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Australian/New Zealand Standard™

Software engineering—Guide for the application of ISO/IEC 12207 to project management

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Australian Computer Society
Australian Electrical and Electronic Manufacturers Association
Australian Society or Technical Communications
Australian Software Metrics Association
Engineers Australia/ACTS Joint Board in Software Engineering
Griffith University
National Association of Testing Authorities Australia
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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee IT-015, Software and Systems Engineering.

The objective of this Standard is to provide Project Managers with guidance that supplements AS/NZS ISO/IEC 12207, *Information technology—Software life cycle processes*, in the area of Management Process.

This Standard is identical with, and has been reproduced from ISO/IEC TR 16326:1999, *Software engineering—Guide for the application of ISO/IEC 12207 to project management*.

As this Standard is reproduced from an international standard, the following applies:

(a) Its number appears on the cover and title page while the international standard number appears only on the cover.

(b) In the source text 'this Technical Report' should read 'this Australian/New Zealand Standard'.

(c) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

Reference to International Standard		*Australian/New Zealand Standard*	
ISO/IEC 12207	Information technology—Software life cycle processes	AS/NZS ISO/IEC 12207	Information technology—Software life cycle processes

The term 'informative' has been used in this Standard to define the application of the annex to which it applies. An 'informative' annex is only for information and guidance.

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INTRODUCTION

Software is an integral part of information technology and conventional systems, e.g., transportation, military, medical care and finance. There is a proliferation of standards, procedures, methods, tools and environments for developing and managing software. This proliferation has created difficulties in software project management and engineering, especially in integrating products and services. The software discipline needs to migrate from this proliferation to a common framework for software practitioners to “speak the same language” to create and manage software. ISO/IEC 12207, *Information technology — Software life cycle processes,* provides a common framework.

The ISO/IEC 12207 framework covers the software life cycle from conceptualization of ideas through retirement/closure and consists of processes for acquiring and supplying software products and services. This framework also provides for controlling and improving these processes.

ISO/IEC 12207 provides a comprehensive set of software life cycle processes. An organization, depending on its purpose, can select an appropriate ISO/IEC 12207 subset to fulfil that purpose. ISO/IEC 12207 is designed to be tailored for an individual organization, project or application. It is also designed to be used when software is a standalone entity, or an embedded or integral part of a total system.

This Technical Report provides guidance for the Management Process as introduced by ISO/IEC 12207, subclause 7.1. Most of the guidance is provided based on Project Management Institute’s (PMI’s) *A Guide to the Project Management Body of Knowledge (PMBOK™ Guide)* [11], ISO 10006, *Quality management — Guidelines to quality in project management* [5] and experience of people who have been successful software project managers.

It is not the intent of this Technical Report to suggest any organizational role or responsibility.

It is recognized that identified processes, activities and tasks have an iterative “life” and they may occur in any order or frequency. These processes, activities and tasks must be coordinated with other processes, activities and tasks not emphasized in this Technical Report, e.g., ISO/IEC 12207’s Supporting and Organizational Life Cycle Processes.

This Software Project Management Technical Report is organized as follows:

— Section 1 provides the document’s scope.

— Section 2 identifies the conformance requirements.

— Section 3 identifies the normative references.

— Section 4 provides the definitions used in this Technical Report.

— Section 5 provides the symbols and abbreviations used in this Technical Report.

— Section 6 has guidance on the ISO/IEC 12207 Management Process.

— Annex A maps ISO/IEC 12207 Management Process activities to the ISO/IEC 12207 Primary Processes.

— Annex B maps ISO/IEC 12207 Management Process activities to [11]’s project management knowledge areas.

— Annex C maps ISO/IEC 12207 Management Process activities to [5]’s project management processes.

— Annex D maps ISO/IEC 12207 to [5]’s process levels and to [11]’s project management knowledge area major processes.

— Annex E provides a bibliography of some reference material. This list is not inclusive, nor an endorsement of any reference.

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Software engineering — Guide for the application of ISO/IEC 12207 to project management

1 Scope

This Technical Report supplements International Standard ISO/IEC 12207, *Information technology — Software life cycle processes,* in the area of Management Process (hereafter referred to as "software project management" or SPM. Thus, in this Technical Report, SPM is not a person, but a process). This Technical Report was developed by (see Figure 1):

— Applying the Management Process in ISO/IEC 12207 to SPM.

— Using *A Guide to the Project Management Body of Knowledge*™ (*PMBOK*™) [11] to define and describe management knowledge areas applicable to SPM.

— Using ISO 10006, Quality management – Guidelines to quality in project management [5].

This Technical Report provides guidance to people responsible for managing the performance of ISO/IEC 12207 software life cycle Primary Processes: Acquisition, Supply, Development, Operation and Maintenance. The guidance addresses:

— General guidance for SPM regarding ISO/IEC 12207, subclause 7.1, management activities as they are supported in each Primary Process.

— SPM applicability for each Primary Process.

— Key areas applicable across the spectrum of SPM.

— Expanded guidance for software Project Managers (PMs) regarding the management tasks from:

  — [11] — Identifies and describes generally that subset of the PMBOK™ which is generally accepted. Generally accepted means that the knowledge and practices described are applicable to most projects most of the time, and there is widespread consensus about their value and usefulness.

  — [5] — Gives guidance on quality system elements, concepts and practices for which the implementation is important to and has an impact on the practice of project management.

This Technical Report addresses aspects of project management that are either "software specific" or are known to cause problems in software projects in any of the ISO/IEC 12207 Primary Processes. For example, it is well known that software projects are often late and/or over budget, or are unable to meet an acquirer's requirements or expectations. While this is not peculiar to software, there are a number of software specific attributes causing this to happen.

Figure 1 illustrates the relationship of ISO/IEC 12207, [11] and [5] in the development of this Technical Report.

1.1 Audience

This Technical Report is written for those who use or plan to use ISO/IEC 12207 on software projects regardless of project scope, product, methodology, size or complexity. This Technical Report is written primarily to aid software PMs in ensuring management processes conform to ISO/IEC 12207, specifically:

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— Managers responsible for establishing and continuously improving ISO/IEC 12207 software life cycle processes.

— Managers responsible for executing any ISO/IEC 12207 software life cycle process at a project level.

— Organizations or individuals subcontracting an SPM effort.

Consideration is given to people who have:

— Worked on software projects, but not as a software PM.

— Been non-software PMs, but are transitioning to be software PMs.

This Technical Report presents the primary ISO/IEC 12207 life cycle processes from the perspective of a software PM and provides advice (based on experience, lessons learned, etc.) about best practices and recommendations to be applied to management tasks by the practitioners. Lastly, this Technical Report enables engineering, technical and other support staffs to see how their efforts integrate within a total, software life cycle.

1.2 Prerequisites

The prerequisites to use this Technical Report are:

— Availability of and familiarity with ISO/IEC 12207.

— Familiarity with the relevant organizational policies and procedures.

— Knowledge of stakeholder and contract requirements (needs and expectations).

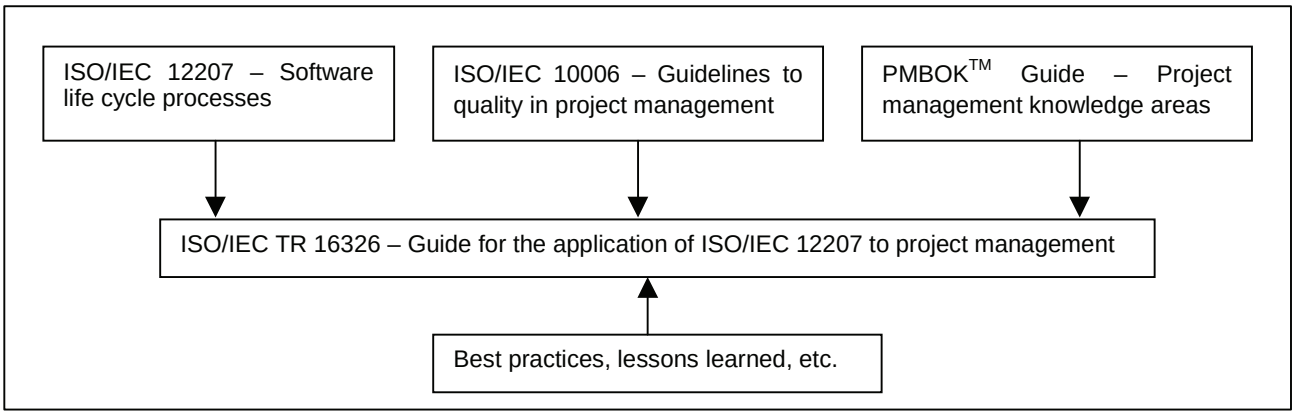

Figure 1 — Use of ISO/IEC 12207, *PMBOK™ Guide* and ISO 10006 to create this Technical Report

2 Conformance

Since this is a Technical Report, there are no conformance requirements.

3 Normative references

Since this is a Technical Report, normative references are not required. See the Bibliography (Annex E) for some informative references.

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4 Terms and definitions

For the purpose of this Technical Report, the definitions given in ISO/IEC 12207, [11] and [5] apply, in that hierarchial order.

5 Symbols and abbreviated terms

The following symbols and abbreviations are used in this Technical Report:

CCB*	Configuration/Change Control Board
ICWG*	Interface Control Working Group
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
PM	Project Manager
SEE	Software Engineering Environment
SPM	Software Project Management
WBS	Work Breakdown Structure

* Depending on the size and complexity of a project, can be a group of people, a single person or a function.

6 Guidance

6.1 Introduction to software project management

A project is a temporary endeavour undertaken to create a unique product or service [11]. As such, a project involves a group of people, resources and events with the following common characteristics:

— The main objectives are to create products, services and results.

— A project has a known beginning and end, i.e., a project is temporary.

— A project is not part of the normal, ongoing operation of most organizations, i.e., it usually has a unique requirement. Some organizations (e.g., Research and Development) exist only to perform projects.

A software project is a project emphasizing software as its product, service or result. So, how does software differ from other project products, services and results? As stated by Watts Humphrey [17]:

— *Software is generally more complex.*

— *Software changes appear relatively easy to make.*

— *Many late-discovered hardware problems are addressed through software changes.*

— *Because of its low reproduction cost, software does not have the natural discipline of release to manufacturing.*

— *Software discipline is not grounded in natural science and it lacks ready techniques for feasibility testing and design modelling.*

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— *Software is often the element integrating an entire system, thus adding to its complexity and creating exposures to late change.*

— *Software is generally most visible, thus most exposed to requirements changes and most subject to user complaint.*

Because software is different from non-software products, services and results, the management of software projects is also different. This is not to say SPM is totally different from the management of non-software projects. The key item is that there are unique areas of SPM and general project management that management must be aware of to achieve project goals, as well as prevent problems.

[11] provides important information about managing projects. ISO/IEC 12207 provides important information about software projects within ISO/IEC 12207, subclause 5.2 (Supply Process) and describes many activities and tasks to be performed. [5] provides information on how to improve the quality of project management. The main purpose of this Technical Report is to highlight how the differences described above impact a software PM, to show how these three documents complement each other and to help PMs manage software projects to a successful conclusion.

Rapidly changing technology in the software discipline is outpacing management and process techniques. This is compounded by the incompleteness of the range of project management tools and techniques available to software engineers as compared to other engineering disciplines.

SPM methodology implementation is determined by many factors, e.g., personnel, organizational and contractual requirements, and project complexity.

A software PM determines the methodology and technology for undertaking a project and should be required to:

— Anticipate and thus prevent or minimize the adverse impact of problems.

— Make timely and firm decisions.

— Resolve problems when they occur.

— Take responsibility for a project's actions, processes, activities, resources, products and results.

As an iterative endeavour, a software PM must consider any systemic impact when undertaking an action, e.g., an action, or failure to act, in an area can affect other areas.

6.2 Management process

This clause examines ISO/IEC 12207's (subclause 7.1) Management Process. ISO/IEC 12207 defines a generic management process (rather than SPM) that may be employed by any party managing its processes. This clause discusses the ISO/IEC 12207 Management Process as it applies to the management of software projects (SPM).

It is recognized that identified processes, activities and tasks may require a reiterative action to accomplish the requirements/goals of a project. For instance, based upon the software life cycle model being used, processes, activities and tasks may be employed at the same time; they may be interdependent; or they may be coordinated in an organized series of Work Breakdown Structure (WBS) dependencies throughout a software project life cycle.

ISO/IEC 12207

7.1 **Management process**. The Management Process contains the generic activities and tasks, which may be employed by any party that has to manage its respective process(es). The manager is responsible for product management, project management, and task management of the applicable process(es), such as the acquisition, supply, development, operation, maintenance, or supporting process.

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ISO/IEC 12207 (subclause 7.1) states “of the applicable process(es)” since a project may not involve all of the Primary Processes. For instance, a project may be only involved with the development or maintenance of a product, rather than product operation.

SPM should define (and the software PM control) the activities needed to ensure products are delivered as specified in a contract, i.e., ensure a software project includes all the work required, and only the work required, to complete the project and product successfully.

6.2.1 Initiation and scope definition

ISO/IEC 12207

7.1.1 Initiation and scope definition. This activity consists of the following tasks:

7.1.1.1 The management process shall be initiated by establishing the requirements of the process to be undertaken.

7.1.1.2 Once the requirements are established, the manager shall establish the feasibility of the process by checking that the resources (personnel, materials, technology and environment) required to execute and manage the process are available, adequate, and appropriate and that the time-scales to completion are achievable.

7.1.1.3 As necessary, and by agreement of all parties concerned, the requirements of the process may be modified at this point to achieve the completion criteria.

Initiation and scope definition is the determination of the feasibility of a process to ensure personnel, materials, facilities, Software Engineering Environment (SEE) and technology required to execute and manage a project are available, adequate and appropriate; and the predetermined times for completion are achievable, timely and economical. This involves choosing a software development strategy (e.g., a project may consist of off-the-shelf software, in-house software, out-sourced software or a combination of these).

Scope (e.g., description of a project product, product characteristics and how the characteristics are to be measured or assessed) related items aim to:

— Document the reason for the project, its goals and its objectives.

— Translate stakeholder requirements into project deliverables and activities to be carried out to achieve and organize a project.

— Ensure people work within the scope.

— Evaluate the results of activities to facilitate the results meeting scope requirements.

In the best case scenario, a new software project has many similarities to a project previously managed by an organization. This provides a high level of assurance that an organization has the capability to perform a software project successfully.

Initiation and scope definition may be difficult to perform when a new project is unprecedented (i.e., has not previously been performed by an organization). For an unprecedented project, special care should be taken to ensure it is properly scoped and monitored. This should be accomplished by having frequent reviews and evaluations, reviewing best practices and lessons learned from somewhat related projects, and by seeking advice from experts.

The key to initiation and scope definition is to establish and document the comprehensive scope and requirements of a software project. This involves identifying and understanding stakeholder requirements, and evaluating and negotiating comprehensive requirements. Special care should be taken to manage change to the scope and requirements throughout a software project’s life cycle. All changes in scope and requirements should be carefully

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evaluated for the impact on cost, schedule, risk and performance. All stakeholders should be involved in the requirements definition of a software project.

Special care should be applied to defining and documenting quality characteristics [19]; for example, when software is to be embedded in a higher-level system, or functions are to be distributed between software and hardware, or between software and external interfacing software or systems.

Responsibility for obtaining stakeholder agreement on project requirements should be determined. Agreement is the result of an iterative process to be employed throughout a software project life cycle. Risks, changes in stakeholder requirements, environment, project budget and schedule, and an evolving design make it necessary to continually reassess and reaffirm agreements and commitments, and make appropriate changes to the project scope, as required.

Establishing completion criteria is very important. The intent, as supported by [11], is to determine if a project, activity or task has been completed successfully.

A business requirement, often ignored by software PMs, is the handling of copyrights, patents, etc. For instance, when does an acquirer own a developing product or what does an acquirer own when a supplier goes out of business prior to final product delivery?

Software specific advice:

— Requirements for software replication, distribution, installation and testing should be carefully determined.

— Traceability between system and software requirements, between software requirements and design, and between software requirements and tests should be established and maintained.

— Interfaces should be specified and controlled as an integral part of software specification and interface description documents.

— Due to the complexity of software development, it is difficult to prove software products meet all user requirements (needs and expections).

— Workload projection depends on the type of project: a new development, embedding in or integration to a system, modification of off-the-shelf software product, porting to different operating systems, etc.

6.2.2 Planning

ISO/IEC 12207

7.1.2 Planning. This activity consists of the following task:

7.1.2.1 The manager shall prepare the plans for execution of the process. The plans associated with the execution of the process shall contain descriptions of the associated activities and tasks and identification of the software products that will be provided. These plans shall include, but are not limited to, the following:

a) Schedules for the timely completion of tasks;
b) Estimation of effort;
c) Adequate resources needed to execute the tasks;
d) Allocation of tasks;
e) Assignment of responsibilities;
f) Quantification of risks associated with the tasks or the process itself;
g) Quality control measures to be employed throughout the process;
h) Costs associated with the process execution;
i) Provision of environment and infrastructure.

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The responsibility for preparing and approving plans should be defined.

Plans should identify the software life cycle model, task, task assignments, commitments and resources. A software project should have one master schedule and all subordinate schedules should be integrated and consistent with the master schedule. A WBS can effectively measure software project progress and provides visibility into processes and products. A WBS technique is strongly encouraged because it organizes and defines the total scope of the project [11]. The WBS should be constructed to allow a software project to be managed at the appropriate level of granularity consistent with the size, complexity, criticality and risk of the software project; familiarity is needed on the technology to be used.

Project estimates used in planning should include:

— Costs associated with process execution.

— Infrastructure.

— Need for resources, including related management and control.

— Quality assurance and control.

— Risk management.

— SEE provisions.

— Work to be performed in each process and/or activity.

Software PMs should make every attempt to use existing organizational infrastructure whenever possible. If existing infrastructure is insufficient to support a project, then adaptation or additions to existing infrastructure should be handled judiciously. This may require the use of subcontracting to satisfy infrastructure deficiencies. Consultants may help bringing agreement on various matters.

Planning is an iterative activity in which a software project is assessed, refined and revised (as necessary) as project execution progresses. Software PMs should have processes in place to facilitate re-planning and refinement of estimates throughout a software project life cycle. There are many interdependencies on every software project and several iterations of planning are usually required to obtain even an initial SPM plan. For information needed by an SPM plan, but provided in other plans, an SPM plan may reference the other plans.

Plans should be updated and at least contain:

— Roles and Responsibilities.

— Activities and tasks to be performed.

— All project deliverables identified in a WBS.

— Completion criteria.

— Completion reporting.

— Cost and schedule reporting.

— Means of initiation - by direction, product or time-based.

— Frequency and means of reporting progress.

— Problem or exception reporting.

— Resource requirements and status.

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