BSI Standards Publication

Quality management — Guidelines for quality management in projects

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National foreword

This British Standard is the UK implementation of ISO 10006:2017. It supersedes BS ISO 10006:2003, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MS/2, Project, programme and portfolio management.

A list of organizations represented on this committee can be obtained on request to its secretary.

This standard does not purport to include all the necessary provisions of a contract. Users are responsible for its correct implementation.

The British Committee draws users' attention to the Introduction which explains the purpose of this document as a supporting standard.

For further information on the generic concepts and requirements of ISO management systems users can refer to guidance on the ISO and BSI website. Users should also pay particular attention to how their project, programme and portfolio management systems are integrated into wider organizational frameworks.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Quality management — Guidelines for quality management in projects

Management de la qualité — Lignes directrices pour le management de la qualité dans les projets

Contents

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 ISO documents 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 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).

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

For an explanation on the 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 176, *Quality management and quality assurance*, Subcommittee SC 2, *Quality systems.*

This third edition cancels and replaces the second edition (ISO 10006:2003), which has been technically revised to align it with ISO 9000:2015, ISO 9001:2015 and ISO 21500:2012.

Introduction

This document provides guidelines for quality management in projects. It outlines quality management principles and practices, the implementation of which are important to, and have an impact on, the achievement of quality objectives in projects. It is aligned with ISO 9000:2015 and ISO 9001:2015, and supplements the guidance given in ISO 21500:2012.

The guidelines given in this document are intended for a wide audience. They are applicable to projects which can take many forms, from the small to very large, from simple to complex, from being an individual project to being part of a programme or portfolio of projects. They are intended to be used by people who have experience in managing projects and need to ensure that their organization is applying the practices contained in the quality management and quality management system standards from ISO/TC 176, as well as those who have experience in quality management and are required to interact with project organizations in applying their knowledge and experience to the project. Inevitably, some users will find that material presented in the guidelines is unnecessarily detailed for them; however, other users require the detail.

This document employs the process approach, which incorporates the Plan-Do-Check-Act (PDCA) cycle and "risk based thinking". The two concepts of "quality management in projects" and "quality management systems in projects" are distinguished as follows:

— quality management in projects includes: quality management systems in projects, management responsibility in projects, resource management in projects, product/service realization in projects, and measurement, analysis and improvement in projects;

— quality management systems in projects includes: project characteristics, quality management principles in projects, project quality management processes and a quality plan for the project.

It is recognized that there are two aspects to the application of quality management in projects: the project processes that are managed within the project management system, and the quality of the project's outputs in the form of products and services. Failure to meet either of these dual aspects can have significant effects on the project's products and services, the project's customer and other interested parties, and the project organization.

NOTE   The expression "products/services" is used as an abbreviation for "products and services" throughout the remainder of this document.

These aspects also emphasize that the achievement of quality objectives is a top management responsibility, requiring a commitment to the achievement of quality objectives to be instilled at all levels within the organizations involved in the project; however, each level needs to retain responsibility for its respective processes and products/services.

The creation and maintenance of process and product/service quality in a project requires a systematic approach. This approach needs to be aimed at ensuring that the stated and implied needs of the customer are understood and met, that other interested parties' needs are understood and evaluated, and that the originating organization's quality policy is taken into account for implementation in the management of the project.

This document is designed to be used in the context of the requirements for quality management systems specified in ISO 9001:2015 and the guidance on project management processes provided in ISO 21500. Project management processes are described in ISO 21500.

The structure of this document reflects its design as a supporting standard providing guidance rather than a management system standard. A matrix is presented in Annex B to provide a cross reference between this document, ISO 9001:2015 and ISO 21500:2012.

INTERNATIONAL STANDARD **ISO 10006:2017(E)**

Quality management — Guidelines for quality management in projects

1 Scope

This document gives guidelines for the application of quality management in projects.

It is applicable to organizations working on projects of varying complexity, small or large, of short or long duration, being an individual project to being part of a programme or portfolio of projects, in different environments, and irrespective of the kind of product/service or process involved, with the intention of satisfying project interested parties by introducing quality management in projects. This can necessitate some tailoring of the guidance to suit a particular project.

This document is not a guide to project management itself. Guidance on quality in project management processes is presented in this document. Guidance on project management and related processes is covered in ISO 21500.

This document addresses the concepts of both "quality management in projects" and "quality management systems in projects". These are distinguished by being addressed separately by the following topics and clauses:

— quality management in projects includes: quality management systems in projects (Clause 4); management responsibility in projects (Clause 5); resource management in projects (Clause 6); product/service realization in projects (Clause 7); and measurement, analysis and improvement in projects (Clause 8);

— quality management systems in projects includes: project characteristics (4.1); quality management principles in projects (4.2); project quality management processes (4.3); and a quality plan for the project (4.4).

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 9000:2015, *Quality management systems — Fundamentals and vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9000 and the following apply.

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

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

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

3.1
activity
identified piece of work that is required to be undertaken to complete a *project* (3.3)

Note 1 to entry: The activity in a project can generally be recognized as the smallest identified entity.

3.2
progress evaluation
assessment of progress made on achievement of the *project* (3.3) objectives

Note 1 to entry: This assessment should be carried out at appropriate phases/steps in the *project life cycle* (3.8) across project processes, based on criteria for project processes and product or service.

Note 2 to entry: The results of progress evaluations can lead to revision of the *project management plan* (3.5).

3.3
project
unique process undertaken to achieve an objective

Note 1 to entry: A project generally consists of a set of coordinated and controlled *activities* (3.1) with start and finish dates, conforming to specific requirements, including the constraints of time, cost and resources

Note 2 to entry: An individual project can form part of a larger project structure and generally has a defined start and finish date.

Note 3 to entry: In some projects the objectives and scope are updated and the product or service characteristics defined progressively as the project proceeds.

Note 4 to entry: The output of a project can be one or several units of product or service.

Note 5 to entry: The project's organization is normally temporary and established for the lifetime of the project.

Note 6 to entry: The complexity of the interactions among project activities is not necessarily related to the project size.

3.4
project management
planning, organizing, monitoring, controlling and reporting of all aspects of a *project* (3.3) and the motivation of all those involved in it to achieve the project objectives

3.5
project management plan
document specifying what is necessary to meet the objective(s) of the *project* (3.3)

Note 1 to entry: A project management plan should include or refer to the project's *quality plan* (3.9).

Note 2 to entry: The project management plan also includes or references other plans such as those relating to organizational structures, resources, schedule, budget, risk management, environmental management, health and safety management, and security management, as appropriate.

3.6
project organization
temporary structure that includes project roles, responsibilities and levels of authority and boundaries that need to be defined and communicated to all interested parties of the *project* (3.3)

3.7
project phase
division of the *project life cycle* (3.8) into manageable sets of activities, such as conception, development, realization and termination

3.8
project life cycle
defined set of phases from the start to the end of the *project* (3.3)

[SOURCE: ISO 21500:2012, 2.12]

3.9
quality plan
specification of the actions, responsibilities and associated resources to be applied to a specific object

[SOURCE: ISO 10005:—[1)], 3.2]

3.10
provider
 supplier
organization that provides a product or a service

EXAMPLE   Producer, distributor, retailer or vendor of a product or a service.

Note 1 to entry: A provider can be internal or external to the organization.

Note 2 to entry: In a contractual situation a provider is sometimes called a "contractor".

Note 3 to entry: In the context of *projects* (3.3), "contractor" or "subcontractor" is often used in place of "provider".

[SOURCE: ISO 9000:2015, 3.2.5, modified — Note 3 to entry has been added.]

4   Quality management systems in projects

4.1   Context and characteristics of the project

4.1.1   General

Both the project organization and the originating organization (see 4.1.2) should consider the context in which their project quality management systems operate. Some internal and external issues can affect the project's ability to achieve the intended project results. Other issues can offer opportunities to work more effectively with internal and external parties (see ISO 9001:2015, 4.1).

Consideration of internal and external issues that can influence the project quality management system enables both the project and originating organizations to:

a)   understand the needs and expectations of interested parties;

b)   establish or adopt project quality management processes necessary to achieve intended project results;

c)   determine risks and opportunities related to project processes and planned outputs.

The main characteristics of projects are as follows:

— they are unique, non-repetitive phases consisting of processes and activities;

— they have some degree of risk and uncertainty;

— they are expected to deliver specified quantified results within predetermined parameters, for example, quality-related parameters;

— they have planned starting and finishing dates, within clearly specified cost and resource constraints;

— they have outputs that can be one or several units of a product or service;

— personnel may be temporarily assigned to a project organization for the duration of the project [the project organization may be assigned by an originating organization (see 4.1.2) and can be subject to change as the project progresses];

— they can be of a long duration, and subject to changing internal and external influences over time.

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1)   Under preparation. Stage at the time of publication: ISO/FDIS 10005:2017.

4.1.2   Organizations

This document makes separate reference to an "originating organization" and to a "project organization".

The "originating organization" is the organization that decides to undertake the project. It can be constituted as a single organization, joint-venture, consortium or any other acceptable structure. The originating organization assigns the project to a project organization.

The originating organization can undertake multiple projects, each of which should be assigned to a different project organization.

The "project organization" carries out the project. The project organization may be a part of the originating organization. There should be a clear division of responsibility and authority between the project organization and other relevant interested parties (including the originating organization) for the project's processes. These should be maintained as documented information.

4.1.3   Phases and processes in projects

Phases and processes are two different aspects of a project. A project may be divided into interdependent processes and into phases, as a means of planning and monitoring the realization of objectives and assessing the related risks.

Project phases divide the project life cycle into manageable sets of activities, such as conception, development, realization and termination.

Project processes are those processes that are necessary for managing the project as well as those that are necessary to realize the project's product or service.

NOTE 1   ISO 21500 gives guidance on project management processes.

Not all the processes discussed in this document will necessarily exist in a particular project, whereas in others additional processes can be necessary. In some projects, a distinction might need to be made between core and supporting processes. Annex A lists and summarizes the processes that are considered to be applicable for the majority of projects.

NOTE 2   To facilitate the discussion of the guidance to quality management in projects, the "process approach" is adopted in this document (see 5.2.5). Additionally, the processes of a project have been grouped into two categories: the project management processes and the processes related to the project's product or service (those primarily concerned with the project's product or service such as design, production, etc.).

The processes are grouped according to their affinity to one another; for example, all time-related processes are included in one group.

The strategic process covered in Clause 5 sets the direction for the project. Clause 6 addresses resource-related processes and personnel-related processes. Clause 7 covers processes related to interdependency, scope, time, cost, communication, risk and procurement. Processes related to measurement, analysis and continual improvement are covered in Clause 8. These clauses include a description of each process and provide guidance to quality management in the process.

4.1.4   Project management processes

Project management includes the planning, organizing, monitoring, controlling and reporting of all processes of a project, including taking the necessary corrective and improvement actions, that are needed to achieve the project objectives, on a continual basis. The quality management principles (see 4.2, 5.2 and ISO 9000:2015, 2.3) should be applied to all the project management processes.

Guidance on quality in project management processes is discussed in this document.

NOTE   ISO 21500 gives guidance on project management and related processes.

4.2 Quality management principles

The guidelines for quality management of projects given in this document are based on the seven quality management principles (see ISO 9000:2015, 2.3):

— customer focus;

— leadership;

— engagement of people;

— process approach;

— improvement;

— evidence-based decision making;

— relationship management.

These generic principles should form the basis for quality management systems for both the originating and project organizations.

NOTE   Guidance on the application of the quality management principles to the planning carried out in the strategic process is given in 5.2.

4.3 Project quality management processes

It is necessary to manage project processes within a quality management system in order to achieve project objectives. Where the project organization operates within the originating organization, the project quality management system should be aligned, as far as is possible, with the quality management system of the originating organization. Where a part or all of the project organization is external to the performing organization, quality management system requirements might need to be specified to ensure that project processes are capable of interfacing effectively.

Documented information needed and produced by the project organization to ensure the effective planning, implementation and control of the project should be defined and controlled (see ISO 9001:2015, 7.5).

4.4 Quality plan for the project

The project quality management system should be documented, maintained and included or referenced in a quality plan for the project.

The quality plan should identify the activities and resources necessary for achieving the quality objectives of the project. The quality plan should be incorporated into, or referenced in, the project management plan.

In specifying and developing the quality plan, both the originating and project organizations should apply risk-based thinking to quality management system processes involved in the achievement of project objectives. Risks and opportunities should be addressed in planning and support processes as well as in the project risk-related processes (see 7.7).

In contractual situations, a customer may specify requirements for the quality plan. These requirements should not limit the scope of the quality plan used by the project organization.

NOTE   ISO 10005 gives guidance on quality plans.

5 Management responsibility in projects

5.1 Top management commitment

The commitment and active involvement of the top management of both the originating and project organizations are essential for developing and maintaining an effective and efficient quality management system for the project.

Top management of both the originating and project organizations should create a culture for quality, which is an important factor in ensuring the success of the project.

Top management of both the originating and project organizations should provide input into the strategic process (see 5.2). Since the project organization is likely to be disbanded upon completion of the project, the top management of the originating organization should ensure that continual improvement actions are implemented for current and future projects. Top management of both the originating and project organizations should facilitate a culture in which lessons learned lead to continuous improvement of current and future projects.

5.2 Strategic process

5.2.1 Application of quality management principles through the strategic process

Planning for the establishment, implementation and maintenance of a quality management system based on the application of the quality management principles is a strategic process. This planning should be performed by the project organization.

In this planning, it is necessary to focus on the quality of both processes and products/services to meet the project objectives.

The general guidance given in 5.2.2 to 5.2.8 should also be applied to the processes described in 6.1, 6.2, 7.2 to 7.8, and in Clause 8, in addition to the specific guidance given in those clauses.

NOTE   See Annex A for an overview of processes.

5.2.2 Customer focus

Organizations depend on their customers and therefore should understand current and future customer needs, meet customer requirements and strive to exceed customer expectations (see ISO 9000:2015, 2.3.1).

Satisfaction of the customer's and other interested parties' requirements is necessary for the success of the project. These requirements should be clearly understood to ensure that all processes focus on, and are capable of, meeting them.

The project objectives, which may include the product/service requirements, should take into account the needs and expectations of the customer and other interested parties. The objectives may be refined during the course of the project. The project objectives should be documented in the project management plan (see 7.2.2), and should detail what is to be accomplished (expressed in terms of time, cost and product/service quality) and what is to be measured.

When determining the balance between time, cost and product/service quality, potential impacts on the project's product or service should be evaluated, taking into consideration the customer's and other interested parties' requirements.

Interfaces should be established with all the interested parties to facilitate the exchange of information, as appropriate, throughout the project. Any conflicts between the interested parties' requirements should be resolved.

When conflicts arise between the requirements of the customer and other interested parties, the customer requirements will normally take precedence, bearing in mind that there can be statutory and regulatory requirements that can affect this.

The resolution of conflicts should be agreed to by the customer and other interested parties. Relevant interested parties' agreements should be retained as documented information. Throughout the project, attention should be paid to changes in the requirements of the relevant interested parties, including additional requirements from new interested parties that join the project after it has started.

5.2.3   Leadership

Leaders establish unity of purpose and direction for the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives (see ISO 9000:2015, 2.3.2).

A project manager should be appointed as early as possible. The project manager is the individual with the defined responsibility and authority for managing the project and ensuring that the project's quality management system is established, implemented and maintained. The authority delegated to the project manager should be commensurate with the assigned responsibility.

The top management of both the originating and project organizations should assume leadership in creating a culture for quality:

a)   by setting the quality policy and identifying the objectives (including the quality objectives) for the project;

b)   by providing the infrastructure and resources to ensure achievement of project objectives;

c)   by promoting the use of the process approach and risk-based thinking;

d)   by supporting an organizational structure conducive to meeting project objectives;

e)   by making decisions based on data and factual information;

f)   by empowering and motivating all project personnel to improve the project processes and products/services, and by being aware of their contribution to the effectiveness of the processes;

g)   by planning for preventive actions.

5.2.4   Engagement of people

People at all levels are the essence of an organization and their full engagement enables their abilities to be used for the organization's benefit (see ISO 9000:2015, 2.3.3).

Personnel in the project organization should have well-defined roles, responsibilities and authorities for their participation in the project. The authority delegated to the project participants should correspond to their assigned responsibility. Competent personnel should be assigned to the project organization.

In order to improve the performance of the project organization, appropriate tools, techniques and methods should be provided to the personnel to enable them to operate, monitor and control the processes.

In the case of multinational and multi-cultural projects, joint ventures, international projects, etc., the implications of cross-cultural management should be addressed.

5.2.5   Process approach

A desired result is achieved more efficiently when activities and related resources are managed as a process (see ISO 9000:2015, 2.3.4).

Project processes and their interrelationships should be determined. Where necessary, the operation and control of these processes should be supported by documented information. The originating organization may communicate the experience gained in developing and using its own processes, or those from its other projects, to the project organization. The project organization can take account of this experience when establishing the project's processes, but it might also need to establish processes that are unique to the project.

In general, the process approach to management allows for the coordination and compatibility of an organization's planned processes and a clear definition of their interfaces.

A project is carried out as a set of planned, interrelated and interdependent processes. The project organization controls the project processes. To do this, the processes should be defined and linked. They should be integrated and managed as a system aligned with the originating organization's overall system.

This can be accomplished:

a) by identifying the appropriate processes for the project;

b) by identifying the inputs, outputs and the objectives for the project's processes;

c) by identifying the process owners and establishing their authority and responsibility;

d) by designing the project's processes in the life cycle of the project;

e) by defining the interrelations and interactions among the processes;

f) by addressing the risks and opportunities associated with the project processes.

Process effectiveness and efficiency can be assessed through internal and external review. Assessments can also be made by benchmarking or evaluating the processes against a maturity scale. Maturity scales typically range in degrees of maturity from "no formal system" to "best-in-class".

NOTE   International Standards on quality management and quality management systems developed by ISO/TC 176 provide guidance on a number of process-related and product/service-related quality management practices; these can assist an organization in meeting its project objectives.

5.2.6   Improvement

Improvement of the organization's overall performance should be a permanent objective of the organization (see ISO 9000:2015, 2.3.5).

The cycle of continual improvement is based on the "Plan-Do-Check-Act" (PDCA) concept (see ISO 9001:2015, 0.3.2).

Both the originating and project organizations are responsible for continually seeking to improve the effectiveness and efficiency of the processes for which they are responsible.

To learn from experience, managing projects should be treated as a process rather than as an isolated task. A process should be put in place to record and analyse the information gained during a project for use in a continual improvement process (see ISO 9001:2015, 10.3).

Provision should be made for self-assessments (see ISO 9004), internal audits and, where required, external audits (see ISO 9001:2015, 9.2 and 9.3) to identify opportunities for improvement. This should also take account of the time and resources needed.

Lessons learned and information from previous projects should be analysed and used to support the improvement of current or future projects.

5.2.7   Evidence-based decision making

Effective decisions are based on the analysis of data and information (see ISO 9000:2015, 2.3.6).

Information about the project's progress and performance should be recorded; for example, in a project status report.

Performance and progress evaluations (see 5.3) should be carried out periodically in order to assess the project status. The project organization should analyse the information from performance and progress evaluations to make effective decisions regarding the project and for revising the project management plan.

5.2.8   Relationship management

An organization and its interested parties are interdependent and a mutually beneficial relationship enhances the ability of both to create value (see ISO 9000:2015, 2.3.7).

The project organization should work with its providers when defining its strategies for obtaining external products or services, especially in cases of products or services with long lead times. Risk sharing with providers may be considered.

Requirements for providers' processes and product or service specifications should be developed jointly by the project organization and its providers, in order to benefit from available provider knowledge. The project organization should also determine a provider's ability to meet its requirements for processes or products or services, and should take into account the customer's preferred list of providers or selection criteria.

The possibility of a number of projects using a common provider should be investigated.

5.3   Management reviews and progress evaluations

5.3.1   Management reviews

The project organization's managers responsible for the project should review the project's quality management system, at planned intervals, to ensure its continuing suitability, adequacy, effectiveness and efficiency (see ISO 9001:2015, 9.3). The originating organization may be involved in management reviews.

5.3.2   Progress evaluations

Progress evaluations should cover all the project's processes and provide an opportunity to assess the achievement of the project objectives. The outputs from progress evaluations can provide significant information on the performance of the project as an input into future management reviews.

a)   Progress evaluations should be used:

　　1)   to assess the adequacy of the project management plan against project objectives and how the work performed conforms to it;

　　2)   to evaluate how well the project processes are synchronized and interlinked;

　　3)   to identify and evaluate activities and results that would adversely or favourably affect the achievement of the project objectives;

　　4)   to obtain inputs for remaining work in the project;

　　5)   to facilitate communication;

　　6)   to drive process improvement in the project, by identifying deviations and changes in risks and opportunities.

b)   The planning for progress evaluations should include:

　　1)   preparing an overall schedule for progress evaluations (for inclusion in the project management plan);

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2) assigning responsibility for the management of individual progress evaluations;

3) specifying the purpose, assessment requirements, processes and outputs for each progress evaluation;

4) assigning personnel to participate in the evaluation (e.g. the individuals responsible for the project processes and other interested parties);

5) ensuring that appropriate personnel from the project processes being evaluated are available for questioning;

6) ensuring that relevant information is prepared and is available for the evaluation (e.g. the project management plan).

c) Those performing the evaluations should:

1) understand the purpose of the processes being evaluated, and their effect on the project quality management system;

2) examine relevant process inputs and outputs;

3) review the monitoring and measuring criteria being applied to the processes;

4) determine if the processes are effective;

5) look for potential improvements in process efficiencies;

6) develop reports, or other relevant outputs, with the progress evaluation results.

d) Once a progress evaluation has been performed:

1) the outputs of the evaluation should be assessed against the project's objectives, to determine whether the performance of the project against the planned objectives is acceptable;

2) responsibility should be assigned for actions resulting from the progress evaluation.

The outputs of progress evaluations can also be used to provide information to the originating organization for continual improvement of the effectiveness and efficiency of the project management processes.

6 Resource management in projects

6.1 Resource-related processes

6.1.1 General

The resource-related processes aim to plan and control resources. They help to identify any potential problems with resources. Examples of resources include people, equipment, facilities, finance, information, materials, computer software and services.

The resource-related processes are:

a) resource planning (see 6.1.2);

b) resource control (see 6.1.3).

NOTE 1   See Annex A for an overview of processes.

NOTE 2   This subclause applies to the quantitative aspects of people management. Other aspects, such as training, are covered in 6.2.

6.1.2 Resource planning

Resources needed for the project should be identified. Resource plans should state what resources will be needed by the project and when they will be required, according to the project schedule. The plans should indicate how, and from where, resources will be obtained and allocated. If applicable, the plans should also include the manner of disposition of resources at the completion of tasks and at the end of the project. The plans should be suitable for resource control.

The validity of the inputs to resource planning should be verified. The stability, capability and performance of organizations supplying resources should be evaluated.

The constraints on, and risks related to, resources should be taken into account. Examples of constraints include availability, safety, cultural considerations, international agreements, labour agreements, governmental regulations, funding and the impact of the project on the environment.

Resource plans, including estimates, allocations and constraints, together with assumptions made, should be documented and included in the project management plan.

6.1.3 Resource control

Reviews should be performed to ensure that sufficient resources are available to meet the project objectives.

The timing of reviews, the frequency of associated data collection and forecasts of resource requirements should be documented in the project management plan.

Deviations from resource plans should be identified, analysed, acted upon and recorded.

Decisions on actions to be taken should only be made after considering the implications for other project processes and objectives. Changes that affect the project objectives should be agreed with the customer and other interested parties before implementation. Changes in resource plans should be authorized as appropriate. Revisions of forecasts of resource requirements should be coordinated with other project processes when developing the plan for remaining work.

Root causes for shortages or excesses in resources should be identified, recorded and used as input for corrective action.

6.2 Personnel-related processes

6.2.1 General

The quality and success of a project will depend on the participating personnel; therefore, special attention should be given to the activities in the personnel-related processes.

These processes aim to create an environment in which personnel can contribute effectively and efficiently to the project.

The personnel-related processes are:

a)   the establishment of the project organizational structure (see 6.2.2);

b)   the allocation of personnel (see 6.2.3);

c)   the team development (see 6.2.4).

NOTE 1   See Annex A for an overview of processes.

NOTE 2   The quantitative aspects of personnel management are covered in 6.1. The communication aspects of personnel management are covered in 7.6.

6.2.2 Establishment of the project organizational structure

The project organizational structure should be established in accordance with the requirements and policies of the originating organization and the conditions particular to the project. Previous project experience should be recorded in the lessons learned and used, when available, for the selection of the most appropriate organizational structure.

The project organizational structure should be designed to encourage effective and efficient communication and cooperation between all participants in the project.

The project manager and the originating organization should ensure that the project organizational structure is appropriate to the project scope, the size of the project team, local conditions and the processes employed. This can result, for example, in a functional or matrix type project organizational structure. The division of authority and responsibility within the project organization structure should also take account of the division of authority and responsibility in the originating organization and its organizational structure.

The relationships of the project organization should be identified and established:

a)   to the customer and other interested parties;

b)   to the functions of the originating organization supporting the project (particularly those in charge of monitoring project functions such as schedules, quality and cost);

c)   to other relevant projects in the same originating organization.

Job or role descriptions, including assignments of responsibility and authority, should be prepared and documented.

The project function responsible for ensuring that the project's quality management system is established, implemented and maintained should be identified. The interfaces of this function with other project functions, the customer and other interested parties should be documented.

Reviews of the project organizational structure should be planned and carried out regularly to determine whether it continues to be suitable and adequate.

6.2.3 Allocation of personnel

The necessary competence in terms of education, training and experience should be defined for personnel working on the project ("competence" is defined in ISO 9000:2015, 3.10.4, as the "ability to apply knowledge and skills to achieve intended results"). In addition, project specific skills should be determined.

Personal attributes should be considered in the selection of project personnel. Special attention should be given to the competence requirements of key personnel.

Sufficient time should be allowed for the recruiting of competent personnel, especially when difficulties are anticipated. Selection of personnel should be based on the job or role descriptions, and should take into account the competence of applicants and references from previous experience. Selection criteria should be developed and applied to all levels of personnel being considered for the project. When selecting a project manager priority should be given to leadership skills.

The project manager should be involved in the selection of personnel for the project positions that are considered essential to the project's success.

The project manager should ensure that a representative of the project organization is appointed with responsibility for establishing, implementing and maintaining the project's quality management system.

When assigning members to project teams, their personal interests, personal relationships, strengths and weaknesses should be considered. Knowledge of personal characteristics and experience can help in identifying the best sharing of responsibilities among the members of the project organization.

The job or role description should be understood and accepted by the person assigned. Whenever a member of the project organization is also reporting to a function in the originating organization, the role, the responsibility, authority and reporting lines of that individual should be documented.

The assignment of personnel to specific jobs or roles should be confirmed and communicated to all concerned. The overall performance, including the effectiveness and efficiency of personnel in their job assignments, should be monitored to verify that the assignments are appropriate. Based on results, appropriate actions should be taken, such as retraining or recognizing achievement.

Changes of personnel in the project organization should be communicated to the customer and other interested parties before implementation, when possible, if the change affects them.

6.2.4   Team development

Effective team performance requires the team members to be individually competent, motivated and willing to cooperate with one another.

To enhance team performance, the project team collectively, and the team members individually, should participate in team development activities. Personnel should receive training in, and be made aware of, the relevance and importance of their project activities in the attainment of the project and the quality objectives (see ISO 10015).

Effective teamwork should be recognized and, where appropriate, rewarded.

Managers in the project organization should ensure the establishment of a work environment that encourages excellence, effective working relationships, trust and respect within the team and with all others involved in the project. Consensus-based decision making, structured conflict resolution, clear, open and effective communication, and mutual commitment to customer satisfaction should be encouraged and developed (see 5.2.3 for a discussion of leadership).

Wherever possible, personnel affected by changes in the project or in the project organization should be involved in planning and implementing the change.

7   Product/service realization in projects

7.1   General

This clause covers project management process groupings that are necessary to produce the project's product or service (see 4.1.3).

7.2   Interdependent processes

7.2.1   General

Projects consist of a system of planned and interdependent processes and an action in one of these usually affects others. The overall management of the planned interdependencies among the project processes is the responsibility of the project manager. The project organization should also manage effective and efficient communication between different groups of personnel involved in the project and establish clear assignment of their responsibility.

The interdependent processes are:

a)   project initiation and project management plan development (see 7.2.2);

b)   interaction management (see 7.2.3);

c)   change management (see 7.2.4);

d)   process and project closure (see 7.2.5).

NOTE   See Annex A for an overview of processes.

7.2.2   Project initiation and project management plan development

A project management plan, which should include or reference the project's quality plan, should be established and kept up to date. The degree of detail included can depend on factors such as scope, size and complexity of the project.

During project initiation, details of relevant past projects from the originating organization should be identified and communicated to the project organization. This will enable the best use to be made of the experience gained (e.g. lessons learned) from these previous projects.

If the purpose of a project is to fulfil the requirements of a contract, contract reviews should be performed during the development of the project management plan to ensure that the contract requirements can be met. Where the project is not the result of a contract, an initial review should be undertaken to establish the requirements and confirm that they are appropriate and achievable.

The project management plan should:

a)   refer to the customer's and other interested parties' documented requirements and the project objectives; the input source for each requirement should also be documented to allow traceability;

b)   identify and document the project processes and their purposes;

c)   identify organizational interfaces, giving particular attention to:

   1)   the project organization's connection and reporting lines with the various functions of the originating organization;

   2)   interfaces between functions within the project organization;

d)   integrate plans resulting from the planning carried out in other project processes, review these plans for consistency and resolve any discrepancies; these plans include:

   1)   quality plan;

   2)   work breakdown structure (see 7.3.4);

   3)   project schedule (see 7.4.5);

   4)   project budget (see 7.5.3);

   5)   communication plan (see 7.6.2);

   6)   risk management plan (see 7.7.2);

   7)   procurement plan (see 7.8.2);

e)   identify, include or reference the product/service characteristics and how they should be measured and assessed;

f)   provide a baseline for progress measurement and control, to provide for planning the remaining work; plans for reviews and progress evaluations should be prepared and scheduled;

g)   define performance indicators and how to measure them, and make provision for regular assessment in order to monitor progress; these assessments should:

   1)   facilitate preventive and corrective actions;

   2)   confirm that the project objectives remain valid in a changing project environment;

h)   provide for reviews of the project required by the contract to ensure the fulfilment of the requirements of the contract;

i)   be reviewed regularly and also when significant changes occur.

The project quality management system should be documented or referenced in the project's quality plan. Linkage should be established between the project's quality plan and applicable parts of the quality management system of the originating organization. As far as is practicable, the project organization should adopt and, if necessary, adapt the quality management system and processes of the originating organization. In cases where specific requirements for the quality management system from other interested parties exist, it should be ensured that the project's quality management system is compatible with these requirements.

7.2.3   Interaction management

To facilitate the interdependencies (which are planned) between processes, the interactions (which are not planned) in the project should be managed. This should include the following:

a)   establishing processes for interface management;

b)   holding project inter-functional meetings;

c)   resolving issues, such as conflicting responsibilities or changes to risk exposure;

d)   measuring project performance, using such techniques as earned value analysis (a technique for monitoring overall project performance against a budget baseline);

e)   carrying out progress evaluations to assess project status and to plan for the remaining work.

The progress evaluations should also be used to identify potential interface problems. It should be noted that risk is usually high at the interfaces.

NOTE   Project communication is an essential factor in project coordination and is discussed in 7.6.

7.2.4   Change management

Change management covers the identification, evaluation, authorization, documentation, implementation and control of change. Before a change is authorized, the intent, extent and impact of the change should be analysed. Those changes that affect the project objectives should be agreed with the customer and other interested parties.

Change management should also take the following into account:

a)   managing changes to the project scope, project objectives and project management plan;

b)   coordinating changes across inter-linked project processes and resolving any conflicts;

c)   processes for documenting change;

d)   improvement (see 8.3);

e)   aspects of change affecting personnel (see 6.2.4).

Changes can result in impacts on the project and such impacts should be identified as soon as possible. The root causes of impacts should be analysed and the results should be used to produce solutions and to implement improvements in the project process.

Before implementation of any change, a change request should be submitted in accordance with the project processes established in the project management plan. The relevant documented information given with the request should include a justification for the change.

An aspect of change management is configuration management. For the management of projects, it is taken to refer to the configuration of the project's products or services. This can include both non-deliverable items (such as test tools and other installed equipment) and deliverable items.

NOTE   Further guidance on configuration management is given in ISO 10007.

7.2.5   Process and project closure

The project itself consists of processes and special attention should be given to their closure.

The closure of processes and the project should be defined during the initiation stage of the project and be included in the project management plan. When planning the closure of processes and projects, the experience gained from the closure of previous processes and projects (see Clause 8) should be taken into account. However, in certain cases it can be necessary to close the project earlier or later than planned, due to unpredicted events.

At any time during the life cycle of a project, completed processes should be closed as planned. When a process is closed, it should be ensured that all documented information is compiled, distributed within the project and to the originating organization, as appropriate, and retained for a specified time.

Whatever the reason for project closure, a complete review of project performance should be undertaken. This should take into account all relevant documented information, including that from progress evaluations and inputs from interested parties. Special consideration should be given to feedback from the customer and other interested parties. This feedback should be measurable where possible.

Based on this review, appropriate reports should be prepared, highlighting experience that can be used by other projects and for continual improvement (see 8.3).

At the closure of the project, there should be a formal handover of the project product/service to the customer. Project closure is not completed until the customer formally accepts the project product/service.

The closure of the project should be communicated to interested parties.

7.3   Scope-related processes

7.3.1   General

The project's scope includes a description of the project's product/service, its characteristics and how they are to be measured or assessed. The scope-related processes:

a) aim:

   1) to translate the customer's and other interested parties' needs and expectations into project requirements to be implemented to achieve the objectives of the project, and to organize activities required for the implementation;

   2) to ensure that personnel work within the scope during the realization of these activities;

   3) to ensure that the activities carried out in the project meet the requirements described in the scope;

b) are:

   1) concept development (see 7.3.2);

   2) scope development and control (see 7.3.3);

   3) definition of activities (see 7.3.4);

4) control of activities (see 7.3.5).

NOTE   See Annex A for an overview of processes.

7.3.2   Concept development

Customer needs and expectations for product/service and processes (both stated and generally implied), as well as any applicable statutory and regulatory requirements, should be determined and defined. These should be translated into documented requirements which, when required by the customer, should be mutually agreed.

Other interested parties should be identified and their needs established. These should be translated into documented requirements and, where relevant, agreed to by the customer.

7.3.3   Scope development and control

When developing the project scope, the characteristics of the project's product or service should be identified and documented in measurable terms and as completely as possible. These characteristics should be used as the basis for design and development. It should be specified how these characteristics will be measured or how their conformity to the customer's and other interested parties' requirements will be assessed. Product/service and process characteristics should be traceable to the documented requirements of the customer and other interested parties.

When alternative approaches and solutions are considered during scope development, supporting evidence (including the analyses performed and other considerations used) should be documented and referenced in the scope.

NOTE   The management of changes to the scope is addressed by the change management process (see 7.2.4).

7.3.4   Definition of activities

The project should be systematically structured into manageable activities to meet customer requirements for products/services and processes.

NOTE   Frequently, the term "breakdown structure" is used to describe the way in which a project can be divided by levels into discrete groups for programming, cost planning and control purposes. Also, terms such as "activities", "tasks" and "work packages" are used for the elements of this structuring, and the result is usually known as a "work breakdown structure" (WBS).

Personnel assigned to the project should participate in the definition of these activities. This will enable the project organization to benefit from their experience and to gain their understanding, acceptance and ownership.

Each activity should be defined in such a way that its results are measurable. The list of activities should be checked for completeness. The activities defined should include quality management practices, progress evaluations, and the preparation and maintenance of a project management plan.

The interactions between activities in a project that could potentially cause problems between the project organization and the interested parties should be identified, managed and documented.

7.3.5   Control of activities

The activities within the project should be carried out and controlled in accordance with the project management plan. Process control includes control of the interactions between activities to minimize conflicts or misunderstandings. In processes involving new technologies, particular attention should be given to their control.

Activities should be reviewed and evaluated to identify potential deficiencies and opportunities for improvement. The timing of reviews should be adapted to the complexity of the project.

The results of reviews should be used for progress evaluations to assess process outputs and to plan for the remaining work. The revised plan for the remaining work should be documented.

7.4   Time-related processes

7.4.1   General

The time-related processes aim to determine dependencies and the duration of activities, and to ensure timely completion of the project.

The time-related processes are:

a)   planning of activity dependencies (see 7.4.2);

b)   estimation of duration (see 7.4.3);

c)   schedule development (see 7.4.4);

d)   schedule control (see 7.4.5).

NOTE   See Annex A for an overview of processes.

7.4.2   Planning of activity dependencies

The interdependencies among the activities in a project should be identified and reviewed for consistency. Any need for changing the data from the activity identification process should be justified and documented.

Whenever possible, during development of the project plan, standard or proven project network diagrams should be used to take advantage of previous experience. Their appropriateness to the project should be verified.

7.4.3   Estimation of duration

Estimates of the duration of activities should be established by personnel with responsibility for those activities. Duration estimates from past experience should be verified for accuracy and applicability to present project conditions. The inputs should be documented and traceable to their origins. When collecting duration estimates, it is useful to obtain associated resource estimates at the same time as an input to resource planning (see 6.1.2).

When duration estimation involves significant uncertainty, the risks should be evaluated, documented and mitigated. Allowance for remaining risks should be incorporated into the estimates.

When required or appropriate, the customer or other interested parties should be involved in duration estimation.

7.4.4   Schedule development

Input data for schedule development should be identified and checked for conformity to specific project conditions. Activities with long lead times or long durations should be taken into account when determining the critical path. The critical path is the sequence of activities that determine the earliest possible completion date for the project or phase, through the network diagram from project start to project end along dependent activities. It requires explicit identification.

Standardized schedule formats, suitable for the different user needs, should be implemented.

The relationships of duration estimates to activity dependencies should be checked for consistency. Any inconsistencies found should be resolved before schedules are finalized and issued. The schedules should identify critical and near-critical activities.

The schedule should identify events that require specific inputs or decisions, or ones at which major outputs are planned. These are sometimes referred to as "key events" or "milestones". Progress evaluation activities should be included in the schedule.

The customer and other interested parties should be involved with, and kept informed of, the development of the schedule when required. External inputs (e.g. customer-dependent inputs expected during the project) should be analysed and taken into account in the schedule.

Appropriate schedules should be supplied to the customer and other interested parties for information or, if required, for approval.

7.4.5   Schedule control

The project organization should carry out regular reviews of the project schedule, as defined in the project management plan. To ensure adequate control over project activities, processes and related information, the timing of schedule reviews and the frequency of data collection should be established.

Project progress should be analysed in order to identify trends and possible risks and opportunities in the work remaining in the project (see 7.7). Up-to-date schedules should be used in progress evaluations and meetings. Deviations from the schedule should be identified, analysed and, if significant, acted upon.

Root causes for variances from schedule, both favourable and unfavourable, should be identified. Action should be taken to ensure that unfavourable variances do not affect project objectives. Causes of both favourable and unfavourable variances should be used to provide data as a basis for continual improvement (see Clause 8).

Possible impacts of schedule changes on the budget and resources of the project and on the quality of the product/service should be determined. Decisions on actions to be taken should only be made based on facts, after taking into account their implications for other project processes and objectives. Changes that affect the project objectives should be agreed with the customer and other relevant interested parties before implementation.

When action is required to take account of variances, the personnel involved and their roles should be identified. Revisions of the schedule should be coordinated with other project processes when developing the plan for the remaining work.

External inputs (e.g. customer-dependent inputs expected during the project) should be monitored. The customer and other interested parties should be kept informed of any proposed changes to the schedule and should be involved in making decisions that affect them.

7.5   Cost-related processes

7.5.1   General

The cost-related processes aim to forecast and manage the project costs. This should ensure that the project is completed within budget constraints, and that cost information can be provided to the originating organization.

The cost-related processes are:

a)   cost estimation (see 7.5.2);

b)   budgeting (see 7.5.3);

c)   cost control (see 7.5.4).

NOTE 1   See Annex A for an overview of processes.

NOTE 2   Further guidance on the economic effects of quality management is given in ISO 10014.

7.5.2   Cost estimation

All project costs should be clearly identified (e.g. cost of activities, overheads, products/services). Cost estimation should consider relevant sources of information and should be linked to the project's breakdown structures (see 7.3.4). Cost estimates from past experience should be verified for accuracy and applicability to present project conditions. The costs should be documented and traceable to their origins.

Particular attention should be given to budgeting sufficient funds for the establishment, implementation and maintenance of the project quality management system.

Cost estimation should take into account present and forecast trends in the economic environment (e.g. inflation, taxation and exchange rates).

When cost estimation involves significant uncertainties, these risks should be identified, evaluated, documented and acted upon (see 7.7.2). Allowance for remaining uncertainties, sometimes called "contingencies", should be incorporated in the estimates.

The cost estimates should be in a form that enables budgets to be established and developed in accordance with approved accounting processes as well as the project organization's needs.

7.5.3   Budgeting

The project budget should be based on the cost estimates and schedules with a defined process for its acceptance.

The budget should be consistent with the project objectives. Any assumptions, uncertainties and contingencies should be identified and documented. The budget should include all authorized costs and should be in a form suitable for project cost control.

7.5.4   Cost control

Prior to any expenditure, a cost control system and associated processes should be established, documented and communicated to those responsible for authorizing work or expenditure.

The timing of reviews and the frequency of data collection and forecasts should be established. This ensures adequate control over project activities and related information. The project organization should verify that the remaining work can be carried out to completion within the remaining budget. Any deviation from the budget should be identified and, if exceeding defined limits, the variance should be analysed and acted upon.

Project cost trends should be analysed, using techniques such as "earned value analysis". The plan for the remaining work should be reviewed to identify uncertainties.

Root causes for variances to budget, both favourable and unfavourable, should be identified. Action should be taken to ensure that unfavourable variances do not affect project objectives. Causes of both favourable and unfavourable variances should be used to provide data as a basis for continual improvement (see Clause 8).

Decisions on actions to be taken should only be made based on facts, after taking into account the implications for other project processes and objectives. Changes in the cost of the project should be appropriately approved and authorized prior to expenditure. Revisions of the budget forecast should be coordinated with other project processes when developing the plan for remaining work.

The information needed to ensure the timely release of funds should be made available and provided as input to the resource control process.

The project organization should carry out regular reviews of the project costs, as defined in the project management plan, and take into account any other financial reviews (e.g. external reviews by relevant interested parties).

7.6 Communication-related processes

7.6.1 General

The communication-related processes aim to facilitate the exchange of information necessary for the project.

They ensure timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information.

The communication-related processes are:

a)   communication planning (see 7.6.2);

b)   information management (see 7.6.3);

c)   communication control (see 7.6.4).

NOTE 1   See Annex A for an overview of processes.

NOTE 2   Further information is given in ISO 9004.

The project organization should ensure that appropriate communication processes are defined and that information is exchanged between the project's processes as well as between the project, other relevant projects, the customer and other interested parties, and the originating organization.

7.6.2 Communication planning

Both the originating and project organizations should ensure that appropriate communication processes are established for the project, and that communication takes place regarding the current status of the quality management system.

Communication planning should take into account the needs of the originating organization, project organization, the customer and other interested parties, and should result in a documented communication plan.

The communication plan should define the information that will be formally communicated, the media used to transmit it and the frequency of communication. The requirements for the purpose, frequency, timing and documented information of meetings should be defined in the communication plan.

The format, language and structure of the project documented information should be planned to ensure compatibility. The communication plan should define the information management system (see 7.6.3), identify who will send and receive information, and should reference the relevant controls on documented information, including security processes. The format for progress evaluation reports should be designed to highlight deviations from the project management plan.

NOTE   ISO 9001:2015, 7.5, provides further information on the control of documented information.

7.6.3 Information management

The project organization should identify its information needs and should establish a documented information management system.

The project organization should also identify internal and external sources of information. The way in which information is managed should take into consideration the needs of both the project and originating organizations.

In order to manage the project's information, processes defining the controls for information preparation, collection, identification, classification, updating, distribution, filing, storage, protection, retrieval, retention time and disposition should be established.

Documented information should indicate the conditions prevailing at the time the activity was recorded. This will allow the validity and relevance of the information to be verified before use in other projects.

The project organization should ensure appropriate security of information, taking into account confidentiality, availability and integrity of information.

Information should be relevant to the needs of the recipients, and should be clearly presented and distributed with strict adherence to time schedules.

All agreements affecting the project performance, including informal ones, should be formally documented.

Rules and guidelines for meetings should be established and should be appropriate to the type of meeting.

Meeting agendas should be distributed in advance and should identify for each item the personnel whose attendance is required.

Minutes of meetings should include details of the decisions made, the outstanding issues and the agreed actions (including due dates and the personnel assigned to carry them out). The minutes should be distributed to relevant interested parties within an agreed time.

The project organization should use the data, information and knowledge to set and meet its objectives. The managers of the project and originating organizations should evaluate the benefits derived from the use of the information in order to improve the management of information (see Clause 8).

The information management system should be as simple as possible.

7.6.4   Communication control

The communication system should be planned and implemented. It should be controlled, monitored and reviewed to ensure that it continues to meet the needs of the project. Particular attention should be given to interfaces between functions and organizations where misunderstandings and conflicts can occur.

7.7   Risk-related processes

7.7.1   General

Commonly "project risks" are the effects of uncertainty on project objectives. The management of project risks deals with uncertainties throughout the project. This requires a structured approach that should be documented in a risk management plan. The risk-related processes aim to minimize the impact of potential negative events and take advantage of opportunities for improvement and innovation related, not only to project processes, but also to increased value for the project, originating organizations, and the customer and other interested parties.

Uncertainties are also related to either the project processes or to the project's product/service.

The risk-related processes are:

a)   risk identification (see 7.7.2);

b)   risk assessment (see 7.7.2);

c)   risk treatment (see 7.7.3);

d)   risk control (see 7.7.4).

NOTE 1   See Annex A for an overview of processes.

NOTE 2   Further information on risk management is given in ISO 31000.

7.7.2   Risk identification

Risk identification should be performed at the initiation of the project, at progress evaluations and other occasions when significant decisions are made. Experience and historical data from previous projects maintained by the originating organization (see 8.3.1) should be used for this purpose. The output of this process should be recorded in a risk management plan, which should be incorporated or referenced in the project management plan.

Potential risks arising from activity-, process- and product/service-related interactions between the project organization, the originating organization and interested parties should be identified and recorded.

Risk identification should consider, not only risks in cost, time and product/service, but also risks in areas such as product/service quality, security, dependability, professional liability, information technology, safety, health and environment, or potential changes to statutory and regulatory requirements. The risk identification process should consider:

a)   the interactions between different risks;

b)   the risks resulting from new technologies and developments.

While identifying risks, a lookout for potential opportunities is recommended. Identified opportunities and respective actions can offer important benefits regarding costs, quality, timeliness and image of the project/service. Any identified risk with significant impact should be documented and a person should be assigned with the responsibility, authority and resources for managing that risk.

7.7.3   Risk assessment

Risk assessment is the process of analysing and evaluating identified risks to the project processes and to the project's product/service.

All identified risks should be assessed. In this assessment, experience and historical data from previous projects should be taken into account.

The criteria and techniques to be used in the assessment should be evaluated. A qualitative analysis should be made and a quantitative analysis should follow wherever possible.

NOTE   There are various qualitative and quantitative methods of risk assessment available for performing such analyses. These are generally based on assessing the probability of occurrence and the impact of identified risks.

Levels of risk acceptable for the project, and the means to determine when agreed-to levels of risk are exceeded, should be identified.

The results of all analyses and evaluations should be recorded and communicated to relevant personnel.

7.7.4   Risk treatment

Solutions to eliminate, mitigate, transfer, share or accept risks, and plans to take advantage of opportunities should preferably be based on known technologies or data from past experience. Consciously accepted risks should be identified and the reasons for accepting them recorded.

When a solution to an identified risk is proposed, it should be verified that there will be no undesirable effects or new risks introduced by its implementation, and that the resulting residual risk is addressed.

When contingencies to manage risks are made in the time schedule or in the budget, they should be identified and maintained separately.

Special attention should be given to developing solutions for potential risks arising from activity-, process- and product/service-related interactions between the project organization, the originating organization and interested parties.

7.7.5   Risk control

Throughout the project, risks should be monitored and controlled by an iterative process of risk identification, risk assessment and risk treatment.

The project should be managed by taking into account that there are always risks. Personnel should be encouraged to anticipate and identify risks and report them to the project organization.

Risk management plans should be maintained ready for use.

Reports on project risk monitoring should be part of progress evaluations.

7.8   Procurement processes

7.8.1   General

The procurement processes deal with obtaining products/services for the project.

NOTE 1   ISO 9001:2015, 8.4, describes requirements for the control of externally provided processes and products/services.

The procurement processes are:

a)   procurement planning and control (see 7.8.2);

b)   documentation of procurement requirements (see 7.8.3);

c)   external provider management and development (see 7.8.4);

d)   contracting (see 7.8.5);

e)   contract control (see 7.8.6).

NOTE 2   See Annex A for an overview of processes.

NOTE 3   The terms "purchase", "acquisition" or "procurement" are also often used in this context.

7.8.2   Procurement planning and control

A procurement plan should be prepared in which the products or services to be obtained are identified and scheduled, taking note of product/service requirements including specification, time and cost.

All products/services that are input to the project should be subjected to the same levels of procurement controls, regardless of whether they are obtained from external providers or from the originating organization (i.e. "in-house"). External products/services are normally obtained by contract. In-house products/services can be obtained using internal acquisition processes and controls. For in-house products/services, some of the procurement controls described in this subclause may be simplified.

Procurement should be planned so that the interfaces and interactions with external providers can be managed by the project organization.

Adequate time should be allocated to complete the activities in the procurement processes. Previous experience of external provider performance should be used to plan for potential problems, such as the delivery of items with long delivery times.

To provide adequate procurement control, the project organization should carry out regular reviews of the procurement progress, which should be compared to the procurement plan and action should be taken if needed. The results of the reviews should be input into progress evaluations.

7.8.3 Documentation of procurement requirements

Procurement documents should identify the products/services, their characteristics, appropriate quality management system requirements and associated documented information. They should also include procurement responsibility, cost and delivery dates for the products/services, requirements for auditing (when necessary) and right of access to external provider premises. It should be ensured that customer requirements are taken into account in the procurement documented information.

Tendering documented information (e.g. "requests for quotation") should be structured to facilitate comparable and complete responses from potential external providers.

Procurement documented information should be reviewed before distribution, to verify that all product/service-related requirements, and other aspects (such as procurement responsibility), are completely specified.

7.8.4 External provider management and development

External providers to the project should be evaluated. An evaluation should consider all the aspects of an external provider that can impact on the project, such as technical experience, production capability, delivery times, quality management system and financial stability.

A register of approved external providers should be maintained by the project organization. A register may also be maintained by the originating organization and be communicated to the project organization, where applicable.

7.8.5 Contracting

There should be a process for the project organization to contract with external providers to the project. It should include communication of the project's quality management system requirements and, where applicable, the quality policy, quality objectives and contract quality plan requirements. The external provider should be requested to provide a contract quality plan as a part of the tender evaluation process.

In tender evaluations, all deviations from the specification in an external provider proposal should be identified and taken into account in the evaluation. Deviations from the specification, and recommendations for improvement, should be approved by the same functions that carried out the original review and approval of the specification.

Cost evaluation of tenders should be based, not only on the price from external providers, but also on other associated costs, such as cost of operation, maintenance, licences, transport, insurance, customs duty, exchange rate variation, inspection, audits and resolution of deviations.

The contract documented information should be reviewed to ensure that it includes the results of any pre-contract negotiation with the external provider.

Before contracting for the supply of products/services, the external provider's quality management system should be evaluated. The project organization should consider:

a) the reliability of other evidence that the external provider is capable of meeting quality management system requirements;

b) the surveillance of contract performance that will be required to ensure that project requirements, including quality requirements, will be met.

7.8.6 Contract control

Contract control starts at the placing of the contract, or at the time of an agreement in principle to award the contract, such as a letter of intent. A system should be implemented to ensure that the contract conditions, including due dates and required documented information, are met.

Contract control should include the establishment of appropriate contractual relationships and the integration of the outputs from these relationships into the overall management of the project.

External providers' performance should be monitored to ensure that it meets contract conditions. The results of monitoring should be fed back to external providers and any actions agreed.

Prior to contract closure, it should be verified that all contract conditions have been met and that feedback on external provider performance has been obtained to update the register of approved external providers.

8 Measurement, analysis and improvement in projects

8.1 General

This clause provides guidance on how the originating and project organizations should learn from projects.

Both organizations should use the results of measurement and the analysis of data from the project processes and should apply methods for correcting, preventing or reducing undesired effects (see ISO 9001:2015, Clause 10) to enable continual improvement in both current and future projects.

8.2 Measurement and analysis

The originating organization should ensure that the measurement, collection and validation of data are effective and efficient, in order to improve the originating organization's performance and to enhance the satisfaction of the customer and other interested parties.

Examples of the measurement of performance include:

a) evaluation of individual activities and processes;

b) auditing;

c) evaluation of the actual resources used, together with cost and time, compared to the original estimates;

d) evaluation of products/services;

e) evaluation of external provider performance;

f) achievement of project objectives;

g) satisfaction of the customer and other interested parties.

NOTE Further information on performance evaluation is given in ISO 9001:2015, Clause 9.

The managers responsible for the project from the project organization should ensure that documented information on nonconformities and the disposition of the nonconformities in the project's products/services and processes is analysed to assist learning and to provide data for improvement. The project organization, in conjunction with the customer, should decide which nonconformities should be recorded and which corrective actions undertaken.

8.3 Improvement

8.3.1 Improvement by the originating organization

The originating organization should define the information it needs to learn from projects and should establish a system for identifying, collecting, storing, updating and retrieving information from projects.

The originating organization should ensure that the information management system for its projects is designed to determine and collect relevant information from the projects, in order to improve project management processes.

The originating organization should maintain a list of all significant risks managed by its projects (see 7.7.5).

The originating organization should ensure that relevant information is used by other projects that it originates.

The relevant information needed to learn from projects can be derived from information contained within the project, including feedback from the customer and other interested parties. Information can also be derived from other sources, such as project logs, appropriate closure reports, claims, audit results, analysis of data, corrective and preventive actions, and project reviews. Before using this information, its validity should be verified by the originating organization.

Just prior to closing the project, the originating organization should carry out reviews of the project's performance, highlighting experience from the project that can be used by other projects. The results of the reviews should be retained as documented information. The project management plan should be used as the framework for conducting the review. If possible, these reviews should involve the customer and other interested parties.

For long-term projects, interim reviews should be considered to collect information more effectively and to allow for timely improvements.

8.3.2 Improvement by the project organization

The project organization should design the project's information management system to implement the requirements specified for learning from the project by the originating organization.

The project organization should ensure that the information it provides to the originating organization is accurate and complete.

The project organization should implement improvements using information relevant to the project, which has been established by the originating organization using the system described in 8.3.1.

NOTE   ISO 9001:2015, Clause 10, provides further information on improvement.

Annex A
(informative)

Overview of processes for quality management in projects

Table A.1 provides an overview of processes for quality management in projects.

NOTE 1   ISO 21500 gives guidance on project management processes.

NOTE 2   The processes listed might not be required in every project and some projects can require additional project management processes.

Table A.1 — Overview of processes for quality management in projects

Clause	Subclause	Subclause	Process	Process description
Clause 5 Management responsibility in projects	5.2 Strategic process	—	Strategic	A direction-setting process which includes planning the establishment and implementation of the quality management system based on the application of the quality management principles.
Clause 6 Resource management in projects	6.1 Resource-related processes	6.1.2	Resource planning	Identifying, estimating, scheduling and allocating all relevant resources.
		6.1.3	Resource control	Comparing actual usage against resource plans and taking action if needed.
	6.2 Personnel-related processes	6.2.2	Establishment of the project organizational structure	Defining a project organizational structure tailored to suit the project needs, including identifying roles in the project and defining authority and responsibility.
		6.2.3	Allocation of personnel	Selecting and assigning sufficient personnel with the appropriate competence to suit the project needs.
		6.2.4	Team development	Developing individual and team skills and the ability to enhance project performance.
Clause 7 Product/service realization in projects	7.2 Interdependent processes	7.2.2	Project initiation and project management plan development	Evaluating customer's and other interested parties' requirements, preparing a project management plan and initiating other processes.
		7.2.3	Interaction management	Managing interactions during the project.
		7.2.4	Change management	Anticipating change and managing it across all processes.
		7.2.5	Process and project closure	Closing processes and obtaining feedback.

Clause	Subclause	Subclause	Process	Process description
Clause 7 Product/service realization in projects	7.3 Scope-related processes	7.3.2	Concept development	Defining the broad outlines of what the project product will do.
		7.3.3	Scope development and control	Documenting the characteristics of the project product in measurable terms and controlling them.
		7.3.4	Definition of activities	Identifying and documenting activities and steps required to achieve the project objectives.
		7.3.5	Control of activities	Controlling the actual work carried out in the project.
	7.4 Time-related processes	7.4.2	Planning of activity dependencies	Identifying interrelationships and the logical interactions and dependencies among project activities.
		7.4.3	Estimation of duration	Estimating the duration of each activity in connection with the specific conditions and the resources required.
		7.4.4	Schedule development	Interrelating the project time objectives, activity dependencies and their durations as the framework for developing general and detailed schedules.
		7.4.5	Schedule control	Controlling the realization of the project activities, for confirming the proposed schedule or for taking adequate actions for recovering from delays.
	7.5 Cost-related processes	7.5.2	Cost estimation	Developing cost estimates for the project.
		7.5.3	Budgeting	Using results from cost estimation to produce the project budget.
		7.5.4	Cost control	Controlling costs and deviations from the project budget.
	7.6 Communication-related processes	7.6.2	Communication planning	Planning the information and communication systems of the project.
		7.6.3	Information management	Making necessary information available to project organization members and other interested parties.
		7.6.4	Communication control	Controlling communication in accordance with the planned communication system.
	7.7 Risk-related processes	7.7.2	Risk identification	Determining risks in the project.
		7.7.3	Risk assessment	Evaluating the probability of occurrence of risk events and the impact of risk events on the project.
		7.7.4	Risk treatment	Developing plans for responding to risks.
		7.7.5	Risk control	Implementing and updating the risk plans.

Clause	Subclause	Subclause	Process	Process description
Clause 7 Product/service realization in projects	7.8 Procurement processes	7.8.2	Procurement planning and control	Identifying and controlling what is to be purchased and when.
		7.8.3	Documentation of procurement requirements	Compiling commercial conditions and technical requirements.
		7.8.4	External provider management and development	Evaluating and determining which external providers and subcontractors should be invited to supply products.
		7.8.5	Contracting	Issuing invitations to tender, tender evaluation, negotiation, preparation and placing of the subcontract.
		7.8.6	Contract control	Ensuring that subcontractors' performance meets contractual requirements.
Clause 8 Measurement, analysis and improvement in projects	8.1 General	—	Improvement	Gives guidance on how both the originating and project organizations should learn from projects.
	8.2 Measurement and analysis	—	Measurement and analysis	Gives guidance on the measurement, collection and validation of data for continual improvement.
	8.3 Improvement	8.3.1	Improvement by the originating organization	The steps the originating organization should take for continual improvement of the project process.
		8.3.2	Improvement by the project organization	The information that the project organization should supply to the originating organization to enable continual improvement.

Annex B
(informative)

Cross reference matrix between this document, ISO 9001:2015 and ISO 21500:2012

Table B.1 provides a cross reference matrix between this document, ISO 9001:2015 and ISO 21500:2012.

Table B.1 — Cross reference matrix between this document, ISO 9001:2015 and ISO 21500:2012

This document	ISO 9001:2015	ISO 21500:2012
Foreword	Foreword	Foreword
Introduction	Introduction	Introduction
1. Scope	1. Scope	1. Scope
2. Normative references	2. Normative references	
3. Terms and definitions	3. Terms and definitions	2. Terms and definitions
4. Quality management systems in projects	4. Context of the organization	3. Project management concepts
4.1 Context and characteristics of the project 4.1.1 General 4.1.2 Organizations 4.1.3 Phases and processes in projects 4.1.4 Project management processes	4.1 Understanding the organization and its context 4.2 Understanding the needs and expectations of interested parties 4.3 Determining the scope of the quality management system	3.1 General 3.2 Project 3.4 Organizational strategy and projects 3.5 Project environment 3.11 Project constraints 3.12 Relationship between project management concepts and processes 4. Project management processes 4.1 Project management process application 4.2 Process groups and subject groups 4.3 Processes
4.2 Quality management principles		
4.3 Project quality management processes	4.4 Quality management system and its processes	
4.4 Quality plan for the project		4.3.32 to 4.3.34
5. Management responsibility in projects	5. Leadership	3.3 Project management 3.6 Project governance 3.8 Stakeholders and project organization
5.1 Top management commitment	5.1 Leadership and commitment 5.2 Policy	
5.2 Strategic process		

This document	ISO 9001:2015	ISO 21500:2012
5.3 Management reviews and progress evaluations	5.3 Organizational roles, responsibilities and authorities 9. Performance evaluation 9.2 Internal audit 9.3 Management review	
6. Resource management in projects	7. Support 7.2 Competence 7.3 Awareness 7.4 Communication 7.5 Documented information	4.3.15 to 4.3.20
6.1 Resource-related processes	7.1 Resources	4.3.6 to 4.3.31
6.2 Personnel-related processes		3.9 Competencies of project personnel
7. Products/services realization in projects	8. Operation 8.1 Operational planning and control 8.2 Requirements for products and services 8.3 Design and development of products and services 8.4 Control of externally provided processes, products and services 8.5 Production and service provision 8.6 Release of products and services 8.7 Control of nonconforming outputs	3.7 Projects and operations
7.1 General		
7.2 Interdependent processes		
7.3 Scope-related processes		
7.4 Time-related processes	6. Planning 6.2 Quality objectives and planning to achieve them 6.3 Planning of changes	4.3.21 to 4.3.24 4.3.9
7.5 Cost-related processes		4.3.25 to 4.3.27
7.6 Communication-related processes		4.3.38 to 4.3.40
7.7 Risk-related processes	6.1 Actions to address risks and opportunities	4.3.28 to 4.3.31
7.8 Procurement processes		4.3.35 to 4.3.37
8. Measurement, analysis and improvement in projects	10. Improvement	
8.1 General	10.1 General	
8.2 Measurement and analysis	9.1 Monitoring, measurement, analysis and evaluation	

This document	ISO 9001:2015	ISO 21500:2012
8.3 Improvement	10.2 Nonconformity and corrective action 10.3 Continual improvement	4.3.8
Annex A (informative): Overview of processes for quality management in projects		Annex A (informative): Process group processes mapped to subject groups
Annex B (informative): Cross reference matrix between this document, ISO 9001:2015 and ISO 21500:2012		

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2)   Under preparation. Stage at the time of publication: ISO/FDIS 10005:2017.

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