इंटरनेट मानक

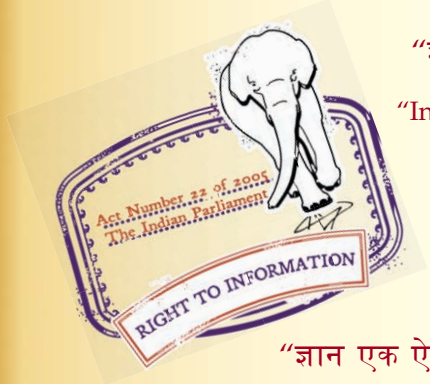
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 15883-1 (2009): Construction project management - Guidelines, Part 1: General [CED 29: Construction Management including safety in Construction]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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भारतीय मानक

निर्माण परियोजना प्रबंधन — दिशा-निर्देश

भाग 1 सामान्य

Indian Standard

CONSTRUCTION PROJECT MANAGEMENT — GUIDELINES

PART 1 GENERAL

ICS 03.100.40

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 2009

Price Group 6

FOREWORD

This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards, after the draft finalized by the Construction Management (Including Safety in Construction) Sectional Committee had been approved by the Civil Engineering Division Council.

A construction project is an endeavour undertaken by a project team on behalf of owner/client to create a built facility suited to the defined functional objectives. From inception to commissioning, the project goes through various distinct stages leading to progressive achievement of project objectives. Each stage involves specific inputs, processes (both technical and managerial) and deliverables. Typically, the life cycle of a project from commencement to completion involves the following stages:

a) *Project Appraisal* — Inception, feasibility and strategic planning;
b) *Project Development* — Project brief development, planning and design, finalization of proposals, procurement strategy, construction documentation including tender drawings, working drawings, specifications, cost estimates, bills of quantities, procurement documents;
c) *Planning for Construction* — Sequencing of project components, planning tools, resource planning and time cost trade-off;
d) *Tender Action* — Open competitive bidding/pre-qualification of agencies, issue of tender documents, evaluation of bids, negotiation if required and award of work;
e) *Construction* — Execution, monitoring, control, work acceptance; and
f) *Commissioning and Handing Over* — Contractual closeout, financial closeout, defect liability commencement, facility handing over.

The distinct features of a construction project include the temporary nature of the organizations involved, the evolutionary process of project deliverables during project development stages and the unique output of the built facility. As a result of these features, unless there is efficient and effective project management, a construction project is faced with challenges of uncertainties leading to time over-runs, cost over-runs, changes in project parameters, loss of quality and inability to meet the functional objectives. While technical soundness of a proposal is an important aspect of a construction project, the management aspects, which involve techno-legal, financial and other issues, have also a significant role in the success of a project. Therefore, management functions and technical processes in a construction project need to be integrated towards achieving project objectives. Top management commitment plays an important role in harmoniously achieving these project objectives. In some of the public sector projects, it may be necessary to share relevant information with public at large through appropriate means.

This standard is intended to provide a general overview of construction project management and information regarding the applicable tools and techniques. It gives brief guidelines on various construction project management functions and formulation of other parts of this standard to cover detailed guidelines on each of these management functions may be taken up subsequently. Users of this standard are encouraged to employ suitable construction management software as an aid to implement provisions of this standard.

The guidelines may be applicable in general to all construction projects. However, for smaller projects, the applicability of various provisions may be decided appropriately by the parties concerned.

The composition of the Committee responsible for formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CONSTRUCTION PROJECT MANAGEMENT — GUIDELINES

PART 1 GENERAL

1 SCOPE

1.1 This standard (Part 1) covers general guidelines for construction project management.

1.2 The aspects regarding project formulation and appraisal up to the stage of preparation of preliminary proposals for financial approval are not covered in this standard. The scope of this standard, therefore, covers the stages subsequent to the stage of approval (when a decision to implement the project including its financing is taken) till commissioning and handing over of the project.

2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
7337 : 1985	Glossary of terms in project network analysis
10400 : 1992	Glossary of terms in inventory control
14580	Use of network analysis for project management:
(Part 1) : 1998	Management, planning, review, reporting and termination procedures
(Part 2) : 2006	Use of graphic techniques
15198 : 2002	Glossary of terms in human resource development

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 7337, IS 10400 and IS 15198 shall apply.

4 GENERAL

4.1 A project is generally a non-recurring task having a definable beginning and end, with a definite mission and has a set of objectives and achievements. Project Management is application of knowledge, skills, tools and techniques to achieve the objectives of a defined project with the aim to ensure that a project is completed within the scheduled time, authorized cost and to the requirement of quality standards. The Construction Project Management refers to such project management when applied to construction of built facility. Project objectives depend on the requirements of the built facility. From the point of view of Construction Project Management, project objectives may be defined in terms of scope, time, cost and quality. This may usually take place in project appraisal stage. Information and guidelines given under **4.2** to **4.6** shall be appropriately utilized under different stages for Construction Project Management.

NOTE — For the purpose of this standard, Construction Project Management objectives are drawn from the project development stage and do not cover inception, feasibility and related project strategic planning.

4.2 Stakeholder

Stakeholder is a person, group of persons or organizations who are actively involved in the project or those who have an interest in the success of a project and its environment. Generally in a construction project, besides the owner/client, the project manager, consultant, construction agency and the user are the stakeholders. In addition, depending on the nature of the project, there may be other stakeholders such as financer, government and public at large.

4.3 Construction Project Life Cycle

Construction project life cycle consists of project appraisal, project development, planning for construction, tender action, construction, and commissioning and handing over, as main stages. These stages involve defined decisions, deliverables and completion of milestones for control of project, ensuring that the adverse impact of uncertainties is overcome at each stage in the progress. Accordingly, the responsibilities of project team should be defined and measured for acceptance and liabilities determined objectively.

Project objectives, drawn out of feasibility established in the appraisal stage, are achieved progressively through each of the project life cycle stages. The stage-wise break-up of project objectives, tasks, compliance and authorization to proceed further in the next stage

should be structured comprehensively through various stages of life cycle. Each stage of construction project life cycle may be considered as a sub-project, thus making overall complexities of a project more manageable.

A typical construction project life cycle is given in Fig. 1.

4.4 Construction Project Delivery Models

Project delivery model determines the manner in which the project is planned, designed, executed and contract administration carried out. It also determines the contractual relationships between the owner/client, design consultants and construction agency. The delivery model shall define the span of control and role and responsibilities of each of the above parties. The main types of project delivery models that are in vogue in the construction projects are: (a) traditional design-bid-build, (b) design-build with variants, (c) turn-key, and (d) build, operate and transfer and its variants. Each of the delivery models can adopt different types of contracts depending upon the suitability of the contract type in relation to the nature and type of projects, project objectives and other project specific considerations.

4.5 Construction Methodologies/Techniques

Suitable construction methodologies/techniques, including conventional, prefabrication, systems building approach, mixed/composite construction, mechanization in construction, other innovative technologies, etc, shall be considered and an appropriate choice made depending upon the project objectives in terms of factors such as scope, time, cost and quality requirements.

4.6 Organizational Structures

Organizational structure depends on the project delivery model. As an example, a typical organization chart for Design-Bid-Build model is given in Fig. 2.

4.6.1 *Construction Project Management Organizational Teams*

For any given project delivery model, an appropriate organizational structure shall be selected so as to facilitate constitution of teams across various agencies involved. Such teams are fundamental functional units generally specific to each of the life cycle stages of a project.

HSE and quality set up shall directly report to the Project Manager.

5 CONSTRUCTION PROJECT MANAGEMENT STAGES

Typically a construction project (whether small or large) may be considered to involve the following distinct broad stages:

a) Project appraisal stage (*see* Note):
   1) Inception,
   2) Feasibility, and
   3) Strategic planning.
b) Pre-construction stage:
   1) Project development,
   2) Planning for construction, and
   3) Tender action.
c) Construction stage, and
d) Commissioning and handing over stage.

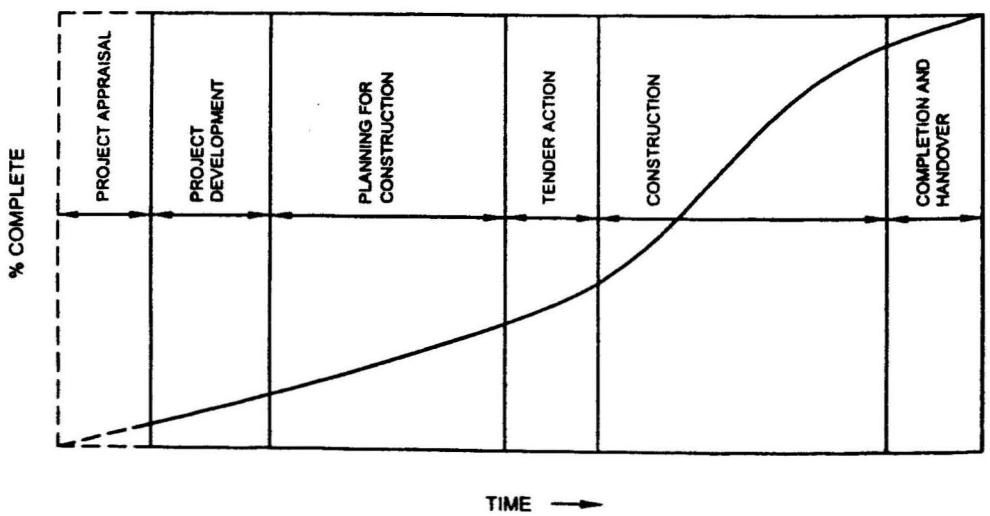
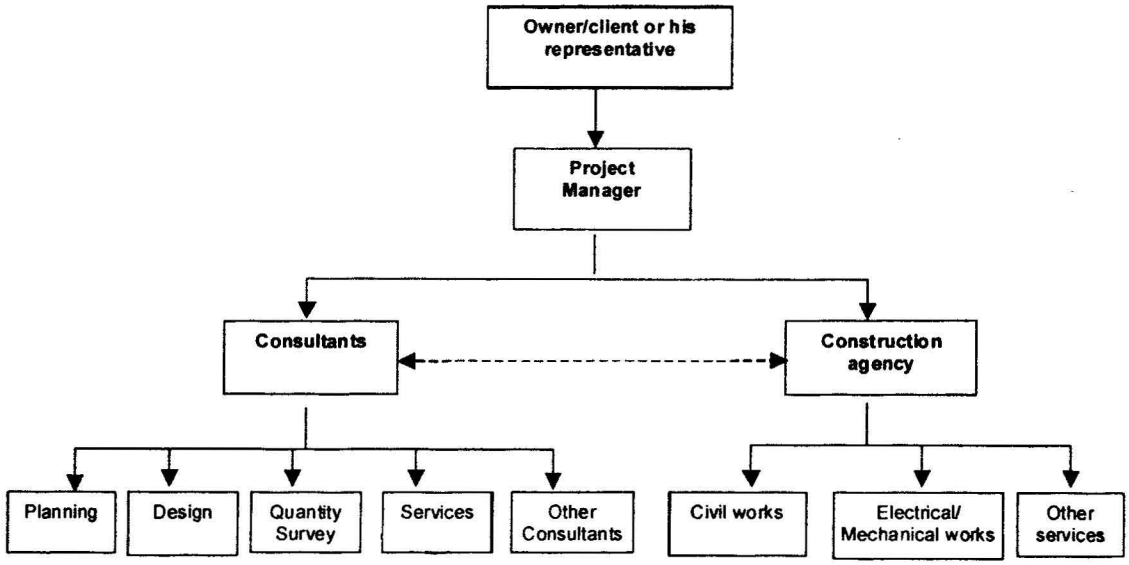


FIG. 1 TYPICAL CONSTRUCTION PROJECT LIFE CYCLE



NOTE — 'Consultants' may cover in-house teams or outside consultants.

FIG. 2 TYPICAL ORGANIZATION STRUCTURE FOR DESIGN-BID-BUILD MODEL

NOTE — As the scope of this standard covers activities starting from pre-construction stage, the project appraisal stage has not been covered here.

Under each of the above stages, the relevant construction management function guidelines given in **6** should be employed for achieving the intended objectives.

5.1 Pre-construction

5.1.1 *Project Development*

This will involve:

a) Formalization of design brief;
b) Site survey and soil investigation;
c) Hazard risk vulnerability analysis;
d) Alternative concept designs with costing and finalization;
e) Preliminary designs and drawings;
f) Development of design of each discipline and their integration;
g) Obtaining statutory approvals;
h) Decision on construction methodology;
j) Preliminary cost estimates;
k) Detailed design of each discipline;
m) Construction working drawings and related specifications with integration of engineering inputs of all concerned disciplines;
n) Detailed cost estimate;
p) Detailed specifications and bill of quantities; and
q) Tender documents.

Peer review/proof checking of the drawings/designs/ estimates shall be done in case of important projects, depending upon their complexity and sensitivity. Environment impact analysis and social impact analysis shall be done in applicable cases.

5.1.2 *Planning for Construction*

The following aspects shall be considered:

a) Sequencing of project components,
b) Planning tools:
   1) Work breakdown structures (WBS),
   2) Bar charts, and
   3) Network techniques and scheduling.
c) Resource planning, and
d) Time cost trade-off.

5.1.2.1 *Sequencing of project components*

Methodology of construction shall be detailed before the start of the project. Sequencing of project components shall be done on the basis of methodology adopted and availability of resources. This shall be reviewed during the progress of the project and revised, if necessary.

5.1.2.2 *Planning tools*

The planning tools described below may be employed for effective management of a construction project:

a) *Work Breakdown Structure (WBS)* — The WBS shall identify the total scope of works involved in the project and shall form the basis

for the development of detailed project schedule. Through WBS, the project shall be sub-divided into major sub-divisions (work packages) and each major sub-division shall be further sub-divided into additional levels as required up to the level of activities that could form the basis for monitoring and control of project performance in terms of time, cost and quality parameters. WBS shall provide activity listing with associated cost account codes for the preparation of project schedule either by bar charts or by network diagramming methods.

b) *Bar Chart* — Bar chart is the simplest form of project scheduling and used for small and complex projects and in preliminary planning and tender stages of major projects. A typical bar chart form of project schedule depicts the various activities on a calendar time scale in the form of bars in their relative positions with start and finish dates and length of bar indicating probable activity duration. Linked bars represent the interdependencies between the activities. Bar chart type of schedule shall be used to comprehend, summarize and display the results of complex project network analysis and further monitoring and controlling process.

c) *Network Techniques and Scheduling*

1) *Network Diagramming Methods* — Network based project schedule shall be used for major and complex projects. In this method, the network of project activities identified through WBS is developed incorporating their logical relationships and interdependencies. The two available approaches for network diagramming techniques are Arrow Diagramming Method (ADM) and Precedence Diagramming Method (PDM).

2) *Network Analysis and Scheduling* — The project network incorporating the activity durations and logical relationships shall be analyzed with forward and backward pass schedule calculations to establish early and late start and finish time of activities with their available floats, critical activities, critical path and overall project duration. The project schedule is prepared in terms of calendar dates of start and finish of activities with available floats. The network schedule shall also be presented in the form of linked bar chart or in tabular format.

For details on network preparation and analysis, reference shall be made to IS 14580 (Part 1) and IS 14580 (Part 2). Network schedule shall be prepared for all disciplines and they shall be integrated into a Master Control Schedule.

5.1.2.3 *Resource planning*

This shall involve the following:

a) *Resource Allocation* — The feasibility of the network shall be checked with respect to manpower, equipment, other resources required at the site.

b) *Resource Levelling* — It shall be done by re-allocating the slack resources from non-critical path to critical path activity in order to obtain a reduction of time or by shifting the activities within the floats available with them, to obtain an optimum uniform resource requirements.

c) *Resource Schedule* — Schedule of following resource requirements with respect to time shall be prepared on the basis of network developed and kept in the database for project control purposes:

1) Technology,
2) Manpower:
   i) Technical staff,
   ii) Skilled labour, and
   iii) Unskilled labour.
3) Machinery,
4) Materials, and
5) Cash flow.

Resource schedule shall be prepared separately for client, consultant and construction agency.

5.1.2.4 *Time cost trade-off*

Time cost trade-off analysis shall be done to obtain a minimum total cost of the project within the specified time. This shall be done taking into consideration direct cost and indirect cost of the project.

5.1.3 *Tender Action*

5.1.3.1 *Preparation of tender documents*

The bill of quantities, specifications, drawings and conditions of contract should be prepared on the basis of design and details finalized in project proposal development stage (*see* **5.1.1**) keeping in view the construction project delivery model selected. The format, terminologies and terms and conditions should be as per the standard engineering practices. In case of any special item or condition, the same shall be described clearly to avoid any ambiguity.

5.1.3.2 *Selection of Construction agency*

Selection of construction agency shall be done by either:

a) *Open Competitive Bidding* — In this case, tender notice should be publicized adequately to obtain competitive tenders from competent agencies for the project; or

b) *Limited Competitive Bidding* — In large, specialized and important works, pre-qualification of contractors shall be done considering their financial capability, bid capacity, experience of similar type of works, past performance; technical staff; and plants and machinery available.

5.1.3.3 *Bid evaluation, negotiation and award of work*

After due evaluation and negotiation, with the bidders, if required, the work shall be awarded to the construction agency based on competitive technical and financial bids.

5.2 Construction

This is one of the most important stages of construction management where pre-construction stage outputs are realized into physical tangible form within the constraints of time and cost. The intent or need for functional and physical characteristics, defined in the pre-construction stage outputs through specifications, drawings and consolidated project brief is realized through various construction project management functions described in **6** and particularly through:

a) Time management,
b) Cost management, and
c) Quality management.

5.3 Commissioning and Handing Over

After the project is complete as per specifications and designs, project commissioning and handing over stage follows. It shall need the compliance of the following:

a) Clearing of site,
b) Removal of all defects at the time of completion and during defect liability period,
c) Preparation of list of inventories,
d) Certification and settlement of construction agency's final bills for payment,
e) Obtaining completion certificate from local government bodies/departments,
f) Preparation of maintenance manual,
g) Performance compliance verification of built facility,
h) Handing over all other required documents to the client/owner,
j) Restoration of surroundings, and
k) Preparation and handing over all as-built drawings.

6 CONSTRUCTION PROJECT MANAGEMENT FUNCTIONS

Construction Project Management consists of number of processes and these can be grouped under the following management functions:

a) Scope management,
b) Procurement management,
c) Time management,
d) Cost management,
e) Quality management,
f) Risk management,
g) Communication management,
h) Human resources management,
j) Safety, health and environment management,
k) Integration management, and
m) Other management processes.

The project management functions briefly described below may be employed for effective management of construction project during its different stages as applicable. Some of the processes may, however, overlap more than one function.

6.1 Scope Management

It should be ensured that project features and functions remained as established during the finalization stage. Scope management includes the processes of scope planning, scope definition, scope verifications, scope monitoring and change control.

Scope monitoring and change control are critical to the construction stage in order to control time and cost over-runs. The work breakdown structure of the project shall be the basic tool for defining the scope baseline. Scope control should aim to identify factors influencing scope change, determine the impact of scope changes and establish the system for scope change approval and revision of scope baseline. Accordingly, a detailed scope management plan should be drawn to lay down all the necessary practices including technical and organizational interfaces.

6.2 Procurement Management

Procurement management includes processes for purchase of materials, equipment, products, soliciting services of consultants and engaging agencies for execution of works under a contract. Project procurement processes, which depend on type of project delivery model include identification of

procurement needs, preparation for procurement, soliciting proposals, selection of suppliers/consultants/ works contractors, administering of contract, contract management and closure of contract. Project manager is charged with the responsibility to help structure and develop contract to suit the specific needs of the project. As contract, which is an output of project procurement management processes, is a legal document, the procurement processes should follow detailed procedures with adequate review and stakeholder appraisal opportunities.

One of the fundamental issues in construction projects, managed through project managers, is to determine what needs may be met by procuring products, services and works from external agencies and what should be accomplished by the project team. This decision is best arrived at the earlier stages of the project (so that the opportunities of procurement initiation at earlier stages is not lost) and reviewed at each of the subsequent life cycle stages of the project. Such decisions should draw inputs from the time, cost, quality and scope management processes. Various procurement routes should be analyzed on their suitability to both time and cost criteria of project. As a strategy for procurement, a project procurement management plan should be developed to document: contract types to be used; procurement documents; coordination of procurement with schedules; constraints and assumptions; risk mitigation activities (performance bonds, insurances, etc); and pre-qualification of suppliers. In addition, specifications, quality standards, performance data at work locations, etc, which are part of project scope statement, should be described. Inventory management plays an important role in the procurement management process.

Provision of establishment of suitable dispute redressal system should be inbuilt to take care of any disputes that may arise.

6.3 Time Management

Time management aims to complete the project within the stipulated time period. Time management essentially involves the following processes:

a) Defining project scope in the form of work breakdown structure to generate activity identification and listing,
b) Activity duration estimating,
c) Activity sequencing with interactivity dependencies,
d) Project schedule development, and
e) Project schedule control.

Work breakdown structure should be used as a tool to prepare the project schedule by defining the project scope and identifying and listing of the activities in the work packages. For the quantum of work involved in the activities, the activity durations are estimated based on the standard productivity norms for different trades of work. Past-documented experience and expertise should also be used for determination of the activity durations with the construction technology adopted and manpower and equipment resources used. Based on the construction methodology proposed with the consideration of project specific constraints, the sequencing and interdependencies of the activities are determined and the graphical representation of activities in the form of network should be prepared. The network thus prepared should be analyzed to develop the project schedule with information on early and late start and finishing of activities with their available floats and the critical path/critical activities on the network. Incorporating the calendar dates, the baseline schedule may be finalized with the incorporation of milestones for subsequent schedule monitoring and control processes.

During the construction stage, schedule monitoring involves methods of tracking and comparing the actual schedule with the baseline schedule and schedule control activities should ensure to remove deficiencies and slippages corrected to acceptable levels.

Project scheduling and monitoring is a dynamic process and periodic schedule updating should be done for effective monitoring and control process. In the process, the status of each activity should be examined. For completed activities, actual durations utilized, are incorporated; and for activities in progress, balance to complete revised durations and estimated finish dates are determined and incorporated. If the actual schedule lags behind the baseline schedule, various options should be considered to control and bring back the schedule to acceptable levels. The possible control actions, which may be considered are: possible reduction in activity duration of future activities with alternate technology options, increasing the resources, alteration in the construction logic and activity sequencing, etc.

6.4 Cost Management

The objective of the project cost management is to ensure that the project is completed within the authorized budget. The major processes involved in the cost management are: resource planning, cost estimation, cost budgeting/cost planning and cost monitoring and control. The resource planning involves determination of various types of resources, such as appropriate technology, workforce, materials, equipments and infrastructure facilities, their quantum and their requirements during different stages of the

project. Preliminary cost estimate with defined scope of work is required for obtaining the project sanction. Detailed item wise cost estimates with bill of quantities and specifications should be made for tendering and subsequent project execution. The type of contract adopted such as item rate, percentage rate, lump sum and cost plus, influences the cost management strategy.

Most of the cost optimization techniques through value management studies are achieved during the pre-construction stage of the project. Value management is a useful technique for application in cost management. It is a systematic multi-disciplinary effort directed towards analyzing the functions of project or item for the purpose of achieving the best value at the lowest overall life cycle project cost. It is an established technique for determining value based decisions rather than cost reduction based on change in specifications. Suitability of construction techniques, selection of equipments for specific purposes, considering alternative materials and other design changes are some of the areas of application of value engineering.

During construction stage, the efforts are more on control mode for adherence to the budgeted cost. For the purpose of cost control during execution, the time based cost baseline of the project which forms the basis for the measurement and monitoring of cost performance, should be generated. The cost baseline is generated by allocating the overall cost estimate to individual project activities based on the project schedule. Using the cost baseline, the cost control, which comprises the following, should be exercised:

a) Periodical cost reporting,
b) Comparison of the actual cost against the planned cost,
c) Obtaining early warning for corrective actions,
d) Control and monitoring cost changes,
e) Forecasting of final cost at completion based on cost trend and cost changes, and
f) Modification of the cost baseline for authorized cost changes and preparation of revised estimates.

6.5 Quality Management

Quality management in construction aims to achieve required functional and physical characteristics of a constructed facility through management actions including planning, direction and control. Quality is the key determinant of requirements which is expressed through drawings and specifications. Main function of quality management is to achieve quality objective of satisfying requirements through performance evaluation of construction processes and ensure that they are directed towards overall quality. Quality management during construction stage assumes that the design and specifications comprehensively incorporate requirements of users and other stakeholders. Prior to setting out for the construction, the client should completely understand the implications of changes to the design and specifications during the construction stage, which may affect quality.

Although quality is an all-encompassing concept which also has bearing on time and cost aspects, the specific scope of quality management may be limited to its key functions of quality planning, quality assurance and quality control. Quality planning refers to the identification of relevant quality standards and determining how to satisfy them. Quality assurance activities include consistent evaluation of project performance to provide confidence that the project satisfies the relevant quality standards. Quality control monitors project results related to the compliance to quality standards and identifying means to eliminate non-conformity.

On-site operations constitute most of the construction processes. Scope of quality management for on-site operations may be categorized broadly in three distinct stages. In the 'receiving stage', materials and supplies are inspected and tested for conformance to the specified standards. During 'in-process stage', materials and supplies are processed to form project product components wherein process control ensures conformance to the specified standards. In the 'final stage', inspections and tests monitor the functional and physical performance of the product/service to ensure that they satisfy the requirements.

Planning being an integral part of the quality management, may also consider efficient site layout and its management for on-site operations. In addition to time and cost implications of the site management, the quality performance improves by efficient organization of activities by way of providing adequate and appropriate conditions for the work processes. Site management needs to consider construction technology constraints with reference to aspects related to space availability such as permanent services, access to site, temporary services, location of material stores, stacking and storage areas and plants, fencing and other temporary structures.

The various organizations connected with the project should have their own quality management systems.

6.6 Risk Management

Project risks have an impact on the project objectives and need a planned response. Project risk management processes ensure proper planning, identification,

analysis, monitoring and control to the best interest of the project.

Risk management planning processes develop an approach to risk management activities which include planning, execution and monitoring. A risk management plan should define lead and support role responsibilities of project team in relation to management, budgeting, risk responsive scheduling, classification of risk activities based on risk break-down structure and explanation of probability and impact for risk context.

Risk response planning determines actions required for reducing impact of risks. Risk responses are established and assigned to appropriate project participants. Suitable risk mitigation measures should be evolved for identified risks.

6.7 Information and Communication Management

For information and communication management, Management Information System (MIS) is used as an important tool for systemized approach to furnish information. It comprises a system that collects, stores, sorts and analyzes data to generate and communicate information. It may be a combination of manual and computerized systems.

At the construction stage of a project, there are many agencies involved like client, architect, engineer, project manager, various consultants, material suppliers, construction agencies and sub-contractors. Each agency is divided into top level management taking policy decisions, middle level management monitoring the project and lower level management involved in day to day operations of the project.

Each level of management requires information of varying details, at different periodicities and in different formats. Project progress information flows from lower level to the top level management and policy decisions flow from top level to the lower level management.

MIS integrates the work and information flow within each agency and flow of information between different agencies.

In construction stage of the projects, the information may be in the form of data reflecting status of project in terms of actual execution time for each activity, cost incurred, resources used, quality control, material management, bills, organization management and other administrative aspects like disputes that may come up. This data should be analyzed to understand the overall progress achieved and to update schedules of the project.

Basic objectives of MIS of a construction project may be summarized as:

a) Providing benchmark against which to measure or compare progress and costs, like time network schedules, cost estimates, material and labour schedules, specifications, working drawings.

b) Providing an organized and efficient means of measuring, collecting, verifying and reflecting the progress and status of operations on the project with respect to progress, cost, resources and quality.

c) Providing an organized, accurate and efficient means of converting the data from operations into information.

d) Reporting the correct and necessary information in the required format and at the required level of detail to managers at all levels and to the supervisors.

e) Identifying and isolating the most important and critical information at various stages to be communicated to the managers and supervisors for taking decisions.

f) Communicating the information to the managers and supervisors in time so that decisions may be taken at the right time.

Total MIS configuration of the construction project may be divided into the following modules:

a) Planning and scheduling module.

b) Cost control and accounting module.

c) Trend and forecast module.

d) Project administrative and financial module.

e) Historical and documentation module.

All modules should be interlinked in flow of information and generation of reports.

For large public projects, suitable mechanism may be established for communication of relevant information to public at large.

6.8 Human Resource Management

All construction projects involve large number of skilled/unskilled persons. Human resources in a project should be adequately qualified, trained and competent.

Quality of construction work depends on the quality of labour resource. For skilled and unskilled labour, the requirement for technical knowledge, skill and general awareness are varied for different construction processes. Labour is required to understand their respective responsibilities especially towards the work. Therefore, construction management practices should emphasize on development of competence of this critical human resource through training programmes.

The critical activities should be identified from the point of view of technological innovations, workmanship and environmental conditions which determine labour behaviour and performance. In each construction project, there are certain work related peculiarities which call for job specific orientation. There should be a clearly defined competence requirement for the workmen. As far as possible, a formal training or a certified course undertaken should be a preferred selection criterion for the workers. A periodic review of the performance may be made to establish the nature of training required and methods for imparting training. There is a need to address the motivational aspects, for better performance.

6.9 Health, Safety and Environment Management

6.9.1 Health management issues include looking into the risk factors to health of construction personnel and providing hygiene conditions at construction sites and methods of their management. It includes managing,

a) occupational/physical health hazards,
b) short term as well as long-term ill effects of the activities and the working environment of the construction sites,
c) provision of personal protective equipment required for specific health hazards, and
d) laying down of construction hygiene control methods.

6.9.2 Safety management issues include managing work processes, equipment and material handling at site for striving to achieve zero accident status at site. For prevention and management of accidents, a proper organizational and administrative mechanism is required. Following steps should be taken for achieving the same:

a) Laying down of safety regulations or mandatory prescriptions concerning different work processes.
b) Standardization of work processes and management actions.
c) Regular and stipulated inspection of works and machinery/equipments for enforcement of mandatory regulations.
d) Providing education and training to workers on safety issues.
e) Publicity and appeal to develop safety consciousness.
f) Insurance of built facilities, construction personnel and third party.
g) Regular safety audit of construction sites.
h) Effective post accident action including accident analysis and reporting.
j) Effective post accident management including corrective measures to avoid repetition of such accidents.

Safety Officer shall be appointed in accordance with the concerned provisions of the *Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act*, 1996. Safety officer who is posted at a medium to major construction site shall:

a) look after the safety of the personnel, safe handling of materials and machinery, safe work practices and standard operating procedures;
b) be responsible for compliance of all statutory obligations of the employer in regard to safety of personnel and structures;
c) guide and assist the site managers/engineers to make their sites safe and accident free;
d) train personnel in construction safety, conduct safety surveys and design suitable documents for recording and promoting safety on sites and in the construction industry; and
e) arrange for safety briefing for all the persons entering the construction area.

6.9.3 Environment management issues include the following:

a) Minimizing adverse environmental impact of activities, products and services.
b) Limiting any adverse impact within the laws/ prescribed norms and their monitoring.
c) Safety of environment while working with hazardous materials and maintaining material safety data sheets.
d) Management of disposal of waste from the construction sites.
e) Considering positive environmental contribution particularly after completion of construction.
f) Mechanism to review concerns of interested parties.

6.10 Integration Management

Integration management aims to provide processes necessary for coordination amongst various organizations and their teams involved. It ensures that various organizational teams perform in an integrated manner, with their actions coordinated to the mutual interests towards the project. Integrated management processes provide opportunities for resolving conflicts and competing interests through appropriate trade-offs. Integration is necessary where processes interact, especially when process responsibilities belong to different organizational groups. Such process

interactions need organizational interfaces to be defined and resolved at an overall level.

Integration management may also be required for specific situations when impact of one management functions is a cause for concern for other management functions. For example, if there is a time delay in performing a particular construction process, it may often have impact on the cost aspects of not only that process but other processes involving other organizational groups; the rescheduling may affect coordination amongst performing groups in the down-stream processes and activities.

6.11 Other Management Issues

With the steady increase in global population and the rapid depletion of natural resources, the project manager may have to address various other issues such as energy management and sustainability.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Construction Management (Including Safety in Construction) Sectional Committee, CED 29

Organization	*Representative(s)*
In personal capacity (*103, Charak Sadan, Vikaspuri, New Delhi*)	SHRI P. KRISHNAN (***Chairman***)
Airports Authority of India, New Delhi	REPRESENTATIVE
Builders' Association of India, Mumbai	SHRI H. S. PASRICHA SHRI SANJAY SONI (*Alternate*)
Building Materials and Technology Promotion Council, New Delhi	DR SHAILESH KR AGRAWAL SHRI I. S. SIDHU (*Alternate*)
Central Building Research Institute (CSIR), Roorkee	SHRI S. G. DAVE SHRI AJAY SINGH (*Alternate*)
Central Public Works Department, New Delhi	CHIEF ENGINEER (CDO) SUPERINTENDING ENGINEER (S&S)
Construction Industry Development Council, New Delhi	SHRI P. R. SWARUP SHRI RAVI JAIN (*Alternate*)
Consulting Engineering Services (India) Pvt Ltd, New Delhi	SHRI P. K. DATTA
Delhi Development Authority, New Delhi	SHRI D. D. SHARMA SHRI R. K. MITTAL (*Alternate*)
Delhi Metro Railway Corporation, New Delhi	REPRESENTATIVE
Delhi Tourism and Transportation Development Corporation, New Delhi	SHRI JOSE KURIAN SHRI SHAILENDRA SHARMA (*Alternate*)
Engineers India Limited, New Delhi	SHRI V. N. PRASAD SHRI A. K. TANDON (*Alternate*)
Hindustan Prefab Limited, New Delhi	SHRI JAIVEER SRIVASTAVAA SHRI J. S. TOMER (*Alternate*)
In personal capacity (*411, Technology Department, Patparganj, Delhi*)	SHRI R. P. LAHIRI
Indian Buildings Congress, New Delhi	SHRI A. K. SRIVASTAVA SHRI P. S. CHADHA (*Alternate*)
Indian Institute of Public Administration, New Delhi	PROF NAND DHAMEJA PROF ANIL C. ITTERYERAH (*Alternate*)
Indian Institute of Technology, New Delhi	PROF B. BHATTACHARJEE DR K. N. JHA (*Alternate*)

Organization	*Representative(s)*
Larsen and Toubro Ltd, ECC Group, Chennai	SHRI M. P. NAIDU SHRI P. R. SURENDRA BABU (*Alternate*)
M. N. Dastur & Company (P) Limited, Kolkata	SHRI S. K. GUHA SHRI D. M. KAPOOR (*Alternate*)
Military Engineer Services, Engineer-in-in-Chief's Branch, Army Headquarters, New Delhi	SHRI J. B. SHARMA SHRI J. BHATTACHARJEE (*Alternate*)
National Buildings Construction Corporation Limited, New Delhi	SHRI AMITABHA BASU SHRI S. K. GAMBHIR (*Alternate*)
National Highways Authority of India, New Delhi	SHRI H. C. ARORA
National Institute of Construction Management and Research, Mumbai	SHRI ANIL AGARWAL
Nirman Vikas Anusandhan Sansthan, Chattisgarh	SHRI SANJEEV KASLIWAL SHRI AMARJEET SINGH (*Alternate*)
Planning Commission, New Delhi	SHRI SHATRUGHAN LAL
Rajiv Gandhi Rural Housing Corporation Ltd, Bangalore	SHRI N. S. MAHADEVA PRASAD
School of Planning and Architecture (Department of Building Engineering and Management), New Delhi	DR V. THIRUVENGADAM SHRI V. K. PAUL (*Alternate*)
Shelter Consulting Engineers, Noida	SHRI MANOJ KUMAR MITTAL
Spectral Services Consultants Pvt Ltd, New Delhi	SHRI SANDEEP GOEL SHRI B. S. GULATI (*Alternate*)
The Institution of Engineers (India), Kolkata	LT-GEN HARI UNIYAL (Retd)
BIS Directorate General	SHRI A. K. SAINI, Scientist 'F' & Head (Civ Engg) [Representing Director General (*Ex-officio*)]

Member Secretaries
SHRI SANJAY PANT
Scientist E & Director (Civ Engg), BIS
SHRI S. ARUN KUMAR
Scientist B (Civ Engg), BIS

Panel for Construction Project Management, CED 29/P1

In personal capacity (*103, Charak Sadan, Vikaspuri, New Delhi*)	SHRI P. KRISHNAN (***Convener***)
Building Materials and Technology Promotion Council, New Delhi	SHRI I. S. SIDHU
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