भारतीय मानक

गुणता प्रबन्ध — परियोजना प्रबन्ध में गुणता की मार्गदर्शिका

Indian Standard

QUALITY MANAGEMENT — GUIDELINES TO QUALITY IN PROJECT MANAGEMENT

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BUREAU OF INDIAN STANDARDS
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NATIONAL FOREWORD

This Indian Standard which is identical with ISO 10006 :1997 'Quality management — Guidelines to quality in project management' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Quality Management Sectional Committee (MSD 2) and approval of the Management and Systems Division Council.

The text of the ISO standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

> Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

In the adopted standard, normative references appear to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 8402 : 1994	IS/ISO 8402 : 1994 Quality management and quality assurance — Vocabulary (*first revision*)	Identical
ISO 9004-1 : 1994	IS/ISO 9004-1:1994 Quality management and quality system elements : Part 1 Guidelines (*fourth revision*)	do

In the adopted standard, informative references appear to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated :

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 9000-1 : 1994	IS/ISO 9000-1 :1994 Quality management and quality assurance standards : Part 1 Guidelines for selection and use	Identical
ISO 9000-4 : 1993	IS/ISO 9000-4 : 1993 Quality management and quality assurance standards : Part 4 Guide to dependability programme management	do
ISO 9001 : 1994	IS/ISO 9001 : 1994 Quality systems — Model for quality assurance in design/development, production, installation and servicing (*first revision*)	do
ISO 9004-2 : 1991	IS/ISO 9004-2 :1991 Quality management and quality system elements : Part 2 Guidelines for services	do
ISO 9004-4 : 1993	IS/ISO 9004-4 : 1993 Quality management and quality system elements : Part 4 Guidelines for quality improvement	do
ISO 10005 : 1995	IS/ISO 10005 :1995 Quality management — Guidelines for quality plans	do

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Introduction

This International Standard provides guidance on quality system elements, concepts and practices for which the implementation is important to, and has an impact on, the achievement of quality in project management and supplements the guidance given in ISO 9004-1.

These guidelines 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. They are intended to be used by people who have experience in project management and need to ensure that their organization is applying the practices contained in the ISO 9000 family of standards, 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 groups will find that material presented in the guidelines is unnecessarily detailed for them, however they should remember that other readers may be dependent on it.

It is recognized that there are two aspects to the application of quality in project management: the quality of the project processes and the quality of the project product. A failure to meet either of these dual aspects may have significant effects on the project product, the project stakeholders and the project organization. This also emphasizes that the achievement of quality is a management responsibility, requiring a commitment to quality to be instilled at all levels within the organizations involved in the project, who each retain responsibility for their respective processes and products.

The creation and maintenance of process and product quality in a project requires a systematic approach. This approach should be aimed at ensuring that the customer's stated and implied needs are understood and met, that other stakeholders' needs are evaluated, and that the organization's quality policies are taken into account for implementation in the management of the project.

Indian Standard

QUALITY MANAGEMENT — GUIDELINES TO QUALITY IN PROJECT MANAGEMENT

1 Scope

These guidelines use project management processes to serve as a framework to discuss their application.

This International Standard is applicable to projects of varying complexity, small or large, of short or long duration, in different environments, and irrespective of the kind of project product (including hardware, software, processed material, service or combinations thereof). This may necessitate some tailoring of the guidance to suit a particular project.

This International Standard is not a guide to project management itself.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 8402:1994, *Quality management and quality assurance — Vocabulary.*

ISO 9004-1:1994, *Quality management and quality system elements — Part 1: Guidelines.*

NOTE — Annexes A, B and C contain further information and additional references on achieving quality in project management.

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 8402, together with the following, apply.

3.1 project: Unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources.

NOTE 1 An individual project may form part of a larger project structure.

NOTE 2 In some projects the objective(s) is(are) refined and the product characteristics defined progressively as the project proceeds.

NOTE 3 The outcome of a project may be one or several units of product.

NOTE 4 The organization is temporary and established for the lifetime of the project.

NOTE 5 The interactions among project activities may be complex.

3.2 project product: That which is defined in the project product scope and delivered to the customer.

NOTE — The project scope may be updated as the project proceeds.

3.3 project plan: Document setting out what is required to meet the objective(s) of the project.

NOTE 1 A project plan should include or refer to the project's quality plan.

NOTE 2 The project plan also includes such other plans as organizational structures, resources, schedule and budget.

3.4 stakeholder: An individual or group of individuals with a common interest in the performance of the supplier organization and the environment in which it operates.

[ISO 9000-1:1994,3.5]

NOTE 1 In the context of this definition the supplier organization is the project organization.

NOTE 2 Stakeholders may include:

— customer, recipient of the project product;

— consumer, such as a user of the project product;

— owner, such as the organization originating the project;

— partner, as in joint-venture projects;

— funder, such as a financial institution;

— subcontractor, organization supplying products to the project organization;

— society, such as jurisdictional or regulatory bodies and the public at large;

— internal personnel, such as members of the project organization.

NOTE 3 There may be conflicting interests among stakeholders.

3.5 process: Set of inter-related resources and activities which transform inputs into outputs. [ISO 8402:1994,1.2]

NOTE 1 Resources may include management, services, personnel, finance, facilities, equipment, techniques and methods.

NOTE 2 Project processes include project management processes.

3.6 progress evaluation: Assessment of outputs of project activities, carried out at appropriate points in the project life cycle across project processes, based on defined criteria for project processes and product.

NOTE — Revision of the project plan may be required as a result of progress evaluation.

4 Project characteristics

4.1 General

This clause deals with those characteristics of projects which are important to the application of this document.

4.2 Project management

Project management includes the planning, organizing, monitoring and controlling of all aspects of the project in a continuous process to achieve its objectives. The processes and objectives of quality management (see ISO 8402) apply to all project management processes.

4.3 Organization

For the purposes of this International Standard, the originating organization is the organization that decides to undertake the project and assigns the project to a project organization. The project organization is the organization that carries out the project. The project organization may be a part of the originating organization which may be constituted as a joint-venture or consortium, etc.

4.4 Project phases and project processes

A project is a process which can be divided into many different interdependent subprocesses. Implementing the sequence of subprocesses in an orderly and progressive manner may (in some cases should) require the consistent grouping of subprocesses into phases. To the organization responsible for the project, "phasing" gives a means of monitoring the realization of objectives (and assessing the related risks) in order to achieve a progressive commitment. Significant overlapping of phases may occur in the project life cycle.

To facilitate the discussion of the guidance to quality in project management, a process approach has been adopted in this International Standard. The project processes have been grouped into two categories: the project management processes and the project product-related processes (those which are concerned solely with the project product such as design, production and verification).

Guidance to quality in the project management processes is discussed in this International Standard and guidance to quality in the project product related processes is covered in ISO 9004-1.

NOTE — In this International Standard, the term process also covers subprocess.

5 Quality in project management processes

5.1 General

Table 1 lists and summarizes the project management processes which are considered to be applicable for the majority of projects. Not all the processes discussed in this International Standard will necessarily exist in a particular project, whereas in others additional processes may be necessary.

The project management processes are grouped according to their affinity to one another, for example all time-related processes are included in one group. Ten groups of project management processes are presented. The first one is the strategic process which legitimizes and sets the direction for the project. The second group covers the management of the interdependencies among the other processes. The other eight groups are processes related to scope, time, cost, resource, personnel, communication, risk and purchasing.

Each of the project management processes is presented in a separate subclause which includes a description of the process and guidance to quality in the process.

5.2 Strategic process

The strategic project process is a direction-setting process that organizes and manages the realization of the other project processes.

In setting the direction for the project, the following concepts, which are important to the achievement of quality in project management, should be considered:

— satisfaction of the customer's and other stakeholders' stated and implied needs is paramount;

— a project is carried out as a set of planned and interdependent processes;

— a focus on the quality of both processes and products is necessary to meet the project objectives;

— management is responsible for creating an environment for quality;

— management is responsible for continual improvement.

This subclause gives guidance on considering these concepts in the strategic process. Guidance on considering these concepts in the other processes is given in 5.3 to 5.11.

The achievement of quality in the strategic process is dependent on ensuring that these concepts are considered in all processes.

5.2.1 Satisfaction of the customer's and other stakeholders' stated and implied needs is paramount.

Customer and other stakeholder needs should be clearly understood to ensure that all processes focus on and are capable of meeting these needs.

Interfaces should be established with all the stakeholders and feedback obtained as appropriate throughout the project. Any conflicts between stakeholder needs should be resolved. Normally, when conflicts arise between the needs of the customer and other stakeholders, customer needs take precedence. Resolution of conflicts should be agreed to by the customer. Stakeholder agreements should be formalized. Attention to changing stakeholder needs, including those of new stakeholders, should continue throughout the project.

The project objectives should be defined to meet the agreed requirements and, if necessary, refined during the course of the project. They should describe what is to be accomplished, be expressed in terms of time, cost and product characteristics, and, where possible, be measurable.

5.2.2 A project is carried out as a set of planned and interdependent processes.

The project processes, their owners and the owners' responsibilities and authority should be identified and documented. Policies should be set for the project processes. The structure of the end product and its components should be considered to ensure that the appropriate processes are identified. The process interdependencies should be defined, coordinated and integrated. The processes should be designed to take into account processes that occur later in the product life cycle, such as those related to maintenance. A strategy for obtaining external goods and services should be considered, together with any impacts on the project organization.

Relationships and a clear division of responsibility and authority between the originating organization and the project organization should be determined and formalized, as well as those with other relevant stakeholders.

Progress evaluations (see annex B) should be planned in order to assess the project status and, when required, provide information for revising the project plan.

5.2.3 A focus on the quality of both processes and products is necessary to meet the project objectives.

To meet the project objectives, emphasis should be placed on the quality of the project management processes and the quality of the project product.

The ISO 9000 family of standards presents a number of process- and product-related quality practices, such as documentation, audits and process controls, which help in meeting the project objectives. Typical practices applicable across project processes are listed in annex A.

5.2.4 Management is responsible for creating an environment for quality.

Management of both the originating organization and the project organization should cooperate in creating an environment for quality. The ways and means to create such an environment should include the following:

— providing an organizational structure and support conducive to meeting the project objectives;

— making decisions based on data and factual information;

— providing for progress evaluations and using them for quality (see annex B);

— involving all project personnel in achieving the quality of the project processes and product;

— establishing mutually beneficial relationships with subcontractors and other organizations.

Competent personnel should be allocated and appropriate tools, techniques, methods and practices applied to carry out, monitor and control the processes, to implement corrective and preventive action and to improve the processes.

A project manager should be appointed as early as possible. The project manager is the individual with the defined accountability, authority and responsibility for managing the project. The authority delegated to the project manager should be commensurate with the assigned responsibility.

NOTE — The title of the project manager may vary from project to project.

5.2.5 Management is responsible for continual improvement.

In an organization originating projects, management is responsible for continually seeking to improve the quality of its project processes by learning from experience. To learn from experience, project management itself should be treated as a process rather than as an isolated activity. A system should be put in place to collect and analyse the information gained during a project for use in a continual improvement process.

The project organization is responsible for continually seeking to improve the quality of its own project processes and activities. Provision should be made for self assessments, internal and possibly external audits, taking account of the time and resources needed.

NOTE — ISO 9004-4 gives guidance on quality improvement.

5.3 Interdependency management processes

Projects consist of processes and an action in one of these usually affects others. The overall management of the interdependencies among the project processes is the responsibility of the project manager. The interdependency management processes are the following:

— project initiation and project plan development: evaluating customer and other stakeholder requirements, preparing a project plan and initiating other processes;

— interaction management: managing interactions during the project;

— change and configuration management: anticipating change and managing it across all processes;

— closure: closing processes and obtaining feedback.

5.3.1 Project initiation and project plan development

A project plan including a quality plan should always be prepared and kept up to date. The degree of detail included will be a function of the size and complexity of the project.

The project plan should refer to the documented customer and other relevant stakeholder requirements and the project objectives. The input source for each requirement should also be documented to allow traceability.

The product characteristics and how they should be measured and assessed should be identified and included in the project plan.

Contract reviews should be performed if the purpose of a project is to fulfil the requirements of a contract.

During project initiation, projects that are the most similar among those already undertaken by the originating organization should be identified in order to make the best use of feedback from previous projects.

The project plan should identify and document the project processes and their intention.

The quality system of the project organization should be established and include provision for facilitating and promoting continual quality improvement. Since quality is an integral part of good project management, the quality system of the project should be an integral part of the project management system. The quality system should be documented in the quality plan.

As far as is practicable, the project organization should adopt and, if necessary, adapt the quality system and procedures of the originating organization. Reference should be made in the quality plan to applicable parts of the quality system documents from the originating organization. In cases where specific requirements for the quality system from other stakeholders exist, it should be ensured that the resulting quality system meets the project needs.

Project plan development involves integrating the plans resulting from the planning carried out in other project processes. These plans should be reviewed for consistency and any discrepancies resolved.

The project plan should identify, plan for and schedule reviews (see 'reviews' in annex A) and plan for retention of records. Reviews should include reviews of the quality system and of the project plan and their adequacy to meet the project objectives.

To provide a baseline for progress measurement and control and to provide for planning of the remaining work, progress evaluations (see annex B) should be scheduled and included in the project plan.

Requirements for quality practices (see annex A), such as documentation, verification, recording, traceability, reviews and audits throughout, the project should be established.

In order to monitor progress, performance indicators should be defined and provision made for their regular assessments. These assessments should facilitate preventive and corrective actions, and should confirm that the project objectives remain valid in a changing project environment.

Interfaces should be identified in the project plan. Particular attention should be given to the following interfaces:

— liaison with the customer and other stakeholders;

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

— liaison between functions within the project organization.

5.3.2 Interaction management

To facilitate the planned relationships between processes, the interactions in the project need to be managed. This should include establishing procedures for interface management, having interfunctional project meetings, resolving issues such as conflicting responsibilities or changes to risk exposure, measuring project performance using such techniques as earned value analysis and carrying out progress evaluations to assess project status and plan for the remaining work (see annex B).

The progress evaluations should also be used to identify potential interface problems. It should be noted that the interfaces are usually where risk is greater and need to be specially coordinated.

Project communication is a key factor in project coordination and is discussed in 5.9.

5.3.3 Change management

Change management covers the identification and documentation of the need for and of the impact of change, and the review and approval of changes to processes and product.

Change management includes managing changes to the project scope and to the project plan. Before a change is authorized, the intent, extent and impact of the change should be analysed and those that affect the project objectives agreed with the customer and other relevant stakeholders.

Change management includes coordinating changes across interlinked project processes and resolving any conflicts.

Procedures for change management should include document control.

NOTE 1 For further guidance on change management, see also ISO 9004-1.

NOTE 2 For guidance on configuration management, see ISO 10007.

5.3.4 Closure

During the project, it should be ensured that all the project processes are closed as planned. This includes ensuring that records are compiled and retained for a specified time.

Whatever the reason for project closure, a complete review of project performance should be undertaken. It should take into account all relevant records, including those from progress evaluations and inputs from stakeholders. Special consideration should be given to feedback from the customer and other relevant stakeholders, which should be quantified where possible. Based on this review, appropriate reports should be prepared, highlighting experience that can be used by other projects.

The closure of the project should be formally communicated to relevant stakeholders.

5.4 Scope-related processes

For the purposes of this International Standard, "scope" includes a description of the project product, its characteristics and how they are to be measured or assessed.

These processes aim to:

— translate the customer and other stakeholder requirements into activities to be carried out to achieve the objectives of the project and to organize these activities;

— ensure that people work within the scope, during the realization of the activities;

— ensure that the activities carried out in the project meet the requirements described in the scope.

The scope-related processes are the following:

— concept development: defining the broad outlines of what the project product will do;

— scope development and control: documenting the characteristics of the project product in measurable terms and controlling them;

— activity definition: identifying and documenting activities and steps required to achieve the project objectives;

— activity control: controlling the actual work carried out in the project.

5.4.1 Concept development

Customer needs for product and processes, both expressed and implied, should be translated into documented requirements which should be agreed to by the customer.

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

5.4.2 Scope development and control

When developing the scope, the characteristics of the project product should be identified and documented as completely as is possible in measurable terms for use as the basis for design and development. It should be specified how these characteristics should be measured or how their compliance with customer and other stakeholder requirements should be assessed. Product characteristics should be traceable to customer and other stakeholder requirements.

Supporting evidence on alternative approaches and solutions, including the results of analyses performed, considered and included in the scope development, should also be referenced.

Managing changes to the scope is dealt with within the change management process.

5.4.3 Activity definition

The project should be systematically structured into manageable activities to meet customer needs for product and processes.

NOTE — Frequently, 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). For the purposes of this International Standard, the term "activity" is used as the generic term for an element of the structure.

When defining activities, project management should involve the personnel who will carry out the activities, in order to benefit from their experience, and to gain their understanding and acceptance.

Each activity should be defined in such a way that its outputs are measurable.

The list of activities should be checked for completeness. Among the activities defined should be quality practices, progress evaluations and preparing a project plan.

The interactions between activities and the interfaces between the project and the stakeholders should be identified and documented.

5.4.4 Activity control

Those activities defined through the activity definition process (see 5.4.3) should be carried out and controlled in accordance with the project plan. Control of activities includes interaction control to minimize conflicts or misunderstanding. Particular attention should be given to activities which involve new technologies.

Activities should be reviewed and evaluated to identify 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 remaining work should be documented.

5.5 Time-related processes

These processes aim to determine dependencies and the duration of activities and to ensure timely completion of the project. They are the following:

— activity dependency planning: identifying inter-relationships and the logical interactions and dependencies among project activities;

— duration estimation: estimating the duration of each activity in connection with the specific conditions and with the resources required;

— schedule development: inter-relating the project time objectives, activity dependencies and their durations as the framework for developing general and detailed schedules;

— schedule control: controlling the realization of the project activities, for confirming the schedule or for taking adequate actions to recover from delays.

5.5.1 Activity dependency planning

The inter-relationships, logical interactions and interdependencies among the project activities should be identified and reviewed for consistency. Any need for changing the reference data should be identified, justified and documented.

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

5.5.2 Estimation of duration

Estimates for the duration of activities should be established by personnel with responsibility for those activities. Duration estimates from past experience should be checked for correctness and applicability to present project conditions. The inputs should be documented and traceable to their origin. When collecting duration estimates, it is useful for resource planning to obtain associated resource estimates at the same time.

Particular attention should be paid to allocating sufficient time for the quality practices listed in annex A.

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

When useful or required, the customer and other stakeholders should be involved.

5.5.3 Schedule development

Input data for schedule development should be identified and verified for compliance with specific project conditions. Special care should be taken to identify activities with long lead times, long duration activities and the critical path.

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

Inconsistencies found in the integration of duration estimates with activity dependencies should be resolved before schedules are finalized and issued. The schedules should identify critical and near-critical activities.

The schedule should identify particular events, sometimes referred to as key events or milestones, requiring specific inputs or decisions or at which major outputs are planned such as progress evaluations.

The customer and relevant stakeholders should be kept informed during the development of the schedule and involved when required. Appropriate schedules should be supplied to them for information or, if required, for approval.

5.5.4 Schedule control

The timing of schedule reviews and the frequency of data collection should be established in order to ensure adequate control over project activities and related information. Deviation from the schedule should be identified, analysed and, if significant, acted upon.

Up-to-date schedules should be used in progress evaluations and meetings. Project management should carry out regular reviews of the project schedule as defined in the project plan.

Project progress trends should be analysed together with the remaining work to anticipate risks and opportunities.

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 as a basis for continual improvement.

Possible impacts of schedule changes on the budget and resources of the project and on the quality of the product should be determined. Decisions on actions to be taken should only be made after taking into account the implications for other project processes and objectives. Changes that affect the project objectives should be agreed to by the customer and relevant stakeholders before implementation. When action is required to recover from time delays, the personnel involved, and their role, should be identified. Revisions of the schedule should be coordinated with other project processes in developing the plan for the remaining work.

The customer and other relevant stakeholders should be kept informed of any proposed changes to the schedule and involved in making decisions which affect them.

5.6 Cost-related processes

These processes aim to forecast and manage the project costs and to ensure that the project is completed within budget constraints and are the following:

— cost estimation: developing cost estimates for the project;

— budgeting: using results from cost estimation to produce the project budget;

— cost control: controlling costs and deviations from the project budget.

NOTE — For further guidance, see ISO 10014.

5.6.1 Cost estimation

All project costs should be clearly identified (activities, goods and services) and cost estimation should consider relevant sources of information and be linked to the work breakdown structure. Cost estimates from past experience should be checked to ensure that they are correct for present project conditions. The costs should be documented and traceable to their origin.

Particular attention should be paid to allocating sufficient costs for the quality practices (see also annex A.)

NOTE — For further guidance on the economic effects of quality management, see ISO 10014.

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

When cost estimation involves significant uncertainty, the risks should be evaluated and mitigated, and appropriate allowances for remaining risks should be incorporated in the estimates.

The cost estimates should be in a form which enables budgets to be established and developed in accordance with approved accounting procedures as well as project management needs.

5.6.2 Budgeting

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

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

5.6.3 Cost control

Prior to any expenditure, the procedures to be followed in the cost control system 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 in order to ensure adequate control over project activities and related information. It should be checked that the remaining work to completion can be carried out within the remaining budget. Any deviation from the budget should be identified, and, if exceeding a defined limit, analysed and acted upon.

Project cost trends should be analysed, using techniques such as earned value analysis, and the plan for the remaining work reviewed to anticipate risks and opportunities.

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 as a basis for continual improvement.

Decisions on actions to be taken should only be made after taking into account the implications for other project processes and objectives. Changes in the cost of the project should be appropriately authorized prior to expenditure. Revisions of the budget forecast should be coordinated with other project processes in 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.

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

5.7 Resource-related processes

These processes aim to plan and control resources. They help to identify any possible problems with resources. Examples of resources include computer software, equipment, facilities, finance, information systems, materials, personnel, services and space. These processes are the following:

— resource planning: identifying, estimating, scheduling and allocating relevant resources;

— resource control: comparing actual usage against resource plans and taking action, if needed.

NOTE — This subclause applies to the quantitative aspects of personnel management only when regarded as a resource. The other aspects are covered in 5.8 because their management differs significantly from that of other resources.

5.7.1 Resource planning

Resources needed for the project should be identified. Resource plans should state what resources will be required by the project, and when they will be required according to the time schedule. The plans should indicate how and from where resources will be obtained and allocated and, if applicable, the methods of disposition of excess resources. The plans should be suitable for resource control. The validity of the inputs to resource planning should be verified.

The stability, capability and quality of the organizations supplying resources should be evaluated when identifying resources needed for the project.

Constraints on resources should be taken into account. Examples of constraints include availability, safety, environmental and 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.

5.7.2 Resource control

The timing of reviews and the frequency of data collection and forecasts should be established in order to ensure adequate control over the resource supply and to ensure that the remaining resources are sufficient to meet the project objectives.

Deviations from the resource plan should be identified, analysed and acted upon.

Decisions on actions to be taken should only be made after taking into account the implications for other project processes and objectives. Changes that affect the project objectives should be agreed to by the customer and relevant stakeholders before implementation. Changes in the resource plan should be authorized as appropriate. Revisions of the resource forecast should be coordinated with other project processes in developing the plan for remaining work.

Root causes for shortages or excesses in resources should be identified and used for continual improvement.

5.8 Personnel-related processes

People determine the quality and success of the project.

The personnel-related processes aim to create an environment in which people can contribute effectively and efficiently to the project. These processes are the following:

— project organizational structure definition: defining a project organizational structure tailored to suit the project needs, including identifying roles in the project and defining authority and responsibility;

— staff allocation: selecting and assigning sufficient personnel with appropriate competence to suit the project needs;

— team development: developing individual and team skills and ability to enhance project performance.

NOTE — The quantitative aspects of personnel management are covered in 5.7.

5.8.1 Definition of project organizational structure

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

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

The project manager should ensure that the project organizational structure is appropriate to the project scope, size of the project team, local conditions and the division of authority and responsibility with the originating organization. This division will depend on the originating organizational structure such as a matrix or functional structure. Special attention should be given to identifying and establishing the inter-relationships of the project organization with the following:

— customer and other relevant stakeholders;

— relevant functions of the originating organization supporting the project, particularly if some are in charge of monitoring project functions such as schedules, quality and costs.

Assignments of accountability, authority and responsibility should be defined and job descriptions prepared.

Special attention should be given to the project function dealing with implementing and monitoring the quality system and to its interfaces with other project functions.

Reviews of the project organizational structure should be planned and carried out periodically to confirm its validity and adequacy.

5.8.2 Staff allocation

The necessary competence in terms of education, knowledge and experience should be defined for personnel working on the project. When difficulties are anticipated in recruiting personnel due to the competence requirements, sufficient lead time should be allowed for additional recruiting and training.

The selection of personnel should be performed in a timely manner on the basis of the job descriptions and should take into account their competence and references from previous experience. The selection

criteria should be applied to all project personnel whether directly part of the project organization or while still maintaining their original affiliation.

The project manager should be involved in the appointment of the other key team members.

When selecting managers for the project, priority should be given to leadership skills.

When assigning members to teams, their personal interests, interpersonal relationships, strengths and weaknesses should be considered. Knowledge of personal characteristics and experience may help in identifying the best sharing of responsibilities within the members of the project organization. The job description should be understood and accepted by the appointee. Appointments should be confirmed and communicated to all concerned.

The efficiency and effectiveness of personnel should be monitored and appropriate action should be taken, if needed.

5.8.3 Team development

Individual development is important to team development and is addressed in ISO 9004-1.

Team development should include management and individual actions taken specifically and primarily to improve team performance. Good teamwork should be recognized and rewarded. Management should create a work environment which encourages excellence, good working relationships, trust and respect within the team and with all others involved in the project. Consensus decision making, clear and open communication and mutual commitment to customer satisfaction should be encouraged.

5.9 Communication-related processes

These 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. These processes are the following:

— communication planning: planning the information and communication systems of the project;

— information management: making necessary information available to project organization members and other relevant stakeholders;

— communication control: controlling communication in accordance with the planned communication system.

5.9.1 Communication planning

Communication planning should take into account the needs of the project and of the individuals involved in the project. The communication plan should define the information that will be formally communicated, the media used to transmit it and the frequency of communication. The frequency, timing and purposes of meetings should be defined in the plan.

The format, language and structure of documents should be defined to ensure compatibility. The plan should define the information management system, identify who will send and receive information and reference the relevant document control and security procedures. The format for progress reports should be designed to highlight deviations from the project plan.

5.9.2 Information management

The information management system should be designed taking into consideration the needs of both the project and originating organizations. It should include procedures for preparing, collecting, identifying,

classifying, distributing, filing, updating, archiving and retrieving information. Information should include conditions prevailing at the time of occurrence. This will allow the validity and relevance of the information to be checked before use in other projects.

To be effective, information should be relevant to the needs of the recipients, clearly presented and distributed with strict adherence to time schedules. All agreements, including informal ones, that affect the project performance should be formally documented. Where practical, the use of electronic media could be advantageous.

Rules and guidelines for meetings should be established appropriate to the type of meeting. Meeting agenda should be distributed in advance and should identify for each item the personnel whose attendance is required. Minutes of meetings should include decisions made, outstanding issues, and agreed actions and the personnel assigned to carry them out. These minutes should be distributed to relevant parties within an agreed time.

5.9.3 Communication control

The communication system should be implemented as planned and be monitored and reviewed to ensure it continues to meet the needs of the project. Particular attention should be paid to interfaces between functions and organizations where misunderstandings and conflicts frequently occur.

5.10 Risk-related processes

Management of project risks deals with uncertainties throughout the project and requires a structured approach. The aim of the risk related processes is to minimize the impact of potential negative events and to take full advantage of opportunities for improvement. In this International Standard, the term risk covers both aspects. Risks are related either to the project processes or to the project product. The risk-related processes are the following:

— risk identification: determining risks in the project;

— risk assessment: evaluating the probability of occurrence of risk events and the impact of risk events on the project;

— risk response development: developing plans for responding to risks;

— risk control: implementing and updating the risk plans.

It is particularly important that these processes and their output are documented.

5.10.1 Risk identification

Risks to the project processes and product and the means to determine when acceptable limits are exceeded should be identified. Experience and historical data from previous projects should be used.

Risk identification should be performed at the initiation of the project, at progress evaluations and other occasions when significant decisions are made.

Risk identification should consider not only risks in cost, time and product but also in areas such as security, dependability, professional liability, information technology, safety, health and environment, taking into account applicable current and anticipated statutory or regulatory requirements. It should be noted that the interactions between different risks need to be considered. Critical and new technologies should also be identified.

An identified risk with significant impact should have a person assigned to it with the responsibility, authority and resources for managing the risk.

5.10.2 Risk assessment

The probability of the occurrence and impact of identified risks should be assessed, taking into account experience and historical data from previous projects; the criteria and techniques used should be recorded. A qualitative analysis should always be made and a quantitative analysis should follow wherever possible.

5.10.3 Risk response development

Solutions to eliminate, mitigate or transfer risks, decisions to accept risks, and plans to take advantage of opportunities should preferably be based on known technologies or data from past experience to avoid introducing new risks.

When a risk is identified and needs a contingency plan, it should be checked that there will be no undesirable effects caused by implementation of the plan.

When provisions are made in the time schedule or in the budget to cope with risks, they should be identified and maintained separately for use if required, such as insurance for product liability.

Risks consciously accepted should be identified and the reasons for accepting them documented.

5.10.4 Risk control

Throughout the project, risks should be controlled by an iterative process of risk identification, risk estimation and risk response. The project should be managed taking into account that there are always risks. People should be encouraged to anticipate and identify further risks and to report them.

Contingency plans should be maintained in a state of readiness for use.

The project's risk situation should be monitored and reports on risks should be part of progress evaluations.

5.11 Purchasing-related processes

These processes deal with the purchase, acquisition or procurement of products obtained for the project. The purchasing-related processes are the following:

— purchasing planning and control: identifying and controlling what is to be purchased and when;

— requirements documentation: compiling commercial conditions and technical requirements;

— subcontractor evaluation: evaluating and determining which subcontractors should be invited to tender;

— subcontracting: issuing invitations to tender, tender evaluation, negotiation, preparation and placing of the subcontract;

— contract control: ensuring that subcontractors' performance meets contractual requirements.

NOTE 1 As noted in ISO 8402, the term "product" includes service, hardware, processed materials, software or a combination thereof.

NOTE 2 For the purposes of this International Standard, and for reference to ISO 9004-1, the organization is the project organization, and subcontractors supply products to the project organization.

NOTE 3 Guidance, in addition to that given below, can be found in clause 9 of ISO 9004-1:1994.

5.11.1 Purchasing planning and control

Purchasing planning activities should identify and schedule the products to be obtained, taking special note of items critical to quality, time and cost of the project product.

From the project management point of view, all products are considered to be purchased, whether they are obtained from external subcontractors or from the originating organization. In both cases the requirements should be the same, but whereas external products are obtained by formal contract, "in-house" products would be obtained using internal acquisition procedures and controls. For "in-house" products, some of the purchasing procedures described below may be simplified or may not be required.

Purchasing should be planned so that the interfaces with subcontractors can be handled by the project organization.

Sufficient time should be allowed for the total purchasing process. This will include subcontractor evaluation, study of the requirements and contract review by the subcontractors.

To provide adequate purchasing control, the purchasing progress should be compared to the purchasing plan and action taken if needed.

5.11.2 Documentation of requirements

Purchasing documents should identify scope, product characteristics, appropriate quality management requirements and associated documentation. They should also include delivery dates for the product and requirements for the right of access to subcontractor premises. It should be ensured that the customer's requirements are taken into account in the purchasing documents.

Documents should be structured to facilitate accurate, comparable and complete responses from potential subcontractors.

Purchasing documents should be reviewed to verify that all requirements are completely specified.

5.11.3 Evaluation of subcontractors

The evaluation of subcontractors should consider all aspects that may impact on the project, such as technical experience, plant capability, delivery times, quality system and financial stability.

NOTE — For further guidance on subcontractor evaluation, see also ISO 9004-1.

5.11.4 Subcontracting

There should be a procedure for subcontracting and for passing information to the subcontractor about the projects' quality policy and quality system if necessary.

In tender evaluation, all deviations from the requirements in a subcontractor's proposal should be identified and taken into account in the evaluation. Deviations proposed for acceptance should be approved by the same functions or organizations that carried out the original review and approval of the requirements.

Evaluation of tenders should be based not only on the price from subcontractors, but also on other associated costs such as cost of operation, maintenance, licence fees, transport, insurance, customs duty, exchange rate variation, inspection, quality audit and deviation solution.

Before contracting for the supply of product, the effects on quality of any trade-off among requirements should be given due consideration.

The contract documents should be checked to ensure that they include the result of any pre-contract negotiation with the subcontractor.

5.11.5 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 requirements, including due dates and records, 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.

Regular verifications should be carried out to ensure that the performance of each subcontractor meets contract requirements. The results of verifications should be fed back to subcontractors and any actions agreed.

Prior to contract closure, it should be verified that all contract conditions and requirements have been met and feedback on subcontractor performance made to update the register of subcontractors.

6 Learning from the project

This clause provides guidance on how the originating organization should learn from the project as part of a programme for continual improvement in other projects, current and future.

The originating organization should establish a system for collecting, storing, updating and retrieving information for projects and ensuring that this information is used.

The information needed to learn from the project should be derived from information contained within the project, including feedback from the customer and other stakeholders. Before using this information, its validity should be checked.

Before the project information management system is designed, the originating organization should define the information needed to learn from the project and should ensure that a system for collecting this information is implemented.

Just prior to closing the project, the originating organization should carry out documented reviews of project performance, highlighting experience from the project that can be used by other projects. If possible, these reviews should involve the customer and other relevant stakeholders.

TABLE 1 — DESCRIPTION OF PROJECT MANAGEMENT PROCESSES (informative)

PROCESS	DESCRIPTION	Clause
STRATEGIC PROCESS		
Strategic process	Setting the direction for the project and managing realization of the other project processes.	5.2
INTERDEPENDENCY MANAGEMENT PROCESSES		
Project initiation and project plan development	Evaluating customer and other stakeholder requirements, preparing a project plan and initiating other processes.	5.3.1
Interaction management	Managing interactions during the project.	5.3.2
Change management	Anticipating change and managing it across all processes.	5.3.3
Closure	Closing processes and obtaining feedback.	5.3.4
SCOPE-RELATED PROCESSES		
Concept development	Defining the broad outlines of what the project product will do.	5.4.1
Scope development and control	Documenting the characteristics of the project product in measurable terms and controlling them.	5.4.2
Activity definition	Identifying and documenting activities and steps required to achieve the project objectives.	5.4.3
Activity control	Controlling the actual work carried out in the project.	5.4.4
TIME-RELATED PROCESSES		
Activity dependency planning	Identifying interrelationships and the logical interactions and dependencies among project activities.	5.5.1
Estimation of duration	Estimating the duration of each activity in connection with the specific conditions and with the resources required.	5.5.2
Schedule development	Interrelating the project time objectives, activity dependencies and their durations as the framework for developing general and detailed schedules.	5.5.3
Schedule control	Controlling the realisation of the project activities, for confirming the proposed schedule or for taking adequate actions for recovering from delays.	5.5.4
COST-RELATED PROCESSES		
Cost estimation	Developing cost estimates for the project.	5.6.1
Budgeting	Using results from cost estimation to produce the project budget.	5.6.2
Cost control	Controlling costs and deviations from the project budget.	5.6.3
RESOURCE-RELATED PROCESSES		
Resource planning	Identifying, estimating, scheduling and allocating all relevant resources.	5.7.1
Resource control	Comparing actual usage against resource plans and taking action, if needed.	5.7.2
PERSONNEL-RELATED PROCESSES		
Organizational structure definition	Defining a project organizational structure tailored to suit the project needs including identifying roles in the project and defining authority and responsibility.	5.8.1
Staff allocation	Selecting and assigning sufficient personnel with appropriate competence to suit the project needs.	5.8.2
Team development	Developing individual and team skills and ability to enhance project performance.	5.8.3
COMMUNICATION-RELATED PROCESSES		
Communication planning	Planning the information and communication systems of the project.	5.9.1
Information management	Making necessary information available to project organization members and other stakeholders.	5.9.2
Communication control	Controlling communication in accordance with the planned communication system.	5.9.3

RISK-RELATED PROCESSES

Risk identification	Determining risks in the project.	5.10.1
Risk estimation	Evaluating the probability of occurrence of risk events and the impact of risk events on the project.	5.10.2
Risk response development	Developing plans for responding to risks.	5.10.3
Risk control	Implementing and updating the risk plans.	5.10.4

PURCHASING-RELATED PROCESSES

Purchasing planning and control	Identifying and controlling what is to be purchased and when.	5.11.1
Documentation of requirements	Compiling commercial conditions and technical requirements.	5.11.2
Evaluation of subcontractors	Evaluating and determining which subcontractors should be invited to supply products.	5.11.3
Subcontracting	Issuing invitations to tender, tender evaluation, negotiation, preparation and placing of the subcontract.	5.11.4
Contract control	Ensuring that subcontractors' performance meets contractual requirements.	5.11.5

Annex A
(informative)

Quality practices in project management — References to the ISO 9000 family of standards

This annex presents quality practices that are applicable to many project processes. It indicates where further information can be found in the ISO 9000 family of standards. Some of these practices have also been covered in clause 5.

Approvals: Requirements for approvals should be established and the approvals documented (refer to ISO/IEC Guide 2).

Corrective action: Corrective action should be carried out whenever appropriate with regard to the change management process. Further guidance is given in clause 15 of ISO 9004-1:1994. The definition of "corrective action" is given in subclause 4.14 of ISO 8402:1994.

Documentation: Documentation includes specifications, quality system documents and records. Planned and actual inputs and outputs of processes should be documented. Further guidance on documentation is given in ISO 9004-1:1994, clause 17 (records) and subclause 5.3 (quality system documentation). The definition of "specification" is given in subclause 3.14 of ISO 8402:1994.

Inspection: The definition of "inspection" is given in subclause 2.15 of ISO 8402:1994.

Preventive action: Preventive action should be carried out throughout the project. The definition of "preventive action" is given in subclause 4.13 of ISO 8402:1994.

Process control: Process control should be carried out throughout the project. Further guidance on process control is given in clause 11 of ISO 9004-1:1994.

Quality assurance: The definition of "quality assurance" is given in subclause 3.5 of ISO 8402:1994.

Quality audits: Quality audits can be carried out for both internal and external purposes. They may be applied to all project processes. Further guidance is given in subclause 5.4 of ISO 9004-1:1994, in subclauses 4.9 and 4.9.3 of ISO 9000-1:1994 and ISO 10011. The definition of "quality audit" is given in subclause 4.9 of ISO 8402:1994.

Quality improvement: Quality improvement should be carried out throughout the project. Further guidance is given in 5.6 of ISO 9004-1:1994 and ISO 9004-4:1993.

Quality planning: The definition of "quality planning" is given in 3.3 of ISO 8402:1994.

Quality system: The definition of "quality system" is given in subclause 3.6 of ISO 8402:1994.

Reviews: Subjects of reviews should include inputs and outputs of project processes including documents. The types of reviews defined in ISO 8402:1994 are "management review" (3.9), "contract review" (3.10) and "design review" (3.11).

Specification and design: Guidance is given in clause 8 of ISO 9004-1:1994.

Traceability: The definition of "traceability" is given in subclause 3.16 of ISO 8402:1994.

Training: Guidance is given in subclause 18.1 of ISO 9004-1:1994 and subclause 6.4 of ISO 9000-1:1994.

Validation of tools and techniques: The methods, tools, techniques and software used should be appropriate to the project and valid. The definition of "validation" is given in subclause 2.18 of ISO 8402:1994.

Verification: Outputs of project processes should be verified. The definition of "verification" is given in subclause 2.17 of ISO 8402:1994. Further guidance on product verification is given in clause 12 of ISO 9004-1:1994.

Annex B
(informative)

Use of progress evaluations for quality

B.1 General

This annex illustrates how progress evaluations may be used for quality purposes. "Progress evaluation" is defined in subclause 3.6.

Progress evaluations provide an opportunity for considering quality since they look across processes.

Progress evaluations should be used to assess the adequacy of the quality plan and how the work performed complies with it. They should evaluate how well the project processes are synchronized and interlinked. They should also identify and evaluate activities and results that would adversely affect the achievement of project objectives. They should be used to obtain inputs for remaining work in the project and to facilitate communication. They should be used to drive process improvement in the project by identifying deviations and changes in risks.

Progress evaluations should be used to provide information to the continual improvement program of the originating organization.

B.2 Implementation

Responsibility for managing progress evaluations should be assigned. Progress evaluations should involve the individuals responsible for the project processes and may also involve other stakeholders.

The purpose of each scheduled progress evaluation should be determined, including which processes are to be assessed and the outputs required, to ensure that the appropriate personnel and information are available. During the evaluation the outputs should be assessed against predefined criteria for acceptable performance and responsibility assigned for actions required.

The processes to be assessed, assessment criteria and responsibilities for each progress evaluation should be included in the project plan in sufficient time to allow for the measurement and assessment.

Annex C
(informative)

Bibliography

[1] ISO 9000-1:1994, *Quality management and quality assurance standards — Part 1: Guidelines for selection and use.*

[2] ISO 9000-4:1993, *Quality management and quality assurance standards — Part 4: Guide to dependability programme management.*

[3] ISO 9001:1994, *Quality systems — Model for quality assurance in design, development, production, installation and servicing.*

[4] ISO 9004-2:1991, *Quality management and quality system elements — Part 2: Guidelines for services.*

[5] ISO 9004-4:1993, *Quality management and quality system elements — Part 4: Guidelines for quality improvement.*

[6] ISO 10005:1995, *Quality management — Guidelines for quality plans.*

[7] ISO 10007:1995, *Guidelines for configuration management.*

[8] ISO 10011:1991, *Guidelines for auditing quality systems.*

[9] ISO 10013:1995, *Guidelines for developing quality manuals.*

[10] ISO 10014:— [1], *Guidelines for managing the economics of quality.*

[11] ISO/IEC 12207:1995, *Information technology — Software life cycle processes.*

[12] ISO/IEC Guide 2:1996, *Standardization and related activities — General vocabulary.*

[13] IEC 300-3-3:1995, *Dependability management — Part 3: Application guide — Section 3: Life cycle costing.*

[14] IEC 300-3-9:1995, *Dependability management — Part 3: Application guide — Section 9: Risk analysis of technological systems.*

1) To be published.

(*Continued from second cover*)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 10007 : 1995	IS/ISO 10007:1995 Quality management — Configuration management	Identical
ISO 10011-1 : 1990	IS/ISO 10011-1 : 1990 Guidelines for auditing quality systems : Part 1 Auditing	do
ISO 10011-2 : 1991	IS/ISO 10011-2 : 1991 Guidelines for auditing quality systems : Part 2 Qualification criteria for quality systems auditors	do
ISO 10011-3 : 1991	IS/ISO 10011-3 : 1991 Guidelines for auditing quality systems : Part 3 Management of audit programmes	do
ISO 10013 : 1995	IS/ISO 10013 : 1995 Guidelines for developing quality manual	do

The concerned Sectional Committee has reviewed the provisions of the following ISO/IEC standards which have been referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard :

ISO/IEC 12207 : 1995	Information technology — Software life cycle processes
ISO/IEC Guide 2 : 1996	Standardization and related activities — General vocabulary
IEC 300-3-3 : 1995	Dependability management : Part 3 Application guide – Section 3: Life cycle costing
IEC 300-3-9 : 1995	Dependability management : Part 3 Application guide – Section 9: Risk analysis of technological system

At the time of publication, the editions of standards mentioned above, both normative and informative, were valid. All standards are subject to revision, and users of these standards are advised to nvestigate the possibility of applying the most recent editions of the standards indicated.

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