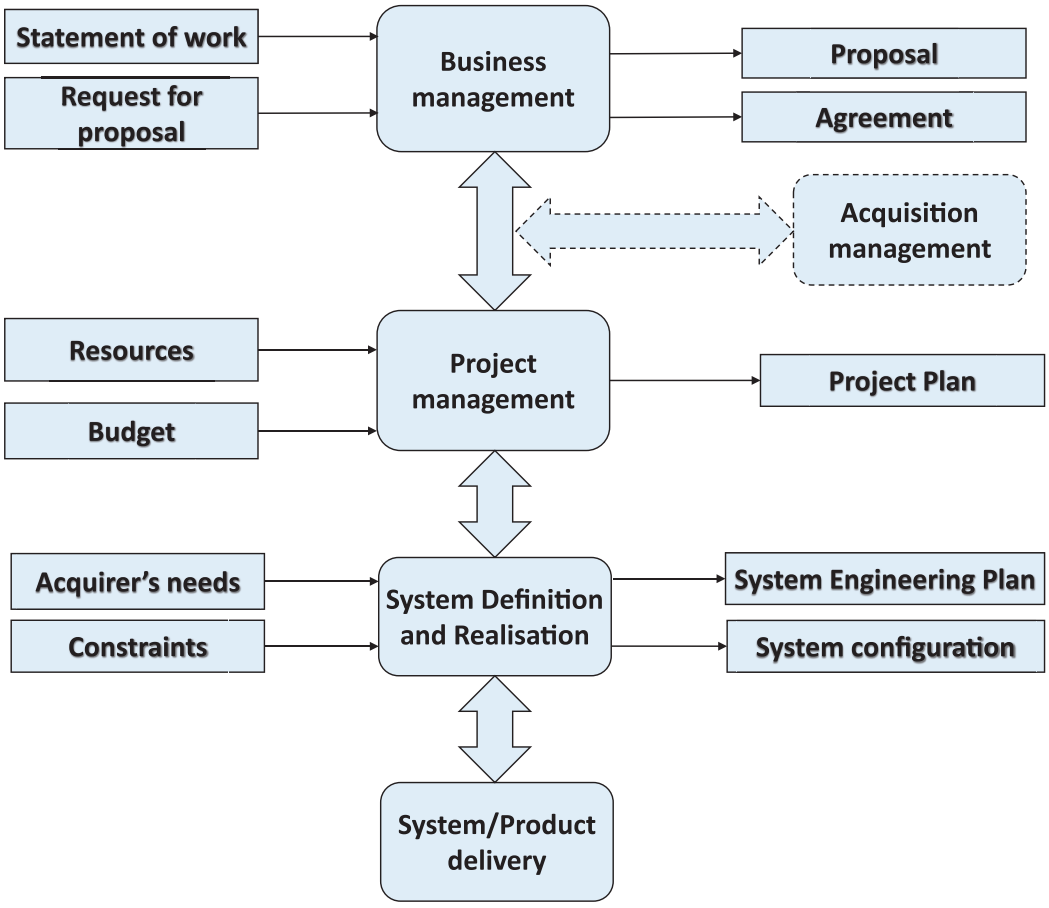

Figure 2 — Intermediate profile processes

7 Business Management (BM) process

7.1 BM purpose

The purpose of the Business Management process is to identify opportunities, evaluate all in-place *Agreements* or requests from customers for fit with organisational 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 and protect its intellectual property and 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 including, for example, agile, evolutionary, incremental, test driven development, etc. based on the VSE or project needs.

7.2 BM objectives

BM.O1. Initiate and sustain suitable projects that fit with the organisational goals and resources (human, knowledge and material) in order to meet the business objectives of the VSE.

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

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

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

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BM.05. Collect and analyse measures with VSE actors in order to disseminate internally the results as lessons and to institutionalise them as lessons learned for all projects.

BM.06. Protect the intellectual property and the security of the assets and information items of the VSE.

BM.07. Establish and maintain current an Organisational Repository, to capture, maintain history and disseminate the projects' relevant documentation. Including BM input and output work products.

BM.08. Provide structure for all projects evaluation, critiques and mentoring, if required, in order to deliver to the Acquirer a system of defined quality, in time, and on cost.

7.3 BM input work products

Table 2 provides a list of input work products.

Table 2 — BM input work products

Name	Source
Agreement	Customer
Request for Proposal	Customer
Change Request	Customer Project Manager
Resource Request	Project Manager
Purchase Order	Project Manager
Human Resource Record	Project Manager

7.4 BM output work products

Table 3 provides a list of output work products.

Table 3 — BM output work products

Name	Destination
~~*Contract*~~ *Agreement*	Business Management
Project Plan	Business Management
Proposal	Customer
System Configuration	Customer

7.5 BM internal work products

Table 4 provides a list of internal work products.

Table 4 — BM internal work products

Name
Business Objectives
Project Opportunities
Security and Intellectual Property Protection Plan
Resource Request
Budget Request
Organisational Lessons Learned Record
Process Improvement Record

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7.6 BM roles involved

Table 5 provides a list of roles involved in the BM process.

Table 5 — BM roles involved

Role	Abbreviation
Business Management	BM
Project Manager	PJM
Proposal Manager	PROM
Customer	CUS

7.7 BM process description

7.7.1 BM diagram

Figure 3 shows the flow of information between the Business Management Process activities including the most relevant work products and their relationships.

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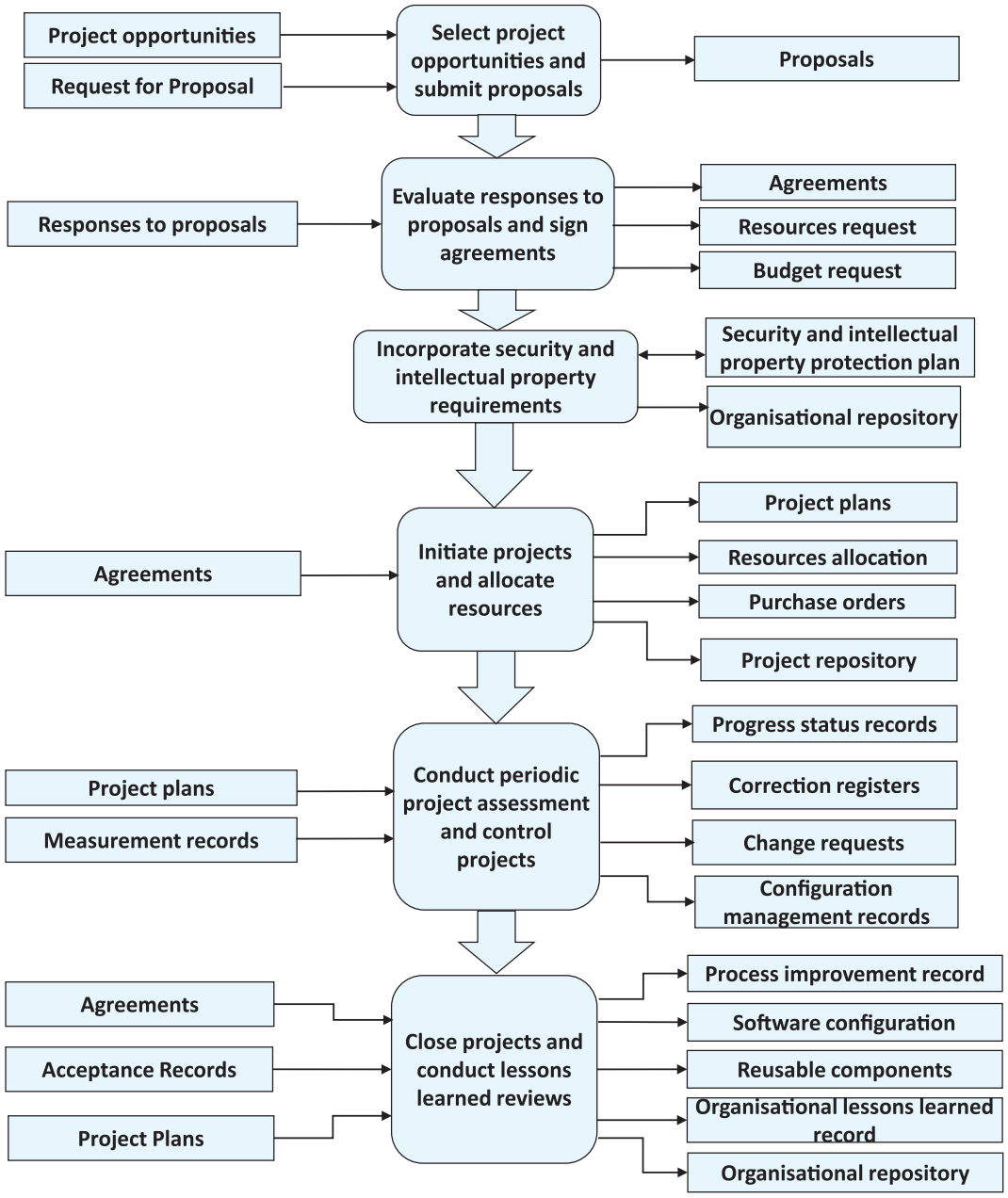

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Figure 3 — Business Management Process diagram

7.7.2 BM activities

7.7.2.1 General

The Business Management Process has the following activities:

— BM.01.Select Project Opportunities and Submit Proposals;

— BM.02. Evaluate Responses to Proposals and Sign Agreements;

— BM.03. Incorporate Security and Intellectual Property Requirements;

— BM.04. Initiate Projects and Allocate Resources;

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— BM.05. Conduct Periodic Project Assessment and Control Projects;

— BM.06. Close Projects and Conduct Lessons Learned Reviews and institutionalised them.

7.7.2.2 BM.01 Select Project Opportunities and Submit Proposals (BM.O1)

The Select Project Opportunities and Submit Proposals activity describes the tasks and information items needed to document project opportunities and proposals sent to potential customers. BM.01 task list is given in Table 6.

The activity provides:

— Project Opportunities, and

— Proposals submitted to potential customers.

Table 6 — BM.01 task list

Role	Task list	Input work products	Output work products
BM PJMs	BM.01.01 Document *Project Opportunities*. Agreements (e.g. contracts) and Statement of Work from past projects could be used to document the *Project Opportunities*.	*Statements of Work (from past projects)* *Agreements (from past projects)*	*Project Opportunities [initiated]*
BM PROM PJMs	BM.01.02 Select *Project Opportunities*.	*Project Opportunities [updated]* *Request for Proposal/ Statement of Work.*	*Proposal analysis [approved]* *Project Opportunities [approved]*
BM PROM PJMs SYS	BM.01.03 Prepare and approve *Proposals.* *Proposals could be developed using the Proposal template in the Work product description section of this document.*	*Project Opportunities [approved]* *Proposal template*	*Proposal [approved]*
BM PJMs	BM.01.04 Submit *Proposals* to potential Customers.	*Proposal [approved]*	*Proposal [submitted]*

7.7.2.3 BM.02. Evaluate Responses to Proposals and Sign Agreements (BM.O1)

The Evaluate Responses to Proposals and Sign Agreements activity involves the evaluation of the responses to proposals received from 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 documents its project plan. BM.02 task list is given in Table 7.

The activity provides:

— Request for Proposal(s), and

— Agreements.

Table 7 — BM.02 task list

Role	Task list	Input work products	Output work products
BM PROM	BM.02.01 Evaluate all responses to *Proposals* from potential Customers and Prepare *Agreements* for the accepted *Proposals.*	*Proposals [submitted]*	*Agreement [initiated]*

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Table 7 *(continued)*

Role	Task list	Input work products	Output work products
BM CUS	BM.02.02 Negotiate, finalize and sign all *Agreements* with Customers.	*Agreement [initiated]*	*Agreement [signed]*
BM PJMs	BM.02.03 Approve Projects and assign Project Managers to develop *Project Plans and Resources Requests.* Update *Project Opportunities* (if applicable). Project Plans are developed according to the Planning activity of the PM Process.	*Agreement [approved]*	*Projects Managers assigned* *Project Opportunities [updated]*

7.7.2.4 BM.03 Incorporate Security and Intellectual Property Requirements (BMS.O6)

The Incorporate Security and Intellectual Property Requirements 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. BM.03 task list is given in Table 8.

The activity provides:

— Security and Intellectual Property Protection Plan, and

— Organisational Repository to store assets and information items securely.

Table 8 — BM.03 task list

Role	Task list	Input work products	Output work products
BM	BM.03.01 Develop a *Security and Intellectual Property Protection Plan* using the template provided in the work product description table.	*Security and Intellectual Property Protection Plan Template*	*Security and Intellectual Property Protection Plan [initiated]*
BM PJMs	BM.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]*
BM PJMs	BM.03.03 Implement the *Security and Intellectual Property Protection Plan.*	*Security and Intellectual Property Protection Plan [approved]*	*Security and Intellectual Property Protection Plan [implemented]*
BM	BM.03.04 Establish and maintain an *Organisational Repository.* The repository needs to protect the security and intellectual property of the VSE and its customers.	*Security and Intellectual Property Protection Plan [approved]*	*Organisational Repository [established]*

7.7.2.5 BM.04. Initiate Projects and Allocate Resources (BM.O3, BM.O3, BM.O7)

The Initiate Projects and Allocate Resources activity is initiated with the approval of Project Plans and the Resources Requests. Human resources are allocated to Projects. If work products or services have to be acquired, Purchase Orders are approved. A project repository is established. BM.04 task list is given in Table 9.

The activity provides:

— Approved Project Plans,

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— Approved Resources Requests,

— Approved Purchased Orders, and

— Human Resource Record.

Table 9 — BM.04 task list

Role	Task List	Input work products	Output work products
BM PJMs	BM.04.01 Review and Approve all *Project Plans* Budget allocations and *Resource Requests.* Assign required Human resources and other resources to Project (e.g. work team, computer facilities).	*Agreements [approved]* *Project Plans [initiated]* *Resources Requests [initiated]* *Human Resource Record*	*Project Plans [approved]* *Resources Requests [approved]* *Budget [approved]*
BM PJMs	BM.04.02 Obtain *Resources* and train Project team members if needed.	*Resource Requests [approved]* *Human Resource Record*	*Resources obtained and trained* *Human Resource Record*
BM PJMs	BM.04.03 Decide if work products or services have to be acquired from *Suppliers* and list the work *products* or services to be acquired. NOTE If a work product (e.g. software component) or a service has to be acquired from supplier(s), use the Acquisition Management Process of this document.	*Project Plans [approved]*	*List of Products or Services to be acquired*
BM PJMs	BM.04.04 Approve all *Purchase Orders* to obtain work products or services from *Suppliers*. Purchase Orders are approved by the Project Plan Execution activity of the PM process.	*List of Products or Services to be acquired* *Purchase Orders [initiated]*	*Purchase Orders [approved]*
PJMs	BM.04.05 Establish and maintain an *Organisational Repository.*	*Security and Intellectual Property Protection Plan [approved]*	*Organisational Repository [established]*

7.7.2.6 BM.05. Conduct periodic Project Assessment and Control Projects (BM.O2, BM.O6)

The Conduct periodic Project Assessment and Control Projects 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. BM.05 task list is given in Table 10.

The activity provides:

— Progress Status Record,

— Correction Register, and

— Change Request.

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Table 10 — BM.05 task list

Role	Task list	Input work products	Output work products
BM PJMs	BM.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]* *Progress Status Records* *Measurement Records Financial/Budget Records*	*Progress Status Records [evaluated]*
BM PJMs	BM.05.02 Establish actions to correct deviations or problems and identified risks. Concerning the accomplishment of the plan, as needed, document them in *Correction Register* and track them to closure.	*Progress Status Records [evaluated]*	*Correction Registers*
BM PJMs	BM.05.03 Identify changes to requirements or *Project Plans or both.* 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]*
BM	BM.05.04 Record and report the status of the items and modifications.	*Configuration Management strategy* *Configuration Management Records*	*Configuration Management Records [updated]*

7.7.2.7 BM.06. Close Projects and Conduct Lessons Learned Reviews (BM.O1, BM.O5)

The Close Project and Conduct Lessons Learned Reviews activity formalizes, at the organisational level, the project closure activity of the PM process, by delivering the work products to Customers. Organisational Lessons Learned reviews are performed using the output of the Project Closure activity of the PM process. Process Improvement opportunities are document and implemented and reusable components are identified and stored in the Organisational Repository. BM.06 task list is given in Table 11.

The activity provides:

— Acceptance Record;

— Delivery Instructions signed by Customer;

— Software Configuration;

— Organisational Lessons learned;

— Process Improvement Record;

— Reusable Components;

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— Updated Organisational Repository.

Table 11 — BM.06 task list

Role	Task list	Input work products	Output work products
BM PJMs CUS	BM.06.01 Formalize the completion of the projects according to the *Delivery Instructions.* As established in the *Project Plans,* providing acceptance support and getting the *Acceptance Record* signed from the Customers.	*Agreements [approved]* *Acceptance Records [initiated]* *Delivery Instructions [signed by Customer]* *Software Configuration [delivered internally]*	*Acceptance Records [signed]* *Delivery Instructions [signed by Customer]* *Software Configuration [accepted]*
BM PJMs	BM.06.02 Conduct a lesson learned review of all projects. Analyse lessons learned to identify improvements to processes, document and prioritise them in the *Improvement Record*. Implement selected improvements.	*Agreements [approved]* *Project Plans* *Meeting Records* *Project Lessons Learned Record* *Measurement Records*	*Organisational Lessons Learned Record* *Process Improvement Record*
BM PJM	BM.06.03 Identify Reusable Components from Project Repositories and store them in the Organisational Repository.	*Software Configuration* *Project Repositories*	*Organisational Repository [updated]* — *Reusable Components*
BM PJM	BM.06.04 Update the *Organisational Repository*.	*Software Configuration [accepted]* *Project Repositories*	*Organisational Repository [updated]*

7.7.3 BM incorporation to the Organisational Repository

The list of work products to be saved in *Organisational Repository* is given in Table 12.

Table 12 — BM repository work products

Name
Organisational Objectives
Project Opportunities
Proposal
Agreement
Project Plan
Acceptance Record
Security and Intellectual Property Protection Plan
Organisational Lessons Learned Record
Process Improvement Record
Meeting Record
Purchase Order
Reusable Components
Resource Request
Human Resource record

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8 Project Management (PM) process

8.1 PM purpose

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

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

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

8.2 PM objectives

PM.O1. The *Project Plan*, the approved VSE proposal and commitments are reviewed and accepted by both the Acquirer, the Organisational 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 taken when project targets are not achieved. Closure of the project is performed to get the Acquirer acceptance documented in the *Product Acceptance Record*. The System is disposed according to the Agreement.

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

PM.O4. Review meetings with the Work Team and the Acquirer, suppliers are held. Reviews of work products of activities are conducted. Agreements are registered and tracked.

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

PM.O6. A ~~product~~ project *Configuration Management Strategy* is developed. Configuration Items (CI) are identified, defined and baselined. Modifications and releases of the Configuration Items are controlled and made available to the Customer and Work Team. The status of the Configuration items and modifications are recorded and reported; the completeness and consistency of the Configuration Items is ensured; the storage, handling and delivery of the items are controlled

PM.O7. Quality Assurance is performed to provide assurance that PM process and work products comply with the Business Management goals and resources (human, knowledge and material), ensuring the respect of cost, schedule, risks for the perennity of the VSE.

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

PM.O8. A *Disposal Management Approach* is developed <u>in accord with the Acquirer</u> to end the existence of a system entity <u>and dispose of it</u>

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8.3 PM input work products

Table 13 provides a list of input work products.

Table 13 — PM input work products

Name	Source
Request for Proposal	Acquirer
Statement of Work	Acquirer
All deliverables from SR	Work Team
Change Request	Acquirer, Stakeholders Work Team Suppliers

8.4 PM output work products

Table 14 provides a list of output work products.

Table 14 — PM output work products

Name	Destination
Project Plan	System Definition and Realisation
Product Acceptance Record	Organisational Management
Organisational Repository	System Definition and Realisation
Meeting Record	Acquirer, Stakeholders, Systems Engineer
Measurement Record	Organisational Management
Product	Acquirer, Stakeholders System Definition and Realisation Suppliers
Purchase Order	Suppliers
Disposed System	Acquirer, Stakeholders Suppliers

8.5 PM internal work products

Table 15 provides a list of internal work products.

Table 15 — PM internal work products

Name
Change Request
Correction Register
Justification Document
Measurement Record
Meeting Record
Progress Status Record
Organisational Repository
Product Acceptance Record
Verification Report

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8.6 PM roles involved

Table 16 provides a list of roles involved in the PM process.

Table 16 — PM roles involved

Role	Abbreviation
Project Manager	PJM
Acquirer	ACQ
Customer	CUS
Designer	DES
Systems Engineer	SYS
Technical Leader	TL
Tester	IVV

8.7 PM diagram

Figure 4 shows the flow of information between the Project Management Process activities including the most relevant work products and their relationship.

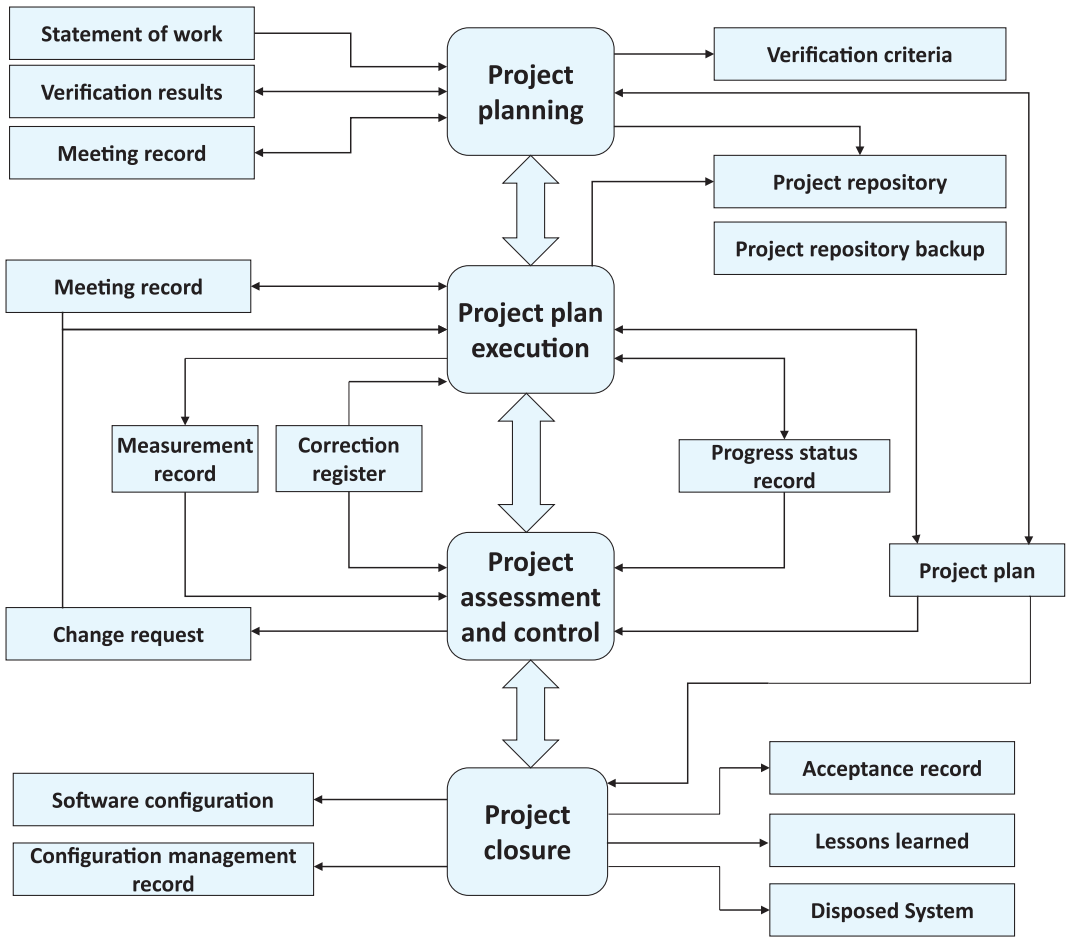

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Figure 4 — Project Management Process diagram

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8.8 PM activities

8.8.1 General

The Project Management Process has the following activities:

— PM.1 Project Planning

— PM.2 Project Plan Execution

— PM.3 Project Assessment and Control

— PM.4 Project Closure

8.8.1.1 PM.01 Project Planning, (PM.O1, PM.O5, PM.O6, PM.O7)

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

— Reviewed Request for Proposal (RFP) and its Statement of Work (SOW) 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 validationof 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 17.

Table 17 — PM.01 task list

Role	Task list	Input work products	Output work products
PJM SYS	PM.01.01 Review the *Request for Proposal* (RFP) and its *Statement of Work.*	Request for Proposal Statement of Work	Request for Proposal Statement of Work *[reviewed]*
PJM ACQ	PM.01.02 Define with the *Acquirer* the *Delivery Instructions* of each one of the *Deliverables* specified in the *Statement of Work.*	Request for Proposal Statement of Work *[reviewed]*	*Project Plan* Delivery Instructions

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Table 17 *(continued)*

Role	Task list	Input work products	Output work products
PJM DES	PM.01.03 Define the *System Breakdown Structure* (SBS) that represents the relationship between the system and its system elements. NOTE The system boundaries need to be defined. NOTE This task is iterative as the SBS is based on the System Design Document (SDD). The SDD is at the beginning preliminary and all system elements hierarchy is not necessary defined completely. The SBS is updated while the SDD is progressively completed.	System Design Document	Project Plan — System Breakdown Structure
PJM WT	PM.01.04 Select a product lifecycle and define milestones according to the *Statement of Work*.	Project Plan — System Breakdown Structure Statement of Work	Project Plan — Milestones
PJM SYS	PM.01.05 Identify the specific *Tasks* to be performed in order to produce the *Deliverables* and their *System Elements* identified in the *Statement of Work.* 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. Identify the *Tasks* to perform the *Delivery Instructions.* Document the *Tasks.* This task is performed in parallel with the definition of the SEMP.	Statement of Work *[reviewed]* Project Plan — System Breakdown Structure	Project Plan — Tasks
PJM	PM.01.06 Establish the *Estimated Duration* to perform each task.	Project Plan — Tasks	Project Plan — Estimated Duration
PJM	PM.01.07 Identify and document the *Resources*: human, material, equipment and tools, standards, including the required training of the Work Team to perform the project. Include in the schedule the dates when *Resources* and training will be needed.	Statement of Work *[reviewed]*	Project Plan — Resources
PJM	PM.01.08 Establish the *Composition of Work Team* assigning roles and responsibilities according to the *Resources.*	Project Plan — Resources	Project Plan — Composition of Work Team
PJM	PM.01.09 Assign estimated start and completion dates to each one of the *Tasks* in order to create the *Schedule of the Project Tasks* taking into account the assigned *Resources*, sequence and dependency of the *Tasks*. Define milestones of the project (e.g. end of phases, payments, deliveries).	Project Plan — Tasks — Estimated Duration — Composition of Work Team	Project Plan — Schedule of the Project Tasks — Milestones
PJM	PM.01.10 Calculate and document the project *Estimated Effort and Cost.* Using available in-house metrics or acquiring commercial Work estimation tool.	Project Plan — Schedule of the Project Tasks — Resources	Project Plan — Estimated Effort and Cost

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