TECHNICAL REPORT

ISO/IEC TR 29110-5-6-3

First edition
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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

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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).

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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.

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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*.

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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.

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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.

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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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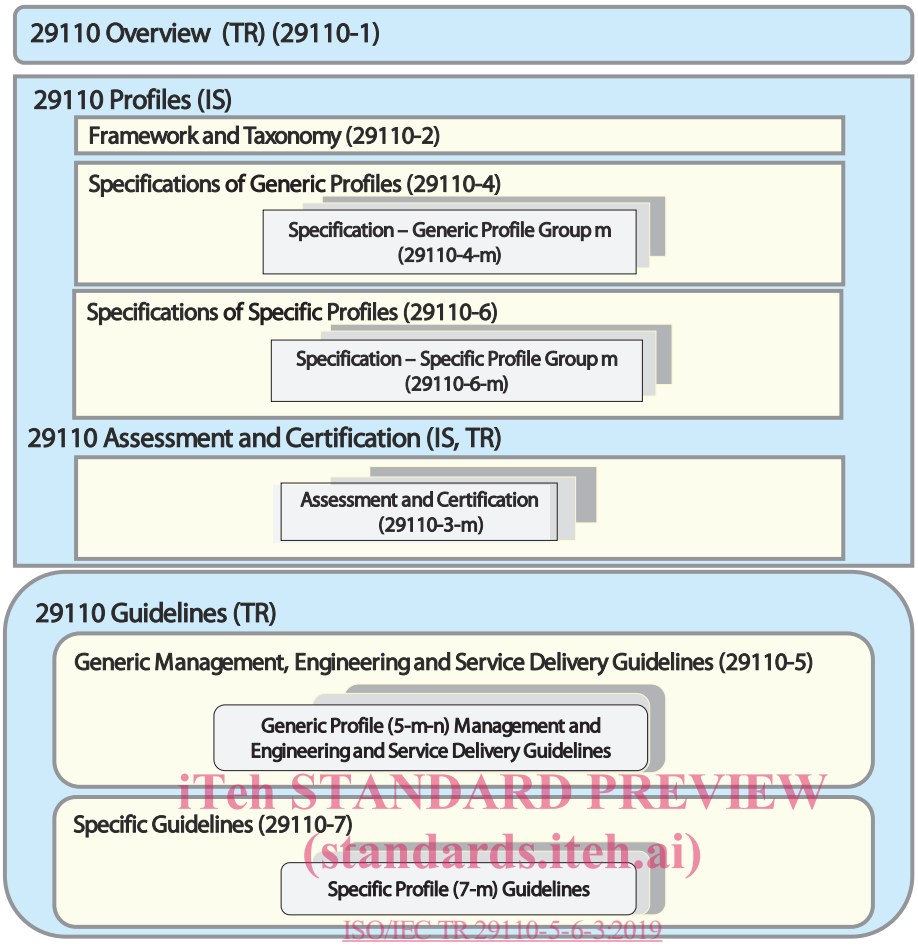

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Figure 1 — The ISO/IEC 29110 Series

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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.

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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.

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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/

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

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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)

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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.

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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

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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.]

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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.

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

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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:

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— added text:

  — is underlined;

  — except for the processes of the Intermediate profile;

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— 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

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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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