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PROJECT MANAGEMENT

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INTRODUCTION

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Project management refers to the process of leading the work of a team to achieve objectives and meet success criteria at a specified time. The primary challenge of project management is to achieve all of the project goals within the given constraints. In the absence of a good project management system, even a well-conceived project may fail or collapse. For any business, investment in capital projects is a crucial decision. All major companies undertake project investment with ambition, and at the same time care and caution. Project investment decisions involve several steps that include generation and screening of ideas, estimating costs and benefits, allocation of funds on competing projects and preparation of a project report before implementation, and a project review and post completion audit.

The primary aim of any business activity is to gain profits. Whether a project is financially viable or not can be determined with the help of projected financial statements, such as profit and loss accounts and balance sheets, which are prepared on the basis of other preliminary statements employing accounting based project evaluation methods.

Organizations and businesses try to set up an organizational system for generating project ideas and for systematically processing them, all the way through to completion. Some key areas that are monitored are time, cost and performance. A lag in any of these might even render the project unviable.

This book, *Project Management*, is written with the distance learning student in mind. It is presented in a user-friendly format using a clear, lucid language. Each unit contains an Introduction and a list of Objectives to prepare the student for what to expect in the text. At the end of each unit are a Summary and a list of Key Words, to aid in recollection of concepts learnt. All units contain Self Assessment Questions and Exercises, and strategically placed Check Your Progress questions so the student can keep track of what has been discussed.

BLOCK - I
BASICS, IDENTIFICATION, PLANNING
OF PROJECT MANAGEMENT

*Basics of Project
Management*

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UNIT 1 BASICS OF PROJECT
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1.0 INTRODUCTION

Project management is the art of managing the human and material aspects of a project by relying on modern management techniques. It entails developing and implementing a plan for a project while also considering resources that are available to the organization. It is important to manage a project properly so that the reputation of the organization is not hampered. This unit will discuss the meaning of project management, the role of project managers and the phases of a project life cycle. The essentials of project management will also be discussed.

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1.1 OBJECTIVES

After going through this unit, you will be able to:

- Understand the meaning, need and importance of project management
- Discuss the project management knowledge areas
- Explain the role of project managers
- Examine the phases of project life cycle
- Discuss the project management process
- Explain the impact of delay in project completion
- Explain the essentials of project management philosophy

1.2 MEANING OF PROJECT MANAGEMENT

Project management is the art of directing and coordinating the human and material resources throughout the project by using modern management techniques. The main purpose of project management is to achieve the predetermined objectives of scope, cost, time, quality and the satisfaction of the participant.

Project management includes developing and implementing a plan for the project while considering the available resources such as manpower, material and cost in the organization. Project management involves the following activities:

- Planning and analysing the objectives of the project
- Measuring and controlling the risk-involved in the project
- Estimating the organizational resources required in the project
- Assigning tasks to the employees related to the project
- Directing and motivating employees to improve their performance
- Organizing project activities
- Formulating the project
- Forecasting trends in the project
- Completing the project on time
- Keeping up the quality of the project

Characteristics of Project Management

Project management is concerned with achieving a specific goal in a given time by using the resources available for that specific period. Project management requires attention for goal-oriented systems, the environment, sub-systems and their relationships. This is what makes project management a 'systems approach' to management.

The application of principles and practices from the classical, behavioural and systems viewpoints to the unique requirements of projects has led to a new set of concepts which may be called the 'project viewpoint'. Cleland and Kind have identified the following characteristics of project management:

- The project manager is the single focal point for bringing together all the necessary resources for achieving the project objectives. The project manager formally heads the project organization and operates independently the normal chain of commands. The project organization reflects the cross-functional, goal-oriented nature of the project.
- Since each project requires a variety of skills and resources, many functional areas may perform the work in a combined form. The project manager is responsible for integrating the people from different functional disciplines working on the project.
- The project manager will negotiate directly with the functional managers for support. The functional managers are responsible for the activities of the individuals and for the personnel coming under the scope of their functional groups. However, the project manager has to concentrate on integrating all the project activities and overseeing the activities from the beginning to end.
- The project manager focuses on delivering a particular product or service at a certain point of time and cost to the satisfaction of the technical requirements. In contrast, the functional units must maintain an ongoing pool of resources to reach the ultimate organizational goals instead of the limited project goals. Thus, conflicts may often arise between the project and functional managers over the optimum allocation of resources to a project.
- A project in an organizational structure has two chains of command. One is the vertical, functional reporting relationship and the other is the horizontal, project reporting mechanism.
- For rewarding incentives and distributing responsibilities, the decision making, accountability, outcomes and rewards should be shared among all the members of the project team and the supporting functional units.
- Though the project organization is temporary, the functional units from which it is formed are permanent. Thus, when a project ends, the project team is scattered and the project personnel either return to their functional units or they are reassigned to new projects. Projects may originate from different areas of the organization. Product development and related projects tend to emerge from marketing whereas technological applications originate in Research and Development (R&D).
- Project management sets into motion numerous other support functions such as personnel evaluation, accounting and information systems.

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1.2.1 Importance and Need of Project Management

Organizations have to manage their projects effectively in order to create and maintain their reputation in the market. Many organizations fail to manage their projects properly due to the following reasons:

- Project is completed late or without fulfilling the demands of the client
- Project is not giving any valuable information
- Project lacks proper planning and organization of the activities
- The techniques and standards used are not advanced

A good project management offers various techniques and guidelines to manage employees and workloads. Project management provides the following benefits in an organization:

- **Saving cost:** Project management offers a common methodology for managing the project, i.e., if the processes and procedures are planned once, then they can be used in all the future projects again. Consequently, it helps in saving the cost and time required in completing the project.
- **Improving working conditions:** If the projects are successful, the client will be more involved in the projects. This helps in improving the working environment of the organization, which in turn encourages the morale and confidence of the project team.
- **Improving financial management:** Better estimation of the actual costs involved in the project helps in managing the budget of the organization. This results in better financial predictability and cost control.
- **Resolving problems:** Team members in a project spend a lot of time and energy in dealing with project problems. This is because the project team members do not know how to resolve the project problems. If the project is properly managed and planned, then the process of project management helps in solving the project problems quickly.
- **Determining risk:** The process of project management helps in identifying and managing risks in the near future.
- **Improving product quality:** The process of the project management helps team members understand the needs of customers. Once customer needs are recognized, team members can implement quality control and assurance techniques to fulfil customer demands.

Need for Project Management

Modern project management ideas originated in the construction and aerospace industries in the USA and Western countries. This was because the environment and activities in those industries demanded flexible and imaginative forms of management. The spread of project management ideas has come about due to necessity rather than desire. The major reason for its slow growth can be attributed

to the reluctance in accepting new approaches and techniques. The major problems identified by the managers, who attempted the new system, revolve around conflicts in authority and resources. The three major problems identified are as follows:

- Project priorities and competition for talent would interrupt the stability of the organization and interfere with its long-range interests by upsetting the normal business of the functional organizations.
- Long-range planning would suffer if the company gets more involved in meeting the schedules and fulfilling the requirements of temporary projects.
- Shifting people from project to project would disrupt the training of new employees and specialists.

Let us briefly consider some of the organizational factors influencing the need for project management.

- (i) The first is the size of the organization. A small organization such as a consulting firm, an engineering office or a small contractor who has a budget, a schedule and limited requirements to control quality and production could get along without any formal project organizational system. However, the quantitative methods and procedures of the project management approach are still necessary. On the other hand, a large organization executing a prestigious, complex, multi-disciplinary and capital-intensive project would certainly require a formal project management organizational system as well as quantitative techniques.
- (ii) The second factor is the style of management needed to meet the complexities of a rapidly changing business environment. Most industrial, public service and government organizations have solved the problem of complexity due to a hierarchical management structure inherited from the military. The top management has been very comfortable with the hierarchy because of its simple 'one boss' reporting system. The hierarchy also lends itself to convenient subdivision of the organization into groups or departments, each of which represents a speciality, a discipline or a function.

While these so-called line, functional or disciplinary divisions often enhance efficiency and maximize productivity, they suffer from the following flaws:

- o The ability of a specialized organization to work together and coordinate effectively with external agencies such as the clients, vendors and regulatory agencies is critical to the success of the project. Line managers often suffer from 'tunnel vision' or lack of knowledge of the overall organizational goals. In addition, competition between line divisions may result in inefficiency or failure to communicate vital information.
- o The responsibility for important external coordination may become mixed-up because of overlapping or inadequately defined roles. The allocation of responsibility for a job that overlaps several functional divisions in a project complicates the process of decision-making

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affecting the entire project. This may increase the possibility of inadequate or tardy responses to changing conditions which could make all the differences between the success or failure of a project.

- o As an organization grows in size and complexity, it becomes increasingly difficult for the top management to connect itself with the day-to-day problems of each project.

A chief executive may face a project failure for any of these reasons, and in an attempt to determine the cause for the failure, the executive may find the divisional managers blaming each other. It can be a very disturbing experience for the top management to realize their inattentiveness over the official issues. A chief executive needs a single point of information and control if complex projects are to be successfully completed.

In determining the need for project management, one should examine the project and organization carefully and ask the following questions:

- Is the job very large?
- Is the job technically very complex?
- Is the job a true system in which it has many separate parts or sub-systems that must be integrated to complete the operational whole?
- Is the job a part of a larger system and must be closely integrated, especially if the larger system has a project-oriented organization?
- Does the top management really feel the need for a single point of information and responsibility for the total job?
- Are strong budgetary and fiscal controls required?
- Are tight schedules and budgetary constraints foreseen?
- Are quick responses to changing conditions necessary?
- Does the job cross many disciplinary and organizational boundaries?
- Will the proposed job drastically disrupt the present organizational structure?
- Are more than two divisions involved? Is more than one division going to deal directly with the client or customer?
- Are there other complex projects being conducted concurrently with this one?
- Is there scope for a conflict between the line managers concerning this project?
- Is the organization committed to a firm completion date?
- Is it likely that changing conditions may seriously affect the project before its completion?
- Are there major items to be procured from outside the company?

- Are there major portions of the system which must be sub-contracted outside the organization?
- Is it necessary to have the project reviewed or approved by government regulatory agencies? Will these review processes and approvals generate problems and controversy?

The answers to the above questions help in the various project management considerations for an organization. From the above discussions, it can be concluded that project management can be applied to any ad hoc undertaking. This includes a broad range of activities such as writing a research paper, remodelling a house or constructing a children's park.

There are two situations in which project management should be used:

- The more unfamiliar or unique the undertaking, the greater the need for project management to ensure that nothing gets overlooked.
- The more numerous, interdisciplinary and interdependent activities in the undertaking, the greater the need for a project manager to ensure that everything is coordinated, integrated and completed.

Cleland and King have suggested five general criteria to decide when to use project management techniques and the corresponding organizational structures. These criteria are briefly described below:

- **Effort:** The magnitude of the effort should be more when the job requires more resources in an organization and for this purpose the project management techniques are necessary. For example, the Atlas missile programme requires major undertakings in the defence, aerospace, space, energy and transportation sectors. However, micro-level industrial activities may also need formal project management, e.g., in the case of relocation of facilities, merger of two companies and placing of a new product on the market.
- **Coordination:** Even when a job lies primarily in one functional area, the task of coordinating its work with the other functional area is necessary. For example, the task of computer installation in a company may seem to be the sole concern of the Electronic Data Processing (EDP) department, as many corporate executives thought during the last two decades in India. Only a few smart executives and organizations realized early on in the game that during the process of computerization, there will be a continuous meshing of policies, procedures and resources of all the departments affected by computer installation. Often hundreds of people may be involved and the required coordination and integration might be more than what a single department such as EDP can tackle efficiently and effectively.
- **Modification:** A project always requires modifications from time to time. Minor changes in products such as annual automobile design changes can usually be accomplished without setting up a project team.

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On the other hand, undertaking the modernization of an automobile plant calls for non-routine efforts such as revising the facilities layout, modifying the assembly line, replacing equipment, retraining employees and altering policies and work procedures. For this, project management requires to bring all the functional areas together. In a changing environment with rapid changes taking place in the economic, social and technological environment, more and more industrial organizations are seeking creative, innovative and flexible forms of management. Companies that operate in the computers, communications, electronics and pharmaceutical sectors are exposed to high innovations, rapid product changes, shifting markets and consumer behaviour. Other industries, such as those in biotechnology, petrochemicals and ceramics, though less volatile, also have highly competitive and dynamic environments.

- **Changing environment:** Another aspect of the changing environment that is particularly relevant for the Indian economy is the government's policy of liberalization and transition to the free market mode. Changing environments present opportunities that organizations must capture swiftly. Project management provides flexibility and diversity needed to deal with changing goals and new opportunities. When a joint effort is required, project management attempts to build lateral relationships between functional areas in order to accelerate work and reconcile the conflicts inherent in multi-functional and multi-disciplinary organizations. The project manager links and coordinates the efforts of the divisions within the parent organization as well as those of the outside: sub-contractors, suppliers and customers.
- **Reputation:** The reputation of the undertaking and what is at stake may determine the need for project management. An unsuccessful project will result in either a loss of future contracts, damaged reputation, loss of market share or, in the worst case, financial ruin; therefore, there is a strong case for utilizing formal project management techniques and organizational form. For example, in the launching of American multinational Pepsi soft drinks and snack food operations in India or introduction of its new 1000 c.c. car by Maruti Udyog Ltd or setting up of its joint venture in the form of Tata-IBM by IBM Corporation formally, each of the undertakings warranted the adoption of a formal project management approach. The obvious reason, in each of the above cases, is that the likelihood of successfully completing the undertaking is increased when a single competent individual is assigned responsibility for overseeing it. The project manager, with the assistance of technical support groups, can do much to reduce the problems inherent in large, complex undertakings.

Check Your Progress

1. Define project management.
2. What makes project management a 'systems approach' to management?
3. State any two reasons why organizations fail to manage their projects.

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1.3 PROJECT MANAGEMENT KNOWLEDGE AREAS

Project management rules are governed by Project Management Body of Knowledge called PMBOK. According to it, there are ten knowledge areas. The knowledge areas of project management overlap with the process groups which are project initiation, planning, execution, monitoring and controlling, and project closing. These phases are sequential and irrespective of the nature of project, each project has to go through them. The project management knowledge area includes those aspects of project management that every manager and project professional should know in order to manage a project effectively. These areas are found in every project and are core technical content vital for effective project management. There are ten broad Knowledge Areas that have been defined in project management. These are:

1. Project Integration Management
2. Project Scope Management
3. Project Schedule Management
4. Project Cost Management
5. Project Quality Management
6. Project Human Resource Management
7. Project Communications Management
8. Project Risk Management
9. Project Procurement Management
10. Project Stakeholders Management

1. Project Integration Management: The Project Management Institute defines Project Integration Management as: 'the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the project management process groups'.

Project Integration Management consists of three processes; they are Project Plan Development, Project Plan Execution, and Integrated Change Control. These three areas, project planning, project execution, and change control,

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are repeated constantly throughout the functioning of the project. Project planning and execution involve evaluating the project objectives with respect to the various alternatives available to ensure that the project is completed successfully. The aim of integration is to ensure that the need to execute changes during the execution phase can be avoided. There are cost and resources involved in carrying out the changes.

- 2. Project Scope Management:** Another knowledge area of project management is project scope management. Defining the project scope is a huge step towards moving in the right direction for the project development and execution to achieve the goals. The various activities involved in project scope management are identifying the requirements of the project, defining the goals and missions that will complete the project diagram and creating the correct work breakdown structure. It also clarifies what is not included in the project and what is included. There are five processes that are part of this scope, these are, Initiation, Scope Planning, Scope Definition, Scope Verification, and Scope Change Control. A clear communication of each of these scopes to various stakeholders ensures that there is no dispute over this at a later stage.
- 3. Project Schedule Management:** Project schedule management is one of the most time consuming among all the knowledge areas. In this phase, the project is divided into tasks and creates schedule and budget. The scheduling consists of creating the start and finish date for each task and the budgeting includes cost estimation. Various processes that are included into it are Activity Definition, Activity Sequencing, Activity Duration Estimating, Schedule Development, and Schedule Control. All these processes leads towards estimating the duration of the project plan activities, building a project schedule, and monitoring and controlling deviations from the schedule. This helps in assuring that the project is completed in time.
- 4. Project Cost Management:** This is the knowledge management area of project management that is concerned with cost and budget. Here the role of the project manager is to indicate how cost will be estimated, budgeted, managed, monitored and controlled. Here all the possible cost involved in a project including materials, resources, tools and equipment are included. There are four processes included in this knowledge area; these are Resource Planning, Cost Estimating, Cost Budgeting, and Cost Control.
- 5. Project Quality Management:** This knowledge area of project management is aimed towards achieving consistency across the project. What we need to remember here is that in case of project management, quality is not all about perfection but also about utilization of resources and achievement of scope of the project within the required budget and time and hence it is not advisable to look for perfections. The project quality management knowledge area assures that the project meets the requirements that the project was undertaken to produce. The processes included in the

area are meant for monitoring the project and measuring overall performance to compare them with the planned standard set out at the beginning of the project.

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- 6. Project Human Resource Management:** The human aspect of project management falls in the knowledge area. This knowledge area includes assessment of all aspects of people management and personal interaction. Features like coaching, leading, dealing with conflict, etc. and other stakeholders. Each of these participants requires a use of different leadership skills, communication styles and team-building skills. A good project manager is one who knows what skill and style is going to work with whom.
- 7. Project Communications Management:** There is a very fine line between over communication and under communication and this knowledge area is meant for managing it. A good communication management is needed to identify who needs what kind of information. Various processes involved in this area are Communications Planning, Information Distribution, Performance Reporting, and Administrative Closure. These processes are meant to ensure that all information related to project including project plans, meeting notes, and risk assessments, are collected and documented for future reference. It also guarantees that appropriate information is circulated and shared with stakeholders.
- 8. Project Risk Management:** There is no project that goes without any hitch and if one assumes so, then it is very unrealistic. This knowledge management area concerns with identifying and planning for potential risks that may impact the project. This helps in identifying all the risks and preparing a possible action plans to manage the risk as and when it arises. The various processes concerned with this area includes Risk Management Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, Risk Response Planning, and Risk Monitoring and Control.
- 9. Project Procurement Management:** Not all the teams and resources required for the completion of the project are available in hours. In such cases, the project manager has to hire certain contractor or vendor to complete the task. This knowledge area helps in providing a blueprint for the activities or task that is required to be outsources. It includes the processes involved with goods procurement or services delivery vendors, contractors and suppliers. The various processes involved in the Project Procurement Management knowledge includes, Procurement Planning, Solicitation Planning, Solicitation, Source Selection, Contract Administration, and Contract Closeout.
- 10. Project Stakeholders Management:** The ultimate success or failure of the project depends upon the delivery of the project to the stakeholders. The stakeholders can be people, groups and organizations who are going to be affected by the delivery of the project. It not only

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include the requester but also includes, the team members, the contractors, the customers, the suppliers, the public and many other internal and external stakeholders. It all starts with the identification of the right stakeholder and classifying them into external and internal stakeholders. The stakeholder management is carried out at each stage of the project; at the planning phase, it includes planning about the roles and rights of the stakeholders where as in the execution phase, it involves management of the engagement of stakeholders. In case any issue arises in the project, the same is managed with appropriate communication. Managing and Controlling phase includes management of the engagement before the project is sign off. This is done to ensure smooth transaction of the project.

Check Your Progress

4. What are the ten knowledge areas in project management?
5. Define Project Integration Management.

1.4 THE PROJECT MANAGER (PM)

Organizations face different challenges while managing a project due to various reasons such as lack of management skills and disputes among the team members. Following are the different challenges in project management:

- **Unrealistic deadlines:** The biggest challenge project managers face is to complete the project on time and meet project deadlines. This challenge can be overcome by proper planning of the project activities along with developing the communication among team members.
- **Communication deficit:** In most organizations, project managers and team members do not give adequate information to the customers. The deficiency of communication occurs when there is a lack of communication network and infrastructure in the organization. This challenge can be overcome by developing proper communication flow between the project managers and team members.
- **Resource competition:** There is a lot of competition in resources required for projects due to availability of the resources such as manpower and material in the organization. It is difficult to select a particular project from various projects for utilizing these resources.
- **Undefined vision and goals:** Sometimes, the goals of a project are not clearly defined. Therefore, communicating these project goals to the team members becomes a difficult task. This challenge can be overcome by discussing the queries of the team members of the project. The documents of the project should be prepared with specific goals and objectives.

- **Failure to manage risk:** Risk is involved in each and every project. The plans of various projects have a list of risk but no further analysis is done which affects the project badly. If the risks involved in the project are determined, then the team members should take proactive measures to avoid these risks.
- **Insufficient team skills:** The biggest challenge in managing a project is insufficient skills of team members. The main reason can be the inadequate training. This challenge can be overcome by guiding the team in an appropriate manner such as providing good training, additional resources and external advisors.

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Role of Project Managers

Project manager is the individual who manages the project effectively and efficiently. In every organization, it is the duty or responsibility of the project manager to manage the projects. There are four types of project managers:

- **Project expeditors:** These are individuals who speed up work and achieve coherence of communications. They are not really managers but serve as translators of technical concepts into business concepts of costs, schedules and markets. As their role is limited to providing information to the executives and making suggestions, the expeditor's role is restricted to smaller projects with less risks and lower stakes.
- **Project coordinators:** They act as staff leaders and achieve unity of control over project activities. Typically, coordinators would have the authority and control over project matters and disbursement of funds from the budget but still have no actual line authority over the workers. The authority is derived primarily through the association of the coordinators with the upper-level executives.
- **Matrix managers:** They perform the full range of management functions. They perform the same function as the first two types of project managers, that is, the project expeditors and the coordinators but have the authority to plan, motivate, direct and control the project work. These managers work in matrix organizations which are characterized by criss-cross reporting relationships. In other words, the people that the matrix managers direct are located administratively in other functional departments.
- **Pure project managers:** They direct the people who report directly to them. They achieve unity of command and are primarily integrators and generalists rather than technical specialists. They maintain a balance between technical factors with schedules, costs, resources and human factors. The pure project manager deals with top management, functional managers, vendors, customers and sub-contractors of the project. For example, in a large construction project, a pure project manager may be hired by the developer and delegated the power to take major decisions such as tendering and contracting for architectural, structural and building services.

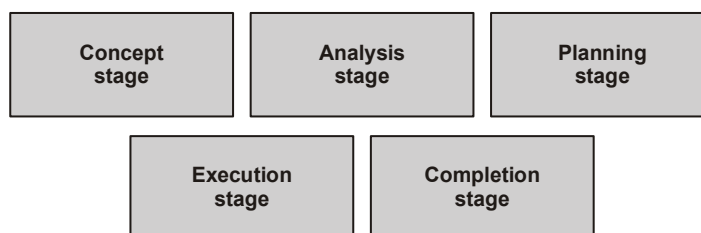
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Check Your Progress

6. What are the four main types of project managers?
7. What are the main functions of project coordinators?

1.5 PROJECT LIFE CYCLE AND ITS PHASES

All projects have their lifecycle which can be viewed at five stages:



There are several activities at each stage of the project lifecycle. These stages of project lifecycle are depicted in Figure 1.1, and stage-wise activities are listed in Table 1.1.

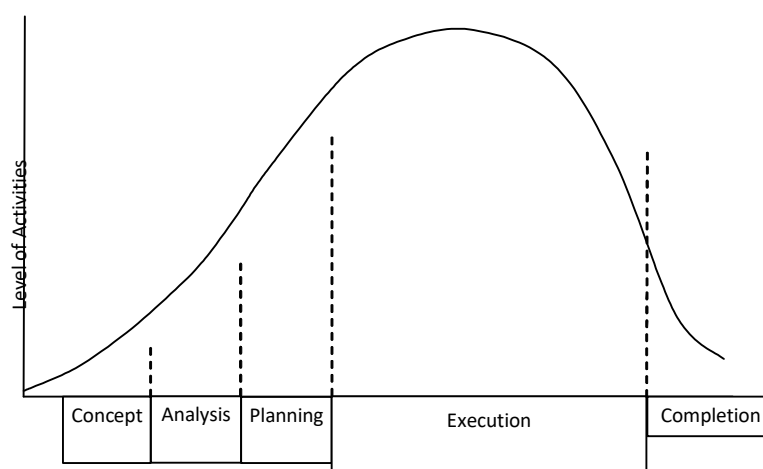


Fig. 1.1 Stages of a Project Lifecycle

Table 1.1 Stages in project Lifecycle and Activities at Each Stage

Concept Stage	Analysis Stage	Planning Stage	Execution Stage	Completion Stage
Idea generation Screening of idea	Market analysis Technical analysis Financial analysis Risk analysis Social cost-benefit analysis	Capital budget allocation Resource planning Contracting Preparation of DPR	Constructing work-packages Action and coordination Monitoring and control	Project transfer Project completion report Post completion audit

1.5.1 Concept Stage

The first stage in project management is the concept stage, which includes two activities: (i) idea generation and (ii) screening of project ideas.

(i) Idea generation

Firms do not *conceive ideas*; individuals in the firms do. However, a proactive firm would provide a system and environment that would allow and encourage creativity and in return, get ideas that are more useful from employees at all levels. Several elements can be built into the organizational system for encouraging idea generation. A proactive organization builds a strong system for idea generation. An example is given in Table 1.2.

Table 1.2 *Systems for Idea Generation*

Formal system →	A management committee Planning department or group Strategy group Periodic strategic planning exercise Management audit (also cost audit and functional audit) Periodic consulting by external expert Target costing mechanism Slack management system
Semi-formal system →	Suggestion box system and committees Innovation committees Joint departmental committees Quality circles Dialogue session and open house Value engineering groups Task forces and individual reports/Proposals
Informal system →	Individual experiments Individuals encouraged to work as task-force

Formal and semi-formal systems would work better if a very clearly shared vision is evolved and if a strategic planning process is in place to provide trickledown effect of strategic plans in the entire organization. In an informal system, individuals are empowered to think and act creatively: for example, in 3-M company, Post-IT product is the result of a failed experiment on a batch of adhesive material, followed by a creative search for a potential application of a special property (that it sticks but can be removed without stain and can be re-stuck) that was observed in the spoilt batch.

Creative thinking is encouraged, motivated, and more importantly, guided by the well-designed strategic planning process. Strategic investment decisions like growth direction, growth rate and growth strategies would offer a broader theme about what is an acceptable and what is not an acceptable investment proposal. The ideas of investment proposals that fit the theme of strategies of business must be generated in the organization.

(ii) Screening of project ideas

Once the idea is presented, it must go through several stages of screening. An idea that is very risky and novel would typically go through the following steps:

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Initial brainstorming

Concept testing

First feasibility report

Market survey

Test marketing or pilot project

Market research

Usually, the department or group that represents the idea will undertake the initial brainstorming on the project idea. The initial brainstorming would largely centre around two things, (a) whether the idea is judgmentally viable and (b) if yes, whether it fits into the strategic thrust of the business. If the idea does not fit in the strategic thrust of the business, but it is extremely good in initial judgment then at some level brainstorming is done to explore the need for changing the strategy itself.

Projects can be classified in several ways but for this purpose, let us classify based on logic versus intuition. Logic means data or information and intuition means judgment or sixth sense. The logic versus intuition is depicted in the decision-grid given in Figure 1.2.

Projects that are high on intuition but low on logic (information), like project A, need to go through a detailed scrutiny because hardly any information is available, for example, launching a new product line or opening up a store in international markets. On the other side, fixture replacement is like project C on the decision grid in which case, the firm has a lot of information and does not have to rely on intuition for decision-making.

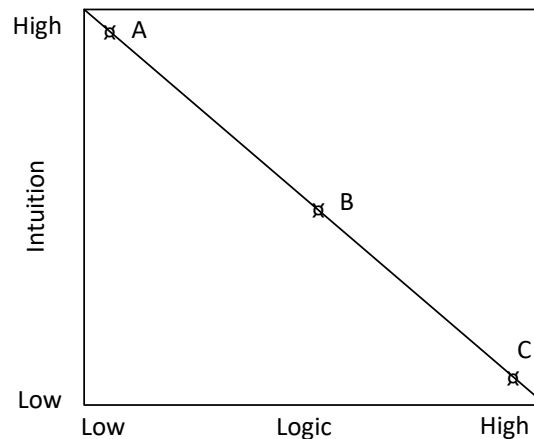


Fig. 1.2 A Decision Grid

Concept testing may be advisable if the concept of the project is new. Concept testing is a market survey aimed at testing the idea on the prospective consumer groups to judge their responses. If the results of concept testing are encouraging, the subsequent stages are considered otherwise further expenses are saved.

The feasibility report is very rudimentary, like back-of-the-envelope calculation. It is based on secondary data and focused on market feasibility more than technical feasibility. After the initial estimate of market potential, a cursory check is done for availability of commercially exploitable technology. The cost of project is estimated using some thumb-rules at this stage of the feasibility report. The market feasibility is checked at this stage by receiving the input of demand and supply from the results of the concept testing or from the secondary sources. The focus of the market feasibility is on the evaluation of demand-supply gap and not so much on the study of marketing variables that determine demand. Similarly, though the financial implications are roughly estimated, the financing arrangements are not planned at this stage.

The market survey may be required in some cases even though feasibility report indicated the viability of the project proposal. The market survey will focus on ascertaining the expected demand for the product/service that the company will sell, if the project proposal is accepted. It may also encompass the study of factors, which may possibly influence the consumer behaviour. The stage of market survey will improve the firm's knowledge about the demand of its prospective product and the influencing factors.

Test marketing and a pilot project may be required in some cases, especially if the proposals are new in concept. The respondents' responses in the concept testing stage are hardly based on experience if the project concept is new. Therefore, even if the results of the concept testing may be encouraging, it may not provide enough confidence to go ahead with the commercial scale operations. As some pilot work is done in that case at the minimum investment; merchandise is produced and tested on the select group of consumers, and subsequently the experience-based responses are collected. The consumer response may be different after actually consuming pre-packed cold coffee than what it was at the concept testing stage. The idea may still be carried forward only if the results of test marketing indicated the viability of the project proposal.

A market research may be required in some cases with the main purpose of studying risk and critical success factors. The focus of market research will be absolutely sharp on the selected variables identified as potential sources of risk. Enhanced knowledge of risk-causing variables offers obvious advantage. The results of market research would also help in fine-tuning the cost-benefit estimates. The viability check is conducted once again on the improved data. In a way this stage overlaps with the next one.

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1.5.2 Analysis Stage

After a project proposal is conceptually cleared, it enters into the analysis stage. Several types of analyses are done with two-fold objectives. One objective is the risk assessment via improving the information base so that one has to rely less on intuition. The other objective is to generate information so that one can do cost-benefit analysis.

The benefits from the retail project must outweigh the cost of the project. Costs and benefits are studied at various stages of capital budgeting process. When the initial feasibility report is prepared, the costs and benefits are at the best guesstimates based upon own experience or others' experiences or thumb rules. At the time of preparation of a detailed project report, all costs and benefits are retail projected based on studied assumptions. Whether guesstimates or educated estimates, the cost-benefit analysis involves three primary areas of analyses, namely market analysis, technical analysis and financial analysis; and additionally the risk analysis and social cost benefit analysis.

(i) Market demand and situation analysis

Market analysis is the heart of cost-benefit analysis. If there is no market for goods and services produced, then it makes no business sense to invest money. Usually, for existing products and services, one would estimate demand over the time to come and compare it with potential supply. If a positive gap exists, the chances that the project will succeed are more. Depending upon a firm's ability to cope with globalization, one has to decide whether to consider domestic as well international demand and supply or not. A firm that cannot operate globally should consider international supply but domestic demand. A firm that can operate globally must consider total world demand and global supply including domestic supply in target economies.

Some projects aim to offer goods or services for which currently there is no demand. Such projects require full support from the firm producing such goods in order to create awareness and demand. In case of services, a firm must ascertain the gap in the market for such services and ensure the right target segment for their business. These are risky projects.

(ii) Technical analysis

Technical analysis of a project idea is more related to essential requirements of the project. The viability with respect to location, size of the store, processes, equipment and IT infrastructure and product mix are ensured. These aspects are extremely crucial for the success of any business, and also have huge impact on investments of the project. Technical analysis becomes very important process as it serves as a base for calculation of cost-benefit analysis along with market analysis.

(iii) Financial analysis

Good market demand and suitability of technology and processes may not be worth it if one cannot make money. Financial analysis involves detailed calculations to verify financial outcomes of the project. Financial analysis accepts marketing and technical assumptions developed during market analysis and technical analysis and goes further into estimating investment requirements, financing plan, working capital plans and cost estimates for the operations. These financial estimates are, then used for calculating project cash flow and cost of capital before the financial viability is determined using one or more evaluation techniques. A financial analysis will check whether various financial milestones could be achieved from the project. These milestones are defined in terms of payback period, accounting rate of return, net present value or internal rate of return and in terms of average interest cover ratio and average debt service coverage ratio, etc.

(iv) Risk analysis

Often, estimates do not come true and financial goals are not achieved. That is because future is uncertain and risky. A firm must study the risk associated with the project and its impact on the firm as a whole. Thus, risk analysis has two aspects; one project risk; and two-portfolio risk or firm risk.

(v) Analysis of project risk

A business must take 'calculated risk'; means a business must determine the amount of risk it can take, identify the risk associated with the project, measure it and mitigate it as far as possible. Sensitivity analysis is used for identifying the important sources of risk so that those sources can be studied further to reduce the elements of 'unknown', then project should be designed appropriately so that project risk is minimized to the extent it is acceptable to the firm. Risk profile of a project can also be studied through simulation and in some cases even decision tree approach has to be employed for taking risk-based decision.

(vi) Firm risk and market risk

At times, a risky project (after project risk is mitigated) may be better than a less risky project. That is because the impact of project risk on the firm depends on the correlation between the existing risk-profile of the firm and the new project risk. If the current firm is risky and if the new project is also risky but the correlation between the firm's cash flow and project cash flow is negative (or in some cases even small positive), the firm can have 'diversification' advantage and aggregate risk (portfolio risk), after the new project is accepted, may reduce.

Firm risk has a direct bearing on its value (share price). For a given profitability, a low risk firm will have a higher value (and less volatile share prices) as compared to the high-risk firm. A low risk firm is able to raise funds from the market at a lower cost, which reduces cost of capital and enhances the net present

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value of the project and the firm. Thus, risk analysis and risk management are very important aspects of capital expenditure planning or project management.

1.5.3 Planning Stage

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The projects which are successful at all the stages of analysis are found ‘acceptable’ from financial and strategic perspectives. But, at any given time there could be several projects laying their claim on the limited funds. Therefore, in the planning stage, first the project must win budgetary allocation, before any resource planning, contract negotiation and the preparation of a detailed project report are done in the planning stage of the project lifecycle.

(i) Capital rationing (multiple projects and constraints)

A project that is likely to generate acceptable financial results and has a risk within the acceptable limit cannot always be accepted. At any point of time, a firm would have several projects competing for limited funds. Some projects may be urgent (sometimes like maintenance projects), some projects may be pet projects of the senior management, some may be strategically important and some other may generate excellent financial returns. In the light of limited funds, (because of either externally imposed limit or internally imposed limit) a decision maker has to selectively allocate funds and optimise attainment of varying (and conflicting) goals. A set of projects, from among all acceptable ones, that can collectively establish a balance among all the needs within the available capital is the best set at a given point of time.

Once capital allocation signal is given, a firm has to get ready to undertake the project. Getting ready for the project would include resource planning, contracting and network analysis, all finally documented in a detailed project report, which becomes a blueprint for the execution of the project.

(ii) Resource planning

A project requires numerous resources in terms of materials to offer, setup, and manpower. Many of these resources are bought and many are hired, and some are reallocated from the routine sites. Right source, right price and right timing of resource acquisitions are critical in the successful completion of a project. A detailed resource acquisition and mobilisation plan would allow the flow of work progress smoothly without distracting the attention of project team on non-technical parameters.

(iii) Contracting

A project is a congregation of several interdependent activities and work-structure, many of which a firm cannot build on its own and may need an external expertise. Such work-packages are contracted out retaining the rest. A project manager will deal with number of contractors for jobs and labour. A strong coordination among them is very important. Despite good intentions, sometimes due to their own priorities

and problems the contractors may fail to deliver the right quality job in the right time, which may delay the project and make it inefficient. A clearly written contract, excellent report and coordination with all contractors, and if needed, ability and willingness to hard decisions are essential parts of project management.

(iv) A detailed project report (network techniques for project management)

A detailed project report (DPR) is prepared at this stage. A detailed project report is a blueprint of the implementation plan. The exact resources are listed, the sources are identified, technical specifications are detailed, costs are estimated after obtaining quotations, sequencing of activities is planned, calendar of activities is prepared with the start and the end dates, time-wise needs of funds are estimated and so on.

Several network techniques are deployed for depicting the sequencing of activities; for identifying the critical path, for the preparation of the calendar of resource acquisition and allocation along with costs.

1.5.4 Execution Stage

During the planning stage subcontracts are given, teams and sub-teams are formed, team leaders are appointed, coordination is established, documentations are designed and reporting system is developed. Now it is the time to execute the projects. Project execution is a very active stage in project management. It involves activities like actual construction of work-packages, action and coordination and monitoring and control.

(i) Constructing work-packages

A project team begin constructing different work-packages (activities) in the order as per the network plan prepared in the detailed project report. Each sub-team of the project, with different expertise, is heavily engaged in different activities. These activities are visible, and create enthusiasm and excitement, which may sometimes take the eyes off from the scope of the project.

(ii) Action and coordination

At any given point of time, several sub-teams are on the job. Progress on their work together with resources consumed and needed have bearing on what other sub-teams are doing and would do in the future. Someone has to provide a strong leadership for the effective coordination among all sub-teams and sub-contractors, and also coordination for resource allocation on various sub-teams.

(iii) Monitoring and control

Troubleshooting becomes a daily event, review of several configurations and activities takes place, need for design change is felt and it goes on. During implementation, there is always a very high chance that the project may go in the wrong trajectory due to the involvement of several people, difficulty in coordination,

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lost focus and several such reasons and the project may get delayed. Project control mechanism is extremely important. A good project control mechanism would efficiently balance the cost, time and performance aspects; where performance aspects cover quantitative as well as qualitative targets.

1.5.5 Completion Stage

At the end of the project execution stage the last work-package is constructed and the project is up and ready for running. That does not mean the project is completed and the task of project management is over. The constructed/executed project must be transferred to the operating team, and the learning exercises must begin. A study and preparation of a project completion report and where needed conducting the post completion audit are the two learning activities in the completion stage of the project lifecycle.

(i) Project transfer

Project implementation ends with handing over of the completed project to the operations team. For example, after implementation and test run of new billing software, the project team exits and the operation team takes over at the project site. After the physical activity of the project ends, the project team oversees the operating team running the project. In the beginning of operations, there may be numerous unexpected troubles and the project team handles the troubleshooting activities. Once the routine operations are trouble-free, the retail project is transferred completely over to the operating team, who will then operate the retail project independently.

(ii) Project completion report (project review)

A project review is undertaken at the end of execution. The review generates a Project Completion Report (PCR). PCR is a report on the qualitative and quantitative aspects of project planning and execution. A project completion report is essentially a comparison between the DPR and the actual data of project execution. The budgeted costs, time and performance are compared with the actual and deviations are studied. At this stage, even the initial assumptions, policies and processes are questioned. PCR offers useful learning about the mistakes, if any, in project planning and implementation.

(iii) Post-Completion Audit (PCA)

Many project management activities end with the preparation of the project completion report. Some projects need a Post-Completion Audit (PCA) also. PCA is useful especially in case of multi-phased projects and where a project is undertaken in anticipation of demand. PCA is an exercise for systematic learning from mistakes. It is conducted with the objective of avoiding mistakes in the future and for redesigning the subsequent phases of the projects in the light of experiences.

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Timing of post-completion audit is important. It is desirable to conduct the post-completion audit only after the expected benefits of the project start accruing. This occurs only after the project is commissioned; it operates full-fledged and attains a significant milestone in generating benefits. E.g. a firm decides to open up thirty retail outlets in all metro and mega cities over the period of two years. However, the firm first plan to take up the most familiar territory where the probability of success are higher according to research and experience and considers the performance of one or few such stores before planning and execution of more outlets in other cities after necessary modifications. In the PCA, several questions are asked regarding the assumptions of the project covering all stages starting from conceiving the idea to Project Completion Report (PCR) and studying the reasons for the actual benefits being different from projected benefits.

Check Your Progress

8. Mention the two activities that are included in the concept stage of the project management process.
9. What is a Project Completion Report?

1.6 PROJECT MANAGEMENT PROCESSES

Projects have always been very important and critical for any organization and every project, whether it's launching an app, constructing a building or rolling out a marketing campaign, requires a chain of activities to bring it to the desired state. The various stages and phases in the project lifecycle includes:

- Project Initiation
- Project Planning
- Project Execution
- Monitor and Control
- Closeout and Evaluation



Fig. 1.3 Phases of Project Life Cycle

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1. Project Initiation

Project initiation is the first point of any project. In this process, all the activities related to winning a project takes place. During this phase, the project is conceptualized and feasibility is determined. This is the start of the project, and the goal of this phase is to define the project at a broad level. Various activities involved in the initiation phase includes defining of project goals and scope, identification of the key stakeholders and the project manager, identifying the risk associated with the project, etc.

Some of the activities that should be performed during this process include defining the project goal, defining the project scope, identifying the project manager and the key stakeholders, identifying potential risks, and producing an estimated budget and timeline.

2. Project Planning

The next phase of project management is Project planning. This phase is the key to successful project management and focuses on developing a roadmap that everyone will follow. If this step gets wrong, the entire project may go wrong and hence one has to be very careful. This requires an integrated planning, where the project scope, requirements and schedules are elaborated and cost, time estimations and budgets are prepared.

The project planning phase began with setting goals. Two popular methods of setting goals are CLEAR and S.M.A.R.T

C.L.E.A.R. Goals – The CLEAR Goal setting method stands for Collaborative, Limited, Emotional, Achievable and Refinable. This method takes into consideration the environment of modern fast paced business.

- Collaborative – The goal should be such that it should motivate employees to work together.
- Limited – The goal should be such that it should be limited in time and scope and to keep it manageable.
- Emotional – The goals should be such that it should get into the blood of the employees and they should feel emotionally connected with it. This helps in improving the quality of work.
- Achievable – The larger goals should be broken into smaller goals. This helps in achieving the goal quickly.
- Refinable – The goal should be such that if new situation arise, it should be refinable.

S.M.A.R.T. Goals – Another method to set the goal is SMART i.e. Specific, Measurable, Attainable, Realistic and Timely. This method of goal setting helps in

ensuring that the goals have been meticulously vetted. This also helps in providing a way to clearly comprehend the impact of the goal-setting process.

- **Specific** – Each goal set should be very specific. There should be no ambiguity.
- **Measurable** – There should be clearly defined criterion to measure the success of the goal.
- **Attainable** – It is important to identify the most important goals and the ways to achieve the same.
- **Realistic** – The goal set should be realistic.
- **Timely** – With each goal, the timeframe to achieve should also be defined.

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3. Project Execution

Once all the planning is done, the next step is to execute the project to achieve project's objectives. During the execution phase, each member of the team carried out their assigned task so that the activities can be completed within time. The project's progress is tracked through a details project schedule. Following are the activities that are included in this phase:

- **Executing the Plan:** The plan execution activities includes, following the plan as created and then assigning the same to various team members. Later on the same is monitored for tracking the project's progress.
- **Administrate:** Many reporting activities are carried out at the time of project execution. Daily status report of the project is required by the senior management; at the same time client may also require the progress report.

4. Monitor and Control

Once the project is executed, the next stage is monitoring and control. This is done to ensure that the project plan is being actualized. The aim is to compare the ground work with the planned work and to ensure that the project plans, quality and communication plans are followed. This also ensures that the initial protocols of the projects are followed. If, while monitoring and control, the project manager feels that there is a need to adjust schedules and resources, the same can be carried out to keep project on track. Following are the indicators used for monitoring and control:

- **Project Objectives:** This type of tracking helps in identifying whether or not the project is able to meet the objectives.
- **Effort and Cost Tracking:** This measures whether the project is in the budget and on schedule or not. This type of tracking helps in identifying whether the project will meet its completion date or not.
- **Quality Deliverables:** This measure helps in identifying whether the specific tasks are delivered as per required quality or not.

- **Project Performance:** This indicator helps in monitoring changes in the project. The same is achieved by analyzing the nature of issues and how quickly the same were resolved.

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5. Closeout and Evaluation

This is the last phase of the project and represents the completed project. If the project outcomes are at par with the acceptance criteria defined by the client, the same will be duly accepted and the payment is being made. This happens when the project is able to deliver all the client's requirements. The project is finally handed over to the client; it includes the activities of scope evaluation and administration.

- **Scope:** The project team must ensure that the project deliverables have been completed as planned.
- **Administration:** In the final stage, the project team must close out all outstanding contracts and administrative matters and same should be reflected in the handing over. Also, all the required paperwork should be completed and the same should be disseminated to appropriate parties.

Once the project closeout takes place, it is time to evaluate the entire project. In this the team should evaluate the mistakes if any made by the project team so that the same can be avoided in future projects.

1.7 IMPACT OF DELAYS IN PROJECT COMPLETIONS

Project delays can plague any industry, any team and any individual project. Delay and cost overrun are intrinsic part of most projects in spite of the much acquired knowledge in project management. Although some may argue that this is negligible. A project delay can represent a costly occurrence for any organization especially in the present age of cut throat competition and diminishing margins. Therefore, it is important for an organization to understand what causes a delay and how to prevent it from occurring. The major causes of project delay are as follows:

- Design errors
- Subcontractor Delays
- Scope change
- Shipping and Supply Delays
- Inappropriate and inadequate procurement
- Climate Delays
- Complexity of project
- Client-End Delays
- Post execution phase Delay

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Design errors: In many projects, the design error is one of the major reason for cost overrun. A design with errors practically means insufficient or wrong depiction of project deliverables. This will lead to incorrect application of techniques in achieving result. When these errors are visible in the project, a lot of time and resources will be used in rectifying the errors and will eventually lead to delay. Proper representation of client's requirement and the blue print to achieving good technical input is an important factor for the success of the project.

Subcontractor Delays: In case a company is dependent on contractual work for certain part of the project, delays may occur. This is more prevalent in projects where the dependency is for skilled labor. It is difficult to anticipate these situations and the only way to overcome them is to wait for them to get over. One of the common cause of subcontractor delays is handling of too many projects by the subcontractor.

Scope change: Scope change could be another reason for delay and cost overrun in project. It is scope that defines the entire deliverables that is expected at the end of a project. Hence a change in it may lead to change in entire project plan and deliverables and eventually delay. Project scope change could be a result of wrong initial scope definition, inherent risk and uncertainties, sudden change of interest, project funding change, etc.

Shipping and Supply Delays: Any delay resulting from supply, shipping or other acquisitions associated with required materials can also derail a project from its planned completion date. In certain cases, the business may have the option to switch to a different supplier and avoid the delay; however, in other cases, the only option is to wait for the supply to arrive.

Inappropriate and inadequate procurement: Inappropriate and inadequate procurement and faulty contractual management system could be another reason for cost overrun and delay in project. The contracts should read out every possible aspect of a business correlation, including service levels, payment terms and pricing. Thus a contract that has incomplete project scenario may lead to dispute. For example, ambiguous contractual agreement with unclear clauses can be of potential dispute thus generating delay and cost overrun in project.

Climate Delays: The project can also get delayed due to climatic factors, weather disruptions or natural disasters. Also, there could be a change in the business environment due to change in government policies or political alliance or any other international factor; all these factors can lead to delay. For example, a company could start a project under a particular investment scheme and due to some change in the political climate that scheme may be no more available or may be temporary suspended.

Complexity of project: The complexity of project could be another reason contributing to hindrance and cost overrun. Complexity of the project could be defined in terms of nature and size of the project; most mega projects tend to have

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relatively long implementation period when compared to small projects. Project having longer implementation periods could be affected by inflation, change in material price and changes in exchange rates. In such cases, the initial budget may need to be supplemented for the project to be completed. The result could be cost overrun and long chains of negotiation which will lead to delay.

Client-End Delays: Client's dissatisfaction or frequent changes in the project scope by the client can also lead to project delays. This is one of the most common types of delay found across projects. It is common for the client to request alterations as the work progress; the only way to avoid this delay is to have a clear and specific contract before the project begins.

Post execution phase Delay: Being the very last part of the project life-cycle it is often been ignored even by organizations, especially in multi-project environments. However, there are multiple factors that could lead to delay at this stage. The reason for slow closeout includes but not limited to contracts and procurement, unresolved disputes linked with client acceptance, poor documentation, poor close out, slow client acceptance. Delay and cost overrun of slow closeout can be avoided when the project closure phase is implemented as planned.

Check Your Progress

10. What are the two popular methods for setting goals of a project?
11. State two causes for delay in projects.

1.8 ESSENTIALS OF PROJECT MANAGEMENT PHILOSOPHY

In order to reduce the cost of constructing a project, organizations should consider various factors such as cost and time for the successful competition among projects. Following are the prerequisites for a successful project management:

- **Adequate project formulation:** Project formulation is the process of converting project ideas into project proposals in a structured manner. Generally, project formulation suffers from the following shortcomings:
 - o Use of informal methods for estimating the costs and benefits, such as maintaining paper records instead of using computers
 - o Deliberate overestimation of benefits and underestimation of cost of constructing a project
 - o Faulty judgements due to lack of experienced managers and employees

It is essential for an organization to avoid these shortcomings in order to have adequate and meaningful project formulation.

- **Project organization:** A sound organization possesses the following characteristics:
 - o Proper working environment for employees
 - o Well-defined working methods and systems
 - o Proper rewards and penalties to employees for their performances and faults
- **Implementation planning:** After taking investment-related decisions, it is necessary for an organization to do proper implementation planning before commencing the actual implementation. Proper implementation planning includes the following steps:
 - o Developing a plan for various activities such as land acquisition, tender evaluation, recruitment of the staff, construction of buildings and creation of an industrial plant
 - o Estimation of the resource requirements such as manpower, materials and money in project
- **Availability of funds on time:** It is important to have funds on time for taking advanced actions in the project activities. Timely availability of funds facilitates the organization to negotiate the cost of the project with suppliers and contractors.
- **Effective monitoring:** In order to have a successful management of the project, a project monitoring system must be established in the organization. This is because effective monitoring helps in analysing the emerging problems and taking corrective actions for the project activities. Following are the factors that should be kept in mind while developing an effective system of monitoring:
 - o It should emphasize on the critical aspects such as the finance of the project management.
 - o It should be simple and not overcomplicated as it may result in a lot of documentation and wastage of resources.

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1.8.1 Project Management Principles

Successful project management can be achieved by proper application of principles instead of implementing different kinds of techniques. Following are the seven principles of project management:

- To identify the project type that is suitable for the business. One needs to select the projects that are good for business.
- To understand the needs and expectations of the customers.
- To prepare the reasonable plans which defines the scope, cost and approach of the project. This helps in reducing unplanned areas in the project.

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- To establish a good team with a good leader. This principle conveys that there should be proper working environment and communication flow between the project managers and team members.
- To define the status of the project. This helps improving the project quality and recognizing the various problems in it.
- To make a proper assumption for the project. This principle focuses on the verification of the critical items used in the project in order to reduce the risk.
- To take proactive actions in the problems of the project. This is because the problem usually gets worse over time which in turn increases the chances of risk.

Check Your Progress

12. Mention two shortcomings of project formulations.
13. What are the characteristics of a sound organization?

1.9 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Project management is the art of directing and coordinating the human and material resources throughout the project by using modern management techniques.
2. Project management requires attention for goal-oriented systems, the environment, sub-systems and their relationships. This is what makes project management 'a systems approach' to management.
3. Many organizations fail to manage their projects properly due to the following reasons:
 - Project is completed late or without fulfilling the demands of the client.
 - Project is not giving any valuable information
4. The ten Knowledge Areas that have been defined in project management are Project Integration Management, Project Scope Management, Project Schedule Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management, and Project Stakeholders Management.
5. Project Integration Management is defined as 'the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the project management process groups'.

6. The four types of project managers are project expeditors, project coordinators, matrix managers and pure project managers.
7. Project coordinators act as staff leaders and achieve unity of control over project activities. Typically, coordinators would have the authority over project matters and disbursement of funds from the budget but still have no actual line authority over the workers.
8. The first stage in project management is the concept stage, which includes two activities: idea generation and screening of project ideas.
9. Project Completion Report is a report on the qualitative and quantitative aspects of project planning and execution.
10. Two of the more popular methods for setting goals are S.M.A.R.T. and C.L.E.A.R.
11. Two causes of project delay are as follows:
 - Design errors
 - Subcontractor Delays
12. Project formulation suffers from shortcomings two of them are as follows:
 - Use of informal methods for estimating the cost and benefits, such as maintaining paper records instead of using computers
 - Deliberate overestimation of benefits and underestimation of cost of constructing a product
13. A sound organization possesses the following characteristics:
 - Proper working environment for employees
 - Well-defined working methods and systems
 - Proper rewards and penalties to employees for their performances and faults

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1.10 SUMMARY

- Project management is the art of directing and coordinating the human and material resources throughout the project by using modern management techniques. The main purpose of project management is to achieve the predetermined objectives of scope, cost, time, quality and the satisfaction of the participant.
- Project management includes developing and implementing a plan for the project while considering the available resources such as manpower, material and cost in the organization.
- Organizations have to manage their projects effectively in order to create and maintain their reputation in the market. A good project management

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offers various techniques and guidelines to manage employees and workloads.

- Project management saves costs, improves working conditions, improves financial management, resolves problems, determines risk and improves product quality. Project Management rules are governed by Project Management Body of Knowledge called PMBOK. According to it, there are ten knowledge areas. Project management knowledge areas coincide with the process groups, which are project initiation, project planning, project execution, monitoring and controlling, and project closing.
- The ten Knowledge Areas that have been defined in project management are Project Integration Management, Project Scope Management, Project Schedule Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management, and Project Stakeholders Management.
- Organizations face various challenges while managing a project. Some of these challenges are unrealistic deadlines, communication deficit, resource competition, undefined vision and goals, inability to manage risk, insufficient team skills, etc.
- The four types of project managers are project expeditors, project coordinators, matrix managers and pure project managers.
- All projects have their lifecycle which can be viewed at five stages:
 - o Concept stage
 - o Analysis stage
 - o Planning stage
 - o Execution stage
 - o Completion stage
- The first stage in project management is the concept stage, which includes two activities: idea generation and screening of project ideas.
- Firms do not generate ideas, individuals in the firms do. However, a proactive organization builds a strong system for idea generation.
- Once an idea is presented, it must go through several stages of screening. An idea that is very risky and novel would typically go through the following steps:
 - o Initial brainstorming
 - o Concept testing
 - o First Feasibility Report

- o Market Survey
- o Test Marketing or pilot project
- o Market research
- After a project proposal is conceptually cleared, it enters into the analysis stage. Several types of analyses are done with two-fold objectives. One objective is the risk assessment via improving the information base so that one has to rely less on intuition. The other objective is to generate information so that one can do cost-benefit analysis.
- The cost-benefit analysis involves three primary areas of analysis, namely market analysis, technical analysis and financial analysis; and additionally the risk analysis and the social cost benefit analysis.
- The projects which are successful at all the stages of analysis are found 'acceptable' from financial and strategic perspectives. But, at any given time there could be several projects laying their claim on the limited funds. Therefore, in planning the first stage, first the project must win budgetary allocation, before any resource planning, contract negotiation and the preparation of a detailed project report are done in the planning stage of the project lifecycle.
- During the planning stage, subcontracts are given, team and sub-teams are formed, team leaders are appointed, coordination is established, documentations are designed and reporting system is developed. Project execution is a very active stage in project management. It involves activities like actual construction of work-packages, action and coordination and monitoring and control.
- At the end of the project execution stage, the last work-package is constructed and the project is up and ready for running. That does not mean the project is completed and the task of project management is over. The constructed/executed project must be transferred to the operating team and the learning exercises must begin. A study and preparation of a project completion report and where needed conducting the post completion audit are the two learning activities in the completion stage of the project lifecycle.
- The entire project life cycle is seen as consisting of number of phases or stages:
 - o Project Initiation
 - o Project Planning
 - o Project Execution
 - o Monitor and Control
 - o Closeout and Evaluation

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- The major causes of project delay are as follows:
 - o Design errors
 - o Subcontractor Delays
 - o Scope change
 - o Shipping and Supply Delays
 - o Inappropriate and inadequate procurement
 - o Climate Delays
 - o Complexity of project
 - o Client-End Delays
 - o Post execution phase Delay
- In order to reduce the cost of constructing a project, organizations should consider various factors such as cost and time for the successful competition among projects.
- Successful project management can be achieved by proper application of principles instead of implementing different kinds of techniques.

1.11 KEY WORDS

- **Project management:** It is the art of directing and coordinating the human and material resources throughout the project by using modern management techniques.
- **Concept testing:** It is a market survey aimed at testing the idea on the prospective consumer groups to judge their responses.
- **Globalization:** It is the process of interaction and integration among people, companies, and governments worldwide due to advances in transportation and communication technology.
- **Project completion report:** It is a report on the qualitative and quantitative aspects of project planning and execution.

1.12 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. State the benefits of project management.
2. Write a short note on the processes involved in Project Procurement Management.
3. What are the challenges in project management?
4. What are the seven principles of project management?

Long-Answer Questions

*Basics of Project
Management*

1. Discuss the organizational factors influencing the need for project management.
2. Examine the ten Knowledge Areas defined in project management.
3. Discuss the major causes for delay in project management.
4. Analyse the prerequisites for a successful project management.

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1.13 FURTHER READINGS

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- Kerzner, Harold, R. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.
- Singh, Narendra. 2000. *Project Management and Control*. Delhi: Himalaya Publishing House.
- Choudhury, Sadhan. 1988. *Project Management*. New Delhi: Tata McGraw-Hill.

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UNIT 2 PROJECT IDENTIFICATION AND SELECTION

Structure

- 2.0 Introduction
- 2.1 Objectives
- 2.2 Project Identification Process
- 2.3 Project Initiation
 - 2.3.1 Pre-Feasibility Study
- 2.4 Feasibility Studies
 - 2.4.1 Project Break-Even Point
- 2.5 Answers to Check Your Progress Questions
- 2.6 Summary
- 2.7 Key Words
- 2.8 Self Assessment Questions and Exercises
- 2.9 Further Readings

2.0 INTRODUCTION

The project identification process begins with the recognition of an opportunity. Project ideas can generate from various sources. These sources can range from an analysis of the performance of the existing industry to government guidelines and schemes. Once the projects are identified, the process of project initiation commences. At this stage, the proposed projects are evaluated and the aim of the project is defined. The feasibility of the project is also ascertained which involves an examination of market feasibility, technical feasibility and financial feasibility. This unit will discuss these three aspects of project feasibility in detail. Project break-even point will also be explained.

2.1 OBJECTIVES

After going through this unit, you will be able to:

- Discuss the project identification process
- Explain the purpose of project initiation and pre-feasibility studies
- Examine the three types of feasibility studies

2.2 PROJECT IDENTIFICATION PROCESS

The investment proposal, which originates from various departments, is the *opportunity*. Those who conceive the idea or sense the opportunity are likely to

see only a part of the whole investment requirement. There may be some technically or economically dependent investment requirements (opportunities) that the proposers may not visualize. For example, technological upgradation may require expensive retraining of employees, or may require a sequential change in upstream or downstream activities.

Opportunity is usually incomplete due to the economic dependence of one opportunity on the other. In addition, an alternative opportunity may serve an equal or better purpose. A firm should have a mechanism where (a) opportunities are received, (b) alternatives are searched, (c) economic dependence is studied and then (d) projects are formed before detailed cash flows are estimated. These four actions are the essential ingredients of efficient investment analysis.

Two opportunities are (said to be) economically dependent, if the adoption of one of the opportunities affects the profitability or the ability to adopt the other opportunity.

Economic dependence can be in four forms:

1. Positive synergy emanating from the acceptance of two or more opportunities.
2. Negative synergy, when more than one opportunity is simultaneously accepted.
3. Acceptance of one automatically results in rejection of the other, even if the other is profitable.
4. Stochastic dependence, where uncertainty is considered.

Only positive and negative synergy and mutually exclusive characteristics are considered for the efficient investment analysis at the initial stage.

Projects and Alternative Projects

The process of grouping opportunities is called formation of projects. A project is a set of one or more investment opportunities with the following characteristics:

- Each opportunity included in a project is independent of all other opportunities not included in that project
- Acceptance of any opportunity included in a project (an alternative) is conditional on the acceptance of the (alternative) project itself
- Every opportunity is included in some project

Economic dependence may be of two types in the context of time — (a) two or more opportunities are present at the same point of time and they are economically dependent on each other and (b) some future opportunity may be dependent on the present opportunity. A captive power plant and a steel plant fall in the first type of economic dependence; whereas in case of two alternative machines, one with a lifespan of five years and another of ten years, the first machine has future opportunity dependent on it. If the machine with a five-year lifespan is purchased over the one with a ten-year lifespan, at the end of five years, one more machine will be required. Future investment at the end of the fifth year is dependent on the option of machine

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selected at present. All opportunities that are dependent either immediately or in the future should be included in a single project. Without that, economic analysis will be less than efficient.

Let us take an example. Ten investment opportunities are received and developed by a capital expenditure committee (CEC) of XYZ Company Limited. The CEC has studied the dependence factor and concluded that:

- O_1, O_2, O_3 and O_4 are economically dependent on each other, but independent of all other opportunities
- O_5, O_6 and O_7 are economically dependent on each other, but independent of the rest
- O_8 is independent of all other projects
- O_9 and O_{10} are mutually exclusive opportunities, but independent of all others

In this case, the number of projects and project alternatives are as follows:

Project No.	Opportunities Included in the Project	Project Alternatives	No. of Alternatives in the Project
A	O_1, O_2 and O_3	$O_1, O_2, O_3, O_4, O_1O_2, O_1O_3, O_1O_4, O_2O_3, O_2O_4, O_3O_4, O_1O_2O_3, O_1O_2O_4, O_1O_3O_4, O_2O_3O_4, O_1O_2O_3O_4, \text{None}$	16
B	O_5, O_6, O_7	$O_5, O_6, O_7, O_5O_6, O_5O_7, O_6O_7, O_5O_6O_7, \text{None}$	8
C	O_8	O_8 or None	2
D	O_9, O_{10}	O_9, O_{10}, None	3
Total number of alternatives			29

In an efficient investment analysis, after formation of projects and identification of alternative projects, the best alternative which offers the highest profit is selected. Here, the second condition is applied. If the $O_1O_2O_3$ alternative is found attractive, then O_1, O_2 and O_3 are all selected.

Sources of Project Ideas

Project ideas could originate from the various sources, such as:

- Success story of a friend/relative
- Experience of others in manufacture/sale of product or rendering service
- Examination of the inputs, processes and outputs of industries and search for improved process, substitute input, and so on
- Government plan outlays, schemes and guidelines
- Development programmes of financial institutions and developmental agencies
- Investigation of local resources, material and human and the ways of tapping them

- Economic and social changes of the economy
- B2B advertisements, C2B communications, and so on
- Project profiles and industrial potential surveys
- Visits to trade fairs, industrial exhibitions
- Unfulfilled human needs
- Possibility of reviving and rehabilitating sick units
- New inventions and patents, and new technological developments and business opportunities around them
- Tender notifications of businesses, government departments, universities, etc.
- Liberalization, privatization and globalization policy drives by governments, as this means new business opportunities for private sector, MNCs, etc.

Let us briefly discuss these sources of project ideas.

- **Analysis of the performance of existing industries:** A study of existing industries in terms of their profitability and capacity utilization is helpful. The analysis of profitability and break-even level of various industries could indicate promising investment opportunities. An examination of capacity utilization of various industries provides information about the potential for further investment. Such a study becomes more useful if it is done region-wise, particularly for products which have high transportation costs.
- **Examination of the inputs, process and outputs of industries:** An analysis of the inputs required for various industries may throw up project ideas. Opportunities exist when (i) materials and supplies are presently being procured from different sources with attendant time lag and transportation costs and (ii) several firms produce internally some components/parts which can be supplied at a lower cost by a single manufacturer who can enjoy economies of scale. A study of the output structure of existing industries may reveal opportunities for further processing of output or even processing of waste. A study of the processes followed may reveal opportunities for improving the process, with time and cost advantages.
- **Examination of volume, value and direction of imports and exports:** An analysis of import statistics for a period of five to seven years is helpful in understanding the trend of imports of various goods and the potential for import substitution. Indigenous manufacturing of goods currently imported is advantageous for several reasons:
 - o It improves the balance of payments situation.
 - o It provides market for supporting industries and services.
 - o It generates employment.

Likewise, an examination of export statistics is useful in learning about the export possibilities of various products in various countries.

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- **Plan outlays and government guidelines:** The government plays a very important role in many economies. Government's proposed outlays in different sectors provide useful pointers toward investment opportunities. For instance, the schemes of distribution of free colour TVs, gas stoves, dhoties and sarees, bicycles, books, etc. are providing new opportunities for businesses. They indicate the potential demand for goods and service required by different sectors.
- **Developmental schemes of financial institutions and developmental agencies:** In a bid to promote development of industries in their respective states, state financial corporations, state industrial development corporations and other developmental bodies conduct studies, prepare feasibility reports and offer suggestions to potential entrepreneurs. The developmental schemes suggested by them lead to new project ideas.
- **Investigation of local resources (material and human):** A search for project ideas may begin with an investigation into local resources and skills, various ways of adding value to the locally available materials. Similarly, the skills of local artisans may suggest products that may be profitably produced and marketed.
- **Analysis of economic and social changes:** A study of economic and social changes is helpful in projecting demand for various goods and services, identifying shifts in demand for goods and services, and so on. Changing economic conditions provide new business opportunities. A great awareness of the value of time is dawning on the public. Hence, the demand for time saving products like packaged food items, ovens and powered vehicles has been increasing. Another change that we are witnessing is that the desire for leisure and recreational activities has been increasing. This has caused a growth in the market for recreational products, fitness products and services.
- **Exploration of the possibility of reviving and rehabilitating sick units:** Industrial sickness does happen in developed and developing countries. Sick units are either closed or face the prospect of closure. A significant proportion of sick units, however, can be nursed back to health by sound management, infusion of further capital and provision of complementary inputs. Hence, there is a fairly good scope for investment in this area. Such investments typically have a shorter gestation period because one does not have to begin from scratch. Indeed, in many cases, marginal efforts would suffice to revive such units.
- **Identification of unfulfilled human needs:** For well established, multi-brand product groups like bathing soaps, detergents, cosmetics and tooth pastes, the question to be asked is not whether there is an opportunity to manufacture something to satisfy an actual physical need but whether there are certain psychological needs of consumers which are presently unfulfilled.

To find whether such an opportunity exists, the technique of spectrum analysis may be followed. This analysis is done somewhat as follows.

- o Important factors influencing brand choice are identified
- o Gaps which exist in relation to consumer psychological needs are identified
- **Visit to trade fairs:** Attending the national and international trade fairs/exhibitions/conventions/conferences provides an excellent opportunity to know about new products/services and their development.
- **B2B advertisements, C2B communications, Yellow page ads, and so on:** B2B advertisements, C2B communications, and so on give out business solicitations, joint venture opportunities and the like. Trade journals and business dailies also provide business solicitations.
- **Government agencies, credit institutions, non-governmental organizations, village panchayats and public:** Project ideas may be generated by the government agencies, credit institutions, non-governmental organizations and also by public. The government has the largest resources and has the necessary information to generate project ideas and it plays a predominant role in this sphere. The government has the required facilities and manpower to conduct detailed studies which may lead to making investment decisions. Banks and other financial institutions are actively involved in sharing the social responsibility of achieving the national objectives of economic development. The cooperatives and non-governmental organizations as well as individual entrepreneurs now actively participate in identification of projects. The awareness of involving the people or the beneficiaries in project identification is now increasing fast. Since the local people have the first hand knowledge of the potentials and problems of the area to which they belong, more realistic project identification has become possible with their involvement. It needs no emphasis that the project ideas would be generated in better manner both in the qualitative as well as quantitative terms when the knowledge and ideas of the government functionaries, people, financial institutions and other experts are pooled together.

Check Your Progress

1. What are the essential ingredients of an efficient investment analysis?
2. List any two sources of project ideas.
3. How can industrial sick units be revived and rehabilitated?
4. How is spectrum analysis done?

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2.3 PROJECT INITIATION

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The purpose of project initiation is to evaluate proposed projects and to reach a consensus on the projects that are to be selected. During project initiation, the project charter is presented, the strength of a project's business case and the viability of the proposed solution are evaluated. A determination is made as to whether the project is consistent with the institution's business and/or strategic plan, and if the budget of the project planning (high level) is affordable.

In project initiation, all the necessary analysis is undertaken to allow the project to be planned. It usually involves a considerable amount of work, and expenditure. Project initiation is considered to be a stage in its own right i.e., it should be formally given approval to go ahead and should be planned and budgeted for as a phase of the project.

Project Initiation Document (PID) is the single most important piece of documentation that is produced at this stage, and probably during the course of the entire project. The Project Initiation Document starts with the business Case, if it exists, and capitalizes on it using the information and analysis data produced during the initiation activities.

A Project Initiation Document (PID) should include:

- Detailed project goals and objectives and the critical success factors on the basis of which the achievement of the objectives will be judged.
- Details of the scope of the project in relation to the organization, functional areas and time as well as a statement about any related areas that are considered to be out of scope.
- Details of identified risks and any constraints affecting the project.
- Details of any kind of assumptions made about the project. These assumptions might be based on the support you will receive from other parts of the institution or, if you are working with a third party supplier, assumptions about what the supplier will deliver.

The project initiation document is the 'contract' for the project (between the project manager and the project board.) It sets out:

- What does the project aim to achieve?
- Why it is important to achieve it?
- Who will be involved in managing the process and what are their responsibilities?
- How and when will the project be undertaken?

The PID has to answer the above questions to a sufficient level of detail to help maintain control of the project.

2.3.1 Pre-Feasibility Study

The feasibility report is very rudimentary, like back-of-the-envelope calculation. It is based on secondary data and focused on market feasibility more than technical feasibility. After the initial estimate of market potential, a cursory check is done for availability of commercially exploitable technology. The cost of project is estimated using some thumb-rules at this stage of the feasibility report. To take an example, a feasibility report on setting up of an independent power project will consider the cost of the project at the rate of Rs 10 crore per mega-watt capacity and will neglect the technical details of the project. The market feasibility is checked at this stage by receiving the input of demand and supply from the results of the concept testing or from the secondary sources. The focus of the market feasibility is on the evaluation of demand-supply gap and not so much on the study of marketing variables that determine demand. Similarly, though the financial implications are roughly estimated, the financing arrangements are not planned at this stage.

A market survey may be required in some cases even though feasibility report indicated the viability of the project proposal. The market survey will focus on ascertaining the expected demand for the product that the company will produce if the project proposal is accepted. It may also encompass the study of factors, which may possibly influence consumer behaviour. The stage of market survey will improve the firm's knowledge about the demand of its prospective product and the influencing factors.

Test marketing and a pilot project may be required in some cases, especially if the proposals are new in concept. The respondents' responses in the concept testing stage are hardly based on experience if the project concept is new. Therefore, even if the results of the concept testing may be encouraging, it may not provide enough confidence to go ahead with the commercial plant. A small pilot plant is set up in that case at the minimum investment; product is produced and tested on the select group of consumers and subsequently the experience-based responses are collected. The consumer response may be different after actually consuming pre-packed cold coffee than what it was at the concept testing stage. The idea may still be carried forward only if the results of test marketing indicated the viability of the project proposal.

A market research may be required in some cases with the main purpose of studying risk and critical success factors. The focus of market research will be absolutely sharp on the selected variables identified as potential sources of risk. Enhanced knowledge of risk-causing variables offers obvious advantage. The results of market research would also help in fine-tuning the cost-benefit estimates. The viability check is conducted once again on the improved data. In a way, this stage overlaps with the next one.

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Check Your Progress

5. What is the purpose of project initiation?
6. What is market survey focused on?

2.4 FEASIBILITY STUDIES

Some investment proposals pass through the stage of project feasibility study. Large projects usually need a feasibility test before a significant amount of money is committed. The strategic content in such projects is high but availability or relevance of internal data is less. In this section, data needed for market and technical feasibility study, techniques used in the market analysis and basics of financial feasibility of a project will be discussed.

Project feasibility is a test where *prima facie* viability of investment is evaluated. Evaluation is based on secondary but comprehensive data. Rough estimates based on the experience of others form the basis of the viability check in the project feasibility study. There are basically three types of feasibilities evaluated in the project feasibility study:

- Market feasibility
- Technical feasibility
- Financial feasibility

When projects are evaluated by government or government agencies, economic and social feasibilities are also considered, in addition to the environment assessment. Market feasibility is carried out in detail at this stage. Technical feasibility and financial feasibility are less emphasized at this stage.

I. Market Feasibility

Products where sales potential is high are less risky to invest in. Market feasibility study aims at assessing the potential sales of a proposed product, if any. This is also known as market analysis.

Approach for conducting market feasibility study would vary depending upon the type of the proposed product. In case of a novel product idea (product is novel if the same or similar product is not in the market anywhere in the world), market feasibility check has to be based on absurd judgement and wishful thinking. At the most, indicators of buyer behaviour (in terms of their response to 'new' or 'dream' product) can be taken into account for estimating potential demand of the product.

If a proposed product is new in an economy, however, it has been successfully marketed in some other economy, its market feasibility is assessed through a meaningful comparison of some broad economic and cultural indicators in the two

economies. Each economy is likely to experience almost identical buying pattern and preferences for products, if economic indicators are comparable. Cultural differences and other factors should be adjusted before drawing conclusions about demand potential. Per capita income, income disparity level, pattern-indicating shift in choice for consumption, literacy level and other related economic factors can indicate the potential of demand for a particular proposed product.

If the proposed project is for addition in the capacity existing in the economy, the task of market feasibility study will be different. Historical data analysis and study of factors, which influence consumption trends, become essential in that case. The following discussion is centred on the study of market feasibility for the product which is already selling in the market. It is divided into five points:

- Study of general economic factors and indicators
- Demand estimate
- Supply estimate
- Identification of critical success factors
- Estimating demand-supply gap

Let us discuss these aspects of market feasibility in detail.

(a) General economic indicators

The demand potential of any product is likely to have some kind of association with some economic indicators. Changes in demand and changes in a particular or some economic indicators may take place simultaneously or with lead or lag. Some of the important economic indicators include gross domestic product, per capita income, income disparity, rate of urbanization, population growth rate, literacy rate, government spending, money supply and others. Some western economies have developed a comprehensive index comprising the general economic indicators.

To take an example, per capita income, especially of the upper middle class has exploded the demand for cars in India since the 1990s. Demand for consumer durable goods like white goods and electronics are linked with income trends.

Situation analysis

Situation analysis is especially important if the project proposal is for adding the capacity. It is important where the project proposal involves production and sale of new products and services; new for the company but not new in the market.

The situation analysis framework is primarily designed for preparation of a marketing plan. It can also be used as a part of market analysis in project planning. Mere existence of market is not enough for a company or project to succeed but the company should be able to sell the product. Situation analysis uses a framework where some internal factors are studied in the light of some external factors with a

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view to arrive at a judgment whether the company *can* sell the product in the market. The factors studied in situation analysis are called the five Cs. Some take three, four or even six Cs. These factors and a sample of items studied in each of them are given below:

Company

The assessment of the company can be done with opinion-based evaluation of the following factors:

- Number of products
- Market perception of the company
- Company's strategic plans and goals
- Company's culture and values
- Company's current technology and technology gap, if any
- Overall financial position

No one else would know the company better than the internal management. However, a frank review is required. If one is in a mode of denial and attempts to justify everything, he is more likely to avoid admitting a real picture and more likely to avoid looking at mistakes.

Collaborators (or partners)

The partners of a company can have the following information about it:

- Company's major customers
- Company's distributors
- Company's major suppliers
- Joint ventures, management agreements and other alliances, if any

A lot of this information can be obtained without much difficulty from published or paid sources.

Customers

This is in fact about the potential markets for the product that will be produced as a part of the project.

- Size of the market along with segments
- Expected rate of growth of the market
- Current demand-supply gap
- Potential customers' expected behaviour and factors affecting their choice of product
- At the customer end, who could be the decision maker and what would be the decision unit

- Where from do these customers currently purchase the product?
- How is the product purchased (impulse buys, internet, etc.,)?
- Trends in consumer tastes
- Company's distributors

Industry data is available for the existing products. For a new product, one may need to conduct a survey and sometimes test marketing. A lot depends on judgment as well. For a foreign market, a country report can be used.

Competitors

Know your rivals:

- Who are the actual and potential competitors?
- Knowing their products, positioning, market shares, strengths, weaknesses and marketing strategies.
- Who are the indirect competitors, producing competing products?
- Is the quality of competition healthy or unhealthy?

Those who keep their eyes open know their competitors well. One can hire a consulting firm too, to get a balanced view of the competitive scenario.

Climate (or environment)

Economic environments, political scenario, regulatory system, all have effect on the market:

- What is the political environment like? Who is in the government, whether the government and its policies are stable or not, how does bureaucracy work or does not work?
- How are the regulations and their implementations?
- What are the macroeconomic factors (like business cycle, inflation, interest rate) and which are likely to affect the market?
- What are the social and cultural trends? (This may go with 'customer' factor as well)
- What is the technological environment, available technology and its cleanliness, rate of change in technology?

A country report usually gives a fair view of the political scenario, regulatory environment, economic factors and social and cultural analysis. Technological environment has to be studied separately.

By combining analysis of customers, competitors and climate with the company's strengths and collaborators, the firm can identify the market opportunities and can prepare workable marketing strategies to include them in the marketing plan.

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(b) Demand estimate

Demand projection is a most important step in project feasibility study. Salient points related to demand estimation are briefly enumerated below:

- End-user profile
- Study of influencing factors
- Regional, national and export market potential
- Infrastructure facilities which may facilitate or constrain demand
- Demand forecasting

Different end-user profile

A product may have different usages and different end-users. The total demand of the product is made of different end-users. For example, demand for cement can be divided into some broad categories, namely housing, business and rehabilitation activities and infrastructure projects, such as irrigation, canal, railways, roads and ports. These different market segments may not be interlinked. The housing sector may be dull but the infrastructure sector may remain bullish for the cement demand. Scope of alternative usage also should be assessed. End users are further classified into the government and non-government categories and urban and rural categories. In case of plastic, a whole market of packaging is wide open with newer applications of it, which may affect and in fact, has already affected the tinplate-packaging industry.

Influencing factors

Product demand may have influencing factors also. Those factors must be assessed. The demand for some products may be direct and for some it may be a derived demand. Demand of tyres depends upon the sale of automobiles, a fertilizer sale is dependent on monsoon and sales of steel and industrial growth have same association. Normally, the demand for intermediate goods and services is a derived demand, which depends on the demands for the end product of customer businesses. Factors that affect demand, whether direct or derived, must be estimated.

Regional, national and export market potential

The market potential of a product in different segments may be different for several reasons. The study of national demand may not be appropriate in some cases because there may be regional imbalances caused by several constraints. India has a large demand for electric power but due to inadequate infrastructure for its distribution, some states are power-surplus states, whereas, others have a shortage of power. In case of cement, regional demand matters more than national demand due to transportation cost working as a deterrent. Assessment of export potential is a different exercise. First, the economic distance to which a particular product

can be exported is a matter of evaluation. Next is the finding out of the importing countries in that part of the globe and zeroing in on the countries that do not have an exportable surplus. Cost and quality aspects of the goods should also be compared with other potential exporting countries. International relations, import and export barriers in respective countries and such other factors also need consideration.

Infrastructure facility

Infrastructure has an impact on market: for example, Indian cement's exportability is less not due to the quality or cost of production but due to high cost of transportation. Bulk cargo facility is not adequate in India. As a result, cargo cost becomes prohibitive in exporting cement. Even in the Indian market, the uncertainty surrounding availability of railway wagons makes it difficult for cement firms to serve the demand in a region, which is far in terms of economic distance from the factory.

Demand forecasting

This is an important step in the assessment of demand potential. Growth in demand in the past can be indicative of the future demand. There are various methods of demand forecasting. Some assume that factors influencing consumption behaviour in the past will continue to influence in the future, others provide for adjustment of some economic indicators, which are likely to be different in the future.

(c) Supply estimate

Supply estimate is not easy. The past trend of supply of goods can be studied and further extrapolated. Projections so made need to be adjusted with the help of additional information like new projects planned by businesses in the economy, import possibility as governed by import policy, import tariff and international prices. Information regarding entry barrier is also useful. Long gestation period and high capital to labour ratio in an industry may create natural entry barriers. Government licensing policy, non-availability of the required input, like material and skilled labour, also create entry barriers. Product category, where entry barrier is high is unlikely to see sudden spurt in supply, offering position that is more comfortable to existing players.

(d) Estimating demand-supply gap

Demand and supply estimates, fine-tuned with the changing factors, are now compared with each other for finding a gap. Demand-supply gap, for relevant geographical territory only, is meaningful. It is quite likely that the forecast of demand and supply may not be a single point forecast. It may be in terms of various scenarios. Multiple-point forecast gives the most adverse, most likely and most favourable forecasts of demand and supply. How is it done? The demand and supply projections given in Table 2.1 shows calculation of demand-supply gap for a

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particular product in the next five years.

Table 2.1: Demand-Supply Gap Calculation for Five Years

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Year	Cement Demand			Cement Supply		Demand Surplus		
	Min.	Likely	Max.	Likely	Max.	Min.	Likely	Max.
1	48.00	48.00	48.00	48.00	0.00	0.00	0.00	0.00
2	49.44	50.40	51.36	50.70	50.70	-1.26	-0.30	0.66
3	51.66	53.93	56.50	53.38	63.24	-11.58	0.55	3.12
4	54.76	58.78	63.84	61.03	65.46	-10.70	-2.25	2.81
5	58.60	65.25	74.69	62.45	53.38	5.22	2.80	12.24
Demand Surplus: Minimum = Min demand - Max Supply								
Likely = Likely demand - Likely Supply								
Maximum = Max demand - Likely Supply								
Note: All the confirmed capacity additions constitute 'likely supply scenario', while 'maximum supply scenario' assumes another capacity addition in the third year to fifth year. It is assumed that firms will be able to operate at 80 per cent capacity.								

In case, a supply shortage is estimated that is sufficiently large, then market feasibility of the product is said to be positive. Aggressive promoters, however, study the strength and weaknesses of the present manufacturers and set up the large plant capacity with the clear intention and strategy of eating up the market of some current players. They leverage on their own strength and take advantage of others' weaknesses.

II. Technical Feasibility

If there is an ample market demand without enough supply, the focus should shift over to technology. The following inquiries must be made with respect to technology analysis:

- Availability of commercially exploitable technology and its alternatives.
- Transferability of those technologies
- Other inquiries about the technologies
 - Normal capacity utilization
 - Requirement of plant and equipment and fabrication facility
 - Production process needed
 - Possible product mix
 - Possible alternate usage
 - Flexibility
 - Rate of change
 - Waste disposal
- Risk implications

(e) Resource availability

The key considerations of technology analysis are discussed below:

(a) Availability

A task-force will search for technology for the operations required for running the project. If technology is available, commercial exploitability must be verified. If commercially available technology is available, then alternative technology and their sources are identified. One must also inquire whether any of the technologies is currently used by any business and study their experiences.

If technology is available, then should one buy the latest technology or would an old one be fine? Usually, in a cheap labour economy, less than the latest technology works fine from the labour-to-capital ratio angle. However, the choice has to depend on the effects of technology on the desired quality of product and cost of product versus investment needed in a given technology.

(b) Transferability

Technology transfer issue has to be addressed in dual fashion:

- Whether the transfer of technology is possible from the political angle
- Whether transfer of technology is possible from the operations (environment) angle

Either due to the import restrictions imposed by the government or because of export restriction or economic sanctions imposed by an exporting nation, a particular technology cannot be transferred. In today's regime of the World Trade Organization, normally one cannot expect import restrictions (unless there is no political relationship between the two countries) but economic sanctions from the exporting nations are quite possible, making it impossible to transfer technology from one country to another. Sometimes, the technology owner may not be willing to transfer the technology.

If the technology is transferable from the political view point, one needs to check whether the technology would work in the environment where it will be transferred. Technology is usually very sensitive to the environment or climate in which it is used. Success of technology depends on the temperature level, moisture level, quality of atmosphere, quality of material, method of work and skill of labour, power supply quality and a host of other variables, which may be unique for each user. Given these environmental factors, can a given technology be transferred with minimum difficulties? What kind of adjustment and modifications in the configurations would be warranted to make the technology work? These modifications add to the project cost and sometimes, some modifications may not

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be feasible at all.

(c) Other inquiries

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Numerous other inquiries are made regarding technology. Some important points of inquiries are given below:

Normal capacity utilization

Every technology has its own capacity and the rate of normal utilization, needing the rest of the time for routine or preventive maintenance. In addition, a rated capacity is usually not fully available, depending upon the environment in which it is used. Capacity utilization has a direct impact on available production and cost of production. Therefore, an inquiry about a potential 'normal' capacity utilization of a given capacity assumes great importance.

Requirement of plant and equipment and fabrication facility

Technology comes with knowledge. However, machines for operations have to be fabricated separately. The following questions are essential:

- What kind of plant, machines and equipments would be required for the operations?
- Whether there are machine fabricators, capable of making the required machines as per the specifications?
- Whether the fabricated machines can be transported easily from the fabricators to the project site?
- Whether the required sequencing of processes, synchronization of machines and balancing of machines can be attained?

Production process needed

Efficiency of technology depends on process design. The following inquiry would be appropriate:

- What type of process design will be required?
- Can those processes be built in a desired sequence?
- In case of site-limitations (in terms of size and existing design of building, etc.), can the required processes be arranged with or without modifications?
- Whether the company currently has one or more of the processes required in the new technology and if yes, can the same be used with expanded capacity?

Possible product mix

A project may involve production of goods and services in a particular range and

therefore, the technology and processes should be able to produce them in an appropriate mix.

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Possible alternate usage

A technology that has an alternate use is better because if the company is not able to achieve its sales target, it can always change the product and establish in a different market. Many engineering firms enjoy the benefit of technology that has alternate uses. A company engaged in the business of manufacturing glass-lining equipments for chemical industry can use several of its processes to manufacture concrete-mixing machines.

Flexibility

This is the time of flexible manufacturing system and the same is equally true for service operations. The customer taste changes fast and the rate of change is becoming faster day by day. If the product from the new project is closer to the consumer and has very little room for alternative use, then the processes must be flexible so that the firm can quickly adapt to the changes. Usually, non-flexible machines and processes are cost effective for the production of the products but face the danger of obsolescence if consumer-taste changes. Thus, if the market analysis indicates a shorter life span of demand of the current product and a potential change is envisaged, then one has to look for the technology, processes and machines that can easily adapt to the changes: for example, in the world-recessionary situation of the year 2008, Nissan Motors shifted its sizable operations to Japan because the plant in Japan is capable of producing sixty different models of passenger cars.

Rate of change

It is important to know and estimate the rate of change in technology. For example, information technology changes fast, requiring firms to buy the latest technology as far as possible. In general, the rate of change in technology is expected to be faster in a developed economy with respect to consumer goods but technologies for producing the intermediate products (like steel, aluminium, etc.), which are away from the consumers are less likely to change at a faster pace. A business should be able to recoup the investment in any technology before the technology becomes obsolete for its current use.

Waste disposal problems

Waste disposal is a legal as well as a moral issue. Some technologies face the problem of waste disposal, which sometimes prove costly. For example, nuclear power plants undergo waste disposal problems. Several countries, which have been using nuclear power plants have not found effective ways of waste disposal,

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others have not been conscious about this issue as yet, creating unimaginable problems for the future generations.

(d) Resource availability

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Can there be an access to the required quality of resources needed by the selected technology? For example, a cold-roll mill (CRM) technology in a steel industry requires a high quality of coal with low moisture content and high carbon content. Long-term access to coalmines that have large reserves of coal at different levels of depth is essential. A task force may even consider visiting short-listed coalmines, take samples from different depths and conduct tests in the laboratory to determine suitability of the coal quality and its appropriateness for the technology being considered. Some technology may fail with poor quality of power supply and in some cases, highly skilled workers may be needed, which may not be possible if the current work force is low skilled and the relationship with unions is not good.

(e) Risk implications

One would have noticed that the points discussed so far in technology analysis essentially help in understanding and mitigating the risk. Still, one more aspect is left out. Each technology has its own consequential fixed and variable costs during operations. A technology that ensues in high fixed cost but low variable cost creates a higher degree of operating leverage. A higher degree of operating leverage would enlarge the effect of change in sales revenue on operating profits. High degree of operating leverage is still good if the demand is increasing because the increase in sales revenue will increase operating profit faster but if the sales revenue declines, the operating profit will decline faster. Therefore, if there is any uncertainty about the sales revenue trend, one must select a technology that has a low fixed cost even if its variable cost may be high. So, from among alternative technologies that are found appropriate from the analysis of all factors discussed so far, a company should select a technology that is appropriate from the angle of the degree of operating leverage or internal risk.

One must study the technology in such a way that simultaneously commercial exploitability of a technology, in the environment that can be created in the company, can be evaluated.

III. Financial Feasibility

Demand and price estimates are derived from the market feasibility study. Project costs and operating costs are derived from the technical feasibility study. The estimates need to be supplemented with tax implications depending upon the

prevailing tax laws and financial costs emanating from the financing alternative considered for the project. This provides enough information for the calculation of the financial bottom line of the project.

The financial feasibility check involves a detailed financial analysis. Financial analysis includes quite a few assumptions and calculations. Some are briefly described below:

Estimates

Projections are made for price of product, the cost of various resources required for manufacturing goods and capacity utilization. Use of the thumb rule or actual data of some comparable projects are generally included in the estimates.

Period of analysis

The period of estimate is determined and the terminal value of the project is forecast. The period of estimate should be justified by factors like, the product life cycle, business cycle, ability to forecast, period of debt funds, etc.

Financing alternatives

Financing alternatives are considered and a tentative choice of financing mix is made together with assumptions regarding the cost of funds and repayment schedules.

Basic working

Based on assumptions and estimates, some schedules are prepared. Some of the schedules made for this purpose include:

- Debt servicing schedule (interest payment and principal repayment schedule)
- Working capital schedule
- Working financing schedule (working capital loan, interest and repayment schedule)
- Depreciation schedule for income tax purpose
- Depreciation schedule for the purpose of reporting under Companies Act, 1956 (if depreciation policy is different from income tax rules)
- Schedule of cash flow from operations
- Project cash flow schedule

Bottom-line effect

All assumptions and schedules are translated into the bottom-line financial statements, which include projected income statements, projected balance sheets and projected cash flow statements. The projected income statements indicate the year-wise and average profit during the project life, the projected balance sheets show the financial position of the firm over the period of project analysis

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and the projected cash flow statements show the cash position over the time. Usually, all the bottom-line statements are prepared for business as a whole and projected cash flow statement is prepared on incremental basis.

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Financial indicators

Based on the projected financial statements, some important financial indicators are calculated for a quick viability check. The important financial indicators are:

The **interest cover ratio (also known as times-interest-earned or TIE)** since indicates the safety and timely payment of interest to the lenders of money. It is calculated with the help of the following formula:

$$\text{Interest Cover Ratio} = \frac{PAT + \text{Interest Expense}}{\text{Interest Expense}} \quad (2.1)$$

It is important to note that the depreciation is added back in the profit after tax. This is because the depreciation is a non-cash expense. At times, the depreciation is not added back and the interest cover ratio is calculated. In the context of project, this ratio is calculated as an average for the project financing period.

The interest cover ratio shows how many times the operating cash flow before interest is earned against the interest liability. Usually interest cover ratio of three and above is considered desirable. Though this ratio is useful in determining the health of earning power of the project, it is not a very important indicator of overall project viability.

The **debt-service coverage ratio (DSCR)** uses the same numerator as interest cover ratio, but in the denominator along with the interest payment the principal sum repayment is also included. The formula is,

$$DSCR = \frac{PAT + \text{Depreciation} + \text{Interest Expense}}{\text{Interest Expense} + \text{Principal Sum Payment}} \quad (2.2)$$

The DSCR is usually taken on the basis of the average for the project financing period and not for a particular year. The reason behind this is that though the interest expense may be constant, the principal sum repayment occurs towards the end of the debt-period. Academicians and many financial institutions consider an average DSCR of 1.5 and more as good. A firm that attains 1.5 or greater DSCR is considered to have preserved credit-worthiness. Sometimes even 1.25 DSCR is accepted, especially in financing sick business in its effort of turning around. This is also the safety indicator for lenders of money. A project that generates enough funds to repay all loans along with interest during the period of loan taken for the project is considered good from the business prudence angle.

The **payback period (PBP)** is another method for quick project viability check. The payback period method uses project cash flow and calculates a period

in which initial investment is fully recovered. A quicker payback is better.

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The **net present value (NPV)** is also a cash flow based method of project evaluation, but it calculates time value of the project cash flow and compares it with the initial cash outflow on the project. The time value of cash flows is calculated using an appropriate discount rate. The net present value is the difference between the present value of cash inflows and the present value of cash outflows on the project. If the net present value is positive, the project is said to create shareholder value and is acceptable.

The **internal rate of return (IRR)** is a rate at which the present value of cash inflows and present value of cash outflow are equal, leaving the net present value to be zero. If the internal rate of return is greater than the discount rate, the project is acceptable. The IRR is an alternative version of net present value.

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2.4.1 Project Break-Even Point

The accounting break-even point is the point (level) of a particular variable at which the accounting profit is zero. The result of an imaginary cost data is given below:

Percentage change required for accounting break-even

- Demand reduced by 30 per cent
- Materials cost increased by 50 per cent
- Labour cost increased by 120 per cent
- Overheads increased by 250 per cent

The lower the percentage change required for break-even, the more crucial is the variable. Demand has only a 30 per cent safety margin, materials cost has 50 per cent safety margin. Labour and overheads are less important factors for project viability because their safety margin is large.

The NPV break-even approach in the sensitivity analysis

Accounting-based methods do not comply with the corporate financial objective. One may want to find out the percentage change required in a particular variable for getting a zero net present value. One may get the results like those given below:

Percentage change required for zero (break-even) net present value

- Demand reduced by 33 per cent
- Materials cost increased by 60 per cent
- Labour cost increased by 110 per cent
- Overheads increased by 200 per cent
- Project cost increased by 40 per cent

The NPV break-even point can test the sensitivity to project cost also. It takes into account the time value of money and it can also accommodate differential values of factors over a period.

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Check Your Progress

7. State the three types of feasibilities evaluated in a project feasibility study.
8. What are the five C's of situation analysis?
9. What is net present value?

2.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. A firm should have a mechanism where (a) opportunities are received, (b) alternatives are searched, (c) economic dependence is studied and then (d) projects are formed before detailed cash flows are estimated. These four actions are the essential ingredients of efficient investment analysis.
2. Project ideas could originate from the various sources, such as:
 - Success story of a friend/relative
 - Experience of others in manufacture/sale of product or rendering service
3. A significant proportion of sick units can be nursed back to health by sound management, infusion of further capital and provision of complementary inputs.
4. Spectrum analysis is done in the following manner:
 - Important factors influencing brand choice are identified
 - Gaps which exist in relation to consumer psychological needs are identified
5. The purpose of project initiation is to evaluate proposed projects and to reach a consensus on the projects that are to be selected.
6. The market survey is focused on ascertaining the expected demand for the product that the company will produce if the project proposal is accepted.
7. There are basically three types of feasibilities evaluated in the project feasibility study:
 - (a) Market feasibility
 - (b) Technical feasibility
 - (c) Financial feasibility
8. The five C's in situation analysis are company, collaborators, customers, competitors and climate.
9. Net present value is the difference between the present value of cash inflows and the present value of cash outflows on the project.

2.6 SUMMARY

- The investment proposal, which originates from various departments, is the opportunity. Those who conceive the idea or sense the opportunity are likely to see only a part of the whole investment requirement.
- The process of grouping opportunities is called formation of projects. A project is a set of one or more investment opportunities.
- In an efficient investment analysis, after formation of projects and identification of alternative projects, the best alternative which offers the highest profit is selected.
- Project ideas could originate from various sources such as success story of a friend/relative, government schemes, a study of economic and social changes, etc.
- The purpose of project initiation is to evaluate proposed projects and to reach a consensus on the projects that are to be selected. During project initiation, the project charter is presented, the strength of a project's business case and the viability of the proposed solution are evaluated. A determination is made as to whether the project is consistent with the institution's business and/or strategic plan, and if the budget of the project planning (high level) is affordable.
- Project Initiation Document (PID) is the single most important piece of documentation that is produced at the time of project initiation, and probably during the course of the entire project.
- The feasibility report is based on secondary data and focused on market feasibility more than technical feasibility.
- The focus of the market feasibility is on the evaluation of demand-supply gap and not so much on the study of marketing variables that determine demand.
- A market survey may be required in some cases even though feasibility report indicated the viability of the project proposal. The market survey will focus on ascertaining the expected demand for the product that the company will produce if the project proposal is accepted. Test marketing and a pilot project may be required in some cases, especially if the proposals are new in concept.
- Some investment proposals pass through the stage of project feasibility study. Large projects usually need a feasibility test before a significant amount of money is committed. The strategic content in such projects is high but availability or relevance of internal data is less.
- Project feasibility is a test where the viability of investment is evaluated. Evaluation is based on secondary but comprehensive data. There are

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basically three types of feasibilities evaluated in the project feasibility study:

- a. Market feasibility
 - b. Technical feasibility
 - c. Financial feasibility
- Market feasibility study aims at assessing the potential sales of a proposed product, if any. This is also known as market analysis. The study of market feasibility is based on the following factors:
 - o Study of general economic factors and indicators
 - o Demand estimate
 - o Supply estimate
 - o Identification of critical success factors
 - o Estimating demand-supply gap
 - The demand potential of any product is likely to have some kind of association with some economic indicators. The situation analysis framework is primarily designed for preparation of a marketing plan. By combining analysis of customers, competitors and climate with the company's strengths and collaborators, the firm can identify the market opportunities and can prepare workable marketing strategies to include them in the marketing plan.
 - Demand projection is a most important step in project feasibility study. Salient points related to demand estimation are given below:
 - o End-user profile
 - o Study of influencing factors
 - o Regional, national and export market potential
 - o Infrastructure facilities which may facilitate or constrain demand
 - o Demand forecasting
 - The past trend of supply of goods can be studied and further extrapolated. Projections so made need to be adjusted with the help of additional information like new projects planned by businesses in the economy, import possibility as governed by import policy, import tariff and international prices. Information regarding entry barrier is also useful.
 - Demand and supply estimates, fine-tuned with the changing factors, are compared with each other for finding a gap. Demand-supply gap, for relevant geographical territory only, is meaningful. It is quite likely that the forecast of demand and supply may not be a single point forecast. It may be in terms of various scenarios.

- If there is an ample market demand without enough supply, the focus should shift over to technology. The following inquiries must be made with respect to technology analysis:
 - (a) Availability of commercially exploitable technology and its alternatives.
 - (b) Transferability of those technologies
 - (c) Other inquiries about the technologies
 - (d) Risk implications
 - (e) Resource availability
- Demand and price estimates are derived from the market feasibility study. Project costs and operating costs are derived from the technical feasibility study. The estimates need to be supplemented with tax implications depending upon the prevailing tax laws and financial costs emanating from the financing alternative considered for the project.
- The accounting break-even point is the point (level) of a particular variable at which the accounting profit is zero.
- The NPV break-even point can test the sensitivity to project cost. It takes into account the time value of money and it can also accommodate differential values of factors over a period.

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2.7 KEY WORDS

- **Sick unit:** It is a company which incurs heavy cash losses in a particular year and is likely to continue incurring losses in the following years.
- **Test marketing:** It is a marketing method that aims to explore consumer response to a product or marketing campaign by making it available on a limited basis before a wider release.
- **Situation analysis:** It is the process of critically evaluating the internal and external conditions that affect an organization. It is usually done prior to a new initiative or project.
- **Inflation:** It is a general rise in the price level in an economy over a period of time.

2.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short note on the role of the government in generating project ideas.
2. What is Project Initiation Document?

3. What do you mean by situation analysis?
4. What are the important financial indicators used for project viability check?

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Long-Answer Questions

1. Discuss in detail the various sources of project ideas.
2. Explain the key considerations in market feasibility study.
3. Examine the important aspects of financial feasibility.

2.9 FURTHER READINGS

- Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.
- Kerzner, Harold, R. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.
- Singh, Narendra. 2000. *Project Management and Control*. Delhi: Himalaya Publishing House.
- Choudhury, Sadhan. 1988. *Project Management*. New Delhi: Tata McGraw-Hill.

UNIT 3 PROJECT PLANNING

Structure

- 3.0 Introduction
- 3.1 Objectives
- 3.2 Need of Project Planning
 - 3.2.1 Project Life Cycle
- 3.3 Roles and Responsibilities
 - 3.3.1 Team Work
- 3.4 Project Planning Process
- 3.5 Work Breakdown Structure (WBS)
- 3.6 Answers to Check Your Progress Questions
- 3.7 Summary
- 3.8 Key Words
- 3.9 Self Assessment Questions and Exercises
- 3.10 Further Readings

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3.0 INTRODUCTION

Project planning is an important aspect of project management as it ensures successful project completion. It is important to delineate how a project will be executed, monitored, controlled and closed. In addition to this, the objective of project planning also needs to be clearly set. The project manager not only manages the team but also understands the concerns of the external stakeholders. Furthermore, a project manager is responsible for building team motivation. The project planning process involves several key steps, which will be discussed in the unit. The concept of work breakdown structure will also be explained.

3.1 OBJECTIVES

After going through this unit, you will be able to:

- Understand the need for project planning
- Discuss the roles and responsibilities of a project manager
- Explain the importance of team work
- Describe the project planning process
- Discuss in detail the work breakdown structure

3.2 NEED OF PROJECT PLANNING

Project planning is a very important part of project management. It relates to the use of schedules to plan and subsequently report progress within the project

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environment. Effectiveness of a project is a function of a better understanding of activities and critical success factors at various stages of the project. The schedules, which are generally used for project planning, are:

- A Gantt chart
- A PERT (programme evaluation and review technique) diagram
- A CPM (critical path method) diagram

Several steps and decisions are required in a systematic approach in planning the activities. Initially, the firm has to decide whether they would want multi-level scheduling and multi-project scheduling or not. Following this, the activities must be discretely identified, the time for each activity must be estimated, the resource requirement must be planned and the interdependence must be determined. These activities should then be presented in a manner that will help grasp the complexities clearly and help to determine slack, if any. It will also help in effective resource allocation considering the time period.

Resource planning and levelling requires work structure planning and arrangement of work packages in network to identify slacks and early and late start of activities. The three major resources, for resource planning and levelling are machine and equipment supply, material procurement and manpower planning.

Project planning refers to a procedural step in project management. During project planning, required documentation is created to ensure successful project completion. All actions required to define, prepare, integrate and coordinate additional plans are included in documentation. The project plan clearly defines how the project is executed, monitored, controlled and closed. Project planning requires an in-depth analysis and structuring of the following activities:

- Formulation of project goals
- Identification of project deliverables
- Creation of project schedules
- Creation of supporting plans

These activities are discussed ahead under the project planning process.

At the end of the project planning stage, the following are identified:

- Obstacles in the project
- Minimum time required for the completion of the project
- Major deliverables of the project
- Work required for the completion of the project
- People involved in the project and their key responsibilities
- Required milestones of the project

Project planning is never really complete until a project is done. The project plan may return to the planning stage many times before it is accomplished. Usually, the length of the project planning stage is determined by project complexity.

Objectives of project planning

It is essential to clearly set the objectives of project planning. Clear objectives result in a higher rate of project success. Once you have defined the objectives of your project, the tasks leading towards these objectives can easily be identified. If a sailor, for example, knows where the fish are, he can direct his boat to the proper spot. So is the case with project planning.

Setting good objectives

Since good project plans require good objectives, it is imperative to know how to write good objectives. Good objectives are finite in scope and duration. They can be measured. They are realistic. They are clear and they require actions to complete. They have every element of being achievable if the project plan is followed. Thus, good objectives are specific, measurable, action-driven, realistic and time-bound (SMART).

Examples of bad objectives

Below is a list of some poorly written objectives:

- To increase the number of clients company x serves
- To make customers happy
- To create some sort of new product
- To find funding
- To eliminate quality problems
- To make more money
- To achieve success
- To share knowledge

These objectives are bad because they lack specifics, they do not rely upon actions, or they focus upon a means to an end rather than an end.

3.2.1 Project Life Cycle

We have already discussed this topic early on in the book.

Check Your Progress

1. List the schedules used for project planning.
2. What are the three major resources for resource planning and levelling?
3. What is considered to be a good objective of project planning?

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3.3 ROLES AND RESPONSIBILITIES

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One may think that the only job of a project manager is to execute the project as planned in terms of time, cost and quality. Therefore, his duty would be just to coordinate, monitor and control. The real test of project manager's competence actually lies in the management of changing external environment.

Tasks like planning, scheduling, and resource allocation, and also tasks like generating and reading progress report and forecasting anticipated time and cost of the project on completion have become simple with the advent of project management information system. These are available in ready-to-use software forms. The leadership skills of project manager is demonstrated not only in managing the teams, but largely in watching external changes and responding to them with appropriate actions, if needed. This involves people management outside the project team too. Understanding interest of every stakeholder in right perspective and communicating and coordinating with them and addressing their concerns with suitable actions are essential parts of project manager's responsibilities.

Stakeholders Affecting External Environment

Who are external stakeholders, and what could be their concerns? Some of the most important stakeholders and their concerns are described hereafter:

- (a) **Client of the project:** A project is built for a client. The client remains eager and curious at every stage of project life. During the stages of the project the client may change his thoughts and plans. The client may find that the installed capacity is either low or high; may think about a different technology than chosen as a part of the initial project design; change other specifications of the project etc. Often these change request is guided by either the new knowledge or changing environment. For example, during the testing of a technology one may find that the climate control specifications must be changed without which the technology would not work in the local climate; there may be a change in tax and incentive structure and so on.
- (b) **Society, environmentalists and self-help groups:** Society at large has stake in the project. We have observed that nuclear power plants have been opposed by locals and environmentalists; people have demanded water supply in their villages before project work begins; people and self-help groups have vehemently opposed displacement of people caused by the project.
- (c) **Groups with vested interest:** Here we list the local groups other than people and self-help groups. Often local anti-social groups may create obstacles. Political parties and other local leaders have capability to influence certain factors affecting the project viability.

- (d) **Suppliers:** The project schedule depends on timely delivery from suppliers and quality standards. If a supplier starts facing financial difficulties, the delivery can be delayed as the supplier will not be able to buy resources in time. The delivery can be jeopardised even if workers at the supplier are likely go on strike due to failure of union negotiation.
- (e) **Transporters:** A transporter who has no experience of handling the cargo of the nature is more likely to falter on the timely delivery and often even damage the equipment in transit. Congestion at port from where the equipment is being shipped may cause delay. War among the countries on the route of international movement of cargo may cause delay and risk.
- (f) **Regulators:** The actions of regulators and enforcement authority may cause difficulty. Custom clearance delay, additional duty may be imposed than envisaged, non-arrival of bank papers required for release of shipment may cause delay, and environmental clearances may be delayed too much. These and many other factors associated with the regulators and enforcement authority may cause concerns.
- (g) **Governmental hierarchy:** Local, state and central government and their bureaucracy work as per their own rules, regulations and style. If a project manager has not understood them well, it might cause some concerns at some stage of project construction.

Some of these stakeholders can be influenced and some may have to be taken into confidence at the right time. Managing relationship with all stakeholders at different stages of the project construction is an essential part of the role of a project manager. The relationship management, of course has to be based on the relative importance of each stakeholder. These are the categories of stakeholders. Individual within each category must also be understood in terms of his ability to influence.

3.3.1 Team Work

Effective teams have a higher productivity than groups working on the same task. The reason being that a team can leverage off each others' strengths and compensate for each others' weaknesses. Ensuring a balanced mix of all kinds of human resource will result in an effective team delivering a good project. Conducting a team profiling exercise is also an effective method for getting each project team member to appreciate their respective strengths and weaknesses.

Organizational Behaviour and Motivation

Organizational behaviour is concerned with people's thoughts, feelings, emotions and actions in a work setting. Understanding an individual behaviour is in itself a challenge, but understanding group behaviour in an organizational environment is a monumental managerial task.

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Organizational behaviour can then be defined as ‘the study of human behaviour in organizational settings, the interface between human behaviour and the organizational context, and the organization itself’.

The above definition has three facets—the individual behaviour, the organization and the interface between the two. Each individual brings to an organization a unique set of beliefs, values, attitudes and other personal characteristics and these characteristics of all individuals must interact with each other in order to create an organizational setting. The organizational behaviour is specifically concerned with work-related behaviour that takes place in organizations. Organizational behaviour is a synthesis of many other fields of study and is built upon contributions from a number of behavioural disciplines. The predominant area of psychology is concerned with the study of individual behaviour. Other behavioural disciplines affect the group dynamics and the organizational system.

However, a manager has to remember that people differ by nature, not only in their ability to perform a specific task but also in their will to do so. People with less ability but stronger will are able to perform better than people with superior ability and lack of will. Hard work is crucial to success and achievement.

The force of motivation is a dynamic force setting a person into motion or action. The word motivation is derived from motive that is defined as an active form of desire, craving or need that must be satisfied. All motives are directed towards goals. New needs and desires affect or change your behaviour that then becomes goal oriented. For example, if you ordinarily do not want to work overtime, it is likely that at a particular time, you may need more money (desire) so you may change your behaviour, work overtime (goal oriented behaviour) and satisfy your needs.

Motivated people are in a constant state of tension. This tension is relieved by drives towards an activity and outcome that is meant to reduce or relieve such tension. The greater the tension, the more activity will be needed to bring about relief and hence higher the motivation.

Team Motivation

We have understood that people are the assets of an organization. It is for the team leaders or project managers to formulate strategies to create and maintain enthusiasm among members. There are, however, some who are self motivated and work towards acquiring recognition and opportunity to show their worth. But they are considered a threat among coworkers and attract skepticism. Below are some steps a manager may take to motivate members to road to growth.

- (i) Sharing organizational vision with all staff members
- (ii) Ensuring a healthy communication

- (iii) Make people feel appreciated
- (iv) Encourage fresh talents, creativity and new ideas
- (v) Throw challenges
- (vi) Give each individual opportunity to grow while empowering them
- (vii) Managing each member individually and supporting them
- (viii) Create healthy competition
- (ix) Ensure no scope of boredom
- (x) Ensuring a good working environment

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Check Your Progress

4. What is the real test of a project manager's competence?
5. Define organizational behaviour.

3.4 PROJECT PLANNING PROCESS

The project planning process involves a number of stages that we shall discuss subsequently:

Identification and Prioritization of Business Needs

The first step for planning the project is identification of business needs and then prioritizing them. The prioritization of the needs depend upon the importance and interdependency of tasks. For example, in a retail grocery shop, it is important to consider a billing machine that automatically enters the weight of the vegetables selected by customers while scanning them for final billing. Such a billing machine is a need for the business. Also the store planning will be dependent on the finalized number of billing machines, as the layout will need to accommodate enough space for machines considering the size and number.

Generate a Thorough Set of Requirements

There are various tasks that are independent as well as interdependent on other tasks. Also in many cases, there are possibilities to undertake two tasks simultaneously. Project planning identifies such activities and carefully creates requirements for each set of activities that are interdependent or running simultaneously. This enables the project to use optimum time while scheduling. For example, refurbishing in one area will require make shift arrangements for the stock of that area at some other place. Logistics needs to be arranged for transferring stock from one place to other depends on the nature of the stock. Hence, logistics and manpower to remove stock from a particular place is a part of set requirements to initiate refurbishing in one area of store.

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Breaking the Set of Requirements into Tasks

Once the set of activities have been identified, each set is broken down into further tasks. Taking the above example further, the tasks of arranging for logistics, deciding on a place to move the stock, manpower requirement requirements for the task etc. are tasks associated with single set of activities. These tasks are then allotted to be dealt by different team members according to their suitability of the tasks.

Estimating Milestones of the Set of Tasks

In order to get maximum efficiency and effectiveness, the project manager not only breaks down the set of activities into smaller tasks but also estimates the milestones for each set of tasks. These estimations are about the efforts and time required for a particular set of activities. For example, for starting the refurbishing of the store, moving stock to clear space will be one milestone. Estimation of milestones gives better scope for control. If the first milestone is not achieved in time, then the scheduling is required to be altered accordingly to achieve the second milestone faster, so that the overall project do not suffer from delay and increased cost.

Undertake Resource Analysis to Determine Cost

The project planning has to take care of three aspects: (i) Time, (ii) Cost, (iii) Quality. Resource analysis is done to determine cost at every set of tasks. The verification of resource cost of every set of activities gives more space for financial control. Time, cost and quality are inter-related. Delay in a project will lead to increased cost and higher chances of compromise on quality due to increased pace of work. Resource analysis and planned costing will help the project to deal with adverse situations in a better and controlled way.

Create the Project Planning Documentation

A document of project planning is prepared as a base for further scheduling. This document acts as a guideline for entire project execution. It is important to document the project planning with utmost transparency and clarity, so that any new person joining the project can roll the process without wasting of time. In many cases, the project managers seek guidance from the mentor or a senior at the planning stage before documentation.

Project Plan Audit

Planning is the most crucial stage in the entire project management. The success or failure of the project highly depends on how well the project is planned. Hence, to ensure accuracy of the project plan, many retail firms get their project plans audited by the internal experts or consultants. Alterations made at this stage reduce the scope of changes in the project at the execution stage.

3.5 WORK BREAKDOWN STRUCTURE (WBS)

A work breakdown structure (WBS), in project management and systems engineering, is a deliverable oriented decomposition of a project into smaller components. It defines and groups a project's discrete work elements in a way that helps organize and define the total work scope of the project.

A work breakdown structure element may be a product, data, a service, or any combination. A WBS also provides the necessary framework for detailed cost estimating and control along with providing guidance for schedule development and control.

The work breakdown structure is a tree structure, which shows a subdivision of effort required to achieve an objective; for example a programme, project, and contract. In a project or contract, the WBS is developed by starting with the end objective and successively subdividing it into manageable components in terms of size, duration and responsibility (e.g., systems, subsystems, components, tasks, subtasks, and work packages), which include all steps necessary to achieve the objective.

The work breakdown structure provides a common framework for the natural development of the overall planning and control of a contract and is the basis for dividing work into definable increments from which the statement of work can be developed and technical, schedule, cost, and labor hour reporting can be established.

The concept of work breakdown structure developed with the Programme Evaluation and Review Technique (PERT) in the United States Department of Defense (DoD).

A work breakdown structure permits summing of subordinate costs for tasks, materials, etc., into their successively higher level 'parent' tasks, materials, etc. For each element of the work breakdown structure, a description of the task to be performed is generated. This technique (sometimes called a *system breakdown structure*) is used to define and organize the total scope of a project.

The WBS is organized around the primary products of the project (or planned outcomes) instead of the work needed to produce the products (planned actions). Since the planned outcomes are the desired ends of the project, they form a relatively stable set of categories in which the costs of the planned actions needed to achieve them can be collected. A well-designed WBS makes it easy to assign each project activity to one and only one terminal element of the WBS. In addition to its function in cost accounting, the WBS also helps map requirements from one level of system specification to another, for example a requirements cross reference matrix mapping functional requirements to high level or low level design documents.

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Check Your Progress

6. What is the first step in the project planning process?
7. Why is it important to document project planning with utmost transparency and clarity?
8. What is a work breakdown structure (WBS)?

3.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The schedules, which are generally used for project planning, are:
 - A Gantt chart
 - A PERT (programme evaluation and review technique) diagram
 - A CPM (critical path method) diagram
2. The three major resources for resource planning and levelling are machine and equipment supply, material procurement and manpower planning.
3. A good objective of project planning is specific, measurable, action-driven, realistic, and timebound (SMART).
4. The real test of project manager's competence lies in the management of changing external environment.
5. Organizational behaviour can be defined as 'the study of human behaviour in organizational settings, the interface between human behaviour and the organizational context, and the organization itself'.
6. The first step for planning the project is identification of business needs and then prioritizing them.
7. It is important to document the project planning with utmost transparency and clarity, so that any new person joining the project can roll the process without wasting of time.
8. A work breakdown structure (WBS), in project management and systems engineering, is a deliverable oriented decomposition of a project into smaller components. It defines and groups a project's discrete work elements in a way that helps organize and define the total work scope of the project.

3.7 SUMMARY

- Project planning is a very important part of project management. It relates to the use of schedules to plan and subsequently report progress within the project environment.

- Resource planning and levelling requires work structure planning and arrangement of work packages in network to identify slacks and early and late start of activities.
- Project planning refers to a procedural step in project management. During project planning, required documentation is created to ensure successful project completion. The project plan clearly defines how the project is executed, monitored, controlled and closed.
- Project planning is never really complete until a project is done. The project plan may return to the planning stage many times before it is accomplished. Usually, the length of the project planning stage is determined by project complexity.
- It is essential to clearly set the objectives of project planning. Clear objectives result in a higher rate of project success. Good objectives are specific, measurable, action-driven, realistic, and timebound (SMART).
- The real test of project manager's competence actually lies in the management of changing external environment. The leadership skills of project manager is demonstrated not only in managing the teams, but largely in watching external changes and responding to them with appropriate actions, if needed.
- Some of the most important stakeholders are as follows:
 - o Client of the project
 - o Society, environmentalists and self-help groups
 - o Groups with vested interests
 - o Suppliers
 - o Transporters
 - o Regulators
 - o Government hierarchy
- Managing relationship with all stakeholders at different stages of the project construction is an essential part of the role of a project manager. The relationship management, of course has to be based on the relative importance of each stakeholder.
- Effective teams have a higher productivity than groups working on the same task. The reason being that a team can leverage off each others' strengths and compensate for each others' weaknesses. Ensuring a balanced mix of all kinds of human resource will result in an effective team delivering a good project.
- Organizational behaviour is concerned with people's thoughts, feelings, emotions and actions in a work setting. Organizational behaviour can be defined as 'the study of human behaviour in organizational settings, the interface between human behaviour and the organizational context, and the organization itself'.

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- The team leaders or project managers should formulate strategies to create and maintain enthusiasm among members.
- The project planning process involves a number of stages. They are as follows:
 - (a) Identification and Prioritization of Business Needs
 - (b) Generate a Thorough Set of Requirements
 - (c) Breaking the Set of Requirements into Tasks
 - (d) Estimating Milestones of the Set of Tasks
 - (e) Undertake Resource Analysis to Determine Cost
 - (f) Create the Project Planning Documentation
 - (g) Project Plan Audit
- A work breakdown structure (WBS), in project management and systems engineering, is a deliverable oriented decomposition of a project into smaller components. It defines and groups a project's discrete work elements in a way that helps organize and define the total work scope of the project.
- The work breakdown structure provides a common framework for the natural development of the overall planning and control of a contract and is the basis for dividing work into definable increments from which the statement of work can be developed and technical, schedule, cost, and labor hour reporting can be established.

3.8 KEY WORDS

- **Stakeholders:** They are people who have an interest in a company and can either affect or be affected by the business. The primary stakeholders in a typical corporation are its investors, employees, customers, and suppliers.
- **Organizational behaviour:** It can be defined as 'the study of human behaviour in organizational settings, the interface between human behaviour and the organizational context, and the organization itself'.
- **Logistics:** It is the business of transporting, supplying and delivering goods.
- **Work breakdown structure:** It is a deliverable oriented decomposition of a project into smaller components. It defines and groups a project's discrete work elements in a way that helps organize and define the total work scope of the project.

3.9 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What do you mean by project planning?
2. What are the steps taken by project managers to motivate team members?
3. Write a short note on project planning documentation.
4. What are the advantages of a work breakdown structure?

Long-Answer Questions

1. Discuss in detail the need for project planning.
2. Examine the role of the project manager in maintaining the interest of the shareholders and building team motivation.
3. Explain the different stages of the project planning process.

3.10 FURTHER READINGS

- Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.
- Kerzner, Harold, R. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.
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UNIT 4 ORGANIZATIONAL STRUCTURE AND ORGANIZATIONAL ISSUES

Structure

- 4.0 Introduction
- 4.1 Objectives
- 4.2 Concept of Organizational Structure
- 4.3 Roles and Responsibilities of Project Leader
 - 4.3.1 Relationship between Project Manager and Line Manager
- 4.4 Leadership Styles for Project Managers
- 4.5 Conflict Resolution
- 4.6 Team Management and Diversity Management
- 4.7 Change Management
- 4.8 Answers to Check Your Progress Questions
- 4.9 Summary
- 4.10 Key Words
- 4.11 Self Assessment Questions and Exercises
- 4.12 Further Readings

4.0 INTRODUCTION

Organizational structure explains how the work is divided and accomplished in an organization. Jobs need to be differentiated on the basis of the nature and specialization of the job. Most companies rely on those who have good leadership skills. Leadership involves setting a vision and a goal as well as inspiring people towards the desired change in the organization. The different types of leadership styles are autocratic leadership, participative leadership, laissez-faire leadership, etc. Not only should organization attempt to resolve conflicts within the organization, but also ensure that there are healthy conflicts. The importance of diversity management and change management will be discussed in the unit.

4.1 OBJECTIVES

After going through this unit, you will be able to:

- Discuss the concept of organizational structure
- Explain the roles and responsibilities of project manager
- Examine the advantages and disadvantages of different types of leadership style
- Discuss conflict resolution, diversity management and change management

4.2 CONCEPT OF ORGANIZATIONAL STRUCTURE

Stephen P. Robbins has defined organizational structure as 'how job tasks are formally divided, grouped and coordinated.' It tells how specialised and non-specialised tasks are performed. The framework of an organization is the structure, wherein the job of each and every person is defined, described and coordinated to achieve the organizational goals. The control, command, division of work and placement of jobs are considered under the organizational structure. Centralisation, differentiation and related factors are considered under the organizational structure. The important features of organizational structure are also discussed in this unit.

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Characteristics of Organizational Structure

Organizational structure is the differentiation of functions to facilitate the achievement of goals. Jobs are differentiated according to the nature and specialisation of the jobs. For example, marketing experts have marketing functions and financial experts look after the financial functions of the organization. The main characteristics of the organizational structure are differentiation, standardisation, specialisation, departmentalisation, chain of command and centralisation. The impact of various characteristics are visible on communication network, informed group formation, attitudes of employees, motivation, leadership and so on.

Differentiation: Jobs are differentiated for achieving the goals more efficiently. Interrelated tasks are put under one group. Thus, many job groups or differentiations are developed under structure. The jobs are subdivided into horizontal and vertical forms.

Horizontal differentiation: The division of labour is the best example of horizontal differentiation. The jobs can be divided on the basis of purposes, process, persons and place. Product line change or departmentation is horizontal differentiation. Technological changes are differentiation for the improvement of the process. People are motivated to perform their jobs in an effective manner. Decentralisation is another form of organizational structure.

Vertical differentiation: Vertical differentiation deals with hierarchy, power influence, authority, responsibility and span of control. Level and function are vertical differentiation. Vertical distance is created between the individuals and groups. Scalar or chain of command is used for differentiation. Generally, five levels of authority are observed, viz. top, middle, lower, supervisors and employees. They have different goals and activities. Their function is commanded and controlled accordingly. Each cadre has a different authority and responsibility which are exercised by them for achieving the organizational goals.

Standardisation: The organizational structure is formalised or standardised for simplicity and efficiency. The process input and the output are uniform. There is minimum amount of discretion. Jobs are explicitly defined and described.

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Employees have the least amount of freedom under the standardised structure. They adopt a stereotype process. If the formalisation is low, the employees are free to proceed according to their liking. They behave in a free atmosphere. In the case of standardisation, the behaviour is known. They have to perform according to the set rules of the work process. A less standardised structure gives more freedom to the employees. They exercise discretion in their work. Employees do not have alternatives to behave differently in the case of a standardised structure. This structure differs according to the nature of work. More freedom in behaviour is possible with the less standardised structure and less freedom is there in the case of a standardised structure.

Specialisation: Specialisation is another component of organizational structure. Each and every part of the whole work is done by specialised people. The total work is broken up into small parts and the responsibility of performance of each part is assigned to experts. This makes people more specialised and active. There may be further sub-divisions of each part to make it more specialised. Each step is completed by skilled labour. The specialisation of whole activity is possible by breaking the total work into separate parts, sub-divisions and steps. Specialisation makes all the work more useful, whether it involves skilled or unskilled functions. Even highly sophisticated tasks can be easily performed by a specialised structure. Time, money and energy are effectively utilised through specialisation. The skills of the employees increases by repetition. Complex and sophisticated operations are performed easily by acquiring skills and specialisation. It is a well-known fact that the level of specialisation increases along with the technological development. Specialisation has increased performance and employees' satisfaction.

Departmentalisation: Specialisation is grouped together to form a job which is to be performed by a department. The next step of specialisation is to combine similar activities into a group. Departmentalisation is grouping of specialisation into specific functions. Different functions are grouped on a similar basis. For example, engineering, accounting, personnel, etc. are the important functions which are grouped in separate departments known by their respective functions. Departmentalisation is used in all types of organizations according to their objectives and functions. For example, a university has different departments such as academic, administrative, teaching, etc. Similarly, other organizations have different types of departments based on their objectives and activities. The departmentalisation is done on several bases such as product, process, place, customer services and administration.

Product departmentalisation: Departments are divided on the basis of the product. An organization engaged in cloth manufacturing has ready made department, cloth department, cotton textile department, synthetic fibre department. Each department has its own head who looks after the total functions of his department. The accountability, authority and responsibility are specifically assigned for each department.

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Process departmentalisation: The product department itself is divided into several sub departments. The process of organization is the basis of departmentalisation. For example, proofreading, printing, machine repairing and setting of places are the important departments of a newspaper printing organization. Each process requires different skills. The people working on a process become specialised within a reasonable period.

Place departmentalisation: The department is developed according to territory, geographical areas and place of functions. The departments in one state and other states have different functions according to their nature of work. Regional departments have their specialities in performance and functions. Head office and branch offices are the basic examples of place departmentalisation.

Customer service departmentalisation: Departments are formed according to the needs of the customers' services. For example, the Bata Shoe Company in India has different showrooms and retail stores to meet the requirements of the customers. Wholesaling, retailing and departmental stores are the main departments that cater to the needs of customers. Efforts are made to satisfy the customers' needs in every department. If it is not satisfied, the customers are requested to consult some specialised personnel in higher departments.

Administration departmentalisation: An organization develops its own administration department. The personnel department, secretarial department, training and placement department are the various examples of administrative departments. Accounting, auditing, salary, provident fund, pension, etc. are other examples of such departments. Head office, zonal offices, divisional offices and branch offices are glaring examples of departmentalisation, on the basis of administration. Departments looking after government policy, taxation, social responsibility and human resource development are functioning in big organizations in India.

Chain of command: The organizational structure decides the mode of the chain of command. Line organization has a scalar chain of command and the functional organization has a supervisory command. The chain of command is the unbroken line of authority that extends from the top of the organization to the lowest echelon. It decides the amount of authority, responsibility and accountability at each level of the chain. The delegation of authority flows from a higher to a lower level in different forms in separate organizations. Authority is the legalised power. The higher level asks the lower level to perform some functions which are expected to be carried out by the lower manager or employees. In the line organization, the command is by only one person to whom the lower manager is liable to report. It is known as the unity of command. In a functional organization, the employees are accountable to the functional heads. There may be a number of functional heads depending upon the functional aspects. It is known as the functional command.

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The chain of command decides the span of control which is the number of subordinates a manager can effectively and efficiently direct. The span of control is decided by the formula, $\text{span of control} = n \left[\frac{2^n}{2} + (n - 1) \right]$ where 'n' is the number of employees. If the number of employees is 2, the line of control or span of control will be 6. If the number of employees is 3, the span of control will be 18 because of their direct relationship, group relationship and cross relationship. The number of employees under a supervisor influences the effectiveness. A manager can keep close contact if the number of employees is smaller.

Centralisation: The organizational structure is also based on centralisation and decentralisation. Centralisation is the degree to which decision making is concentrated at a single point. It is the right or authority which is confined to a few people in the organization. The top management, keeps its decision-making power in itself under centralisation. On the contrary, when a lower manager is given the decision making power, it is decentralisation. Under decentralisation, decision is more effective and quick. Modern organizations mainly adopt decentralisation for flexibility and responsiveness. Lower managers are closer to the employees.

Check Your Progress

1. What are the examples of administrative departments?
2. What is centralisation?

4.3 ROLES AND RESPONSIBILITIES OF PROJECT LEADER

If there is any single factor that differentiates between successful and unsuccessful organizations, it could be considered as dynamic and effective leadership or the lack of it. In managing, no matter how competent you are as a manager and a decision maker, your ultimate success will depend upon whether you are able to lead others.

Leadership is defined as the 'ability to influence people toward the accomplishment of goals'. It is associated with the determination of the goals, a vision for the future and the process of change to reach the goals and the future. Although the terms managers and leaders are often used interchangeably in management literature, there are some inherent differences between management and leadership. Managers perform several administrative functions in addition to leadership, such as planning, organizing and controlling. Leadership involves vision, motivation, setting a direction and inspiring people and driving change within the organization. Management and leadership are conceptually independent of each other. Many companies start with a strong leadership but eventually fail because

leaders lack the managerial skills. Companies have high rate of success when leadership skills and management skills complement each other.

The following attributes of leaders also distinguish them from managers:

1. **Leader have followers:** While employees may comply with manager's directives, such compliance may be done out of duty rather than commitment. Motivating and influencing people to move towards a common goal are all essential elements of management, but the willingness and the enthusiasm of the followers to be led highlights a special quality that puts a leader high above others.
2. **Leaders have emotional appeal:** Abraham Zaleznik points out differences in our expectations of managers and leaders. Managers are expected to be rational decision makers while leaders are expected to be charismatic, exciting, and visionary. Leaders can inspire people and bring about a behavioural change.
3. **Leaders meet the needs of followers.** While managers are expected to be more concerned with attaining organizational goals, leaders are expected to be more sensitive to the needs of the followers.

The following exhibit shows some of the key elements that identify the differences between managers and leaders.

Leaders	Managers
• Innovate	• Administer
• Develop	• Maintain
• Inspire	• Control
• Originate	• Imitate
• Change the status quo	• Accept the status quo.

Some useful practices in vision

- Team members in a project must be made to better understand and support the corporate vision and values, understand the purpose of the project, and how the project supports the corporate vision and goals as well as customer needs.
- Team members involved in a project should figure out whether work supports project goals, whether their interests align with that of the project and whether their career objective is being realized.
- There should be clarity of communication regarding issues of project vision, individual member's aspiration, work meaning, and any other problems raised by any of the team member.
- Team members should be frequently or otherwise convinced about quality of their work and their importance in the team.

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4.3.1 Relationship between Project Manager and Line Manager

Project manager and line manager work in sync with each other to get project activities achieved within the constraint of allocated cost limited, time and quality parameters. It is the responsibility of the project manager to achieve the project objectives within the constraints of time, cost and quality. For this, the project manager requires all kinds of human and non-human resources like equipment, money, materials, man-power, information and technology, etc.

Line managers reports to the project manager and is responsible to oversee the business operations and other employees. Line managers are responsible for supervising and managing workers on a daily basis and acts as a liaison between employees and Project Manager. Some of the functions of a line manager includes:

- Filling team positions by recruitments and hiring
- Providing training and support to new hires
- Cross-training employees to ensure job rotation
- Providing performance feedback and coaching to all team members
- Measuring individual and team performance against targets.
- Communicating and ensuring understanding of functional or departmental goals
- Ensuring quality standards for all processes on their team
- Identifying the need for corrective actions when necessary
- Evaluating overall team and individual performance and delivering performance reviews
- Engaging and coordinating with other line managers across the organization
- Providing reports on productivity and other performance indicators to senior management

For the successful completion of a project and its smooth operations, both project manager and line manager works in coordination. Project manager does not control the resources directly; these are collected by line manager and are assigned directly to resources to projects. Those resources that are temporarily loaned by line managers are under the control of the project manager. The project manager keep a track on the activities and task of line manager and keep reminding the line manager of the time and cost constraints of the project. The same is needed for better coordination and control of the resources. If required, the project manager also negotiates with the line manager for resources pooling. Following are the purposes for which the project manager always requires to interact with the line managers:

- To get the required resources from functional department on time.
- To resolve the issues related to the project.

- To achieve balance between line department's work and project works.
- To get good favor and support of line managers while negotiating with various parties in connection with project work.
- To get technical and managerial support.

The coordination between project manager and line manager is very crucial for the effective project management. The success of a project is highly dependent on their working relationship and hence there must be coordination, better communication, reporting and negotiation between them. The project manager can also support the line manager in training him/ her in the following areas:

- Training in understanding of quantitative tools and techniques for planning, scheduling and controlling work.
- Encouraging open communication
- Restructuring the reporting structure if required for faster communication and tackling the problems of dual reporting system.

Check Your Progress

3. Define leadership.
4. State any two functions of the line manager.

4.4 LEADERSHIP STYLES FOR PROJECT MANAGERS

Leadership styles can be classified according to the philosophy of the leaders. What the leader does determines how well he leads. A style of leadership is a 'relatively enduring set of behaviour which is a characteristic of the individuals, regardless of the situation.' Some of the more significant leadership styles are discussed as follows:

Autocratic or Dictatorial Leadership

Autocratic leaders keep the decision making authority and control in their own hands and assume full responsibility for all actions. They structure the entire work situation in their own way and expect the workers to follow their orders. They tolerate no deviation from their orders. The subordinates are required to implement the instructions of their leaders without question. They are entirely dependent on their leader and the output suffers in the absence of the leader.

The autocratic leadership style ranges from tough and highly dictatorial to paternalistic, depending upon whether the leader's motivational approach is threat and punishment or appreciation and rewards. In highly autocratic situations, the subordinates develop a sense of insecurity, frustration and low morale. They are induced to avoid responsibility, initiative and innovative behaviour. The autocratic

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leader believes that his leadership is based upon the authority conferred upon him by some source such as his position, knowledge, strength or the power to punish and reward. Some of the advantages and disadvantages of autocratic leadership are as follows:

Advantages

The advantages of autocratic leadership are as follows:

- (a) Autocratic leadership is useful when the subordinates are new on the job and have had no experience either in the managerial decision-making process or in performing without active supervision.
- (b) It can increase efficiency and even morale when appropriate and get quicker results, especially in a crisis or emergency when the decision must be taken immediately.
- (c) Paternalistic leadership is useful when the subordinate are not interested in seeking responsibility or when they feel insecure at the job or when they work better under clear and detailed directives.
- (d) It is useful when the chain of command and the division of work is clearly understood by all and there is little room for error in the final accomplishment.

Disadvantages

The disadvantages of autocratic leadership are given below:

- (a) One-way communication without feedback leads to misunderstanding and communications breakdown.
- (b) An autocratic leader makes his own decisions which can be very dangerous in this age of technological and sociological complexity.
- (c) It inhibits the subordinate's freedom and fails to develop his commitment to the goals and objectives of the organization.
- (d) It creates an environment which provides for worker resentment and therefore creates problems with their morale resulting in poor productivity in the long run.
- (e) It is unsuitable when the workforce is knowledgeable about their jobs and the job calls for team work and cooperative spirit.

Participative or Democratic Leadership

In this type of leadership, the subordinates are consulted and their feedback is taken into the decision-making process. The leader's job is primarily of a moderator, even though he makes the final decision and he alone is responsible for the results. The management recognizes that the subordinates are equipped with talents and abilities and that they are capable of bringing new ideas and new methodologies to the work setting. Thus, the group members are encouraged to demonstrate initiative and creativity and take intelligent interest in setting plans and policies and have

maximum participation in decision making. This ensures better management-labour relations, higher morale and greater job satisfaction. This type of leadership is especially effective when the workforce is experienced and dedicated and is able to work independently with least directives, thereby developing a climate which is conducive to the growth and development of the organization as well as the individual's personality. The feasibility and usefulness of the participative decision-making style is dependent on the following factors:

1. Participative decision-making process is time consuming. Therefore, there should be no urgency to the decision.
2. The cost of participation of subordinates in the decision-making should not be more than the benefits derived from the decision.
3. The input from the subordinates should be free from any fear of repercussions in case such input is in conflict with the views held by the management.
4. The participation of subordinates should not be of such a degree as to be perceived as a threat to the formal authority of management.
5. Subordinates should be sufficiently responsible so that there is no leakage of confidential information to outside elements.

Advantages of participative leadership

In such situations, the participative style of decision-making has several advantages. These are as follows:

- (a) Active participation in the managerial operations by labour assures rising productivity and satisfaction.
- (b) Workers develop a greater sense of self-esteem due to the importance given to their ideas and their contribution.
- (c) The employees become more committed to changes that may be brought about by policy changes, since they themselves participated in bringing about these changes.
- (d) Leadership induces confidence, cooperation and loyalty among workers.
- (e) It results in higher employee morale.
- (f) It increases the participants' understanding of each other which results in greater tolerance and patience towards others.

It has been demonstrated by numerous research that participation by subordinates improves quality of work, enhances easy acceptance of changes in the organization and improves morale and loyalty.

Disadvantages of participative leadership

Participative leadership has several disadvantages as well. Some of these are as follows:

- (a) Democratic leadership requires some favourable conditions in that the labour must be literate, informed and organized. This is not always possible.

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- (b) This approach assumes that all workers are genuinely interested in the organization and that their individual goals are successfully fused with the organizational goals. This assumption may not always be valid.
- (c) There must be total trust on the part of management as well as employees. Some employees may consider this approach simply as an attempt to manipulate them. Accordingly, the employees must be fully receptive to this approach in order to make it meaningful.
- (d) Some group members may feel alienated if their ideas are not accepted for action. This may create a feeling of frustration and ill-will.
- (e) This approach is very time consuming and too many viewpoints and ideas may make the solid decision more difficult. This may be a source of frustration to impatient management.
- (f) Some managers may be uncomfortable with this approach because they may fear an erosion of their power base and their control over labour.
- (g) This approach relies heavily on incentives and motivation of recognition, appreciation, status and prestige. However, labour may be interested in financial incentives instead of prestige.

Laissez-Faire or Free-Reign Leadership

In this type of leadership, the leader is just a figure-head and does not give any direction. He delegates the authority to subordinates so that they must plan, motivate, control and otherwise be responsible for their own actions. The leader acts principally as a liaison between the group and the outside elements and supplies necessary materials and information to the group members. He lets the subordinates develop their own techniques for accomplishing goals within the generalized organizational policies and objectives. The leader participates very little and instead of leading and directing, he becomes just one of the members. He does not attempt to intervene or regulate or control and there is complete group or individual freedom in decision-making. This type of leadership is highly effective when the group members are highly intelligent and are fully aware of their roles and responsibilities and have the knowledge and skills to accomplish these tasks without direct supervision.

This type of leadership is evident in research laboratories where the scientists are fairly free to conduct their research and make their decisions. Similarly, in a university or a college, the chairperson of a division does not interfere in the professor's teaching method, but only assigns the courses to be taught. From then onwards, the professors are very much their own leaders.

Advantages

The advantages of free-reign leadership are as follows:

- (a) It creates an environment of freedom, individuality as well as team spirit.
- (b) It is highly creative with a free and informal work environment.

- (c) This approach is very useful where people are highly motivated and achievement-oriented.

Disadvantages

The disadvantages of free-reign leadership are given below:

- (a) It may result in disorganized activities which may lead to inefficiency and chaos.
- (b) Insecurity and frustration may develop due to lack of specific decision-making authority and guidance.
- (c) The team spirit may suffer due to the possible presence of some uncooperative members.
- (d) Some members may put their own interests above the group and team interests.

Personal Characteristics of Leaders

Leadership is an intangible quality and its effectiveness can best be judged by the behaviour and attitudes of followers. Even though personal backgrounds and personalities differ widely, some of the factors such as education and socioeconomic status are poor indicators of the judgements of successful leaders. However, some behavioural characteristics may be common to most of the successful and effective leaders. Some of these characteristics are as follows:

- (i) **Ability to inspire others:** This ability may be due to an internal 'charisma' which is an inborn trait and may not be a learnable factor.
- (ii) **Problem solving skills:** An effective leader develops the patience and ability to look at the problem from various angles and get down to the cause of the problem. He tries to solve the problem from its roots rather than the symptoms of the problem.
- (iii) **Emotional maturity:** Emotional stability and maturity is a major ingredient for effective leadership. It pertains to good adjustment to life, calm, cool and calculated reaction to undesirable situations and obstacles and normal acceptance of success as well as failure. Such leaders are self-confident, rational and open hearted towards differences in opinion and opposing viewpoints. They generally have a happy family life and have a balanced outlook towards life and the world. They are warm and sensitive and not vindictive in nature.
- (iv) **Ability to understand human behaviour:** A leader must understand the needs, desires and behaviour of his subordinates and show respect for such desires. He should be emotionally supportive and careful enough to avoid ego-threatening behaviour. He must give credit to subordinates when their efforts are successful.

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- (v) **Verbal assertiveness:** A leader must be an effective orator and must be confident of his views and opinions. He must communicate his views honestly and in a straightforward manner without fear of consequences.
- (vi) **Willingness to take risks:** Routine work, no matter how well done, never makes a leader. Successful leaders always charter the unknown. They must accept and seek new challenges. However, the risks must be calculated ones and the outcomes of actions must be reasonably predicted. Should these risks result in failure, a leader must take full blame and responsibility and not shift the blame on others, even though they may be operative factors. He must be willing to tolerate frustration and defeat and learn from these failures.
- (vii) **Dedication to organizational goals:** A leader must demonstrate his dedication and commitment to the organization's mission, goals and objectives by hard work and self-sacrifice. He must make sure that his followers fully understand the organizational objectives and are equally dedicated and willing to work for these objectives.
- (viii) **Skill in the art of compromise:** Settling differences is a valid part of leadership and genuine differences must be solved by compromise and consensus. This will induce faith in the fairness of the leader. He must be willing to give in where necessary and must be able to take criticism with grace. However, he must not compromise for the sake of compromising or smooth sailing only. He must be willing to take a stand on controversial issues and accept the consequences of his stand.

Tactical Leadership

Tactical leadership is the ability of a leader to use past experiences to understand what specific actions need to be taken to achieve the organization's goals.

Tactical leadership is the concept of taking one's leadership experiences, and making effective use of them in a workplace setting. It also involves the application of new ideas to solve old problems. The tactical leader uses the skills they have learned to train, and prepare, subordinates to accomplish goals and objectives.

Check Your Progress

- 5. State two disadvantages of autocratic leadership.
- 6. Mention two advantages of participative leadership.

4.5 CONFLICT RESOLUTION

Except in situations where the conflict can lead to competition and creativity, it should be resolved as soon as it has developed and all efforts should be made to prevent it from developing.

Preventing conflict

Some of the preventive measures that the management can take, according to Schein are:

- (i) **Goal structure:** Goals should be clearly defined and the role and contribution of each unit towards the organizational goal must be clearly identified. All units and the individuals in these units must be aware of the importance of their role and such importance must be fully recognised.
- (ii) **Rewards system:** The compensation system should be such that it does not create individual competition or conflict within the unit. It should be appropriate and proportionate to the group efforts and reflect the degree of interdependence among units where necessary.
- (iii) **Trust and communication:** The greater the trust among the members of the unit, the more honest and open the communication among them would be. Individuals and units should be encouraged to communicate openly with each other so that they can all understand each other, each other's problems and help each other when necessary.
- (iv) **Coordination:** Coordination is the next step to communication. Properly coordinated activities reduce conflict. Wherever there are problems in coordination, a special liaison office should be established to assist such coordination.

Resolving behavioural conflict

Various researchers have identified five primary strategies for dealing with and reducing the impact of behavioural conflict. Even though different authors have given different terminology to describe these strategies, the basic content and approach of these strategies remain the same. These are as follows:

- (i) **Ignoring the conflict:** In certain situations, it may be advisable to take a passive role and avoid it all together. From the manager's point of view, it may be especially necessary, particularly when getting involved in a situation would provoke further controversy or when conflict is so trivial in nature that it would not be worth the manager's time to get involved and try to solve it. It could also be that the conflict is so fundamental to the position of the parties involved that it may be best either to leave it to them to solve it or to let events take their own course. The parties involved in the conflict may themselves prefer to avoid conflict, especially if they are emotionally upset by the tension that it has caused. Thus, people may try to get away from conflict causing situations.
- (ii) **Smoothing:** Smoothing simply means covering up the conflict by appealing to the need for unity rather than addressing the issue of conflict itself. An individual with internal conflict may try to 'count his blessings' and forget about the conflict. If two parties have a conflict within the organization, the

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supervisor may try to calm things down by being understanding and supportive to both parties and appealing to them for cooperation. The supervisor does not ignore or withdraw from the conflict nor does he try to address and solve the conflict but expresses hope that ‘everything will work out for the best of all.’ Since the problem is never addressed, the emotions may build up further and suddenly explode. Thus, smoothing provides only a temporary solution and conflict may resurface again in the course of time. Smoothing is a more sensitive approach than avoiding in that as long as the parties agree that not showing conflict has more benefits than showing conflict, then such conflict can be avoided.

- (iii) **Compromising:** A compromise in the conflict is reached by balancing the demands of the conflicting parties and bargaining in a ‘give and take’ position to reach a solution. Each party gives up something and also gains something. The technique of conflict resolution is very common in negotiations between the labour unions and management. It has become customary for the union to ask for more than what they are willing to accept and for management to offer less than what they are willing to give in the initial stages. Then, through the process of negotiating and bargaining, mostly in the presence of arbitrators, they reach a solution by compromising. This type of compromise is known as integrative bargaining in which both sides win in a way.

Compromising is a useful technique, particularly when two parties have relatively equal power, thus no party can force its viewpoint on the other and the only solution is to compromise. It is also useful when there are time constraints. If the problems are complex and multifaceted, and the time is limited to solve them, it might be in the interest of conflicting parties to reach a compromise.

- (iv) **Forcing:** As Webber puts it, ‘the simplest conceivable resolution is the elimination of the other party—to force opponents to flee and give up the fight—or slay them.’ This is a technique of domination where the dominator has the power and authority to enforce his own views over the opposing conflicting party. This technique is potentially effective in situations such as a president of a company firing a manager because he is considered to be a trouble-maker and conflict creator. This technique always ends up in one party being a loser and the other party being a clear winner. Many professors in colleges and universities have lost promotions and tenured reappointments because they could not get along well with their respective chairpersons of the departments and had conflicts with them. This approach causes resentment and hostility and can backfire. Thus, management must look for better alternatives, if these become available.
- (v) **Problem-solving:** This technique involves ‘confronting the conflict’ in order to seek the best solution to the problem. This approach objectively assumes that in all organizations, no matter how well they are managed, there will be

difference of opinions that must be resolved through discussions and respect for differing viewpoints. In general, this technique is very useful in resolving conflicts arising out of semantic misunderstandings. It is not so effective in resolving non-communicative types of conflicts such as those that are based on differing value systems, where it may even intensify differences and disagreements. In the long run, however, it is better to solve conflicts and take such preventive measures that would reduce the likelihood of such conflicts surfacing again.

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Resolving structural based conflicts

The structural based conflicts are built around organizational environments and can be resolved or prevented by redesigning organizational structure and work-flow. A general strategy would be to move towards as much decentralization as possible so that most of the disputes can be settled at the lower levels in the organization, and faster too.

Since interdependency is one of the major causes of conflict, it is necessary to identify and clarify poorly defined and poorly arranged interdependencies or to make these adequately understood and reliable. This can be achieved through unifying the work-flow. This work-flow can be designed either to increase the interdependencies or to eliminate them entirely. Increased interdependencies can be achieved through more frequent contacts and improved coordinating mechanisms. This would make the two interdependent units act as a single unit thus eliminating the cause of conflict. The other extreme could be to make the two units totally independent of one another. For example, in the case of units building an automobile engine, instead of an assembly line operation in which each person or unit is involved in sequential assembly so that each unit depends upon the work of the previous units, each major unit can work on the entire engine at the same time.

However, these extremes are not in common practice. More often than not the strategy would be to reduce the interdependency between individuals or groups. A common approach to do that is by 'buffering'. Buffering requires that sufficient inventories be kept on hand between interrelated units so that they always have the materials to work with, thus reducing their interdependency. Another cause of conflict, is the undefined, unclear and ambiguous job expectation. It is important to clarify what each individual and each subunit is expected to accomplish. This would include authority-responsibility relationship and a clear line of hierarchy. In addition, policies, procedures and rules should be clearly established and all communication channels must be kept open so that each person knows exactly what role he has to play in the hierarchical structure. This would avoid situations in which none of the two units does the job because each thought the other was supposed to do or both units do the same job thus, duplicating efforts due to misunderstanding. Thus, if each subordinate is fully aware of their responsibility, then such problems would not occur.

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How to solve conflict arising due to competition for scarce resources? Conflicts will occur whenever the wants and needs of two or more parties are greater than the sum of the firm's resources available for allocation. These resources may be in the form of a pay raise, promotion, office space, office equipment and so on. This conflict can be reduced by planning ahead about the proper distribution of such resources, instead of making haphazard and last minute allocations.

The conflict between different departments may be managed by establishing liaison. Liaison officers are those who are neutral in their outlook and are sympathetic to both parties and kind of 'speak the language' of both groups. They do not have a vested interest in any of these groups. According to studies conducted by Sykes and Bates, it was shown that in one company where there was evident conflict between sales and manufacturing, which are interdependent units, the problem was solved by establishing a demand analysis and sales order liaison office. The liaison group handled all communication for sales and resolved issues such as sales requirements, production capacity, pricing and delivery schedules.

Since one of the major causes of conflict is lack of proper knowledge and facts about how other people think and act, it may be a good idea to let the individuals work with different groups so that they know and understand each other better. Care should be taken however that these individuals are technically capable of fitting in these various groups. This mutual understanding will result in trust and respect, thus, reducing the likelihood of conflict. This understanding can also be achieved by serving as members of the various committees. As individuals from various work units get to know each other better through the membership in the same committee, it leads to increased tolerance and understanding of different viewpoints as well as a realization that basically all units are pursuing similar objectives and same overall goal.

Stimulating conflict

It has been pointed out earlier that under certain circumstances, conflict is necessary and desirable in order to create changes and challenges within the organization. In such situations, the management should adopt a policy of conflict stimulation so that it encourages involvement and innovation. How does the manager recognise a situation that is vulnerable to conflict stimulation? Some of the factors for creating conflict are: too much satisfaction with the status quo, low rate of employee turnover, shortage of new ideas, strong resistance to change, friendly relations taking precedence over organizational goals and excessive efforts at avoiding conflict. Some of the ways of stimulating conflict as suggested by S.P. Robbins are as follows:

- (i) **Appoint managers who support change:** Some highly authoritative managers are very conservative in their outlook and tend to suppress opposing viewpoints. Accordingly, change-oriented managers should be selected and placed in such positions that encourage innovation and change from the status quo.

- (ii) **Encourage competition:** Competition, if managed properly can enhance conflict which would be beneficial to the organization. Such competition can be created by tying incentives to performance, recognition of efforts, bonuses for higher performance and status enhancement. Such competition and conflict would result in new ideas regarding improving productivity.
- (iii) **Manipulate scarcity:** Let the various individuals and groups compete for scarce resources. This would cause conflict and make the individuals and groups do their best in order to fully utilise such resources. For example, one company president felt that the budget allocations to various departments did not reflect changing priorities and accordingly, a zero-based budget system was introduced so that each department had to justify its current budget regardless of the past allocations. This created fierce competition and conflict and resulted in changes in funds allocation that were beneficial to the organization.
- (iv) **Play on status differences:** Sometimes, ignoring the senior staff members and giving visible responsibilities to junior members makes the senior staff work harder to prove that they are better than the junior staff members. In one business school, the dean appointed a low-status assistant professor incharge of the curriculum. The senior professors resented having to answer to the junior professor. This caused conflict and in order to assert their superiority, the senior professors initiated a series of changes that revitalised the entire MBA programme.

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Interpersonal trust building

While there are a number of behavioural as well as organizational factors, as discussed before that contribute to the existence of conflict, there may be just one single factor that may be highly contributory to reducing that conflict. This factor is 'trust'. Trust is, highly intangible element but very important in our civilized living. Its presence or absence can govern our inter-personal behaviour to large extent. Our ability to trust has a great impact on our working lives, our family interactions and our achievement of personal and organizational goals.

Since trust is a function of behaviour, such behaviours that lead to defensiveness must be identified and modified. These defensive or aggressive behaviours create a climate that is conducive to mistrust, thus, leading to conflict in interpersonal areas. Jack Gibb has identified certain behaviours that he calls 'aggressive' behaviours that should be avoided and certain behaviours which he calls 'supportive' behaviours that tend to reduce defensiveness and conflict and should be promoted.

Dr. John K. Stout of the university of Scranton, writing in 'Supervisory Management' (February 1984), suggested that these behaviours are not necessarily mutually exclusive, nor should all the aggressive behaviours be avoided under all circumstances, but in general the supportive behaviour attitudes should be adopted as much as possible. These behaviours are briefly described as follows:

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Aggressive versus supportive behaviours

The various points in aggressive versus supportive behaviours are given below:

- (i) **Evaluative versus descriptive behaviour:** Performance evaluations based upon emotional judgement and tainted by prejudice and residual anger from any previous encounters destroy trust. Making evaluations always brings in subjective opinions and subjective opinions relate to personal relationship rather than operations and facts. Descriptive attitude, on the other hand, simply describes factual elements that are visible, observable and verifiable, without reading behind the lines or making judgements about motives. Using the correct words to describe these activities builds up a feeling of fairness, equity and trust and this, in turn, reduces conflict.
- (ii) **Controlling versus problem-oriented behaviour:** Controlling attitude is highly authoritative and makes the subordinates feel like machines rather than human beings. The contribution of subordinates is limited to what the controller allows and thus, stifles creativity, leading to resentment and conflict.

Problem-oriented behaviour, on the contrary looks for solutions in which all can participate. This will result in new answers and unique opportunities and this approach implies mutuality that builds dedication and commitment.
- (iii) **Using a strategy versus spontaneous behaviour:** A strategy is a carefully structured set of directions that gives the management a tool for maneuverability so that it can manipulate and gear others towards a predetermined objective, which may be resented by subordinates since they fear loss of autonomy.

Spontaneous interactions on the other hand are open, free flowing and result in open and honest communications in exploring each other's needs and viewpoints, exchanging information and ideas and developing a work environment of mutual trust and caring.
- (iv) **Neutral versus empathetic behaviours:** Neutral behaviour, though advisable in many situations, is considered as one of indifference and non-caring. All of us need friendship, respect and affections so we always want others to be on our side. Accordingly, the attitude of neutrality seems so impersonal that it is detrimental to the feelings of trust.

Empathy by contrast is the natural desire to get involved with other people, to share their feelings and emotions, to be interested in their needs and problems, to care and to understand them and their beliefs and attitudes and to be sincere and friendly. In this 'me too' environment, a friendly relationship is always welcome.
- (v) **Superiority versus equality behaviour:** Feelings of superiority based upon rank, prestige, power and authority are highly threatening to others

and if this power is openly exhibited in talk and actions, it creates not only envy but also resentment. For example, the presence of a policeman at your door creates an initial fear because of the power and authority assigned to the police force.

Exhibiting equality, on the contrary, enhances interpersonal trust. We always feel more comfortable in the company of our own age group. A sense of equality reduces the complex feeling of inferiority or superiority, both of which are detrimental to the environment of trust.

- (vi) **Dogmatic versus open-minded behaviour:** A dogmatic person is one who is set in his own ways and is highly opinionated and does not leave any ground for cultivating genuine interaction with others because genuine interaction is based upon 'give and take' attitude that a highly dogmatic person does not possess. As a result, the relationships remain superficial and trust is shallow, if any.

The open-minded individual, on the other hand, is adventurous, takes risks and is willing to experiment with new ideas and thoughts. In most bargaining and negotiating sessions, we are always advised to 'keep our minds open', so that we are receptive to any idea for discussion and adaptation. An open-minded person is like an 'open book' and is highly predictable resulting in respect and trust.

These types of supportive behaviours on the part of management prevent conflict to a large degree and help in resolving conflict if it develops, in a mutually beneficial way. This is a win-win situation in which all parties come out as winners. In order to achieve this situation, the management can initiate a number of steps. First, the management must create a social environment in the work situation that is conducive to mutual problem-solving. This is fundamental to creating trust among people, especially trust among workers. This would involve open channels of communication, respect for each other's views and an open-minded attitude on the part of management. Second, all efforts should be made to make the parties concerned, sensitive to each other's attitudes, values and needs. This, according to Nichols and Steven, can be achieved through 'reflective listening' in which the listener is made to repeat what the speaker has said in order to make sure that he has fully understood the speaker's message before speaking himself. This creates a clear understanding of one's opinions and beliefs and this type of clear and properly understood communication leads to respect and trust. Third, the problem-causing conflict can be redefined or revised in such a manner that it becomes a common problem for both parties rather than making it a 'win-lose' situation where one party wins and the other loses. For example, the problem between sales and production can be redefined as a problem of how to best serve the customer, to which both parties have a concern for, making it a problem to be mutually solved. Finally, only such solutions should be accepted that are acceptable to all concerned parties. This is considered to be the best way to 'manage' conflict.

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Check Your Progress

7. What is smoothing?
8. Why is it considered healthy to stimulate conflict in an organization?
9. What is the single most important factor that plays a role in reducing conflict?

4.6 TEAM MANAGEMENT AND DIVERSITY MANAGEMENT

Now the projects are big and operating often internationally. Moreover, people migrate easily in search of opportunities. Therefore, the projects now are built with the team that consists of people with various ethnicity, different culture, different languages and so on. Managing projects with the team with diverse cultural and ethnic background requires different skills than managing project with wholly a local team. This is also true when stakeholders have different cultural backgrounds.

Thus, a project management can become effective if a project manager also knows how to manage different culture. A tendency to either criticise or blame different culture is more in observance, implying a belief that “my culture is more superior to other cultures”. This is not true. Each culture has its own beauty and background. The convergence of culture enriches the experience. The wisdom is in accepting the cultural differences and working with them to gain good advantage rather than cursing the cultural diversity. The management of technology and project construction is not possible without managing diverse culture.

Culture is very interesting invisible thing. People sensitivity, interpretation of communication, use of verbal and body language, preferences and choices, dressing sense, working style and everything else essential for working in a team could be at the great variance and still they have to perform as a single unified team for delivering the deliverables of the project. Likewise, different stakeholders and parties associated with the project possess different culture; managing communication and relationship with them is also an important responsibility of a project team.

Managing Cultural Diversity

First and important thing for successful management of cultural diversity is acceptance of cultural difference and mutual respect for different cultures. While such acceptance and respect is essential, a systematic approach for its management is very important. It should be made part of project execution strategy. Some steps can be suggested as follows for fostering culture management as a part of the project management.

- 1. Understand the Diversity from the Beginning:** Know about the team members and other stakeholders of the project in terms of their cultural baggage. The advance knowledge would prepare the project manager for

managing them. Then help each team member to understand the cultural diversity and develop cultural sensitivity among them. The knowledge about elements of different culture and sensitivity towards the same would prepare the project manager and team members to deal with that.

Today cultural information is readily available on Internet and many trainers also offer short cultural training sessions.

2. **Build Team:** Before one can embark upon the project construction, the team must be built. Usually different teams are *formed* for the project construction, but the team needs to be *built*. Many culturally sensitive organisations organise various activities for building the teams. Adventure tour and activities, camping in a forest and many other activities can be considered. In such team building activities it is important to take the members of the team away from the workplace and home, so that they can spend precious time together in which interdependence is established, understanding is gained and sensitivity for each other is developed.
3. **Plan Communication and Ensure Transparency:** Once the team gets onto the job the distances are created and contexts are gradually diluted. Therefore, during the project execution one must plan for proper one-on-one communication as well as group communication. While formal communication about progress of work and discrepancies are regularly made through the project management information system, the personal touch gets diluted and a chance for misunderstanding is created. Video conferences as well as personal meetings in formal and informal settings must be planned to continue appreciation for different culture and to remain focussed on the project goals. Transparency in communication is more important than just the communication; one must ensure that the methods of managing diversity do not turn to be very formal. Moreover, if every team member is given a macro picture rather than limited to their work sphere only it would enhance transparency and reduce cultural diversity effects.

Even formal communication must be planned carefully especially when the project team members work in different time zones, with different organisational structure and often multiple reporting lines.
4. **Foster a Culture of Interaction and Build Learning Team:** Within the sub-team as well across the sub-teams the interaction must be encouraged. That would allow the sub-team understand and appreciate their interdependence and improve communication among them. Moreover, interaction would create a learning organisation wherein the people in organisation learn from each other's experience. Useful learning must be documented also. This approach would make transition easy and seamless if for some reasons the constitution of team changes.
5. **Let the Intent Govern Rather than Words and Actions:** Though this point is not exclusive for managing cultural diversity in project situation, it is

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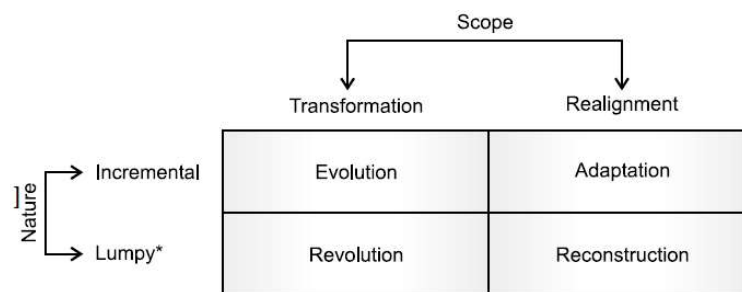
more important in fast-paced project execution environment. People do make mistakes in work and in communication. Instead of taking punitive actions based on the effects of such actions, one should look at the intention. Mistakes happen despite good intention and they need to be corrected rather than aiming at punishing the member who has made mistake; miscommunication must be seen from the cultural sensitivity and intention rather at the face value of it. This would help in building trust based project culture. This approach would foster fearless communication and transparency.

- 6. Foster Adaptation:** As we discussed before, the probability of change in external environment is stronger in project situation. These changes have to be sensed, managed and often have to be adapted. This makes the project construction activity very dynamic. Many of changes could be sensed by the team members who work closer to the ground level tasks and some can be sensed at the higher levels in the team. Team members also can sense flaws in the project design, which is prepared by experts whose knowledge is wide but perhaps lacking ground level reality. Transparency and intent based actions are more likely to encourage the team members to communicate need for the change, if any. The team, in this case, will be more adaptive to the change rather than being critical to the proposal for deviation from the plan.

In nutshell, in this era of complex and global projects, the cultural diversity must be understood and accepted as an enriching element in the project management. Team building, cultural sensitivity, communication, trust, transparency and intention based actions are essential parts of the successful project management.

4.7 CHANGE MANAGEMENT

Change can be of different types or forms. This primarily relates to the pace of change. Changes can be slow or fast; evolutionary or revolutionary; incremental or lumpy (some call it 'big bang'). In terms of nature and scope of change, Balogun and Hailey (1999) have distinguished between four types of change: evolution, revolution, adaptation and reconstruction (Fig. 4.1).



* Balogun and Hailey call it 'Big Bang'

Fig. 4.1 Different Types of Strategic Change

Adapted from J Balogun, and V M Hailey, Exploring Strategic Change (Prentice Hall, 1999).

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Adaptation is the mildest form of change. This is the most common form of change in organizations and can be managed within the present paradigm without change of strategy. *Evolution* means some transformation. This requires paradigm change, but, over time. *Revolution* is a fast and major transformation. In such a case, the pressure for change is the highest; for example, a continuous decline in profit threatening the existence of the organization. Such a situation necessitates major strategy change and policy decision to support it. *Reconstruction* also implies upheaval in the organization, but, this is less drastic than a revolution; for example, major changes in market conditions or the environment requiring structural or organizational change.

This implies that it is necessary to understand and, also, analyse the contextual features, i.e., factors or issues to be considered before initiating change. There is no single correct formula or strategy for managing change. It would depend largely on the contextual features. Major contextual features in organizational change are given below (Fig. 4.2).

• <i>Diagnosis</i>	Diagnosing the change situation or change required.
• <i>Scope:</i>	What is the degree or magnitude of change needed?
• <i>Speed:</i>	How quickly change is required?
• <i>Readiness:</i>	What is the resistance to, or preparedness for, change in the organization?
• <i>Preservation:</i>	Which organizational resources and characteristics need to be left unchanged?
• <i>Capability:</i>	What is the managerial and organizational capability to implement change?
• <i>Capacity:</i>	What is the extent of resources (primarily financial) available for change?
• <i>Power:</i>	What power does the change leader (CEO) have to impose or implement change?

Adapted from G Johnson, and K Scholes, *Exploring Corporate Strategy*, 6th ed. (Pearson Education, 2005), 538 (Exhibit 11.3).

Fig. 4.2 Contextual Features of Corporate Change

Strategy formulation for change should take into account the contextual features outlined above. Given the contextual features, in situations of evolution, revolution or reconstruction, organizations have to adopt appropriate strategies for managing the change. Companies commonly adopt one of the four major strategies: corporate restructuring, divestment, liquidation and turnaround strategies. Besides these, organizations use strategies to manage radical change and also during period of uncertainties. Companies may sometimes adopt a doomsday management approach. Some have also suggested change during good times for progressive companies. Some of these changes are reactive, some are proactive. We would be discussing all these here.

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Corporate Restructuring

Corporate restructuring means organizational change to create a more efficient or profitable enterprise. Similar terms which are used for ‘restructuring’ are ‘revamping’, ‘regrouping’, ‘rationalization’ or ‘consolidation’.

Corporate restructuring has three meanings or connotations: organizational restructuring, business-level restructuring and financial restructuring. *Organizational restructuring* means changes in the *structure* of the organization—changing or reducing hierarchies or delayering, downsizing, i.e., reducing the number of employees, redesigning positions, reallocation of jobs or portfolios or changing the reporting system. *Business-level restructuring* (applies to multi-business organizations) deals with changes in the *composition* of a company’s businesses or product portfolios. The changes are done on the basis of movements in market share or performance of different businesses or products to improve efficiency or profitability at the corporate level. *Financial restructuring* is concerned with changes in *financial management* in terms of equity pattern or equity holdings, debt-equity ratio, borrowing pattern, debt servicing schedule, etc. More common forms of restructuring are organizational restructuring and business-level restructuring. Sometimes, when major crisis develops, restructuring may be comprehensive, which may simultaneously involve, rather combine, business-level restructuring, organizational restructuring and even financial restructuring. This may happen more during a turnaround situation (discussed later).

Restructuring is essentially an adaptation strategy. It is about adaptation to change and is mostly incremental in nature. In contemporary business, most companies are in the process of constant change. Often older companies require more restructuring than the newer ones. This may happen for a number of reasons. First, those companies might have over-diversified including diversification into unrelated areas; second, the organizational structure might be very hierarchical not fitting into a dynamic market environment; third, there might be a conservative financial management system in relation to funds flow and investments.

Divestment Strategy

Divestment, also called *divestiture*, means selling a part of a company—a major division or an SBU. Divestment is usually a part of corporate restructuring or rehabilitation programme as indicated above. Divestment can be part of an overall downsizing or retrenchment strategy of an organization to get rid of businesses which are unprofitable or which require too much capital or which do not fit well with the company’s other existing businesses or activities. Divestment is many a time used to raise capital for new acquisitions or investment. Sometimes divestment

becomes a forced option when an attempt has been made to turnaround the business, but, has not been successful.

Divestment can be done in two ways: selling a business outright or spinning it off as an independent company. Selling a business outright is the more commonly used form of divestment.

A business becomes a good candidate for spinning off as an independent company if it possesses sufficient resource strength to compete successfully on its own. Spinning off business into a separate company may be done because of some strategic reason; may be, it does not fit well with the core business of the company. If a company decides to spin off a business, one important decision the corporate parent has to take is whether to retain partial ownership in the divested business. Retaining partial control is generally recommended if the business to be divested has good profit prospects. Spinning off a business, with or without partial ownership, may be done either by selling shares to the public through an initial public offering (IPO) or by distributing shares of the new company to the existing shareholders of the corporate parent.

Selling a business outright involves finding a suitable buyer. Finding a suitable buyer may be easy or difficult depending on the nature of the business to be divested. It also depends on the structure, size and growth of the industry or market. Many times, businesses are sold not necessarily because they are unprofitable, but because of strategic or environmental reason, say, emerging competitive threat. Parle Products sold its profitable soft drinks business to Coca-Cola because the company did not want to get involved into a marketing warfare with giants like Coke and Pepsi. Also, while selling a business, the seller company should look for a buyer who finds the business a good fit with their existing product mix or product portfolio. For example, for Coca-Cola, buying the soft drink business of Parle Products was a perfect strategic fit. This way the seller company also gets a good price, that is, the divestment becomes profitable.

Divestments are common in corporate functioning of multi-business organizations including multinational companies. From time to time, large companies sell or spin off businesses and add or acquire new businesses in conformity with environmental changes and organizational objectives or goals. The underlying driving force is competitiveness.

Liquidation Strategy

Liquidation means closing down a company and selling its assets. Liquidation can also be defined as ‘selling of a company’s assets, in parts, for their tangible worth.’ This should be the strategy of last resort when no other alternatives like turnaround, restructuring or divestment are applicable or workable. Liquidation is actually a recognition of defeat. But, at some stage of the organizational life cycle, it is advisable to cease operating than continue to operate and accumulate losses.

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Liquidation should be planned. Liquidation may be the toughest decision for a company, but, if it is unavoidable/inevitable, it should be done at the right time and, in a planned manner. Planned liquidation involves a systematic process for maximum benefits for the company and its shareholders. If liquidation is unplanned or haphazard, the company may incur avoidable or unnecessary losses.

In India, liquidation is governed by the Companies Act, 1956. In the Companies Act, liquidation is officially termed as 'winding'. The Act defines winding up of a company as 'the process whereby its life is ended and its property administered for the benefit of its creditors and members'. The Act stipulates appointment of a liquidator who handles the liquidation process. The liquidator takes control of the company, collects its assets, pays its debts and, finally, distributes any surplus among the members, according to their rights. According to the Act, liquidation or winding up may be done in three ways:

- (a) Voluntary winding up;
- (b) Voluntary winding up under supervision of the court;
- (c) Compulsory winding up under an order of the court

The Act also provides for *dissolution* of a company in which case it ceases to exist as a corporate entity for all practical purposes and, all its operations remain suspended for a period of two years. During these two years, the company may be liquidated. Part VII (Sections 425 to 560) of the Act deals comprehensively with various legal aspects of liquidation including dissolution.

Thousands of small businesses in different countries, developed and developing, liquidate every year because of unviable operations. Liquidation, however, is not confined to small business only. General Motors terminated production of its Chevrolet camera and Pontiac Firebird in 2002 and closed the Canadian manufacturing plant when the operation became totally unviable. In India, Navsari Mills and Swadeshi Mills (both of Tata group), Binny, Shri Ambica, Sriram and India United are some of the companies whose products/brands were quite popular at one time, but, ultimately, had to be closed down. Many jute mills in eastern India had the same fate. In China and Russia, thousands of government-owned businesses liquidate as these countries try to privatize and consolidate industries.

Under certain situations, liquidation is particularly recommended. David (2003) has suggested three situational guidelines for liquidation to be an effective strategy:

1. An organization has pursued both a retrenchment strategy and a divestment strategy, but, neither has been successful;

2. For an organization, only alternative left is bankruptcy; liquidation, in this case, represents an orderly and planned means of obtaining maximum possible cash for the organization's assets. A company can legally declare bankruptcy and then liquidate various divisions or businesses to raise funds or capital;
3. The stockholders of a company can minimize their losses by selling the company's assets through liquidation.

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Turnaround Strategy

Corporate *turnaround* may be defined as organizational recovery from business decline or crisis. Business decline for a company means continuous fall in turnover or revenue, eroding profit, or accrual or accumulation of losses. So, business or organizational decline, like business performance, is understood in relative terms, that is, compared with the past. But, some strategy analysts describe business decline in terms of current comparisons also; for example, relative to industry rates or averages or even relative to economic growth of the country. Corporate crisis means deepening or perpetuation of a decline.

Turnaround strategies are usually required for crisis situations. If organizational decline is not continuous or severe, corporate restructuring can provide the solutions. That is why turnaround strategy may be said to be an extension of restructuring strategy. When restructuring is very comprehensive and leads to corporate recovery, it almost becomes a turnaround strategy as mentioned above in the case of Voltas.

Corporate or business decline manifests itself in many forms or symptoms, including profitability. These symptoms are actually different performance criteria of companies. Major symptoms or criteria or situations which signal towards the need for a turnaround strategy are:

- Steadily declining market share;
- Continuous negative cash flow;
- Negative profit or accumulating losses;
- Accumulation of debt;
- Falling share price in a steady market;
- Mismanagement and low morale.

With some or all these symptoms becoming clearly visible (these symptoms are generally interrelated) for a company, a turnaround or recovery becomes highly imperative. But, the situation should be carefully reviewed to assess the extent of recovery possible before undertaking any such programmes. Given a strategy, in some situations, recovery may be more or less successful than in others. Slatter

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(1984) contends that there are four recovery situations in terms of feasibility or success. These situations are:

- (a) Realistically non-recoverable situation;
- (b) Temporary recovery situation;
- (c) Sustained survival situation ;
- (d) Sustained recovery situation.

Realistically non-recoverable situation is one in which chances of survival are very little, because the company is not competitive, the potential for improvement is low, clear cost disadvantage exists and demand for the company's product is in decline stage. In such a situation, divestment or liquidation may be a better option.

Temporary recovery situation exists when there can be initial successful recovery, but, sustained turnaround is not possible. This can happen because repositioning of the product is possible. Some cost reduction programmes may be successful, and revenue generation is also possible at least for sometime.

Sustained survival situation means that recovery is possible but potential for future growth does not exist. This may happen primarily because the industry is in a declining phase (say, black and white TV, audio cassettes, VCR). A company in such an industry or situation can either go for divestment or turnaround if it foresees or can create a niche in the industry and if the growth prospects can be created.

Sustained recovery situation is one in which successful turnaround is possible for sustained growth. In such cases, business decline might have been caused by internal organizational factors or external or environmental conditions which the company is able to deal with effectively. Inherently, the company is strong in terms of competence.

Some Strategic Guidelines for Managing Change

So far we have discussed different kinds of change and various strategies adopted by companies for managing change. We have also analysed different organizational situations, environmental factors, change agents, leadership, etc. From all these, we can formulate some general guidelines for managing change which can be followed by companies. Kanter et al. (1992) have formulated a set of comprehensive guidelines for managing organizational change. They call these 10 commandments for executing change. These are analysed below:

1. *Analyse the organization and its need for change*
 - a. Understand an organization's business and operations;
 - b. Analyse how the organization functions in its environment;

- c. Determine what are the organizational strengths and weaknesses;
and
- d. Examine how the organization will be affected by proposed changes.

2. *Create a shared vision and common direction*

One of the first steps in engineering change is the creation of a common vision. It is like ‘an organizational dream—it stretches the imagination and motivates people to rethink what is possible.’

3. *Deviate from the past (or pattern breaking)*

It is difficult for an organization to create or uphold a new vision for the future until it has isolated the structures, practices and routines which no longer work and has decided to move beyond them.

4. *Create a sense of urgency*

It is critical to rally an organization for change. Sense of urgency for change does not exist in most organizations; it has to be created.

5. *Support a strong leader's role*

Leaders, as change drivers, play a pivotal role in creating a company's vision and evolving an organizational structure which consistently rewards those who contribute towards realization of the vision.

6. *Line-up support/sponsorship*

Leadership alone may not be able to bring about large-scale change. The leader's success depends on a broader base of support from individuals or institutions which first act as followers, then as helpers, and finally, as co-owners of change. This ‘coalition building’ should include the holders of important organizational resources.

7. *Design an implementation plan*

Changing strategy without a proper implementation plan may not succeed. Implementation involves what to do, when to do and how to do. This change plan is a ‘road map’ for execution of change.

8. *Develop enabling structures*

These may range from the *symbolic*—such as changing the organization's name, logo, lay out/interiors, etc.,—to the practical—such as setting up pilot tests, workshops, training programmes, new reward systems, etc.

9. *Communicate and involve people*

Open communication and involvement of people (managers and staff) are effective tools for overcoming resistance and, giving employees a personal stake in the transformation process and the outcome of it.

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10. Reinforce and institutionalize change

Managers and leaders should continually exhibit their commitment to the transformation process, reward risk taking and incorporate new attitudes and values. This phase refers to 'shaping and reinforcing a new culture that fits with the revitalized organization'.

Check Your Progress

10. What is the most common form of change in organizations?
11. What is organizational restructuring?

4.8 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The personnel department, secretarial department, training and placement department are the various examples of administrative department.
2. Centralisation is the degree to which decision making is concentrated at a single point.
3. Leadership is defined as the 'ability to influence people towards the accomplishment of goals'.
4. Some of the functions of a line manager are as follows:
 - Recruiting and hiring talent to fill team positions
 - Cross-training employees to ensure job rotation and minimize assignment coverage gaps.
5. Two disadvantages of autocratic leadership are as follows:
 - One-way communication without feedback leads to misunderstanding and communications breakdown.
 - An autocratic leader makes his own decisions which can be very dangerous in this age of technological and sociological complexity.
6. Two advantages of participative leadership are as follows:
 - Active participation in the managerial operations by labour assures rising productivity and satisfaction.
 - Workers develop a greater sense of self-esteem due to the importance given to their ideas and their contribution.
7. Smoothing simply means covering up the conflict by appealing to the need for unity rather than addressing the issue of conflict itself.
8. Under certain circumstances, conflict is necessary and desirable in order to create changes and challenges within the organization. In such situations,

the management should adopt a policy of conflict stimulation so that it encourages involvement and innovation.

9. Trust is the single most important factor that plays a role in reducing conflict.
10. Adaptation is the most common form of change in organizations and can be managed within the present paradigm without change of strategy.
11. Organizational restructuring means changes in the structure of the organization- changing or reducing hierarchies or delayering, downsizing, i.e., reducing the number of employees, redesigning positions, reallocation of jobs or portfolios or changing the reporting system.

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4.9 SUMMARY

- Organizational structure is the differentiation of functions to facilitate the achievement of goals. Jobs are differentiated according to the nature and specialisation of the jobs.
- The main characteristics of the organizational structure are differentiation, standardization, specialization, departmentalisation, chain of command and centralisation. The impact of various characteristics are visible on communication network, informed group formation, attitudes of employees, motivation, leadership and so on.
- Leadership is defined as the ‘ability to influence people towards the accomplishment of goals’. It is associated with the determination of the goals, a vision for the future and the process of change to reach the goals and the future. Companies have high rate of success when leadership skills and management skills complement each other.
- Certain attributes sets leaders apart from managers. Leaders have followers which puts them at a high pedestal. Leaders can inspire people and bring about a behavioural change. In addition, leaders meet the need of the followers.
- Project manager and line manager work in sync with each other to get project activities accomplished within constraint of allocated cost limited, time and specified quality performance.
- Leadership styles can be classified according to the philosophy of the leaders. Some of the significant leadership styles are autocratic or dictatorial leadership, participative or democratic leadership, laissez-faire or free-reign leadership, etc.
- Autocratic leaders keep the decision making authority and control in their own hands and assume responsibility for all actions. They structure the entire work situation in their own way and expect the workers to follow their orders.

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- In Participative leadership, the subordinates are consulted and their feedback is taken into the decision-making process. The leader's job is primarily of a moderator, even though he makes the final decision and he alone is responsible for the results.
- In Laissez-faire leadership, the leader is just a figure-head and does not give any direction. He delegates the authority to subordinates so that they must plan, motivate, control and otherwise be responsible for their own actions.
- Leadership is an intangible quality and its effectiveness can best be judged by the behaviour and attitudes of followers. Some behavioural characteristics such as the ability to inspire others, problem solving skills, emotional maturity, etc. define the characteristics of a good leader.
- Tactical leadership is the ability of a leader to use past experiences to understand what specific actions need to be taken to achieve the organization's goals.
- Except in situations where conflict can lead to competition and creativity, it should be resolved as soon as it has developed and all efforts should be made to prevent it from developing.
- Various researchers have identified five primary strategies for dealing with and reducing the impact of behavioural conflict. These include avoiding conflict in certain situations, smoothing, compromising, problem-solving skills, etc.
- The structural based conflict are built around organizational environments and can be resolved or prevented by redesigning organizational structure and work-flow.
- Under certain circumstances, conflict is necessary and desirable in order to create changes and challenges within the organization. In such situations, the management should adopt a policy of conflict stimulation so that it encourages involvement and innovation.
- While there are a number of behavioural and organizational factors that contribute to conflict, there is one factor that plays a major role in reducing that conflict. This factor is 'trust'.
- Jack Gibb has identified certain behaviours that he calls 'aggressive' behaviours that should be avoided and certain behaviours which he calls 'supportive' behaviours that tend to reduce defensiveness and should be promoted.
- With globalization and diversity in the team, the challenges of team management has increased manifold. Project management can become effective if a project manager knows how to manage different cultures. Team building, cultural sensitivity, communication, trust, transparency, and intention based actions are the essential parts of successful project management.

- Change can be of different types or forms. In terms of nature and scope of change, Balogun and Hailey (1999) have distinguished between four types of change: evolution, revolution, adaptation and reconstruction.
- Corporate restructuring means organizational change to create a more efficient or profitable enterprise. Similar terms which are used for 'restructuring' are 'revamping', 'regrouping', 'rationalization' or 'consolidation'.
- Divestment, also called divestiture, means selling a part of a company- a major division or an SBU. Divestment is usually part of corporate restructuring or rehabilitation programme.
- Liquidation means closing down a company and selling its assets. Liquidation can also be defined as 'selling of a company's assets, in part, for their tangible worth'. If liquidation is unplanned, the company may incur unnecessary losses.
- Corporate turnaround may be defined as organizational recovery from business decline or crisis. Business decline for a company means continuous fall in turnover or revenue, eroding profit, or accrual or accumulation of losses.

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4.10 KEY WORDS

- **Tactical leadership:** It is the ability of a leader to use past experiences to understand what specific actions need to be taken to achieve the organization's goals.
- **Corporate restructuring:** It means organizational change to create a more efficient or profitable enterprise. Similar terms which are used for 'restructuring' are 'revamping', 'regrouping', 'rationalization' or 'consolidation'.
- **Divestment:** It means selling a part of a company- a major division or an SBU. Divestment is usually part of corporate restructuring or rehabilitation programme.
- **Liquidation:** It means closing down a company and selling its assets. Liquidation can also be defined as 'selling of a company's assets, in part, for their tangible worth'. If liquidation is unplanned, the company may incur unnecessary losses.

4.11 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the characteristics of leaders that set them apart from managers?
2. State the disadvantages of participative leadership.

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3. What are the advantages and disadvantages of laissez-faire leadership?
4. Mention the preventive measures that can be taken by organizations to avoid conflict.
5. How are structural based conflicts resolved?
6. Differentiate between aggressive and supportive behaviour.
7. Write a short note on corporate restructuring.

Long-Answer Questions

1. Explain the characteristics of organizational structure.
2. Discuss in detail autocratic leadership.
3. Analyse the ways conflict can be stimulated in an organization.
4. Discuss the importance of culture management in project management.
5. Examine the different aspects of change management.

4.12 FURTHER READINGS

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BLOCK - II
PERT AND CPM, RISK AND QUALITY
MANAGEMENT OF PROJECT

PERT and CPM

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UNIT 5 PERT AND CPM

Structure

- 5.0 Introduction
- 5.1 Objectives
- 5.2 Development of Project Network
 - 5.2.1 Time Estimation
- 5.3 Determination of the Critical Path and CPM Model
- 5.4 PERT Model
- 5.5 Measures of Variability
- 5.6 Network Cost System
- 5.7 Answers to Check Your Progress Questions
- 5.8 Summary
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5.0 INTRODUCTION

This unit will introduce you to the concept of CPM (critical path method) and PERT (Program Evaluation Review Technique). The CPM is a step-by-step project management technique that identifies critical and non-critical tasks in order to avoid time-frame problems and process bottlenecks. The PERT, on the other hand, uses tools to plan tasks within a project. This makes it easier to accomplish the work. This unit will also discuss the reasons why actual performance of a project differs from planned performance. Network cost system will also be explained.

5.1 OBJECTIVES

After going through this unit, you will be able to:

- Discuss the concept of network and network analysis
- Explain the CPM Model
- Discuss in detail the PERT Model
- Examine the reasons why actual performance of a project differs from planned performance
- Understand network cost system

5.2 DEVELOPMENT OF PROJECT NETWORK

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A number of activities with a great degree of variety and interdependence require the firm to organize the activities in the best planned way to avoid any confusion and complications in the execution of the project. A systematic approach in planning the activities would include several steps and decisions. First, the firm has to decide whether they would want multi-level and multi-project scheduling or not. Then, the activities must be identified discretely, the time for each activity must be estimated, the resource requirement must be planned and interdependence must be determined. These activities should then be presented in a manner that will help grasp the complexities clearly and also help to determine slack, if any. It will also help in effective resource allocation considering the time period. In this section, these issues will be discussed:

Concept of Network

Conceptually, it can be said that a network diagram is a graphical presentation of all the activities of a project, arranged in a proper sequence and with clearly established interdependencies. The network diagram provides a full picture of the project. The diagram can be presented as:

- A Gantt chart
- A PERT (Programme Evaluation and Review Technique) diagram
- A CPM (Critical Path Method) diagram

PERT and CPM are quite similar, except in incorporation of uncertainty of time needed for the completion of each activity.

Purpose of Network Analysis

The goals and purposes of network analysis can be listed as below:

- Identifying discrete activities and sub-activities
- Identifying events signalling either the beginning or ending of the activities
- Estimating the time taken for completion of each activity, if possible on crash basis, normal basis, worst-scenario basis
- Identifying interdependence, if any, of activities
- Identifying critical path, so that one may know the existence of slack time in any activity. This may be helpful in determining the degree of discretion to be given to a sub-project team and in determining the dynamic response cycle

- Identifying slack for efficient resource allocation
- Determining economics of crashing of activities

PERT and CPM

5.2.1 Time Estimation

It is important to estimate the time required for completion of each activity. Time may be a point forecast or more appropriately multiple estimates of possible times for a given activity. Given a level of uncertainty associated with the completion time, one may estimate the following:

- Optimistic time, which is the shortest
- Pessimistic time, which is the longest
- Most likely time, which is somewhere between the optimistic and the pessimistic estimates of time
- Estimated time, which is estimated based on all the previous three estimates of time. Estimated time may either be an average of the optimistic, pessimistic and the most likely time. Often, a different weight is assigned to one or more of these factors in determining the estimated time.

Remember that dummy activities do not consume time.

Check Your Progress

1. What is a network diagram?
2. State any two goals of network analysis.

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5.3 DETERMINATION OF THE CRITICAL PATH AND CPM MODEL

In 1950, a joint venture between the Dupont Corporation and the Remington Rand Corporation for managing plant maintenance projects led to the CPM. Today, it is commonly used with all forms of projects such as construction, software development, research projects, product development, engineering, plant maintenance and so on. Any project with interdependent activities can apply this method of scheduling. Whenever an activity is scheduled by various planning techniques, the necessary resources such as capital, equipment, labour or other inputs are needed for executing the work package or an activity. The fact is that necessary resources are not always available when desired; so, activities must be scheduled at time when resources are available. It is also important to note that the cost and duration of the project are interdependent variables. Altering project schedules influences costs and it should be possible to alter the activity schedules so as to achieve optimum trade-offs between the project cost and the scheduled completion date.

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The CPM is the graphical representation of the interrelationships between the tasks in a project to be performed in a well-defined sequence. It lays stress on the following two aspects of a project:

- The effect of applying more men or other resources to shorten the duration of given jobs
- The increased cost of these additional resources

The procedure of deciding the critical path is executed through the following steps:

1. Firstly, the project is categorized into a series of labelled activities. These activities are then arranged in a logical sequence and represented graphically with an arrow diagram.
2. All the nodes and activities are then numbered. The time required for each activity is calculated and indicated in the arrow diagram.
3. The earliest start and ending time along with the latest start and finish time are then calculated and jotted down.
4. The total float for each activity is then determined by taking the difference between the earliest and the latest time for each node.
5. The critical activities (zero float activities) are then identified and connected with the beginning and the ending node in the network diagram by double line arrow. This gives the critical path.
6. The total project duration is then calculated.
7. In case the total project duration needs to be reduced, the critical activities of the network are crashed.
8. The cost is optimized and the network is then updated accordingly.

Since project schedules change on a regular basis, CPM allows continuous monitoring of the schedule. It enables the project manager to track the critical activities and ensures that the non-critical activities do not interfere along with the critical ones. The following example illustrates CPM in detail.

A small maintenance project consists of the following jobs whose precedence relationships are given in Table 5.1.

Table 5.1 Precedence Relationships

Job	1-2	1-3	2-3	2-5	3-4	3-6	4-5	4-6	5-6	6-7
Duration (days)	15	15	3	5	8	12	1	14	3	14

1. Draw an arrow diagram representing the project
2. Find the total float for each activity
3. Find the critical path and the total project duration

Figure 5.1 shows the arrow diagram representing the project.

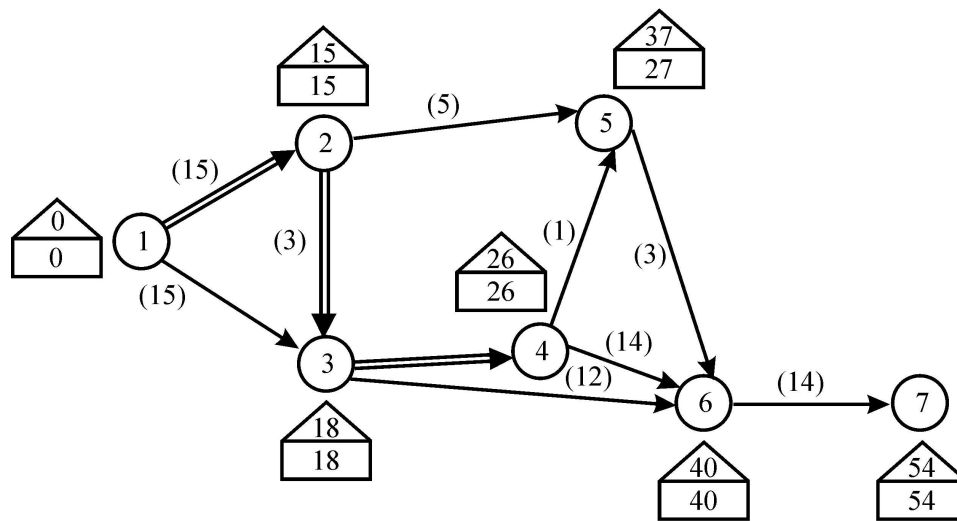


Fig. 5.1 Arrow Diagram

To calculate the critical path and total project duration we first need to find the forward and backward pass calculations.

- **Forward pass calculation:** In this calculation, it is estimated that the earliest start and the earliest finish time ES_j is given by

$$ES_1 = 0$$

$$ES_2 = ES_1 + t_{15} = 0 + 15 = 15$$

$$ES_3 = \text{Max}(ES_2 + t_{23}, ES_1 + t_{13})$$

$$= \text{Max}(15 + 3, 0 + 15) = 18$$

$$ES_4 = ES_3 + t_{34} = 18 + 8 = 26$$

$$ES_5 = \text{Max}(ES_2 + t_{25}, ES_4 + t_{46}, ES_5 + t_{56})$$

$$= \text{Max}(15 + 3, 0 + 15) = 18$$

$$ES_4 = ES_3 + t_{34} = 18 + 8 = 26$$

$$ES_5 = \text{Max}(ES_2 + t_{25}, ES_4 + t_{46}, ES_5 + t_{56})$$

$$= \text{Max}(15 + 5, 26 + 1) = 27$$

$$ES_6 = \text{Max}(ES_3 + t_{36}, ES_4 + t_{46}, ES_5 + t_{56})$$

$$= \text{Max}(18 + 12, 26 + 14, 27 + 3)$$

$$= 40$$

$$ES_7 = ES_6 + t_{67} = 40 + 14 = 54.$$

- **Backward Pass Calculation:** In this calculation, we calculate the latest start and latest finish time LF_j , given by $LF_i = \text{Min}_j(LF_j - t_{ij})$ where LF_j is the latest finish time for the event j .

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$$LF_1 = 54$$

$$LF_6 = LF_1 - t_{67} = 54 - 14 = 40$$

$$LF_5 = LS_6 - t_{56} = 40 - 3 = 37$$

$$LF_4 = \text{Min} (LS_5 - t_{45}, LS_6 - t_{46}) \\ = \text{Min} (37 - 1, 40 - 14) = 26$$

$$LF_3 = \text{Min} (LF_4 - t_{34}, LF_6 - t_{36}) \\ = \text{Min} (26 - 8, 40 - 12) = 18$$

$$LF_2 = \text{Min} (LF_5 - t_{25}, LF_3 - t_{23}) \\ = \text{Min} (37 - 5, 18 - 3) = 15$$

$$LF_1 = \text{Min} (LF_3 - t_{13}, LF_2 - t_{12}) \\ = \text{Min} (18 - 15, 15 - 15) = 0$$

Table 5.2 gives the calculation for critical path and total float.

From the above table, we observe that the activities 1–2, 2–3, 3–4, 4–6, 6–7 are the critical activities and the critical path is given by 1–2–3–4–6–7. The total project completion time is 14 days.

Table 5.2 Critical Path and Total Float

Activity	Normal time	Earliest		Latest		Total Float $LF_j - ES_j$ or $LF_i - ES_i$
		Start	Finish	Start	Finish	
1–2	15	0	15	0	15	0
1–3	15	0	15	3	18	3
2–3	3	15	18	15	18	0
2–5	5	15	20	32	37	17
3–4	8	18	26	18	26	0
3–6	12	18	30	28	40	10
4–5	1	26	27	36	37	10
4–6	14	26	40	26	40	0
5–6	3	27	30	37	40	10
6–7	14	40	54	40	54	0

Advantages of CPM

A CPM schedule simplifies the planning of work assignments in advance and helps improve communication among those who are responsible for project performance. The CPM also helps in better project planning by providing

evaluations and forecasts the success of alternative plans of action. Following are the advantages of the CPM:

- It helps the top management to focus on the critical activities and their timely accomplishment.
- It provides the knowledge of critical and non-critical activities and their completion in time. This helps the management to divert the resources from non-critical to critical activities. The performance of an activity on the critical path is essential otherwise it may postpone the project completion time.
- It creates the best way of planning and scheduling a construction project by showing the critical path.
- It provides the complete information about the importance, duration, size and performance of an activity.

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Disadvantages of CPM

The CPM also suffers from certain drawbacks such as high cost, time consumption, poor time estimate provision and resource allocation.

Some other disadvantages of the CPM are as follows:

- The CPM is based on the estimation of duration of activities which is impractical in real life.
- In case there are changes in the predetermined network, the entire evaluation of the project has to be repeated and a new critical path is required to be created all over again.
- It does not include statistical analysis in determining the time estimates.
- The CPM can become complicated when it involves larger projects.

Time-cost relationship

The CPM assumes that the estimated completion time for a project can be shortened by deploying additional resources for the activities. These additional resources include labour, equipment, capital or any other resource. For example, if the staff in a project normally work an eight-hour shift, one can expedite the work on the project by having the staff work an additional shift (or, at least, a few extra hours), but they will have to be paid extra wages, often at enhanced overtime rates. Thus, the project duration can be shortened, but the direct cost has increased. Similarly, by mechanization and automation, several activities can be sped up beyond their normal rates of progress. But, one has to add additional cost of utilizing costly equipment to the direct cost of getting the work done. The CPM assumes that the time to perform any activity in the project is variable depending on the amount of effort or resources applied to it.

For calculating the time-cost relationship, let us assume that a given activity/work package in a project is performed at the normal work pace. This is the usual

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or customary way of executing the activity and its direct cost and duration are designated as C_n and T_n , respectively, as shown in Figure 5.2. The normal pace is assumed to be the most efficient, and hence, the least costly pace of doing work in a work package or activity. This could be done by employing staff at overtime rates or using costly equipment for automation, mechanization, etc. When the maximum effort is applied to complete an activity in shortest possible time, the activity is said to have been crashed. This condition is represented by the direct cost, C_c , and the duration, T_c , in Figure 5.2. In Figure 5.2, crash condition represents not only the shortest activity duration (T_c), but also the greatest direct cost (C_c) for performing the activity.

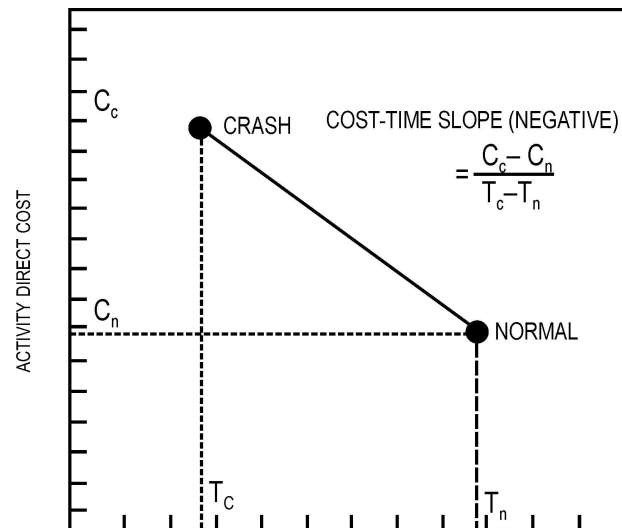


Fig. 5.2 Time-Cost Relationship of an Activity for CPM

Referring again to Figure 5.2, if you connect 'crash' and 'normal' points by a straight line, then this line represents the time-cost relationship for the activity. In other words, this line (or the relationship represented by it) gives the nature of trade-off between the direct cost and the duration of the activity. You shall assume that any intermediate point of operation between the normal and the crash points is feasible for every activity in the project that can be crashed. Every such intermediate point for a given activity is uniquely defined by its time-cost relationship. A very important assumption made in the time-cost relationship is that of linearity. Since you do not know the actual nature of the time-cost relationship for an activity, a simple linear relationship is assumed. In other words, all the feasible intermediate operating points between the normal and the crash points of Figure 5.3 must lie only on the straight line connecting these two points. It is equally important to keep in mind that each activity has its own time-cost relationship.

By using the CPM you can determine the optimal time-cost trade-off for each activity in a project so as to achieve the maximum or desired speed of the

project duration at the minimum total direct cost for the whole project. Before illustrating this procedure with an example of a project, look at the following theoretical concepts.

- An algorithm for solving the CPM problem
- Linear Programming Formulation of the CPM Problem

The basic objective of the CPM is to determine which time-cost trade-offs should be used for each activity so as to achieve the maximum or scheduled speed project at the minimum total direct cost. Mathematically, this description enables you to formulate the problem using linear programming.

Let activities i and j denote an activity originating at event i and terminating at event j in the project network.

The time-cost relationship for this activity can be calculated using the following parameters:

- $T_{ni,j}$ = Normal time taken to perform an activity (i, j) ;
- $C_{ni,j}$ = Normal (direct) cost for activity (i, j) ;
- $T_{ci,j}$ = Crash time for the activity (i, j) ;
- $C_{ci,j}$ = Crash (direct) cost for the activity (i, j) .

The decision variables for the linear programming problem are the intermediate time-cost trade-offs points, or the T'_{ij} 's where,

$T'_{i,j}$ = (selected) duration time for activity (i, j)

The first step in linear programming formulation of a CPM problem is to express the direct cost for each activity as a linear function of the decision variable, T'_{ij} . To do this, compute the cost-time slope of the straight line joining the normal and the crash points. This can be represented as follows:

$$a_{i,j} = \frac{C_{ci,j} - C_{ni,j}}{T_{ni,j} - T_{ci,j}}$$

where a_{ij} = cost-time slope of activity (i, j) , i.e., the incremental direct cost for activity (i, j) per unit decrease in the activity duration time;

$C_{ci,j}$, $C_{ni,j}$, $T_{ni,j}$ and $T_{ci,j}$ are as defined in the previous paragraph.

If you extend the straight line joining the normal and the crash points in Figure 4.7 back to the direct cost axis, the intercept of this line is represented as K_{ij} . Write the equation for the straight line representing the direct cost, C_{ij} , as a function of the activity duration, T'_{ij} as follows:

$$C_{i,j} = K_{i,j} - a_{i,j} \times T'_{ij}$$

where $C_{i,j}$ = Direct cost for activity (i, j) ;

$K_{i,j}$ = Intercept on the direct cost axis of the time-cost straight line for activity (i, j) ;

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$a_{i,j}$ = (negative) Slope of the time-cost relationship for activity (i,j) ;
and

$T_{i,j}$ = (unknown) Duration of activity (i,j)

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If you add equation over all the activities in the project, you can obtain the total direct cost for the project, C_D , as

$$C_D = \sum_{(i,j)} (K_{i,j} - a_{i,j} T_{i,j})$$

Since, the objective in the CPM is to minimize the total direct cost of the project, this means that from Equation

Minimize $C_D = \sum_{(i,j)} (K_{i,j} - a_{i,j} T_{i,j})$ is equivalent to saying

$$\text{Minimize } C_D = \left[\sum_{(i,j)} K_{i,j} - \sum_{(i,j)} a_{i,j} T_{i,j} \right]$$

But, $K_{i,j}$ is just a fixed constant that can be dropped from the objective function. Also, to handle the negative sign outside the second term in the minimization function, convert it to the maximization of the corresponding positive term.

Finally, before you write out the linear programming problem, label event 1 as the start of the project, so that $T_1 = 0$; and event n as the finish of the project, so that

T_n = Expected project completion time

Also define T_i = (unknown) earliest time for event i which is a deterministic function of the decision variable, $T_{i,j}$, for activity (i,j) .

You are now ready to state and formulate the CPM problem using linear programming as follows:

The problem: For a given scheduled project completion time, T_s , determine the

$T_{i,j}$ so as to minimize the total direct cost of the project, CD .

The LP formulation:

$$\text{Minimize } C_D = \sum_{(i,j)} (K_{i,j} - a_{i,j} T_{i,j})$$

Subject to the following conditions:

$$\left. \begin{array}{l} T_{i,j} \geq T_{ci,j} \\ T_{i,j} \leq T_{ni,j} \\ T_i + T_{i,j} - T_j \leq 0 \end{array} \right\} \text{ For all activities}$$

You will notice that the variable T_n , in the equation is analogous to the variable T_e , namely the expected duration of the project, which is also analogous to the earliest expected time (T_e) of the last event of the project. The CPM problem

as formulated by linear programming in the equations above assumes that there is a fixed scheduled project completion time, T_s . Where this is not the case, and you, as a project manager, have flexibility in determining the scheduled project duration, then the selection of T_s is a question of an optimal trade-off between the total direct and indirect cost of the project and its expected duration.

An algorithm procedure for CPM analysis

Even though the CPM problem can be solved mathematically using the linear programming formulation as given in the above equations in practice, the following algorithm is used for determining the time-cost trade-offs of individual activities in order to meet the scheduled project completion at the minimum total direct cost of the project. The steps for algorithm are:

1. Assume normal durations for all the project activities. Construct the AOA network diagram showing all the necessary and sufficient activities and precedence relationships of the project.
2. Perform a PERT analysis for the above project network to determine the earliest expected times, TE's, the latest allowable times, TL's the zero slack events, and the critical path activities of the project.
3. To shorten the project duration below the normal expected duration, T_e , all the activities on the critical path(s) should be quickly determined. To minimize the increase in the direct cost due to the speeding-up of activities, progressively shorten that activity (or those activities) which has the lowest cost-time slope as computed from the equation. The amount by which an activity is shortened depends on the minimum slack in the non-critical events of the project. The reason for this is that when more than the minimum slack of the non-critical events shortens an activity, other activities will become critical.
4. Re-compute the TE's and TL's of all events, the zero-slack events and the new critical path of the project network.
5. Revise the estimate of the total project direct cost by adding the incremental cost(s) of shortening the activity or activities identified in step 3 above.
6. Repeat the steps as often as necessary till one of the following criteria are satisfied:
 - If the desired project completion schedule, T_s , has been met, stop the CPM analysis. The values of the expected project duration, T_e , and the total direct cost, CD , represent the final solution to the CPM problem.
 - If there is no fixed scheduled completion date, T_s , and you wish to crash the project as far as possible, continue till such time as the network will get 'saturated'. This means that a stage is reached when there is no critical path having at least one activity that can be crashed any further.

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The values of the expected project duration, T_e , and the total direct cost, CD, represent the shortest duration of the project and the minimum total direct cost respectively.

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Check Your Progress

3. What is the CPM?
4. What are the disadvantages of CPM?

5.4 PERT MODEL

The PERT was created to handle such projects where the time estimate of activities is non-deterministic. It was developed by a Navy sponsored research team of Messrs D.G. Malcolm in 1950. The PERT is used to organize and coordinate tasks within the project. The objective of the PERT chart is to determine critical path which comprises critical activities that should be completed on schedule. This chart is prepared with the help of information generated in project planning activities such as estimation of effort, selection of suitable process model for software development and decomposition of tasks into subtasks. The advantages of using the PERT are listed below:

- It represents the project in graphical form.
- It provides information about the expected completion time of the project.
- It describes the probability of completion of the project before the specified date.
- It specifies the activities that form the critical path.
- It specifies the starting and ending dates of activities involved in the project.

Figure 5.3 shows an example of the PERT chart. The milestones are numbered as '1', '2', '3', '4' and '5' and represented by either circles or rectangles. When a milestone is completed, it is assigned a greater number than previous milestones. Each milestone is linked with one or more arrows. The activities of the project are represented by 'A', 'B', 'C', 'D', 'E' and 'F'. The direction of arrows determines the sequence of activities. When the activities are completed in sequence, they are known as serial activities. Here activities 'A', 'C' and 'F' are performed in sequence. Similarly, activities 'B' and 'E' are serial activities. On the other hand, when two or more activities are being performed simultaneously, they are known as concurrent activities or parallel activities. Here, activities 'A' and 'B' and activities 'C' and 'D' are performed concurrently. Each activity is allocated a specific amount of time, which is depicted by 't'. Here activity 'A' requires 3 weeks to get completed, activity 'B' requires 4 weeks and so on. Figure 5.3 shows the PERT chart.

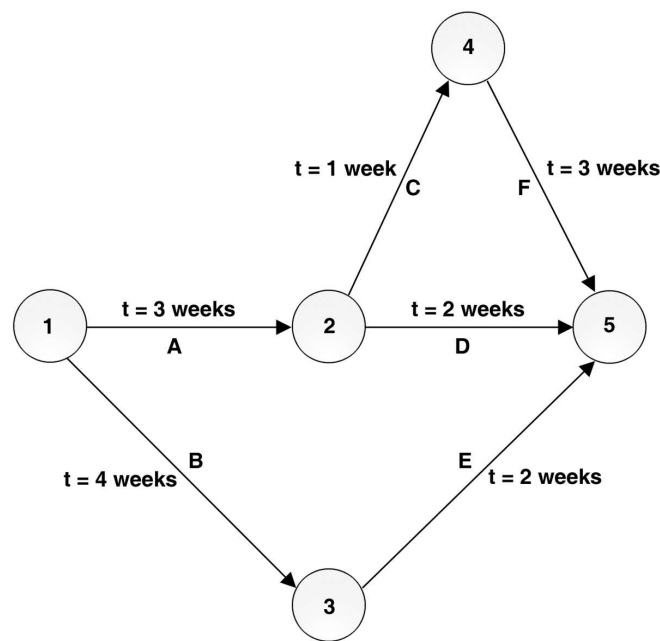


Fig. 5.3 The PERT Chart

To create the PERT chart, follow the steps listed below:

1. **Identify the activities and milestones:** In this step, the activities and milestones that are required to complete the project are described. Once the tasks and milestones are specified, it is easy to understand the sequence and duration of each activity.
2. **Identify the sequence of activities:** In this step, the sequence of activities is determined. The sequence describes the dependency of one activity on another. These activities can either be serial or concurrent. Based on the sequence and dependency of activities, the relationships among activities are depicted. Note that this step is sometimes combined with step 1.
3. **Prepare the PERT chart:** In this step, the PERT chart is prepared.
4. **Estimate the time consumed in activities:** In this step, the amount of time consumed in carrying out each activity is specified. The time can be estimated in months, weeks or days. Generally, the time estimates followed to determine the time consumed in the activities are listed below:
 - o **Optimistic time:** It is the shortest time in which an activity can be completed.
 - o **Most likely time:** It is the completion time having the highest probability.
 - o **Pessimistic time:** It is the longest time that an activity may require for completion.

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5. Determine the critical path: In this step, the critical path for completion of activities is specified. Critical path determines the calendar time required to complete a series of activities according to the project schedule. Note that the speed-up or delays in activities that are outside the critical path do not affect the total project time.

6. Update the PERT chart: In this step, the PERT chart is modified as changes take place in the project on completion of each activity. This chart is also updated when there is a delay in completion of activities or when the additional resources are required to complete the project on time.

The steps involved in executing this method are as follows:

- 1. Project planning:** The purpose of project planning is to identify all the important events which are essential for completion as well as making up of the project. The inter dependence of these events is shown explicitly in the form of a network.
- 2. Time Estimation:** Estimates of the time required to perform each of the network activities are made which are based upon manpower and equipment availability and certain assumptions as a part of the project plan. By incorporating the time required for completing, each of the activities in the network, the project duration as well as the criticality of the activities are calculated.
- 3. Scheduling:** The scheduling computations give the earliest and the latest allowable start and finish times for each activity. As a by-product, they identify the critical path through the network and indicate the amount of 'slack' time associated with the non-critical paths.
- 4. Time-cost trade-off:** If the scheduled time to complete the project as determined in step 3 is satisfactory, the project planning and scheduling may be complete. However, if one is interested in determining the cost of reducing the project completion time, then time-cost trade-offs of activity performance times must be considered for those activities on the critical and nearly critical paths.
- 5. Resource Allocation:** The feasibility of each schedule must be checked with respect to the manpower and equipment requirements. Establishing complete feasibility of a specific schedule may require re-planning and re-scheduling or time-cost trade-offs.
- 6. Project Control:** When the network plan and the schedule have been developed to a satisfactory extent, they are prepared to final form for use in the field. The project is controlled by checking the progress against the schedule, assigning and scheduling manpower and equipment and analyzing the effects of delays. Whenever major changes are made in

the schedule, the network is revised accordingly and a new schedule is computed. In short, this stage comprises periodic updating of the network to monitor the progress of the project and making necessary changes in the schedules to ensure completion of the project as close to the target time as possible.

PERT: Single time estimate

Perhaps the best amongst the relatively new project management techniques is the PERT. It was developed in the late 1950s by Special Projects Office of the US Navy in collaboration with the consulting firm, Booz, Allen, and Hamilton, and the prime contractor, Lockheed Missile Systems.

The developers were concerned with the performance trends in large military programmes in general and Polaris Missile System in particular. The basic requirements for using the PERT as established by the US Navy are as follows:

- All the tasks that are needed to complete a given project must be visualized in a manner that they can be clearly depicted in a network which comprises events and activities. In other words, the PERT network must follow the WBS.
- Events and activities must be sequenced in a network using a highly logical set of ground rules that help determine important critical and sub-critical paths for a project.
- Critical path and slack times must be computed. Critical path is the sequence of activities and events that require the greatest expected time to accomplish an activity.

In complex Research and Development (R&D) programmes such as the US Navy's Polaris missile development effort, several questions are asked to find the feasibility of the research. Some of these questions are as follows:

- What kind of research needs to be done?
- What stages of development are necessary?
- How fast can R & D be completed?

These questions arise largely because of the uncertainty about the final outcome of the R&D project. Such projects are implemented while new developments are still occurring and previous problems in technology, materials and processes can be resolved. Since the time of its development in the late 1950s, the PERT has spread rapidly amongst all industries and is particularly used in those projects where the major emphasis and concern is on the time element or project duration.

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PERT system of three-time estimates

The PERT is a technique where the activity times are represented by a probability distribution. This probability distribution is based upon three different time estimates made for each activity. These estimates are as follows:

- **Optimistic time estimate:** It refers to the time estimate of an activity when everything is assumed to go well as per the plan. It is the estimate of the minimum possible time which an activity takes to complete under ideal conditions and is denoted by t_0 or a .
- **Most Likely time estimate:** It refers to the estimate of the normal time an activity would take to complete. This assumes normal delays and calculates the time which the activity will take most frequently if performed a number of times. It is denoted by t_m or m .
- **Pessimistic time estimate:** It refers to the longest time that an activity would possibly take if normal conditions do not prevail. However, this does not include major catastrophes such as labour strikes, natural calamities and unrest and is usually denoted by b or t .

These three-time values a , m and b are combined statistically to develop the expected time (t_e) for an activity which is given by:

$$t_e = \frac{t_0 + 4t_m + t_p}{6} \text{ (}\beta \text{ distribution with weights of 1,4,1, for } t_0, t_m \text{ and } t_p \text{ estimates, respectively)}$$

Variance of the activity is given by:

$$\sigma^2 = \left[\frac{t_p - t_0}{6} \right]^2$$

The expected length or duration denoted by T_c of the entire project is the length of the critical path or the sum of the t_c 's of all the activities along with the critical path.

The main objective of the analysis performed through the PERT is to find the completion of a particular event within specified date T_s given by:

$$P(Z \leq D)$$

where Z stands for standard normal variable and

$$D = \frac{\text{Due date} - \text{Expected date of completion}}{\sqrt{\text{Project variance}}}$$

PERT process

The PERT process is performed through the following steps:

1. Draw the project network
2. Compute the expected duration of each activity using the formula,

$$t_e = \frac{t_0 + 4t_m + t_p}{6}$$

3. Calculate the expected variance σ^2 of each activity
4. Compute the earliest start, earliest finish, latest start, latest finish and total float of each activity
5. Find the critical path and identify the critical activities
6. Compute the project length variance σ^2 which is the sum of the variance of all the critical activities and find the standard deviation of the project length σ .
7. Calculate the standard normal variable $Z = \frac{T_s - T_e}{\sigma}$

Where T_s = The scheduled time to complete the project

T_e = Normal expected project length duration

σ = Expected standard deviation of the project length

Using the normal curve, we can estimate the probability of completing the project within a specified time.

The PERT can be illustrated with the help of several examples which are as follows:

Table 5.3 shows the jobs of a network along with their time estimates.

Table 5.3 Jobs of a Network

Job	1-2	1-6	2-3	2-4	3-5	4-5	6-7	5-8	7-8
<i>a</i> (days)	1	2	2	2	7	5	5	3	8
<i>b</i> (days)	7	5	14	5	10	5	8	3	17
<i>c</i> (days)	13	14	26	8	19	17	29	9	32

Draw the project network and find the probability that the project is completed in 40 days.

First, the expected time and standard deviation for each activity should be calculated as shown in Table 5.4.

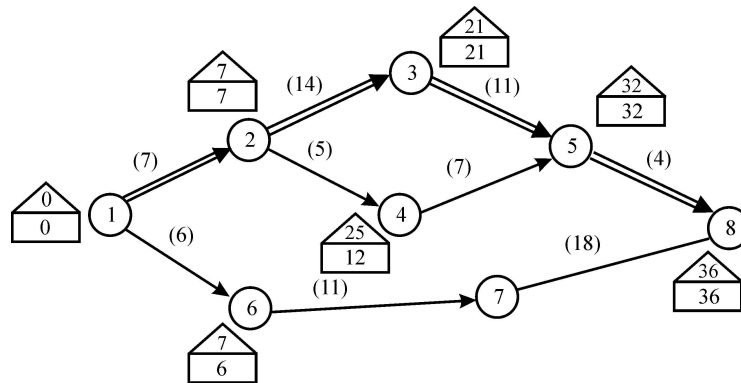
NOTES

Table 5.4 Expected Time and Standard Deviation

Activity	$t_e = \frac{t_o + 4t_m + t_p}{6}$	$\sigma^2 = \left[\frac{t_p - t_o}{6} \right]^2$
1-2	$\frac{1+4 \times 7+13}{6} = 7$	$\left(\frac{13-1}{6} \right)^2 = 4$
1-6	$\frac{2+4 \times 5+14}{6} = 6$	$\left(\frac{14-2}{6} \right)^2 = 4$
2-3	$\frac{2+4 \times 14+26}{6} = 14$	$\left(\frac{26-2}{6} \right)^2 = 16$
2-4	$\frac{2+5 \times 4+8}{6} = 5$	$\left(\frac{8-2}{6} \right)^2 = 1$
3-5	$\frac{7+4 \times 10+19}{6} = 11$	$\left(\frac{19-7}{6} \right)^2 = 4$
4-5	$\frac{5+5 \times 4+17}{6} = 7$	$\left(\frac{17-5}{6} \right)^2 = 4$
6-7	$\frac{5+8 \times 4+29}{6} = 11$	$\left(\frac{29-5}{6} \right)^2 = 16$
5-8	$\frac{3+3 \times 4+9}{6} = 4$	$\left(\frac{9-3}{6} \right)^2 = 1$
7-8	$\frac{8+4 \times 17+32}{6} = 18$	$\left(\frac{32-8}{6} \right)^2 = 16$

NOTES

A graphical description of the above Table is shown in Figure 5.4.

**Fig. 5.4** Expected Time and Standard Deviation

From the above calculation and Figure, we can conclude the expected project duration as that of 36 days and the critical path can be determined as 1-2-3-5-8.

Project length variance is

$$\begin{aligned}\sigma^2 &= 4 + 16 + 4 + 1 \\ &= 25 \\ \sigma &= 5\end{aligned}$$

Probability that the project will be completed within 40 days is given by:

$$\begin{aligned}P(Z \leq D) \\ D = \frac{T_s - T_e}{s} = \frac{40 - 36}{5} = \frac{4}{5} = 0.8\end{aligned}$$

Area under the normal curve for $\Delta = 0.8$

$$\begin{aligned}P(Z \leq 0.8) \\ &= 0.5 + \phi(0.8) [\phi(0.8) = 0.2881 \text{ (from table)}] \\ &= 0.5 + 0.2881 \\ &= 0.7881 \\ &= 78.81\%\end{aligned}$$

If the project is performed 100 times under the same conditions, there will be 78.81 occasions for this job to be completed in 40 days.

Assuming that the expected times are normally distributed, find the probability of meeting the schedule date as given for the network. Table 5.5 shows the necessary data for calculation.

Table 5.5 Activity Times

Activity (i-j) a	Days		
	Optimistic A	Most likely M	Pessimistic b
1-2	2	5	14
1-3	9	12	15
2-4	5	14	17
3-4	2	5	12
4-5	6	6	12
3-5	8	17	20

The scheduled project completion date is 30 days. Find the date on which the project manager can complete the project with a probability of 0.90. The expected time t_e and variance for each activity is calculated in the following Table 5.6.

NOTES

Table 5.6 Expected Time and Variance

Activity	$t_e = (a + 4t_m + b) / 6$	$\sigma^2 = (b - a / \sigma)^2$
1-2	6	4
1-3	12	1
2-4	13	4
3-4	5	1
3-5	16	4
4-5	7	1

NOTES

To determine the critical path, the earliest expected time and the latest allowable time, it is required to draw the project network. Figure 5.5 shows the relevant network.

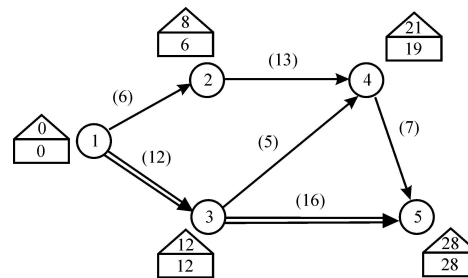


Fig. 5.5 Project Network

The critical path is given by 1-3-5 and the project duration is 28 days.
Project length variance: $\sigma^2 = 1 + 4 = 5$

Standard deviation: $\sigma = 2.236$.

The probability of completing the project within 30 days is given by:

$$P(Z \leq D) \text{ where, } D = \frac{T_s - T_e}{\sigma} = \frac{30 - 28}{2.236} = 0.8944$$

$$\begin{aligned} P(Z \leq 0.8944) &= 0.5 + 0.8944 \\ &= 0.8133 \\ &= 81.33\% \end{aligned}$$

If the project is performed 100 times under the same conditions, then there will be 81.33 occasions for this job to be completed in 30 days.

If the probability for the completion of the project is 0.90, then the corresponding value of $Z = 1.29$.

$$Z = \frac{T_s - T_e}{S.D} = 1.29$$

$$\text{that is, } \frac{T_s - 28}{2 \cdot 2.236} = 1.29$$

$$\text{Therefore, } T_s = (1.29) (2.236) + 28$$

$$T_s = 30.88 \text{ weeks.}$$

Check Your Progress

5. Who developed the PERT model?
6. State two advantages of the PERT model.

NOTES

5.5 MEASURES OF VARIABILITY

Project risk is denoted by variability in operating income. Actual performance of a project, as compared to planned performance, may be at variation due to several reasons. The reasons can be classified into three groups: (1) project planning risk, (2) project construction risk and (3) operating risk.

1. Project planning risk

An ill-conceived, ill-planned project is destined to fail. Due diligence at every stage of planning, starting from idea generation to preparation of the detailed project report, is important from the risk management perspective. Strategic fit of the project, balanced allocation of limited capital, financing-mix, project design and plan for execution are the major activities in the planning process from the angle of project planning related risk.

2. Project construction risk

Inefficient project execution may result in any one of the following:

- (a) Project time-overflow
- (b) Project cost-overflow
- (c) Project quality deterioration

The first two result in a higher cost of project and lost opportunities. The last one has a bearing on the quality of earnings.

Project construction activities need extraordinary care and skills. The company must assess its own strengths and weaknesses before deciding whether to construct the project on its own or give it away to a contractor on turnkey basis

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or through a series of subcontracting arrangements. The choice of project construction alternative should aim at completion of the project in time, within cost and as per quality specifications. The importance of management of projects, project organization, contract management and project monitoring cannot be understated, especially in a competitive environment.

3. Operating risk

The benefits from a project may be uncertain. The operating profit will change faster than the change in sales revenue. The sales revenue may be different because of sales quantity; sales price and sales mix may turn out to be different from what was planned. If the sales revenue targets could be achieved, input resource (material, labour, energy and other expenses) prices and productivity may turn out to be different from those planned. Variation in any of these factors has impact on profits.

Profit uncertainty is caused by variation in those factors as well as the degree of impact on profit due to change in revenue and expenses. The degree of impact is called leverage. There are two types of leverages created in business; one, the degree of operating leverage created by investment decisions and two, the degree of financial leverage created by financing decisions. Thus, investment and financing must be well planned for reducing the operating risk to the acceptable level.

And of course, the portfolio effect of variation in profit is equally important. This brings three concerns in the project risk management, namely:

- (a) Studying and reducing variability in the external factors associated with sales and expenses
- (b) Selecting the project efficiency level so that the impact of change in external factors remains within the acceptable range
- (c) Considering the portfolio effect risk

Check Your Progress

- 7. Mention three reasons why an actual performance of a project may differ from the planned performance.
- 8. What can inefficient project execution lead to?

5.6 NETWORK COST SYSTEM

The techniques of PERT and CPM are time oriented activities; they aim to keep a track on

- How much time on an average would be required by an activity for its completion?

- What is the best schedule for an activity?
- What is the probability of completing the task in a given schedule?

In all such cases, the primary objective is to develop a time schedule in view of time / cost tradeoff. However, it does not focus on developing a detail budget of cost, time-wise and activity wise. Similar is the case when the scheduling is done under funds constrain; the primary aim is to establish a time schedule consistent with funds constrain and not to develop a system for planning and control. All these analysis overlook the cost aspect which is usually as important as the time aspect and sometime even more important.

To provide an instrument for cost planning and control of the project, the Network cost system was developed. It provides an edge over the traditional time oriented network system. The basic system of network cost system is that costs are planned, measured, analysed and controlled in terms of project activities. It represent a departure from the traditional cost accounting system where costs are generally planned, measured, analyzed and controlled in term of functional or organizational divisions. There are two techniques, Cost Projection and Cost Analysis and Control under the network cost system.

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(a) Cost Projection

Once costs are estimated in terms of activities, cost projections can be made for any selected schedule. For cost projection, it is assumed that the expenditure for any activity is incurred evenly over the duration of the activity. In those cases where the assumption does not appear valid, the activity should be divided into sequential components in a manner that for each of the component, the expenditure occurs evenly over the duration of the activity.

(b) Cost Analysis and Control

As the project progresses, the following parameters are measured or estimated periodically for the purpose of monitoring and control:

Costs incurred to date: In a network cost system, the costs are recorded activity-wise. Cost incurred to date can be obtained by summing up costs for various activities.

Budgeted Cost to date: This is obtained from the cost projections made at the beginning.

Value of work done to date: It is measured in terms of extent of work accomplished; the value of work done is obtained as follows:

Value of work done = Budgeted cost × Percentage of Work accomplished.

Cost over-run/ under-run to date: When the cost incurred is more than the value of work done, there is cost over-run and when the cost incurred is less than the value of work done, there is a cost under-run. Cost over-run/ under-run is usually expresses in terms of percentage. It is calculated as follows:

$$\frac{\text{Actual Cost} - \text{Value of Work completed}}{\text{Value of Work Completed}} \times 100$$

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Time over-run to date: In case the project is behind schedule, there is time over-run. Similarly in case the project is ahead of schedule, there is time under-run. It is defined in terms of month behind or month ahead.

Graphical display: The information discussed above can be presented in the form of graphs as follows:

Graph 1: Budgeted cost (Curve A) Actual cost (Curve B) and Value of work (Curve C)

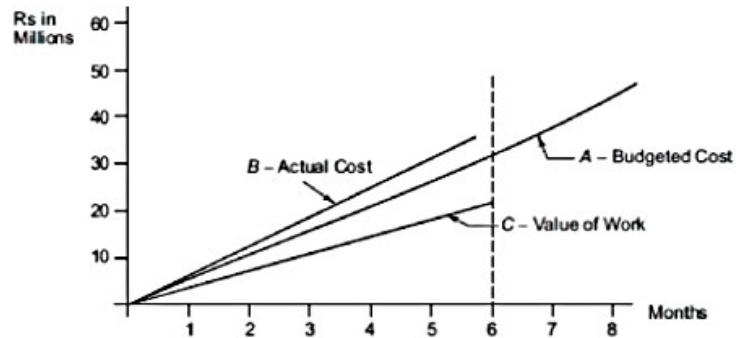


Fig 5.6 Time and Cost, Budget and Actual

Graph 2: In this graph, the percentage over-run or under-run is shown. It may be noted here that curve D is derived from curve B and C. it is obtained as follows: The vertical distance between curve B and C is divided by height of curve C and multiplied by 100 to get curve D.

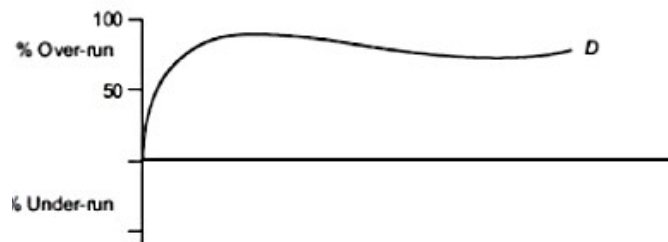


Fig. 5.7 Percentage over-run or under-run to date

Graph 3: This indicates the number of months by which the project is behind or ahead of the schedule. It is shown by curve E. Curve E is derived from curve A and C. The month behind or ahead is nothing but the horizontal distance (measured in month) of curve C from curve A.

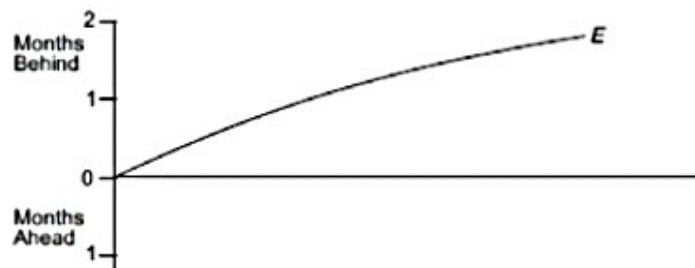


Fig. 5.8 Behind or Ahead to Date

Check Your Progress

9. Mention the two techniques used under the network cost system.
10. How is the value of work done calculated?

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5.7 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. A network diagram is a graphical presentation of all the activities of a project, arranged in proper sequence and with clearly defined interdependencies. The network diagram provides full picture of the project.
2. The goals of network analysis are as follows:
 - Identifying discrete activities and sub-activities
 - Identifying slack for resource allocation
3. The CPM is the graphical representation of the interrelationships between the tasks in a project to be performed in a well-defined sequence.
4. The CPM suffers from certain drawbacks such as high cost, time consumption, poor time estimate provision and resource allocation.
5. The PERT was developed by a Navy sponsored research team of Messrs D.G Malcolm in 1950.
6. Two advantages of using the PERT are listed below:
 - It represents the project in graphical form.
 - It provides information about the expected completion time of the project.
7. The actual performance of a project may differ from the planned performance due to the following reasons:
 - Project planning risk
 - Project construction risk
 - Operating risk
8. Inefficient project execution may result in any one of the following:
 - Project time-overflow
 - Project cost-overflow
 - Project quality deterioration
9. There are two techniques under the network cost system: Cost Projection and Cost Analysis and Control.
10. The value of work done is obtained as follows:
 Value of work done = Budgeted cost × Percentage of Work accomplished.

5.8 SUMMARY

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- A number of activities with a great degree of variety and interdependence require the firm to organize the activities in the best planned way to avoid any confusion and complications in the execution of the project.
- Conceptually, it can be said that a network diagram is a graphical presentation of all the activities of a project, arranged in proper sequence and with clearly defined interdependencies. The network diagram provides full picture of the project.
- In 1950, a joint venture between the Dupont Corporation and the Remington Rand Corporation led to the CPM. Today, it is commonly used with all forms of project such as construction, software development, research projects, product development, engineering, plant maintenance and so on.
- The CPM is the graphical representation of the interrelationships between the tasks in a project to be performed in a well-defined sequence. A CPM schedule simplifies the planning of work assignments in advance and helps improve communication among those who are responsible for project performance.
- The CPM assumes that the estimated completion time for a project can be shortened by deploying additional resources for the activities. These additional resources include labour, equipment, capital or any other resource. The CPM assumes that the time to perform any activity in the project is variable depending on the amount of effort or resources applied to it.
- The basic objective of the CPM is to determine which time-cost trade-offs should be used for each activity so as to achieve the maximum or scheduled speed project at the minimum total direct cost.
- The PERT was created to handle such projects where the time estimate of activities is non-deterministic. It was developed by a Navy sponsored research team of Messrs D.G. Malcolm in 1950.
- The PERT is used to organize and coordinate tasks within the project. The objective of the PERT chart is to determine critical path which comprises critical activities that should be completed on schedule. This chart is prepared with the help of information generated in project planning activities such as estimation of effort, selection of suitable process model for software PERT and CPM development and decomposition of tasks into subtasks.
- The PERT is a technique where the activity times are represented by a probability distribution. This probability distribution is based upon three

different time estimates made for each activity. These estimates are Optimistic time estimate, Most Likely time estimate, and Pessimistic time estimate.

- Project risk is denoted by variability in operating income. Actual performance of a project, as compared to planned performance, may be at variation due to several reasons. The reasons can be classified into three groups: (1) project planning risk, (2) project construction risk and (3) operating risk.
- The techniques of PERT and CPM are time oriented activities. To provide an instrument for cost planning and control of the project, the Network cost system was developed. It provides an edge over the traditional time oriented network system. The basic system of network cost system is that costs are planned, measured, analysed and controlled in terms of project activities. There are two techniques, Cost Projection and Cost Analysis and Control under the network cost system.

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5.9 KEY WORDS

- **CPM:** It is the graphical representation of the interrelationships between the tasks in a project to be performed in a well-defined sequence.
- **PERT:** It is a technique where the activity times are represented by a probability distribution. This probability distribution is based upon three different time estimates made for each activity: Optimistic time estimate, Most Likely time estimate, and Pessimistic time estimate.

5.10 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the goals of network analysis?
2. What are the advantages and disadvantages of CPM?
3. What is the algorithm procedure for CPM analysis?
4. Write a short note on operating risk.

Long-Answer Questions

1. Discuss in detail the CPM Model.
2. Explain the process of creating a PERT chart.
3. Examine the techniques used in network cost system.

5.11 FURTHER READINGS

NOTES

- Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.
- Kerzner, Harold, R. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.
- Singh, Narendra. 2000. *Project Management and Control*. Delhi: Himalaya Publishing House.
- Choudhury, Sadhan. 1988. *Project Management*. New Delhi: Tata McGraw-Hill.

UNIT 6 RESOURCES CONSIDERATIONS IN PROJECTS

*Resources Considerations
in Projects*

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Structure

- 6.0 Introduction
- 6.1 Objectives
- 6.2 Resource Allocation
 - 6.2.1 Scheduling
- 6.3 Project Cost Estimate and Budgets
- 6.4 Cost Forecasts
- 6.5 Answers to Check Your Progress Questions
- 6.6 Summary
- 6.7 Key Words
- 6.8 Self Assessment Questions and Exercises
- 6.9 Further Readings

6.0 INTRODUCTION

In any organization, there is a need to allocate resources on the basis of the projected demand. The resource plan is prepared keeping in mind the type of resourced required and the timing of the need. Once the resource allocation plan is prepared, the resource requirement list is mapped. The decision to choose between multi-level scheduling and multi-project scheduling is done. The process of estimating costs and preparing project budgets is initiated. In addition, cost forecasting arms the project manager with valuable knowledge, enabling proactive project and resource management. This unit will discuss the process of resource allocation, preparation of project budget and cost forecasting.

6.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the importance of resource allocation
- Discuss the concept of multi-level scheduling and multi-project scheduling
- Understand the process of estimating costs and preparing project budgets
- Examine the advantages and disadvantages of cost forecasting

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6.2 RESOURCE ALLOCATION

For an organization, resources refer to people, material, equipment, knowledge and time. Mostly, organizations run short of resources. Hence, there is a tradeoff between resources and everyday and long-term demands. Therefore, there is a need to schedule resources based on projected demands. A resource plan, which describes the type of resource needed and the timing of that need, is critical to effective resource management. As schedules for projects change, resource plan should be enough flexible to accommodate the changes. A foolproof resource plan should be structured with full details of resources needed for each task and have a single task owner on each task. Here, we will briefly outline some of the resources, namely machine and equipment supply, material procurement and manpower planning.

• *Engineering design and erection plan*

Presumably, the plan for the project specifies the end product that is desired and in some cases it may contain considerable details about the components that make the end product. Such information provides the basis for constructing work packages and specifying their contents. In many cases, however, the nature of the work packages cannot be determined simply from the specifications for the end product and engineers must develop a concrete plan, perhaps working backward from the end product first to its components and then to the activities that are required in order to obtain such a component. This process finally culminates in a detailed engineering design and erection plan.

The engineering design would detail all specifications like size, shape, thickness, alloy characteristics and properties and functionalities of every piece included in a machine or equipment and their sub-parts. Erection plan is a step-by-step process of putting all pieces together with the stages of testing and experimentations. The actual idea of time needed for completing an activity and interdependence of a given activity with other activities and cost of activities becomes clear only after the engineering design and the erection plan is prepared. We can call this aspect as the quality and technical performance aspect of the project.

• *Equipment supply*

Projects involve significant investments in machines and equipment, which may be either the core assets for the project or the support assets. The capacity of each machine, the balancing of equipment and the technical specifications are very important in the purchase of machines and equipment. More often than not, machines and equipment have to be fabricated as per specifications. Specialist fabricators with excellent track record and transportation of fabricated machines either in full or in knock-down condition, together with cost are the issues of greater concerns in the planning of equipment supply. Equipment needed for activities on critical path has to get better attention and close follow-up from the

procurement team. Contracts with fabricators are the main driving factors in the successful acquisition of machines and equipment.

- **Material procurement**

Project construction involves procurement of thousands of special material that the business would not keep for its routine activities. Vendors may be unknown and their reliability uncertain. A procurement team has to develop vendors for various material items and buy the resources as and when needed.

- **Manpower planning**

Manpower with different skills and experience would be in demand at different times of project construction. Some scarce manpower would raise the issue of its allocation, which would have a bearing on the project activities' start and end dates. If the firm is drawing some or all manpower resources for routine business operations, then coordination with operations would be an added challenge.

- **Budgeting**

Project budget has two components in it, cost and cash flow. Cash flow budget is required for liquidity planning and for obtaining funds in time. A budget offer has to work in close coordination with the technical staff who prepare project network and with the procurement officers.

After a resource requirement list has been prepared, the next stage is to map this to the activity plan to access the distribution of resources required over the duration of the project. It is better to represent the activity plan as a *bar chart* and use this to produce *resource histogram* for each resource.

In practice, resources have to be allocated to a project on an activity-by-activity basis and finding the best allocation is time-consuming and difficult. As soon as a member of the project team is allocated an activity, that activity acquires a start and finish dates on the schedule. Thus, allocating a resource to one activity limits the flexibility for resource allocation and scheduling for other activities.

Resource Levelling

The network diagram drawn based on the work breakdown structure and the critical path identified on it, both are based on ideal condition of abundance of resources. The network plan is a time schedule and not the resource utilization plan. The resources requirement determined by the ideal network plan is called **resource loading** with reference to time. The resource loading may face two situations:

- The need for a particular resource may vary over time. Often, the need for a resource may vary between 70 per cent and 120 per cent. This means that resource may remain idle sometime, whereas, some other time the same resource may be simply non-available for some task because it is more in

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demand. By adjusting the project schedule (network plan) through the use of slack (early start and late start of non-critical activities) it may be possible to make efficient use of the resource. This is called **resource smoothing**. Resource smoothing does not delay the project completion time, but it reallocates the resources as a result of which schedule of activities change within the available slack time.

- Resource loading does not consider the cost implications. It is possible that the resources are available as per the loading needs, but the cost of resources may not be at the minimum level. The resource levelling aims at reallocation of resources, and as a result the rescheduling of activities also, to minimize the cost of project. As a general rule, an early consumption of resources costs more than the late consumption. Even the cost-implications of delayed completion is considered and if late completion is found cost-effective, the network plan and critical path may be changed.

Resource smoothing and levelling can be done using either the heuristic methods or optimization models. Heuristic methods are judgmental and intuitive. They use thumb rules but are often effective in complex situation. Some examples of heuristic approach for resource smoothing and levelling are the late or an early start of some activities, taking up short and simple activities first, completing those activities early which consume less resource, assigning different resources, changing task dependency, removing or adding tasks, etc. Optimization models include mathematical models like linear programming, but it is very difficult to apply them in a complex activity structure. Most project planning software offer resource smoothing and resource levelling features.

6.2.1 Scheduling

Two basic decisions are important before the network techniques are deployed: one, whether to have multi-level scheduling and two, whether to have multi-project scheduling.

(i) Multi-level scheduling

Different levels of management need different degrees of details in the schedule plan and network diagram. This is more desired in project planning, especially if the project work is an amalgamation of numerous tiny activities. Each minute activity cannot be incorporated in a single work plan, unless the project itself is small and simple (like replacement of machine). So, multi-level scheduling is more common and desirable.

When schedules are prepared at multiple levels, it is called multi-level scheduling. Three to four level schedules can be prepared depending upon the requirements, for example:

- **Master project schedule** is prepared for the top management. This is essentially the milestone chart which gives a one-glance picture of the total

activities. Only major groups of activities are recognized as discrete activities and sub-activities are ignored: for example, activity groups can be land development, civil work, electric work, plumbing, mechanical work, etc. The details in each of these work packages are excluded from the master project schedule for convenience.

- **Functional area schedules** are prepared for the project related activities of each functional department. Usually, the functional heads would need this level of scheduling. The functional area schedule is essentially the sub-group of corporate level master schedule.
- **Schedules of work packages** are the detailed schedules for all work packages that form the part of either the master project schedule or the functional area schedule. This essentially serves the purpose for project sub-teams or subcontractors who execute the activities.

(ii) Multi-project scheduling

A firm, handling more than one project simultaneously, may require multi-project planning and resource allocation. Several resources, including manpower and money, are in common demand from all projects under construction. In that case, if separate project teams are allowed to operate independently, there could be conflicts and sub-optimal utilization of resources leaving unutilized resources some times and scarcity of resources some other times. The task of planning and control, therefore, is more difficult in multi-project activities.

In multi-project scheduling, all projects are collectively treated as a single project for the breakdown of work packages, their sequencing and resource allocation. Activities of one project may have a predecessor activities and/or successor activities in other projects. It becomes imperative for multi-project scheduling to follow multi-level scheduling also and plan for a greater degree of communication, reporting and coordination.

A firm may avoid difficulties of multi-project scheduling by scheduling each project independently but the costs and other potential conflicts in this approach may not be worth taking the risk.

Check Your Progress

1. What is an erection plan?
2. For whom is the master project schedule prepared?

6.3 PROJECT COST ESTIMATE AND BUDGETS

As discussed before, there are two important components of project budget: cost and cash flow. The budget is prepared after a close coordination with technical staff as well as procurement officers.

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PERT-cost

Project budgeting can improve with the PERT-cost. This helps in developing a critical path that is optimum considering both the time and the cost aspects jointly for planning purposes, as it is supposed to provide cost-time trade-off. For control purposes, it is supposed to provide a basis for analysing actual times and actual costs jointly. It also helps in determining the cash flow requirement during the course of the project.

PERT-cost is so complicated that it often loses practical application. In order to control time, the work packages must be quite small but difficulty is experienced in estimating the cost of each small work package.

Bell Curve

If the budgeted cost and the cash flow, prepared in conjunction with the network and the resource plans, are depicted on a chart over the timeline (or activities on critical path), one of the two common patterns is likely to appear. It would be either a bell curve or an S-curve. The costs (or cash flow) depicted over the timeline is likely to be a bell curve as shown in Figure 6.1.

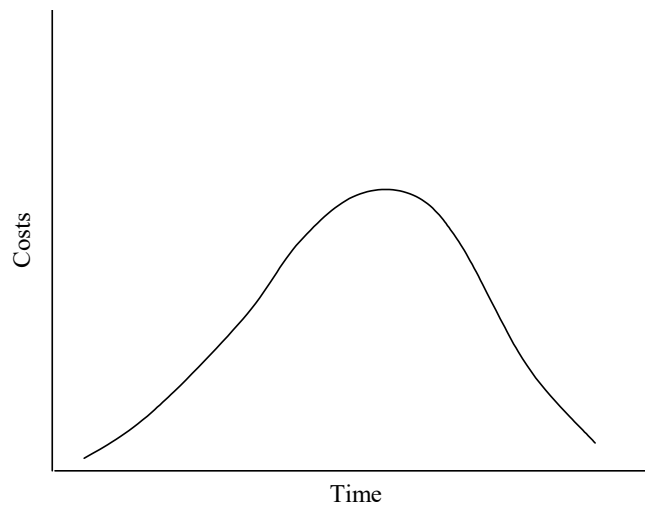


Fig. 6.1 Bell Curve of Costs over Time

The goal of the procurement officer should be to either flatten the bell curve or to make it slowly rising towards the end, like a hockey stick. That will save costs in terms of time value of money. The bell curve can be adjusted by reviewing slacks and determining late start and late finish of activity together with crashing of activities.

S-Curve

The project costs accumulated over time would show S-curve shape as depicted in Figure 6.2. S-curve initially rises slowly, followed by a steep rise and then tapers down. This is a result of bell shaped periodic expenses on project construction.

The goal should be to achieve the rising part of the S-curve as late in the project construction as possible to help minimize the opportunity costs. This again emphasizes on the network design and the coordination among technical staff and procurement staff.

Before producing a resource allocation plan, we should list the resources that will be required along with the expected level of demand. The resource requirement list should be as comprehensive as possible.

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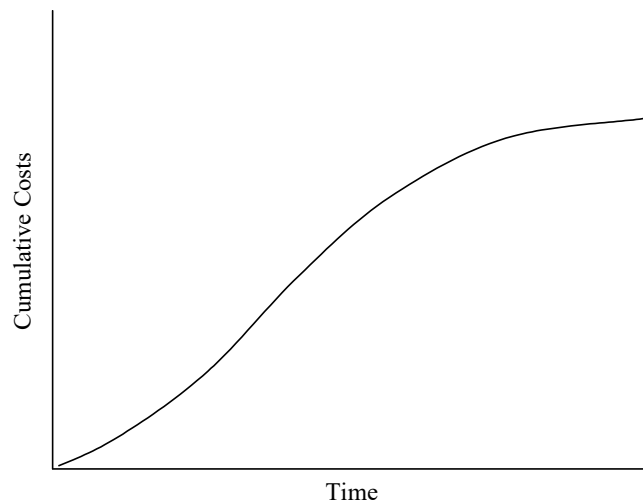


Fig. 6.2 S-Curve of Cumulative Costs over Time

Check Your Progress

3. What are the two components of project budget?
4. What is the main disadvantage of relying on PERT-cost?

6.4 COST FORECASTS

Managing cost of a project requires a careful planning to avoid shortage that can affect the payments and the entire project. The forecasting of the cost or cost forecasting is a very useful exercise to identify the expenses at the various stages of the project. The cost forecast is a method one can use to adapt cost planning to constantly changing circumstances. The aim is to forecast the cost of completing a project with a defined scope. It is one of the important elements of project cost management, a knowledge area that involves planning, monitoring, and controlling a project's monetary cost. Cost estimate is nothing but the approximate total project cost. This value is used to authorize a project's budget and manage its costs. Forecasts can be made for performance or quality level of project deliverables, project duration, overall project cost or a mix of any of these. The forecast may be carried out any time and for a number of projects/tasks. A major element in forecasting is to measure the risk triggers and risk events already occurred.

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Forecasting equips the project manager with valuable information which in turn aids in proactive project management. It is carried out by identifying the updated cost and comparing it with the actual and commitment value. Thus, a clear understanding of the contractual provisions of the project and its schedule is important for accurate cost forecast. Following steps are involved in cost forecasting:

- Analyse the contract
- Analysis of the scope of the project work
- Analysis of the payments system of the project
- Development of the project work break down structure
- Development of the project cost breakdown structure
- Integration of the schedule of project with resource and cost data
- Identification of the indicator giving accurate cost forecast
- Forecasting on the basis of optimistic, pessimistic and most likely scenario
- Formation of risk management plan
- Project periodic review

Key Components of a Cost Estimate

The two key components of cost estimates are indirect costs and direct costs.

Indirect costs: Indirect cost is the cost that cannot be related with a precise cost center and are instead incurred by a number of projects simultaneously. Costs like security costs, quality control, utilities costs are frequently considered as indirect costs as they are shared across a number of projects and are not directly billed against any one project.

Direct costs: These are the cost that can directly be associated with a single project or task in the project. Cost like project team wages, cost of resources used in the project, cost of fuel or equipment used in the project are examples of direct cost.

Beside these costs, there are few common types of expenses; these include:

- Labor cost: It is the cost of human effort spent towards project objectives.
- Equipment cost: This include the cost of buying and maintaining equipment required for the project.
- Materials Cost: This is the cost involved in buying the materials required in the project.
- Services Cost: This includes any external service or support that the project manager seeks.
- Facilities Cost: This includes the cost of using specialized equipment, services, or locations and cost of renting the facility.

- **Hardware Cost:** It is the cost involved in the purchase of the computer hardware.
- **Software:** This includes the cost incurred in acquiring Non-physical computer resources.
- **Contingency costs:** This cost is added to the project budget to deal with specific risks.

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Advantages and Disadvantages of forecasting

The major advantages and disadvantages of forecasting is as follows:

Advantages

Cost forecasting is very helpful in following:

- **Learning from past mistakes:** It helps in learning from the past action and reviewing things that do not happen the way it was predicted.
- **Give valuable insight:** It gives insight into the company's health and provides an opportunity to course-correct or make adjustments during the project as well.
- **It can decrease costs:** If done in the right manner, forecasting cost helps in better planning and reducing inventory thus increasing overall profitability.

Disadvantages

The disadvantages of cost forecasting are as follows:

- **Resource-intensive:** Forecasting involves a lot of data gathering, organization and analysis which requires lots of time and effort.
- **Forecasts are never 100% accurate:** It is very difficult to predict the future. Even if you have a great process in place and forecasting experts on your payroll, your forecasts will never be spot on.

In spite of all these all these disadvantages, one cannot deny that forecasting creates confidence in meeting client demands and allows thoughtful consideration for outsourcing. The following points are required to be done before accessing the cost forecast.

Reschedule: No activity scheduling takes place in the cost forecast. All must be rescheduled first, so that the calculation of the cost to complete takes account of the changed dates.

Calculate overhead on actual and commitment values: In order to calculate the estimated costs at completion, the overhead on actual and commitment values are calculated separately. It considers the following:

- All the actual and commitment values in the project
- Forecast values from confirmations
- The plan values for network activities

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It does not consider the following:

- Network preliminary planning values
- Work Breakdown Structure element plan values
- Plan costs for material components in valuated project stock

Based on planned, actual, and commitment costs, the system determines what is still to be done in network activities and costs this again. The system records the value so determined as cost to complete, by period, in a forecast version for:

- Internally processed activities
- Externally processed activities
- General costs activities
- Material components not managed as part of project stock (whether valued or not)
- Cost estimates are very important for a project any error made could have a serious implication on the scope of the project. Thus estimates should be calculated carefully by the expert team and all stakeholders are responsible for accurate estimates.

Check Your Progress

5. State two disadvantages of forecasting.
6. What are indirect costs?
7. What is facility cost?

6.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. An erection plan is a step-by-step process of putting all pieces together with the stages of testing and experimentations.
2. The master project schedule is prepared for the top management.
3. Project budget has two components in it, cost and cash flow.
4. The PERT-cost is so complicated that it often loses practical application.
5. The disadvantages of forecasting are as follows:
 - **It can be time-consuming and resource-intensive:** Forecasting involves a lot of data gathering, data organizing, and coordination. In addition, it's not uncommon for processes to be manual and labor-intensive, thus taking up a lot of time.
 - **It can also be costly:** Hiring a team of demand planners is a significant investment.

6. The cost that cannot be associated with a specific cost centre and are instead incurred by a number of projects simultaneously, sometimes in varying amounts is called indirect cost.
7. Facility cost includes the cost of using specialized equipment, services, or locations and cost of renting the facility.

*Resources Considerations
in Projects*

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6.6 SUMMARY

- For an organization, resources refer to people, material, equipment, knowledge and time. Mostly, organizations run short of resources. Therefore, there is a need to schedule resources based on projected demands.
- A resource plan, which describes the type of resource needed and the timing of that need, is critical to effective resource management. As schedules for projects change, resource plan should be enough flexible to accommodate the changes.
- The engineering design would detail all specifications like size, shape, thickness, alloy characteristics and properties and functionalities of every piece included in a machine or equipment and their sub-parts. Erection plan is a step-by-step process of putting all pieces together with the stages of testing and experimentations.
- Projects involve significant investments in machines and equipment, which may be either the core assets for the project or the support assets. Equipment needed for activities on critical path has to get better attention and close follow-up from the procurement team. Contracts with fabricators are the main driving factors in the successful acquisition of machines and equipment.
- Project construction involves procurement of thousands of special material that the business would not keep for its routine activities. A procurement team has to develop vendors for various material items and buy the resources as and when needed.
- Project budget has two components in it, cost and cash flow. Cash flow budget is required for liquidity planning and for obtaining funds in time. A budget offer has to work in close coordination with the technical staff who prepare project network and with the procurement officers.
- After a resource requirement list has been prepared, the next stage is to map this to the activity plan to access the distribution of resources required over the duration of the project.
- The resources requirement determined by the ideal network plan is called resource loading with reference to time. Resource smoothing and levelling can be done using either the heuristic methods or optimization models.

*Self-Instructional
Material*

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- Two basic decisions are important before the network techniques are deployed: one, whether to have multi-level scheduling and two, whether to have multi-project scheduling.
- When schedules are prepared at multiple levels, it is called multi-level scheduling. Three to four level schedules can be prepared depending upon the requirements. On the other hand, a firm, handling more than one project simultaneously, may require multi-project planning and resource allocation.
- Project budgeting can improve with the PERT-cost. This helps in developing a critical path that is optimum considering both the time and the cost aspects jointly for planning purposes, as it is supposed to provide cost-time trade-off.
- If the budgeted cost and the cash flow, prepared in conjunction with the network and the resource plans, are depicted on a chart over the timeline (or activities on critical path), one of the two common patterns is likely to appear. It would be either a bell curve or an S-curve.
- The project costs accumulated over time would show S-curve shape. S-curve initially rises slowly, followed by a steep rise and then tapers down. This is a result of bell shaped periodic expenses on project construction.
- The cost forecast is a method one can use to adapt cost planning to constantly changing circumstances. The aim is to forecast the cost of completing a project with a defined scope. It is the primary element of project cost management, a knowledge area that involves planning, monitoring, and controlling a project's monetary costs.
- A key element in forecasting is to review the risk events that occurred and the remaining risk triggers. Forecasting arms the project manager with valuable knowledge, enabling proactive project and resource management.
- A cost estimate is a sum total of all the costs involved in successfully finishing a project, from inception to completion. These project costs can be categorized in a number of ways and levels of detail, but the simplest classification divides costs into two main categories: indirect costs and direct costs.

6.7 KEY WORDS

- **Resource loading:** The resources requirement determined by the ideal network plan is called resource loading.
- **Project budget:** It is a tool used by project managers to estimate the total cost of a project.
- **Cost forecasting:** It is a useful exercise in determining required expenditures at the various payment stages of a project.

6.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

*Resources Considerations
in Projects*

Short-Answer Questions

1. What do you mean by resource smoothing?
2. Write a short note on PERT-cost.
3. What are the advantages of cost forecasting?
4. What are the key components of a cost estimate?

Long-Answer Questions

1. Discuss in detail the resources that should be taken care of in the resource plan.
2. Examine the concept of multi-level scheduling and multi-project scheduling.
3. Explain with the help of graphs the concept of Bell curve and S curve.

6.9 FURTHER READINGS

- Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.
- Kerzner, Harold, R. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.
- Singh, Narendra. 2000. *Project Management and Control*. Delhi: Himalaya Publishing House.
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UNIT 7 PROJECT RISK MANAGEMENT

NOTES

Structure

- 7.0 Introduction
- 7.1 Objectives
- 7.2 Risk Management
 - 7.2.1 Role of Risk Management in Overall Project Management
- 7.3 Steps in Risk Management
 - 7.3.1 Risk Identification and Analysis
- 7.4 Reducing Risk
- 7.5 Answers to Check Your Progress Questions
- 7.6 Summary
- 7.7 Key Words
- 7.8 Self Assessment Questions and Exercises
- 7.9 Further Readings

7.0 INTRODUCTION

Risk management plays a very important role in project management. This is because ill-conceived projects are bound to fail. There should be a clear understanding of the risk involved in the project plan and the things that could go wrong at every step of the project. There are two broad categories into which project risk can be divided: project execution risk and project operating risk. A proactive firm puts in place an effective risk management system. The firm should first identify the sources of risk and then take measures to tackle it. A risk-monitoring system senses the potential risk occurrences so that the project team can respond accordingly. This unit will discuss project risk management and its steps. Risk identification and the techniques of measuring risk will also be explained.

7.1 OBJECTIVES

After going through this unit, you will be able to:

- Understand risk management and its role in project management
- Explain the steps involved in risk management
- Discuss risk analysis and risk control mechanism

7.2 RISK MANAGEMENT

Project risk analysis is the process through which perceived risk gets expression, preferably in numbers so that the same can be meaningfully incorporated in the

decision-making process. Many techniques and approaches have been developed so far for the purpose of project risk analysis. It is a three-stage process:

- Identifying critical sources of risk
- Measuring the quantum of risk
- Incorporating risk in decision making

This classification is made for easy understanding, but they are not strictly followed in many cases. Some techniques that help in identifying sources of risk may through their extension help in taking decision but without quantifying it. Some measures of risk are directly used for decision-making without actually incorporating risk in the analysis.

An element of subjectivity is a responsible factor for a not so clear-cut and step-by-step three-stage approach in risk analysis. Room for a subjective decision is necessary because risk is a perception. The decision, therefore, has to have a strong element of a manager's risk perception and attitude towards risk. This, however, would not demean the purpose of risk analysis. Professional managers, who are habituated in taking informed decisions rather than intuitive decisions, would definitely derive useful guidance from the study of the project risk analysis.

7.2.1 Role of Risk Management in Overall Project Management

An ill-conceived, ill-planned project is destined to fail. Due diligence at every stage of planning, starting from idea generation to preparation of the detailed project report, is utmost important from the risk management perspective. Strategic fit of the project, balanced allocation of limited capital, financing-mix, project design and plan for execution are very important aspects of project planning related risk. Some basic questions are addressed for understanding the risk involved in the project plan, such as; what can go wrong and why things would go wrong? What is the likelihood of things not happening as planned? What can be the damage? How can we reduce such risk? What are the contingency plans in such scenario? Such questions guide the project to prepare in a way that risk can be mitigated and there are higher chances of project success. Project risk can be divided into two categories: (a) Project execution risk and (b) Project operating risk.

Project Execution Risk

Inefficient project execution may result in any one of the following:

- Project time-overflow
- Project cost-overflow
- Project quality deterioration

The first two result in a higher cost of project and lost opportunities. The last one has a bearing on the quality of earnings.

Project design and planning activities need extraordinary care and skills. The company must assess its own strengths and weaknesses while planning for

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the project. For example, the choice of project construction alternative should aim at completion of the project in time, within cost and as per quality specifications. If the firm smells risk in taking up the construction then the alternatives of straight away buying or subcontracting the construction can be considered. The importance of management of projects, project organization, contract management and project monitoring cannot be understated, especially in a competitive environment.

Project Operating Risk

The benefits from a project may be uncertain. The operating profit will change faster than the change in sales revenue. The sales revenue may be different because of sales quantity; sales price and the sales mix may turn out to be different from what was planned. If the sales revenue targets could be achieved, input resource (material, labour, energy and other expenses) prices and productivity may turn out to be different from those planned. Variation in any of those factors has impact on profits.

Profit uncertainty is caused by variation in those factors as well as the degree of impact on profit due to change in revenue and expenses. The degree of impact is called leverage. There are two types of leverages created in business. One is the degree of operating leverage created by investment decisions and the second is the degree of financial leverage created by financing decisions. Thus, investment and financing must be well planned for reducing the operating risk to the acceptable level.

The portfolio effect of variation in profit is equally important. This brings three concerns in the project risk management, namely:

- Studying and reducing variability in the external factors associated with sales and expenses
- Selecting the project efficiency level so that the impact of change in external factors remains within the acceptable range and
- Considering the portfolio effect risk.

Check Your Progress

1. What are the two categories into which project risk can be divided?
2. Name the two types of leverages created in business.

7.3 STEPS IN RISK MANAGEMENT

A proactive firm will institutionalize the process of risk management in its system; more so for the project management. A well-designed system of project risk management will have the following four processes in place:

- Knowledge of sources of risk
- Assessment and prioritization of risks

- Planning for risk management and response
- Risk monitoring and control

These steps are discussed hereafter.

(a) Knowledge of Sources of Risk

This is a process of converting 'unknowns' into 'knowns', and transforming uncertainties into a known risk that can be explained and measured. A fundamental question is investigated at this stage, 'what can go wrong with this project'. This inquiry can be done in several ways, like brainstorming, problem identification meetings, risk profiling, expert interviews, analogy comparison and many other ways. The risk must be defined clearly and in a concise way and it should capture the risk events. One must try to foresee all potential sources of risk without assessing them at this stage.

Risk breakdown structure

Depending upon the type and location of project, a list of potential sources of risk may vary. All the sources of risk can be tabulated in a risk breakdown structure format for better comprehension. An example of a risk breakdown structure for an undefined project is given in the Table 7.1.

Table 7.1: Risk Breakdown Structure of a Hypothetical Project

<i>Project</i>			
Technical related	Organization related	Project management related	External
• Speed of technological advancement • Technical requirements in terms of resource availability, environment etc. • How complex and dependent is the technology • Reliability of technology • Impact on quality • Maintenance requirements	• Funding • Budget flexibility • Resource dependency • Importance of project • Project dependency • Top management support • General culture of the organization • Design of project organization • MIS system • Labour and union related issues	• Project team and level of empowerment • Estimation • Planning • Monitoring and control • Communication • Client relation	• Sub-contractors • Suppliers • Political scenario • Legal matters • Regulatory system and its effectiveness • Law and order situation • Market characteristics • Social values and reaction • General weather conditions • Quality of competition

This is just an illustration. The purpose of this exercise is to take stock of events that might possibly go wrong, before any assessment is done whether any event will go wrong or not. The list in Table 7.1 covers the small list of risk areas

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of project construction only. One may have to add several other elements in the risk breakdown structure, which may be related to project revenue once it is operational. For example, availability of critical resources like material, skilled labour, power and their process, as well as, market potential and selling price, etc.

(b) Assessment and Prioritization of Risk

This is a process of identifying sources of risk that should draw attention of management so that proper risk mitigation actions can be initiated and adequate monitoring system can be designed. Risk-severity matrix and sensitivity analysis are the useful methods for the assessment and prioritization of risk.

Risk-severity matrix

The process of preparing the risk-severity matrix involves systematic assessment of consequences of identified risk events and ranking or classifying them in the order of priority. The risk-severity matrix is prepared in four phases, first the possibility (likelihood) of the occurrence of an event is assessed, then the impact of the occurrence of the event is judged, then the likelihood and impact on project parameters are studied together for evaluating whether the risk event is creating major, moderate or minor risk. Finally, the risk events are prioritized, based upon the severity of risk. These steps are described next.

Likelihood

Each potential source of risk is investigated to identify those risk events that are more likely to occur. In a way this follows the same process of brainstorming, expert opinion etc. The assessment is still opinion based and judgmental. If it is too early to assign probabilities to the likely outcomes, the likelihood is determined on a scale as suitable. Likelihood assessment on a scale of five is more common, in which the likelihood of occurrence of an event is scaled as below:

- a = remote possibility of occurrence
- b = somewhat likely occurrence
- c = likely occurrence
- d = very likely occurrence
- e = almost sure occurrence

Impact of events

Simultaneously, the impact of each risk event on the scope, cost, time and performance of the project is also judged at this phase. The impact is measured using the impact scale. A suggested impact scale is one to five as given in Table 7.2.

Table 7.2: Impact Scale on Project Parameters

Project Parameter	Least Impact 1	Some Impact 2	Moderate Impact 3	High Impact 4	Severe Impact 5
Scope	Hardly noticeable decrease in scope	Few areas of scope affected	Major areas of scope affected	Scope decrease may not be acceptable to client	Scope reduction makes the project meaningless
Cost	Negligible increase in cost	< 5 per cent increase in cost	5–10 per cent increase in cost	10–20 per cent increase in cost	> 20 per cent increase in cost
Time	Negligible increase in time	< 5 per cent increase in time	5–10 per cent increase in time	10–20 per cent increase in time	> 20 per cent increase in time
Quality	Barely noticeable	Only some aspects are affected	Quality deterioration must be approved by the client	Deterioration may be unacceptable to client	Makes project meaningless
Performance	Minimal impact	Some visible impact with reduction in margin	Margin reduction at acceptable level	Margin reduces significantly	Makes project meaningless

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Matrix

Using the likelihood and impact assessment, finally a risk severity matrix is prepared as given in Figure 7.1.

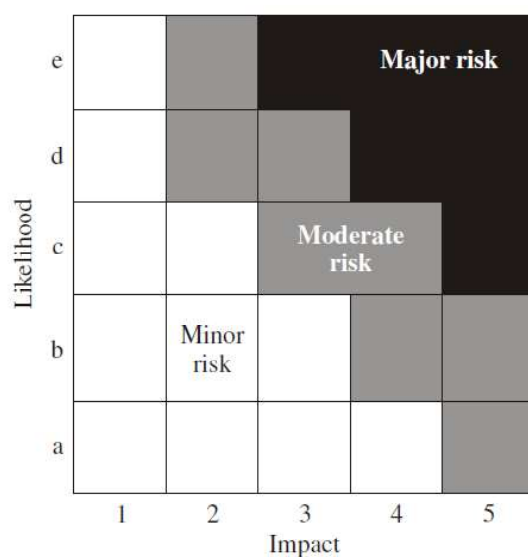


Fig. 7.1: Risk-Severity Matrix

If any event is in the dark shaded area, then that risk event is a priority event. This event wise matrix would help in prioritizing the risk events in the next step.

Prioritization of risk events

The next phase is prioritizing the risk events. High likelihood event with high impact is a priority event needing attention of higher level management. The risk event prioritization can be presented in Table 7.3.

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Table 7.3: Risk Event Prioritization

<i>Activity Reference</i>	<i>Risk Event</i>	<i>Probability</i>	<i>Impact Score</i>	<i>Severity</i>	<i>Rank</i>	<i>Cost</i>	<i>Controllable/ Non-controllable</i>

The risk event prioritization matrix given in Table 7.3 gives a comprehensive picture of all possible events together with the project activity when such event is expected to occur, likelihood (probability) of the event, impact score, severity of impact, overall priority rank of the event, cost effect of the risk event and whether the occurrence is controllable or not.

The risk-severity matrix thus, lays a foundation for the risk mitigation at the planning stage and response cycle when the project execution unfolds.

(c) Planning for Risk Management and Response

Having identified the sources of risk and its prioritization, the next phase is about deciding how to manage the risk, so that the firm takes only acceptable risk and at an acceptable level. The project design will change depending upon the risk management decisions. The project execution plan will also have its effect. For example, the sub-contract components may be changed, sub-teams empowered more, technological option and technical designs also changed, project organization approach may change as well and so on and so forth. After this exercise, the firm takes the risk that it wants to take.

For the risk accepted by the firm, a contingency plan is also prepared at this stage. The contingency plan is the plan of action if things go wrong at either the project execution stage or during the operations. The contingency plan would include steps to be taken by the responsible person or team; and it may include assessment of risk and its impact, assessment whether and to what extent it is manageable, evaluation of alternatives, weighing cost-benefits of action, etc. Project budget should provide for contingency actions, if needed. Contingency plans make the response cycle quick, reducing the hazards of risk occurrence.

The risk-response planning involves preparation of risk-response matrix with information on occurrence of different types of risk events what should be the type of response (e.g., try to reduce the risk, transfer the risk, etc.) a prescribed contingency plan, the trigger point for initiating the action (e.g., delay more than

seven days, cost expected to rise by more than 5 per cent, system getting frozen for more than one, etc., depending upon the slack and impact), and the person or team responsible for the response to the risk event occurrence.

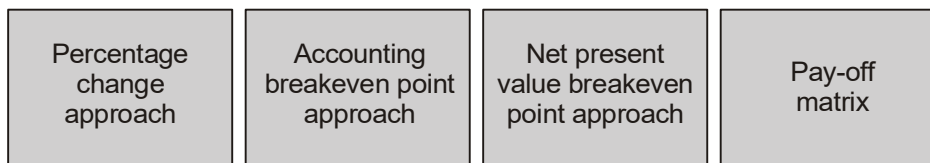
7.3.1 Risk Identification and Analysis

The endeavour of the management should be to first identify the sources of risk that matter. This task is performed at various stages. At the project feasibility stage it has its own meaning. If critical sources of risk are identified at the project feasibility stage, the project planning team would derive valuable guidance for the management of risk, in deciding which part of the risk to transfer or leverage out.

Sensitivity analysis

As the term clearly indicates, sensitivity analysis is a technique in which the sensitivity of profit (or net present value or internal rate of return) to the change in one particular project-variable is studied. The philosophy that ‘only a few factors may warrant management attention’, is embedded in the sensitivity analysis. The vital few have to be identified, as they finally matter for the success of the project.

Sensitivity analysis is carried out in the following four ways:



The first three approaches are generally adopted at the time of project feasibility study. These three approaches do not require prior knowledge of key factors for a project. The pay-off matrix takes a different approach. The analyst is expected to have studied the most adverse and the most favourable scenario, along with the likely scenario, for each important factor before she can construct a pay-off matrix. Net present values (NPVs) are then calculated for every scenario of all factors and presented in a matrix form.

The project planning team has to apply sensitivity analysis in the appropriate form and at the right stages so that the need for collecting more information is identified at minimum cost, and necessary actions are initiated for project risk management. The sensitivity analysis, thus, is not only a tool for identifying sources of risk, but is also a guide for appropriately designing the project for better risk management.

The sensitivity analysis suffers from the following limitations:

Interrelationships of factors is ignored.

Probabilities are not assigned to the possible outcomes.

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These two most important weaknesses of sensitivity analysis are criticized by many. However, it does not fail in serving the basic purpose.

Measuring Risk

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Types of risk measurement are discussed in three parts:

Techniques of measuring risk

Decision rules

Some more tools of measure cum decisions

Techniques of Measuring Risk

The following statistical techniques are useful in measuring risk:

Range	Mean absolute deviation	Variance	Semi-variance	Standard deviation	Co-efficient of variation
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(i) Range

Range is the difference between the highest value of outcome and the lowest value of outcome.

$$R_g = R_h - R_i$$

where, R_g = range of a distribution

R_h = highest value in a distribution

R_i = lowest value in a distribution

Range does not consider probabilities, nor does it consider other possible outcomes between the highest and lowest values. Sensitivity analysis uses range values in its application.

(ii) Mean Absolute Deviation (MAD)

The term 'mean absolute deviation' is quite self-explanatory. The differences between the mean and observations is taken at absolute value (sign is ignored), they are added up, and then the sum is divided by the number of observations to get the mean absolute deviation of a distribution.

$$MAD = \sum_{i=1}^n P_i |R_i - ER|$$

If probabilities are not given, the following equation should be used (it assumes, in a way, that each outcome has equal probability):

$$MAD = \frac{1}{n} \times \sum_{i=1}^n |R_i - ER|$$

where, n = number of observations

P_i = the probability of i th possible value

R_i = the i th possible value of variable

ER = the mean (expected value) of the distribution

$R_i - ER$ = only the absolute value is considered; negative is ignored

Expected return (ER) is calculated using the following equation,

$$ER = \sum_{i=1}^n R_i \times P_i$$

(iii) Variance

Variance measures the dispersion of data using the following equation:

$$Variance = \sum_{i=1}^n P_i (R_i - ER)^2$$

The difference of the observed value from the mean of distribution is squared to avoid negative sign. By squaring the difference the values which are far away from the mean are attached more weight. Due to squaring the variance cannot be compared with expected (mean) return.

(iv) Semi-variance

It is same as variance but it considers R values only if $R_i < ER$ (i.e. only if there is a chance of getting less than expected result). If $R_i > ER$ then zero value is taken for $(R_i - ER)$.

$$SV = \sum_{i=1}^n P_i (R_i - ER)^2$$

where, SV = Semi-variance

$(R_i - ER)$ is consider only if it is positive and negative $(R_i - ER)$ is taken as zero

(v) Standard Deviation (SD or s)

The variance cannot be compared with the expected (mean) return. Therefore, its root is taken and standard deviation is calculated so that it can be compared with return.

$$SD = \sigma = \sqrt{Variance} = \sqrt{\sum_{i=1}^n P_i (R_i - ER)^2}$$

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The standard deviation ignores the size of the project, therefore, comparison of two projects becomes difficult.

(vi) Coefficient of Variation (CV)

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The size of project is considered in coefficient of variation.

$$CV = \frac{\sigma}{ER}$$

When standard deviation (σ) is divided by expected returns (i.e., mean or ER) we get the coefficient of variation. It is, therefore, useful in comparing risks of two projects with different sizes. Lower coefficient of variation is considered good.

Inter-Related Cash Flows

If multi-period cash flows are given, the methodology of calculation will remain the same, if they are not inter-related. If multi-period cash flows are inter-related, then a little modification in calculation is required.

Example: Risk measurement of multi-period cash flow

Consider the following example (assume discount rate of 10 per cent):

Project XYZ

Year-wise Cash Flows with Probabilities

Original Cost: \$200									
Out-come	Year 1			Year 2			Year 3		
	R_1	P_1	R_1P_1	R_2	P_2	R_2P_2	R_3	P_3	R_3P_3
1	100	0.1	10	50	0.1	5	20	0.1	2
2	110	0.1	11	80	0.3	24	60	0.3	18
3	130	0.4	52	150	0.3	45	100	0.3	30
4	150	0.2	30	170	0.2	34	150	0.2	30
5	180	0.2	36	200	0.1	20	250	0.1	25
Expected Returns			139	128			105		
Standard deviation (σ)			25.08	48.12			62.01		

Required:

- Calculate standard deviation if cash flows are (i) independent and (ii) perfectly correlated with each other over the time.
- What formula would you use if the cash flows over the period are partially correlated?

Solution:

- Standard deviation of multi-period cash flow:
 - if cash flows are *independent* of each other,

$$SD \text{ (Independent Multiperiod Cash Flow)} = \sum_{i=1}^n \frac{ER_i^2}{(1+r)^{i \times 2}}$$

$$SD = \sqrt{\frac{(25.08)^2}{(1.1)^2} + \frac{(48.12)^2}{(1.1)^4} + \frac{(62.01)^2}{(1.1)^6}} = \sqrt{4,272} = 65.36$$

- (ii) if cash flows are *perfectly correlated* with each other

$$SD \text{ (Perfectly Correlated Cash Flow)} = \left[\sum_{i=1}^n \frac{ER_i}{(1+r)^i} \right]$$

$$SD = \frac{25.08}{1.1} + \frac{48.12}{(1.1)^2} + \frac{62.01}{(1.1)^3} = 109.16$$

Correlated cash flows have higher standard deviation and are therefore riskier.

- (b) if cash flows are *partially correlated* then the following formula is applied for the calculation of variance:

$$\begin{aligned} VAR(a\bar{x} + b\bar{y} + c\bar{z}) &= a^2\sigma_x^2 + b^2\sigma_y^2 + c^2\sigma_z^2 \\ &+ (2ab\rho_{\bar{x},\bar{y}}\sigma_{\bar{x}}\sigma_{\bar{y}}) \\ &+ (2ac\rho_{\bar{x},\bar{z}}\sigma_{\bar{x}}\sigma_{\bar{z}}) \\ &+ (2bc\rho_{\bar{y},\bar{z}}\sigma_{\bar{y}}\sigma_{\bar{z}}) \end{aligned}$$

where, $\bar{x}, \bar{y}, \bar{z}$ = are expected values of x, y and z variables

$\rho_{\bar{x},\bar{y}}$ = correlation co-efficient between the random variables $\bar{x}$ and $\bar{y}$, and so on

The last three items in the last equation are meant for incorporating correlation among the variables. The risk profile of the entire cash flow series changes when cash flows are inter-related.

Though the statistical formulas are available to handle such correlated (interrelated) cash flow issues, it is true that the degree of correlation among different cash flow streams and over the two different time periods would just be the raw estimates. It is also true that in real life, one does not need a high degree of accuracy in project risk management. The risk assessment methods that we discuss here are adequate for its underlying purpose of deriving managerial guidance for an appropriate action needed for mitigating risk at the project planning stage.

Decision Rules

Four different decision rules are discussed in this section. They include:

E-V rule	Co-efficient of variation
Stochastic measures	Decision-tree approach

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NOTES**(i) E-V rule or mean-variance rule**

The expected return and variance (or standard deviation) are compared for taking a decision. It is also called the '*mean-variance*' rule. As per the mean-variance rule the decision is taken by evaluating investment on the basis of the expected return and variance. Standard deviation is also used in place of variance. As per the rule, one project will be selected over another if one of the following two conditions holds true:

- Select a project with higher (or equal) expected return but has less risk; or
- Select a project with lesser (or equal) risk but higher expected return.

Weaknesses

There are two obvious limitations of the EV rule. Firstly, it does not help when one project has higher risk but also higher returns and secondly, it ignores the sizes of projects. Between Project A and Project C, which one would you prefer? The E-V rule cannot answer it.

(ii) Least coefficient of variation (CV) rule

Coefficient of variation (CV) removes the limitation of the EV rule, because the CV is a measure of risk per unit of return. The CV rule recommends the selection of a project whose risk per unit of return is the least. In another words, the CV rule says 'accept the project with the least *coefficient of variation*'. It takes into account the size of projects. However, this rule also has two limitations. One, it assumes that one expects the same premium per unit of risk at all levels of risk; implying an assumption that a decision maker is risk-neutral with a linear sloping utility curve. This is not true. Another limitation of the CV rule is clearly observed in the following data of two alternative projects:

Project A		Project B	
Return	Probability	Return	Probability
5	1	8	0.5
		18	0.5
ER = 5		ER = 13	
$\sigma = 0$		$\sigma = 5$	
CV = 0		CV = 0.385	

Project B is riskier than Project A as per standard deviation and coefficient of variance. The expected return is considered in coefficient of correlation, but still common sense dictates that Project B and not A is preferable. The minimum return offered by Project B is higher than the risk-free return offered by Project A. Project B does not appear to be risky by any means though statistically it is risky.

(iii) Stochastic measure-based decision

The limitation of co-efficient of variation is overcome through stochastic measures. No statistical technique is applied under the system of stochastic measures and the decision based on it. The decision process is in three steps:

Develop probability distribution of NPV

Calculate cumulative distribution

Apply stochastic dominance rule

First degree stochastic dominance (FSD) criterion is applied for decision making. The FSD rule says ‘select a project if all its values of X_i lie on the right of other project in the graph’.

Decision-Tree Approach

This is one application of E-V rule only for dealing with a particular type of investment problem. Some investment options involve a set of decisions from alternatives in the future point of time. A future decision would be dependent on the decision of that day. Many decision nodes in future make a tree of decisions.

For example, a retail company owns a property in a prime location, and the company faces a decision of whether or not to revamp the property and open up a store. They have an option to undertake a market research indicative of demand potential of that area for their products. There are two alternatives at the second stage. They are either to sell this property or to revamp and use.

The role-back model of decision-tree uses the EV rule and the CV rule. One may, in fact, calculate the CV for all possible branches and select the one with the least CV to find the same answer.

Simulation

The sensitivity analysis suffers with two basic limitations - it ignores probabilities and it considers change in only one variable at a time. In real life, all critical variables are likely to vary from its forecast. A decision maker may not feel confident if all critical factors are not included into a single analysis and that too with probabilities assigned. The sensitivity analysis, therefore, cannot be applied if the decision-maker wants to get a full picture of the risk before making a decision. The simulation method is prescribed as a solution.

Monte Carlo simulation, in particular, is very useful in project risk analysis. It is a complex method and hence the use of computers and special purpose software becomes a necessity.

Two features are combined in Monte Carlo simulation:

- It has a realistic assumption that some or all variable may change but randomly. It considers values for several possibilities of outcomes; any one

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of them could become a reality. But large number of parameters and associated parameters would mean an almost infinite numbers of permutation and combinations.

- Random number selection pays due attention to the probabilities. Thereby, even if number of runs (iterations) is less than total permutations-combinations, the resultant frequency distribution is fairly representative. A large number of runs is, therefore, advisable.

Decision rules

The Monte Carlo simulation method gives the profile of outcomes with due recognition of probabilities. But, decision rules are not given, nor can they be prescribed. However, if the expected return and standard deviation are calculated, then some decision guideline can be drawn. The basic rules and approaches still remain the same as in the EV and the CV rules.

Simulation does not provide the decision rule. However, its value lies in its comprehensiveness. It may be difficult to use, but with the easy availability of computer programmes and computer skills, the simulation models have started finding users in industry, especially in problems where probabilities can be assigned, like product development in the consumer non-durable segment.

Check Your Progress

3. What is the purpose of a risk breakdown structure?
4. What are the useful methods for assessment and prioritization of risk?
5. State the limitations of sensitivity analysis.
6. What are the limitations of EV rule?

7.4 REDUCING RISK

Monitoring and control of risk is a continuous process during the project execution and operation. The risk-monitoring system senses the potential occurrence of risk event, letting the project team respond in a timely fashion. For example, knowledge of tension between the port workers and port management at the port from where machinery will be shipped is useful in taking a prompt action of diverting the shipment to another port. The team has to quickly assess the potential of strike at the port, evaluate a potential delay and make a quick cost-benefit analysis and jump into action to instantly make alternate plans. Empowerment of project teams, presence of contingency plan and contingency budget would let the risk response cycle work. Project risk-monitoring system, thus, keeps an eye on not only the activities but also on the events that trigger is. A potential risk is sensed with the monitoring mechanism and depending upon the severity of the event, appropriate actions are initiated.

Risk-control mechanism is also important. The risk-control mechanism is the system of capturing the potential risk events, recording them and documenting the risk response cycle, which can be later on turned into reports from time to time. Risk-control system is helpful in assigning responsibility and in avoiding the occurrence of similar mistakes. It also helps in the preparation of a project completion report.

Risk-control mechanism would also specify the process of initiating changes in the project scope, time, cost, quality and performance. For example, who would be responsible for authorizing a design change if it is needed to adjust the technology to the local environment and quality of material available, and what should be the process and forms? Generally, changes in core assets are encouraged with justification, changes in support assets are made difficult and changes in peripheral and frill assets are avoided.

The change control process would thus,

- (a) identify the proposed changes
- (b) extend rationale for changes
- (c) evaluate effects of proposed changes on project time, cost, quality and performance
- (d) review, evaluate and approve or disapprove the changes
- (e) identify chain effects and conflicts with other internal and external agencies and resolve them
- (f) communicate with the parties affected by the changes
- (g) manage client communication
- (h) adjust schedules and budgets
- (i) assign responsibilities for implementing the changes
- (j) ensure proper recording of the changes and change process

Risk management process, thus, involves four phases: knowledge of the sources, assessment and prioritization of risk, planning for risk management and finally the response along with the monitoring and control of the risk. The above discussion on project risk management is primarily on the process of risk management during the project execution stage of the project life cycle. The risk management has role in the designing of the project for improving the risk-return profile of the project.

Check Your Progress

7. What is risk-control mechanism?
8. What is the advantage of using a risk-control system?

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7.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

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1. Project risk can be divided into two categories: (a) Project execution risk and (b) Project operating risk.
2. There are two types of leverages created in business. One is the degree of operating leverage created by investment decisions and the second is the degree of financial leverage created by financing decisions.
3. The purpose of a risk breakdown structure is to take stock of events that might possibly go wrong, before any assessment is done whether any event will go wrong or not.
4. Risk-severity matrix and sensitivity analysis are the useful methods for the assessment and prioritization of risk.
5. The sensitivity analysis suffers from the following limitations:
 - Interrelationships of factors is ignored.
 - Probabilities are not assigned to the possible outcomes.
6. There are two obvious limitations of the EV rule. Firstly, it does not help when one project has higher risk but also higher returns and secondly, it ignores the sizes of projects.
7. The risk-control mechanism is the system of capturing the potential risk events, recording them and documenting the risk response cycle, which can be later on turned into reports from time to time.
8. Risk-control system is helpful in assigning responsibility and in avoiding the occurrence of similar mistakes. It also helps in the preparation of a project completion report.

7.6 SUMMARY

- Project risk analysis is the process through which perceived risk gets expression, preferably in numbers so that the same can be meaningfully incorporated in the decision-making process.
- Risk analysis is a three-stage process:
 - o Identifying critical sources of risk
 - o Measuring the quantum of risk
 - o Incorporating risk in decision making
- An ill-conceived, ill-planned project is destined to fail. Due diligence at every stage of planning, starting from idea generation to preparation of the

detailed project report, is utmost important from the risk management perspective.

- Project risk can be divided into two categories: (a) Project execution risk and (b) Project operating risk.
- A proactive firm will institutionalize the process of risk management in its system. A well-designed system of project risk management will have the following four processes in place:
 - o Knowledge of sources of risk
 - o Assessment and prioritization of risks
 - o Planning for risk management and response
 - o Risk monitoring and control
- All the sources of risk can be tabulated in a risk breakdown structure format for better comprehension. The purpose of this exercise is to take stock of events that might possibly go wrong, before any assessment is done whether any event will go wrong or not.
- Risk-severity matrix and sensitivity analysis are the useful methods for the assessment and prioritization of risk.
- The risk-severity matrix is prepared in four phases, first the possibility (likelihood) of the occurrence of an event is assessed, then the impact of the occurrence of the event is judged, then the likelihood and impact on project parameters are studied together for evaluating whether the risk event is creating major, moderate or minor risk. Finally, the risk events are prioritized, based upon the severity of risk.
- Having identified the sources of risk and its prioritization, the next phase is about deciding how to manage the risk, so that the firm takes only acceptable risk and at an acceptable level.
- Sensitivity analysis is a technique in which the sensitivity of profit (or net present value or internal rate of return) to the change in one particular project-variable is studied. The sensitivity analysis is not only a tool for identifying sources of risk, but is also a guide for appropriately designing the project for better risk management.
- The following statistical techniques are useful in measuring risk:
 - (a) Range
 - (b) Mean Absolute Deviation (MAD)
 - (c) Variance
 - (d) Semi-Variance

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(e) Standard Deviation

(f) Coefficient of Variation (CV)

- Four important decision rules are E-V rule, coefficient of variation (CV) rule, stochastic measures and decision-tree approach.
- Monitoring and control of risk is a continuous process during the project execution and operation. The risk-monitoring system senses the potential occurrence of risk event, letting the project team respond in a timely fashion.
- The risk-control mechanism is the system of capturing the potential risk events, recording them and documenting the risk response cycle, which can be later on turned into reports from time to time. Risk-control system is helpful in assigning responsibility and in avoiding the occurrence of similar mistakes. It also helps in the preparation of a project completion report.

7.7 KEY WORDS

- **Risk analysis:** It is the process of assessing the likelihood of an adverse event occurring within the corporate, government, or environmental sector.
- **Sensitivity analysis:** It is a technique in which the sensitivity of profit (or net present value or internal rate of return) to the change in one particular project-variable is studied.
- **Risk-control mechanism:** It is the system of capturing the potential risk events, recording them and documenting the risk response cycle, which can be later on turned into reports from time to time.

7.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is project risk?
2. What are the three major concerns in project risk management?
3. Write a short note on risk-severity matrix.
4. What is sensitivity analysis?

Long-Answer Questions

1. Explain the steps involved in project risk management.
2. Examine the statistical techniques used for measuring risk.
3. Discuss in detail the importance of a risk-control mechanism.

7.9 FURTHER READINGS

- Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.
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- Singh, Narendra. 2000. *Project Management and Control*. Delhi: Himalaya Publishing House.
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UNIT 8 PROJECT QUALITY MANAGEMENT AND VALUE ENGINEERING

Structure

- 8.0 Introduction
- 8.1 Objectives
- 8.2 Quality and Quality Concepts
- 8.3 Value Engineering
- 8.4 Answers to Check Your Progress Questions
- 8.5 Summary
- 8.6 Key Words
- 8.7 Self Assessment Questions and Exercises
- 8.8 Further Readings

8.0 INTRODUCTION

Quality refers to the essential feature of a product or service that should be maintained in order to fulfil the needs of the customers. In addition, Total Quality refers to the quality management system of the total business process across the organizational functions and processes. The Total Quality concept has been further analysed by thinkers like W.E. Deming and Joseph M. Juran. This unit will discuss in detail Quality and other related concepts such as Quality Management and Total Quality Management. The concept of Value engineering will also be explained.

8.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain quality and other related concepts
- Discuss the differences between Quality Management and Total Quality Management
- Understand the concept of value engineering

8.2 QUALITY AND QUALITY CONCEPTS

Quality, in general terms, relates to the ‘features’ or ‘character’ or some ‘attributes’ of a product or services or similar offerings. The attributes or features or character of the product or services should be such that they meet and fulfill the needs of users i.e. customers.

To illustrate, let us consider a wrist watch, which

- must give accurate time
- must be durable and weather proof
- convenient to adjust time, date etc.
- the dial should be easy to read
- should offer value for the money i.e. cost-effective
- should meet any other specific or perceived needs, e.g., style and looks, and
- casing and casing material, band etc.

Any deficiency in these features or quality, from the viewpoint of customer needs, may lead prospective buyers to either not buy it, or to complain about it, if it has been already purchased. This means that failure on the quality front will cause customer dissatisfaction and entail quality complaint. Thus, it is necessary to satisfy the needs of a customer in a business, and this is ensured in a product or service by maintaining its Quality.

It is erroneous to assume that quality means something extra in the product or services for customers. In reality, quality is an essential feature of any product or service, which must be maintained for satisfying the given needs of customers. Quality is assured in products by ‘conformance to customers’ requirements’. The American Society for Quality (ASQ) has put forward the definition of Quality as ‘the totality of features and characteristics of a product or service that bears on its ability to satisfy the given needs’. Therefore, quality must always be built into the products or services to satisfy consumer needs.

This implies that in order to set meaningful quality goals aimed at satisfying consumer needs, the requirements of customers must first be clearly captured, stated and defined in the form of quality specification, leaving no scope for misunderstanding. This quality specification should then be maintained in the product or service by appropriate means to satisfy the given needs of the customer. In order to maintain and conform to the specification, customer’s requirements as captured in the specification are first translated into design, then produced and delivered. Measuring the product characteristics before manufacture, and determining the extent of conformance to customer requirements ensure supply of quality products. In case of non-conformance, corrective steps or actions are taken in order to fulfil the specification. Thus, quality, as a generic term, should be understood to mean the requirements of a customer for fulfilling a given need, which is expressed in the form of specification.

In other words, *quality can be referred to as conformance to specification, where the specification has been developed from the expressed needs of the customer*. Since quality is the means to meet and satisfy the customer requirements, its importance has rapidly increased with increase in competition in

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business. Satisfying the needs of customers by consistently maintaining the required quality in products and services has become an essential part of business operations for winning over the customers. All good Companies are paying more and more attention to quality in order to ensure that their products and services meet the customers' needs and thus win their confidence, which is the basis of how reputations and brands are built with.

What is Total Quality?

Everything that gets done in an organization gets done by some activities, process or combination of processes. A process is a series of procedures that transform a set of inputs into an output. In this process model, output quality could be only as good as the quality of inputs and the quality of business processes that transform the inputs into products or service (GIGO – 'Garbage In, Garbage Out' in the language of the computer programmer). It is, therefore, imperative that for ensuring quality of outputs with consistency and reliability, quality has to be ensured across the whole process, starting from process inputs. Total Quality relates to the quality management system of this total business process across the organizational functions and processes. It is not simply the end-quality of the product or services. The following schematic model illustrates various elements that go into total business process and the need for ensuring rising quality in each of these elements:

Table 8.1: Shows the Scope and Coverage of Total Quality

<i>Inputs</i>	<i>Processes</i> (Total Business Process)	<i>Outputs</i>
Men Machine Methods Materials Money, etc.	Operations/Process Management Order Generation and fulfillment Finance and Accounting Supply Chain Management Market Development & Sales, etc.	Products/ Services for Customers
Total Quality		

Total Quality is thus a company-wide quality coverage for ensuring quality in all things necessary to be done in a company for providing products or services to customers' expectations and delight. In total quality system, quality is the outcome of the collective actions of all members of the organization, because *people* run the processes. All members include not only all the employees, but also the others who are either stakeholders or partners in the business process of the organization. Stakeholders are employees, shareholders, society etc. Partners in business processes are vendors and suppliers, contract jobbers, service providers etc. Management of total quality, therefore, begins with determination of customers' requirements and ends with the fulfillment of their requirements by achieving customer satisfaction and delight. The suppliers and the organization fit between these two end points i.e. requirements and satisfaction of customers. Towards this

end, organizations resort to customer-focused internal processes for ensuring results, i.e., customer satisfaction.

Total Quality Management (TQM) therefore emerges as an integral part of strategic management of a company for excellence in performance and superior business results. The essential approach to total quality management is to promote a work culture that empowers people of the organization and motivates committed action aimed at customer satisfaction by providing targeted quality at lowest cost. In order to bring down cost of quality, TQM lays due emphasis on getting things right the first time...every time.

Difference Between ‘Quality’ Management and ‘Total Quality’ Management

Conventional quality management approach focuses on ensuring that the customers get a defect-free product or service. Based on the product specifications based on customer needs, the approach now becomes product orientated, an alignment taken care of by management through ‘Quality Control’ and ‘Quality Assurance’ activities. For this purpose, management sets up a Quality Control or Assurance Department to ensure that specifications are met. This approach often leads to a situation where the Quality Control Department becomes saddled with the sole responsibility for product quality and attending to customer complaints in a company; production, marketing or other service agencies of the company are thus able to side-step responsibility for any deficiency.

In contrast, TQM approach focuses on the quality and appropriateness of processes that are carried out in the organization for producing and delivering the goods or services to the customers to their satisfaction. Here, emphasis is on ‘Customer satisfaction’. This is achieved by making all employees involved in those processes through ‘internal customer’ system. As a result, everybody in the organization feels responsible for the correct delivery and for meeting the customers’ needs...or even ascertaining what they actually are, in the first place! It’s a team approach to quality, right down the line.

Thus, approach to conventional ‘Quality’ management is product or service orientation, whereas approach to ‘Total Quality Management’ is product, process, people and customer orientation. For distinguishing the two approaches, product orientation is sometimes referred to as ‘small-q-focus’ and total quality involving product, process, people and customer orientation is termed as ‘Big-Q-focus’.

Product orientation of quality management system often lacks in providing certain features crucial to continued business success, viz.:

- how to ensure quality superiority (of product or services) over the competition?
- how to retain customers?
- how to provide better value for money to customers?

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- how to cope with changing needs of customers?
- how to get total commitment of all people for continued customer satisfaction?

With the opening up of global competition, focus is on winning and *retaining* customers with superior products and services. Marketing people know that it is better to retain one satisfied customer than to win ten new ones! With ever-increasing pressure for business performance, a narrow view of product orientation in quality management has become an inadequate survival response. A more comprehensive model of Total Quality management, (TQM), encompassing customers, people, processes, policies and products of the company has become the 'new mantra' for organization-wide quality management.

Given below is a depiction of how the restructured customer processes run across the conventional functions. Function and Restructured processes mentioned here are only illustrative are not exhaustive. (Adopted from McKinsey prescription for Horizontal organization)

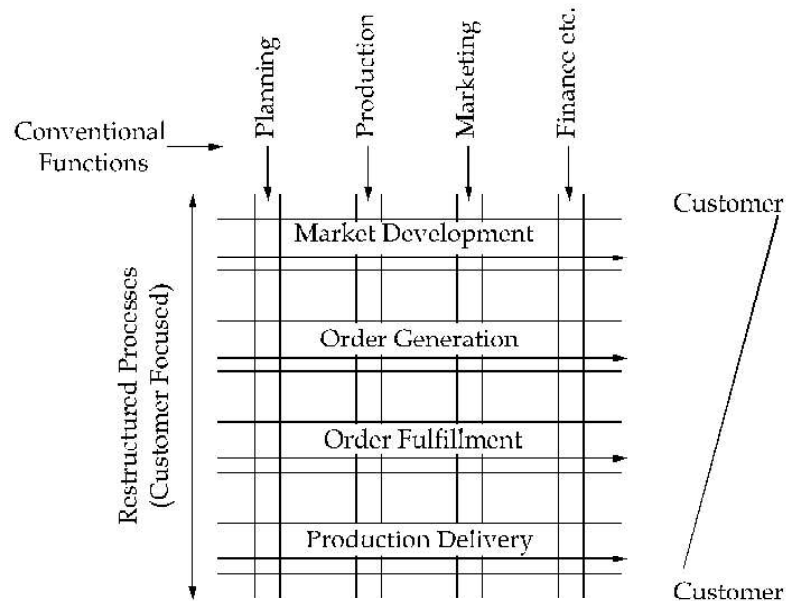


Fig. 8.1 Horizontal customer-focused processes

Total Quality Management aims to ensure quality of all processes and activities in the organization in order to fulfill the expectations of customers. All processes under TQM strategy are, therefore, focused on customers' needs and driven by the people in the organization. Everyone associated with the business or processes are considered as 'links-in-the-chain', a chain running horizontally across all the functions in the organization e.g. R&D, Design, Materials, Operations, Finance, Marketing etc. to deliver what customers want or what have been promised to them; vide Figure 8.1. This is in contrast to conventional Quality Management where vertical boundaries of different functions often insulate outputs

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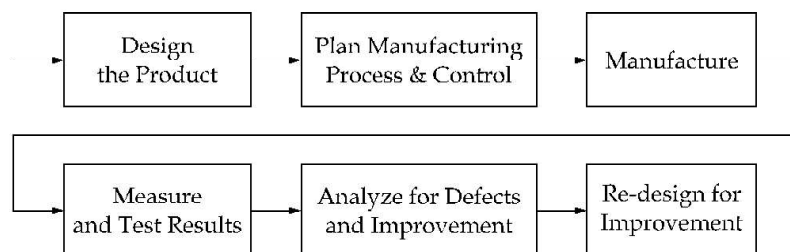
with respect to quality, cost, cycle-time, delivery commitment etc. adversely affecting the goal of customer satisfaction. These horizontal processes are managed in a TQM system by empowered cross-functional teams drawn from different functional areas concerned with the particular process. Cutting across boundaries, this cooperative, 'internal customer' modelled, people-driven approach ensures quality in a seamless flow that spans artificial barriers of function.

Development of Total Quality Concept

Need for organized approach to Quality was seriously realised during World War II, because of inconsistent behaviour and functioning of arms and other ordnance. Soon after the war, W.E. Deming and Joseph M. Juran, two noted 'Quality Gurus' started their pioneering studies on ways of addressing the quality problems of post-war US industries and the reconstructed Japanese industries. 'Quality movement' started from this point.

Deming's quality philosophy was based on improving products and services by reducing uncertainty and variability in the design and manufacturing processes. This moved the emphasis from 'product inspection' to 'process improvement' through statistical checking and data analysis advocated by him. In Deming's view, variation from specification of parts is the chief culprit for 'poor quality'. Poor quality not only means inconsistency in achieving quality specification, but also entails lot of hidden cost. As a result, companies fail to provide value for money, for a product. This leads to customer complaints and dissatisfaction amongst them. This means loss of reputation and declining sales...and profits!

Post-manufacturing inspection of parts cannot be the solution to this problem; Deming advocated prevention of defects by instituting statistical checking *during* the manufacturing process. Similarly, a variation from any committed service leads to customer unhappiness and damages a company's image. To achieve reduced variations and increased conformance to specifications, he advocated a cycle as follows:



These checks for ensuring quality later came to be known as: 'Deming Cycle' of *Plan-Do-Check-Analyse*; (PDCA). Deming stressed that steps to higher quality lead to: Decreased cost, Improved productivity, and Increased market share, the essentials of any successful business process. Seeds for the comprehensive quality management by 'total quality' concept lay in these pronouncements of Deming.

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Juran, who taught quality principles to the Japanese in 1950s, was a principal force in quality reorganization movement in Japanese industries in the nineteen fifties and sixties. Juran focused on three major aspects of quality management, called the '**Quality Trilogy**' of Juran. These three aspects are:

- (a) **Quality planning:** A process for presetting the quality goals and preparation to meet the goals.
- (b) **Quality control:** The process for ensuring that quality goals are being achieved during operations, and
- (c) **Quality improvement:** The process for breaking through to higher levels of quality for superior performance.

As per Juran, planning for quality starts with identifying customers (be they internal within the organization or external ones who ultimately use the goods or services) and their needs and developing the product quality features for meeting those particular needs. Juran identified **customers** as a critical factor in determining quality goals, and prescribed establishing control methods that meet the needs of customers and suppliers alike at a minimum combined cost. Quality Control, as per Juran, should be invoked to:

(1) Determine what to control, (2) Establish measures and measurements, (3) Set standards of performance, (4) Evaluate performance versus goals or standards, and (5) Finally, take actions on the differences.

This, in a way, is parallel to Deming's emphasis on identifying sources of variations and improving the work system.

Juran prescribed a detailed programme—a process for quality improvement. The process steps are: (1) proving the need for improvement, (2) identifying specific area or project for improvement, (3) organizing data and facts for guiding the project, (4) diagnosing the causes of problems, (5) identifying and providing the remedies for the causes, (6) checking that the remedies have solved the problem under the operating condition, and, finally (7) taking steps to hold on to the improvements.

Thus, the philosophies of Deming and Juran provided the fundamentals of 'Total Quality' approach involving customers as a critical factor in setting the quality goals. Their recommendations for emphasis on prevention of defects and quality improvement efforts by P-D-C-A cycle have been the cornerstones of TQM practice. Any study of total quality management will be incomplete without discussions on the pioneering work of Deming and Juran, and their recommendations for effective quality management. Total quality management evolved from philosophies of these pioneering works. Following these philosophical approaches, TQM can be defined as the management of the whole chain of business processes in a company involving the quality of management, its people, processes, resources and commitment to do whatever is needed to be done to satisfy its customers. This comprehensive approach to quality management not only creates

a loyal and satisfied group of customers, but also lead to superior business results, which is the ultimate aim of any business organization.

Check Your Progress

1. Define quality.
2. What is 'small-q-focus' and 'Big-Q-focus'?
3. What is the main aim of Total Quality Management?
4. Why was there a need for organized approach to quality during the Second World War?
5. Name the two 'Quality Gurus' who made an indelible impact on quality studies.

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8.3 VALUE ENGINEERING

Value engineering is the application of the same set of techniques applied to a new product at the design phase. It ensures that all the defined functions are performed at the minimum possible cost by eliminating the weak features at the early stage of production.

Value engineering works on the assumption that in any complicated product, 80 per cent customers need 20 per cent features. It is a technique in which the value of the system output is optimized by creating a mix of performance and costs. In most cases, this practice identifies and removes unnecessary expenditures, thereby increasing the value for the manufacturer and in turn, for their customers. By concentrating on product improvement, it is possible to produce a superior commodity at a lower cost for a majority of the market. When the customer demands more features, they should be sold as options. This approach is of great help in complicated electromechanical products like computer printers, where engineering commands the major product cost. To minimize a project's engineering and design costs, it is constantly divided into sub-assemblies that are devised and evolved once and reused in many slightly different products.

Value engineering is a systematic approach that follows a planned and disciplined procedure to analyse the value of a task. This procedure is called VE job plan. This procedure certifies that:

- Accurate clarity should exist concerning the path that should be followed by the team to develop best value alternatives.
- Every aspect of the problem is analysed so that nothing is missed or overlooked.
- The complete procedure of value engineering is broken into phases so that each phase can be appropriately executed.

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Lawrence D. Miles has suggested the following phases to develop a successful job plan:

- Information
- Function
- Search
- Evaluation
- Execution
- Implementation

Information phase

This is the first phase of a job plan in which all the necessary information such as information about cost of material, labour and machinery is collected from different data sources. This information is then discussed with the concerned employees, designers, engineers, supervisors and buyers to have their suggestions on it.

Function phase

This phase mainly concentrates on the parts and subparts of a product. In this phase, the relevant parts and sub-parts are modified so that they perform the required functions. This phase also identifies:

- Primary and secondary functions of a product
- Scope of the product
- Level of approach followed for the manufactured product
- Time and cost required for manufacturing the product
- Benefits of the product

After identifying these factors, a function cost matrix is prepared that provides information about the cost of accomplishing each function along with its numerical value. This enables you to identify the weak value areas that claim a major share in the production cost but are functionally not important. Therefore, it helps avoid unnecessary costs associated with the product.

Search phase

This is an innovative phase in which brainstorming sessions are carried out among the value engineering team members. These members are from the different departments such as design, inspection, purchasing and R & D of the company. This phase examines all the parts, sub-parts and other constituents of the final product to identify the following factors associated with a product:

- Whether a part of the product performs a necessary or unnecessary function.
- Whether or not the function can be accomplished by any other means without sacrificing any design requirements.

- Whether or not the parts can be simplified without affecting the required performance.

Implementation phase

This is the action phase that implements the accepted ideas and checks whether the actual benefits are derived or not. This phase also ensures that the modified methods reduce the effective cost of production without having an impact on the quality and value of the product.

Evaluation phase

After the search phase, all the suggested ideas are submitted for critical consideration with respect to various factors, such as cost, feasibility and maintainability. It is then decided whether or not the new ideas generated are feasible as compared to the originally used design.

Execution phase

During this phase the best idea is implemented. This phase is also known as the decision or the action phase. Approval is taken from concerned departments and managers. In this phase:

- Efficiency of the solution is examined.
- Utilization of operating experience for further improvement in the solution is done.
- Preparation of new specifications is done to improve the quality of the solution.

Check Your Progress

6. List the phases suggested by Lawrence D. Miles to develop a successful job plan.
7. What does the function phase of a job plan identify?
8. Which phase is the innovative phase of a job plan?

8.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Quality can be referred to as conformance to specification, where the specification has been developed from the expressed needs of the customer.
2. Approach to conventional 'Quality' management is product or service orientation, whereas approach to 'Total Quality Management' is product, process, people and customer orientation. For distinguishing the two approaches, product orientation is sometimes referred to as 'small-q-focus'

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and total quality involving product, process, people and customer orientation is termed as 'Big-Q-focus'.

3. The main aim of Total Quality Management is to ensure quality of all processes and activities in the organization in order to fulfil the expectations of customers.
4. Need for organized approach to Quality was seriously realised during World War II, because of inconsistent behaviour and functioning of arms and other ordnance.
5. 'Quality Gurus' W.E. Deming and Joseph M. Juran are known for their pioneering studies on Quality Management.
6. Lawrence D. Miles has suggested the following phases to develop a successful job plan:
 - Information
 - Function
 - Search
 - Evaluation
 - Execution
 - Implementation
7. The function phase of a job plan identifies:
 - Primary and secondary functions of a product
 - Scope of the product
 - Level of approach followed for the manufactured product
 - Time and cost required for manufacturing the product
 - Benefits of the product
8. The search phase is an innovative phase in which brainstorming sessions are carried out among the value engineering team members.

8.5 SUMMARY

- Quality, in general terms, relates to the 'features' or 'character' or some 'attributes' of a product or services or similar offerings. The attributes or features or character of the product or services should be such that they meet and fulfil the needs of users i.e. customers.
- The American Society for Quality (ASQ) has put forward the definition of Quality as 'the totality of features and characteristics of a product or service that bears on its ability to satisfy the given needs'.
- In other words, quality can be referred to as conformance to specification, where the specification has been developed from the expressed needs of the customer.

- Conventional quality management approach focuses on ensuring that the customers get a defect-free product or service. For this purpose, management sets up a Quality Control or Assurance Department to ensure that specifications are met.
- Approach to conventional 'Quality' management is product or service orientation, whereas approach to 'Total Quality Management' is product, process, people and customer orientation. For distinguishing the two approaches, product orientation is sometimes referred to as 'small-q-focus' and total quality involving product, process, people and customer orientation is termed as 'Big-Q-focus'.
- Total Quality Management aims to ensure quality of all processes and activities in the organization in order to fulfil the expectations of customers. All processes under TQM strategy are, therefore, focused on customers' needs and driven by the people in the organization.
- Need for organized approach to Quality was seriously realised during World War II, because of inconsistent behaviour and functioning of arms and other ordnance. Soon after the war, W.E. Deming and Joseph M. Juran, two noted 'Quality Gurus' started their pioneering studies on ways of addressing the quality problems of post-war US industries and the reconstructed Japanese industries.
- W.E Deming's quality philosophy was based on improving products and services by reducing uncertainty and variability in the design and manufacturing processes. This moved the emphasis from 'product inspection' to 'process improvement' through statistical checking and data analysis advocated by him.
- Juran focused on three major aspects of quality management, called the 'Quality Trilogy' of Juran. These three aspects are quality planning, quality control and quality improvement.
- Value engineering is a systematic approach that follows a planned and disciplined procedure to analyse the value of a task.
- Lawrence D. Miles has suggested the following phases to develop a successful job plan:
 - o Information
 - o Function
 - o Search
 - o Evaluation
 - o Execution
 - o Implementation

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8.6 KEY WORDS

- **Quality:** It can be referred to as conformance to specification, where the specification has been developed from the expressed needs of the customer.
- **Total Quality Management:** It can be defined as the management of the whole chain of business processes in a company involving the quality of management, its people, processes, resources and commitment to do whatever is needed to be done to satisfy its customers.
- **Value engineering:** It is a systematic approach that follows a planned and disciplined procedure to analyse the value of a task.

8.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Define Total Quality Management.
2. Differentiate between Quality Management and Total Quality Management.
3. Write a short note on Juran's 'Quality Trilogy'.
4. What do you mean by value engineering?

Long-Answer Questions

1. Discuss in detail the need for Total Quality Management.
2. Analyse the contribution of W.E Deming and Joseph M. Juran to quality management.
3. Explain the phases of a successful job plan.

8.8 FURTHER READINGS

- Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.
- Kerzner, Harold, R. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.
- Singh, Narendra. 2000. *Project Management and Control*. Delhi: Himalaya Publishing House.
- Choudhury, Sadhan. 1988. *Project Management*. New Delhi: Tata McGraw-Hill.

BLOCK - III
PROJECT MIS, PROJECT PURCHASING AND
PERFORMANCE

*Project Management
Information System*

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**UNIT 9 PROJECT MANAGEMENT
INFORMATION SYSTEM**

Structure

- 9.0 Introduction
- 9.1 Objectives
- 9.2 Project Management Information System (PMIS): Planning and Design of PMIS
- 9.3 Answers to Check Your Progress Questions
- 9.4 Summary
- 9.5 Key Words
- 9.6 Self Assessment Questions and Exercises
- 9.7 Further Readings

9.0 INTRODUCTION

Project management information system (PMIS) helps the organization to plan, execute and close project management goals. It aims at enhancing managerial efficiency and effectiveness in projects. Therefore, it looks over the activities relating to project management throughout the life of the project. This unit will discuss in detail the components and functions of project management information system. The features of a good project management information system will also be explained.

9.1 OBJECTIVES

After going through this unit, you will be able to:

- Discuss project management information system
- Explain the components of a PMIS
- Describe the functions of a PMIS

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9.2 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS): PLANNING AND DESIGN OF PMIS

A project management information system (PMIS) is the complete arrangement of information, which is needed by an organization to successfully execute projects. A PMIS consists of one or more software applications and a methodical process for collecting and using project information. These electronic systems help the organization to plan, execute, and close project management goals. PMIS systems differ in scope, design and features depending upon an organization's operational requirements. In order to improve managerial efficiency and effectiveness in projects, a well-designed PMIS strategy is significant. An information management plan includes PMIS functions, PMIS components, PMIS structure and the responsibility of the project team and information manager in implementing PMIS.

Project Management Information Systems (PMIS)

Understanding project management efficiency comes from a system that backs it up. Small projects may not need any formal and structured information system to support. These projects are small in nature, completed in short duration and have very few activities. They are not sensitive to time, cost and quality parameters. Large projects with maze of several independent and dependent activities, requiring enormous resources in terms of labour and material, involving many contractors and sub-contractors, with high stake of client cannot be efficiently completed without a solid backbone of a well-designed project management information system, generally called PMIS.

As the name indicates, a PMIS is an information system that specifically serves a purpose of conducting the project management activities through the life of a project.

PMIS Components

A PMIS is inclusive of the following:

- **Hardware:** PMIS hardware refers to the visible parts of computer(s) and servers as required for operating software. These are electronic and electronic mechanical parts in a computer, the central processing units as well as input, storage and output devices (known as peripherals). With cloud computing system, many of these devices would not be required in the hardware of a computer for PMIS.
- **Software:** The processing device of a computer would require specific instructions to perform desired operations. These instructions are supplied to the processing unit through a logically developed program called

software. Required input is provided by the user of the program. The input is then processed according to the logic developed in the program to generate the required output. The software or the program is invisible in nature but very important for getting the work done from a computer. Some programs are built on other generic programs. For example, operating system is required to start and operate a computer, but MS Office is required to run Excel and other programs in the MS Office; and some software can be built on the platform of Excel. Complex programs are written using advanced programming language.

- **Database:** A software cannot work without data. Some data are initiated in the software. The final database contains the data used by the software, where stored data is called file.
- **Procedures:** Complex operation of software requires a manual, which would help a user to refer to it and understand how to use software. This is called a procedure document, which can be in electronic form or printed form. Most users prefer searchable electronic form of user manual or procedure, which is often given in ‘help’ menu of a program.
- **Operators:** The term ‘operator’ has many meaning. Mathematical and logical operators are built within the software and is a part of the program. However, operating hardware mentioned earlier, people who operate the system and data administrators, are also known as operators.
- **Documents:** Depending upon the software many documents are generated. Processing transactions are documented; master file is created and documented; reports are generated and saved as files; process inquiries are documented and also the output. These are all documents.
- **Computer Network and Internet:** Some users would need computer network for simultaneous operation and virtual communication of files. The programs can be shared by many users depending upon each one’s role in the project management. In case of users working at distant places even Internet would be needed to work in a virtual environment. Cloud computing would anyway require Internet even if all are working in one area because in cloud computing the software support and some hardware support is provided by the company providing the cloud services.

A Good PMIS

A good PMIS system is one that meets all the requirements of a client. These requirements are different from client to client and from project to project. A PMIS that can comprehensively serve the purposes will encompass the features to address all functions of project management. Figure 9.1 gives a chart of all activities during various stages of project management. A good project management information system would handle these activities.

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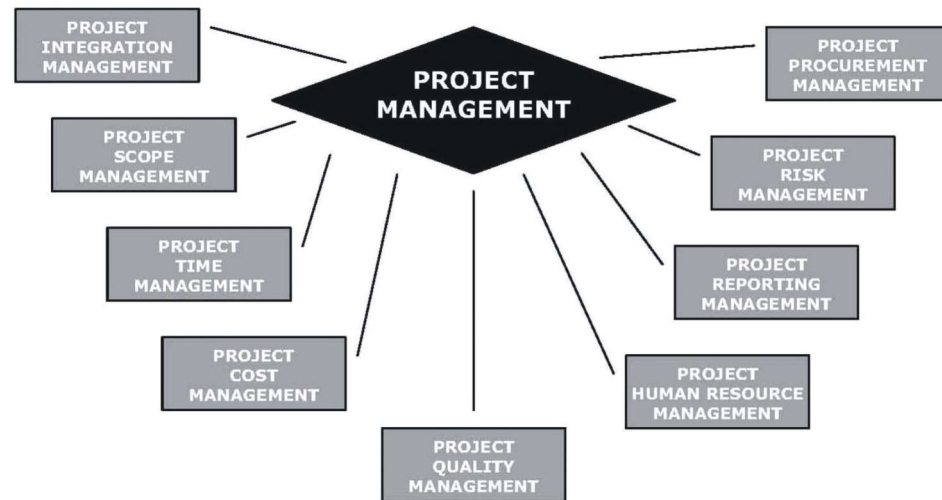


Fig. 9.1 Project Activities in Project Management

Source: <http://www.isi-consult.de/?lang=en&type=dynamic&id=9>

A good project management information system has a big challenge in managing procurement, allocating human resources and handling risks. The watch is on time management, cost management and quality management for which several reports are generated for people at different levels in the project management team and above. It is usually capable of handling project scope management and also handles project integration through an efficient design of the software.

Functions of PMIS

Project management information system (PMIS)'s function emanate from the purpose for which they are designed and used. A good PMIS allows the management to integrate all the stages of the project life cycle into one system and facilitates smooth and seamless functions of planning, scheduling, operations and control aspects related to the project management. Important functions of project management can be listed as the following:

- Record the standards set for each work breakdown package against which actual can be compared. Standards are about the project time schedule, cost schedule, resource allocation schedules, labour and material productivity usage, quality controls and drawings.
- To organise effective ways of collecting actual for time, cost, resource utilisation and actual work in terms of design and quality.
- To decide the frequency of collecting these actual data and to have them in the PMIS. In other words, data is converted from actual operations to the information in the system in an integrated manner.
- To generate reports and communicate them at desired frequency and format to people at various level of project organisation and above.

- To ensure that the report conveys the information in ready-to-interpret manner; flagging the exceptions.
- To generate 'exception' report such that it can trigger the timely actions like heightening the issue for better attention, taking recourse to alternate action as corrective measure, crashing of activities where needed for project viability and even for abandoning the project where necessary.

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Check Your Progress

1. What is a project management information system?
2. What is the scope, design and feature of a PMIS dependent on?
3. What does an information management plan include?
4. What is a procedure document?
5. What are the challenges of a project management information system?

9.3 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. A project management information system (PMIS) is the complete arrangement of information, which is needed by an organization to successfully execute projects.
2. The scope, design and features of PMIS systems is dependent on the organization's operational requirements.
3. An information management plan includes PMIS functions, PMIS components, PMIS structure and the responsibility of the project team and information manager in implementing PMIS.
4. Complex operation of software requires a manual, which would help a user to refer to it and understand how to use software. This is called a procedure document, which can be in electronic form or printed form.
5. The project information management system faces the challenge of managing procurement, allocating human resources and handling risks.

9.4 SUMMARY

- A project management information system (PMIS) is the complete arrangement of information, which is needed by an organization to successfully execute projects.
- A PMIS consists of one or more software applications and a methodical process for collecting and using project information. These electronic systems help the organization to plan, execute, and close project management goals.

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- A PMIS is an information system that specifically serves a purpose of conducting the project management activities through the life of a project.
- A PMIS is inclusive of the following:
 - o Hardware
 - o Software
 - o Database
 - o Procedures
 - o Operators
 - o Documents
 - o Computer Network and Internet
- A good PMIS system is one that meets all the requirements of a client. These requirements are different from client to client and from project to project. A PMIS that can comprehensively serve the purposes will encompass the features to address all functions of project management.
- Project management information system (PMIS)'s function emanate from the purpose for which they are designed and used. A good PMIS allows the management to integrate all the stages of the project life cycle into one system and facilitates smooth and seamless functions of planning, scheduling, operations and control aspects related to the project management.

9.5 KEY WORDS

- **Project management information system:** It is the complete arrangement of information, which is needed by an organization to successfully execute projects.
- **Cloud computing:** It is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user.
- **Cost management:** It is the process of planning and controlling the budget of a project or business.

9.6 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short note on project management information system.
2. What is a PMIS hardware?
3. What are the features of a good project management information system?

Long-Answer Questions

1. Discuss the components of a PMIS.
2. Explain the important functions of project management.

*Project Management
Information System*

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9.7 FURTHER READINGS

- Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.
- Kerzner, Harold, R. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.
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UNIT 10 PURCHASING AND CONTRACTING FOR PROJECTS

Structure

- 10.0 Introduction
 - 10.1 Objectives
 - 10.2 Purchase Cycle
 - 10.2.1 Procurement Process
 - 10.3 Contract Management
 - 10.4 Answers to Check Your Progress Questions
 - 10.5 Summary
 - 10.6 Key Words
 - 10.7 Self Assessment Questions and Exercises
 - 10.8 Further Readings
-

10.0 INTRODUCTION

The purchasing cycle primarily begins with needs analysis and ends with payment and record keeping. It is an integral part of project management as it is through this process that one orders, obtains, and pays for the goods and services the organization needs. Project construction also involves procurement of materials to ensure that there is no hinderance to routine activities. This unit will discuss in detail the purchasing cycle and the procurement process. The process of contract management will also be explained.

10.1 OBJECTIVES

After going through this unit, you will be able to:

- Discuss the stages in the purchasing cycle
 - Examine the procurement process
 - Explain contract management and its stages
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10.2 PURCHASE CYCLE

The purchasing cycle, also called the procurement cycle or procure-to-pay (P2P), is the process by which one orders, obtains, and pays for the goods and services the organization needs. The purchasing cycle begins with needs analysis and ends with payment and record keeping. In between there are steps like generating a

purchase order, inviting tenders or paying for goods directly. There could be some deviation but more or less the steps remains the same. Various steps involved are:

- **Needs Analysis:** At this stage of the purchase cycle, the need to be met is identified. The need could be related to reorder, purchase of raw material for a new product or office supplies.
- **Needs Clarification:** Once the need has been identified, the variety (e.g., brand), amount required, and delivery schedule need to be established.
- **Purchase Requisition and/or Purchase Order:** Once the need is identified and the variety and amount of goods is established, the next stage is to place purchase order. In this stage, those who have the authority to purchase will create a direct purchase order; however those without the authority to approve direct purchase orders will first create and submit a purchase requisition for approval and receipt of goods. Upon approval, the purchase requisition is used to create a purchase order, which is the actual order sent to the supplier for the goods and services required.
- **Authorization:** All purchase order regardless of whether it is generated from a purchase requisition or directly needs to be approved. The approved purchase orders are automatically reassigned through automated routes.
- **Supplier Review:** If an organization has already integrated an automated procurement solution chances are that the list of available and approved suppliers will be available especially for repeat orders. But if the organization is adding new suppliers for existing products or new products to the system, then each candidate must be reviewed for compliance, performance, and reliability.
- **Supplier Selection:** At this stage, the purchaser chooses the supplier who will be filling the order, either from the pre-vetted list in their software catalog or through other means.
- **Price and Term Negotiations:** At this stage the legal terms and condition are set up and the company's agreements are certified. This step is made easier if there is centralized contract and document management and information sharing system. This ensures that previously-negotiated contract terms and best price are already available for each vendor and the same can be added for new vendors. In case of the organizations where the automatic systems are not prevalent, the project team negotiate the payment terms and conditions with the vendor.
- **Order Placement:** At this point, the orders are officially placed and the company and the vendor enter into agreement.
- **Receiving and Inspection:** Goods once arrived are inspected for conformance and reliability; any defective item or goods are marked to be credited back to the buyer. The invoice for the goods received are either

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sent separately or are included with the goods. The inventory is updated for the stock accepted by the organization.

- **Payment:** The invoice is reconciled for accuracy with the purchase order, invoice, and other documentation. Once the reconciliation is over, depending on the terms of the contract for the supply of Goods, payment is issued. It usually takes 30 to 90 days for the release of the project.
- **Records Management:** For the businesses that are using software, the purchase is automatically updated as documents are cross-connected to other departments. However those businesses which are still using manual systems needs to update them manually.

Purchasing process when using Tenders

Except few changes, the purchasing process when using tenders is very similar to the standard purchasing process. The major differences are as follows:

1. Needs Analysis: In case of tendering, the need analysis is much more narrowly defined.
2. The Approval Process: Here the approval process requires more review as compared to standard purchasing.
3. The Tender Process is used instead of the Purchase model and involves the following steps:
 - A very specific Request for Proposal (RFP) is written to formally outline the goods and services needed and request approval.
 - Pre-Qualification Questionnaires are sent to each of the most promising candidates to provide greater detail about their history, capacity and operations.
 - A notification is sent to the public for the expression of interest for tendering. Tenders are invited from the general public to bid for the right to fulfill the request.
 - Tenders (i.e., bids) arrive from the pre-qualified candidates within the specified period.
 - Once the tender date is over, all valid tenders are carefully reviewed and based on the credentials and requirements of the tender; the winning bidder is granted the contract.
4. Once the tender is won by a part, the buyer and the winning supplier negotiate to freeze the deal. Once the negotiation is concluded, the contract is legally awarded to the bidder.
5. It is the company's procurement, financial and legal staff who handles the contract. During the contract period, goods are received and reviewed, for the fulfillment of the required terms and conditions.

6. If the goods received satisfies all the conditions and are accepted, the payments are approved. The approval of the payment is based on terms and condition of the contract. The exceptions are accepted only when the same is mentioned in the contract. After the confirmation of the contract terms, the payments are made. Post this either the contracts end or the vendor is added as a regular vendor for the future tenders.
7. In case of tendering process, the records management is similar to the standard procurement cycle.

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10.2.1 Procurement Process

Project construction involves procurement of thousands of special materials that the business would not keep for its routine activities. Vendors may be unknown and their reliability uncertain. A procurement team has to develop vendors for various material items and buy the resources as and when needed.

Each activity planned in the network analysis, together with the start date and progress plan until the finish, would set a benchmark for ensuring material availability. Material cannot be bought too much ahead of time because of limited and unsafe storage (usually a make-shift facility). The material procurement plan has to emerge from the well-planned network after slack management and crashing plans.

Check Your Progress

1. What is the purchasing cycle also known as?
2. What is the first stage of the purchasing cycle?
3. What do you mean by records management?

10.3 CONTRACT MANAGEMENT

A contract can be defined as an agreement between two or more parties where one party agrees to provide certain deliveries or services, and the other party agrees to pay for those deliveries or services.

How do we get a contract between two parties?

How two parties enter into contract may differ from situation to situation. In certain cases, it might involve an offer made by the company and other party accepting the same. In some other cases, a long round of negotiation may happen before the offer could be accepted by either of the party.

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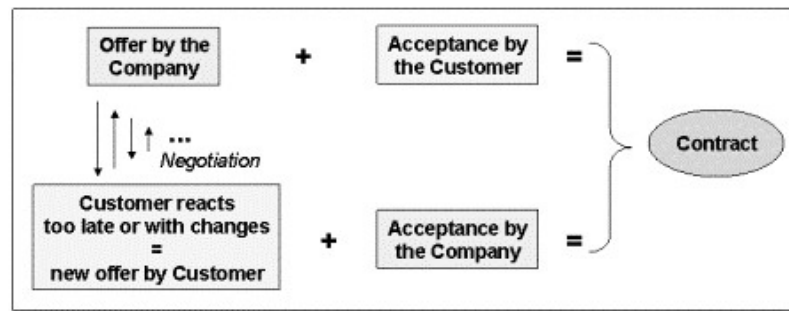


Fig. 10.1 Signing of a Contract

The basic steps do involve some amount of negotiation between the parties before they enter into contract. All the contract are formulated in legal terms to make it binding on the parties involved.

Contract Management

Contract management can be defined as the process of managing contract creation, execution, and analysis to maximize operational and financial performance at an organization, while also reducing financial risk. A contract is binding only when it is signed by both the parties and hence it is must be prior to the launch of the project. The same is needed to manage the operational and financial aspects of the project.

Contract management is part of procurement management, where main activities concern the development and administration of contracts to purchase products and services. Contract management includes negotiating the terms and conditions in contracts and ensuring compliance with the terms and conditions. It also includes documenting and agreeing on any changes or amendments that may arise during its implementation or execution. The various stages of contract management are given below:

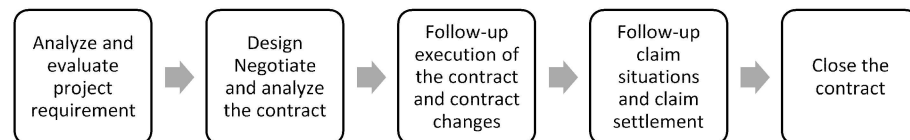


Fig. 10.2 Stages of Contract Management

- **Analyse and evaluate project requirement:** Contract preparation consists of analysing and evaluating the requirements of the project and preparing a clear account of own requirements, and negotiation conditions in order to reach agreement between the parties involved. A detailed analysis of project requirements helps understanding the project better by the execution team. In this way, once the contract is signed and handed over to the implementation team, they are able to understand the same.
- **Design Negotiate and analyze the contract:** This stage comprises of preparing a detailed summary of the major clauses of the contract. This helps in understanding the contract fully to everyone involved and even a

person who does not have much hold on the legal terms can understand the contract.

- **Follow-up execution of the contract and contract changes:** There are situations when due to different interpretations of technical, commercial, or other contractual requirements, the mutual agreement cannot be reached but the same is executed in the larger interest of the project. This is called a claim situation and the same is required to be integrated to claim management system.
- **Follow-up claim situations and claim settlement:** The term claim can be used in situations if a buyer breaches any clause stated in the agreement, which entitles the seller to claim a compensation for the breach made by the buyer. There is more than one way to settle the issue; it could be done through negotiation or through the use of the dispute resolution process. Few of the dispute resolution process are as follows:
 - o Independent expert opinion
 - o Executive tribunal or mini-trial
 - o Dispute review board
 - o Conciliation or mediation
 - o Adjudication
 - o Court trial
- **Close the contract:** The contract comes to a closure when all the task associated with the contract are over and the deliverables mentioned in the contract are delivered in the complete satisfactory manner. The consent and the payments of all the dues from the buyer side is needed to bring the contract to a closure.

Following are few steps that an organization should apply to execute a project contract:

1. Verify the contract documents: All the contract documents should be verified for the accuracy of the content and deliverables. It should clearly reflect the result of negotiation if any and should contain technical document and project plan that had been updated due to negotiation.
2. The project manager needs to present the updated contract before a review committee consisting of legal department and people from management. Once approved and signed, it becomes a legal document.
3. After approval, the contract is booked so that the same can be accepted in the organization's accounting system and business system for purchase integration and payments.
4. After this the contract's responsibilities are transferred to the project manager for execution.

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5. There are many organizations where there is a separate contract management unit that serves as a repository for all the contracts and agreements.

Check Your Progress

4. What does contract management include?
5. Mention some of the dispute resolution processes.

10.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. The purchasing cycle is also known as the procurement cycle or procure-to-pay (P2P).
2. The first stage of the purchasing cycle is the needs analysis. At this stage of the purchase cycle, the need to be met is identified. The need could be related to reorder, purchase of raw material for a new product or office supplies.
3. For the businesses that are using software, the purchase is automatically updated as documents are cross-connected to other departments. This is known as records management. Those businesses which are still using manual systems need to update them manually.
4. Contract management includes negotiating the terms and conditions in contracts and ensuring compliance with the terms and conditions. It also includes documenting and agreeing on any changes or amendments that may arise during its implementation or execution.
5. A few of the dispute resolution processes are as follows:
 - Independent expert opinion
 - Executive tribunal or mini-trial
 - Dispute review board
 - Conciliation or mediation
 - Adjudication
 - Court trial

10.6 SUMMARY

- The purchasing cycle, also called the procurement cycle or procure-to-pay (P2P), is the process by which one orders, obtains, and pays for the goods and services the organization needs. The purchasing cycle begins with needs analysis and ends with payment and record keeping.

- Project construction involves procurement of thousands of special materials that the business would not keep for its routine activities. Vendors may be unknown and their reliability uncertain. A procurement team has to develop vendors for various material items and buy the resources as and when needed.
- A contract can be defined as an agreement between two or more parties where one party agrees to provide certain deliveries or services, and the other party agrees to pay for those deliveries or services.
- Contract management can be defined as the process of managing contract creation, execution, and analysis to maximize operational and financial performance at an organization, while also reducing financial risk.
- A contract is binding only when it is signed by both the parties and hence it must be prior to the launch of the project. The same is needed to manage the operational and financial aspects of the project.
- Contract management includes negotiating the terms and conditions in contracts and ensuring compliance with the terms and conditions. It also includes documenting and agreeing on any changes or amendments that may arise during its implementation or execution.

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10.7 KEY WORDS

- **Purchasing cycle:** It is the process by which one orders, obtains, and pays for the goods and services the organization needs.
- **Contract:** It can be defined as an agreement between two or more parties where one party agrees to provide certain deliveries or services, and the other party agrees to pay for those deliveries or services.
- **Contract management:** It can be defined as the process of managing contract creation, execution, and analysis to maximize operational and financial performance at an organization, while also reducing financial risk.

10.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the steps involved in the tender process?
2. Write a short note on procurement process.
3. What do you mean by contract management?
4. Briefly mention steps taken by an organization to execute a project contract.

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Long-Answer Questions

1. Discuss the steps involved in the purchasing cycle.
2. Examine the various stages of contract management.

10.9 FURTHER READINGS

Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.

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UNIT 11 PROJECT PERFORMANCE MEASUREMENT AND EVALUATION

*Project Performance
Measurement and
Evaluation*

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Structure

- 11.0 Introduction
- 11.1 Objectives
- 11.2 Performance Measurement
 - 11.2.1 Productivity
- 11.3 Project Performance Evaluation
 - 11.3.1 Benefits and Challenges of Performance Measurement and Evaluation
- 11.4 Controlling the Projects
- 11.5 Answers to Check Your Progress Questions
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- 11.9 Further Readings

11.0 INTRODUCTION

Performance measurement is necessary to ascertain whether the objectives of a project have been achieved. It also helps to understand whether the project can be improved further. There are several ways to evaluate the performance of a project. However, the efficiency of these methods is dependent on the project. Moreover, the productivity can be enhanced as well. Project evaluation determines the efficacy of a project. This unit will discuss in detail the importance of performance

11.1 OBJECTIVES

After going through this unit, you will be able to:

- Understand the importance of performance measurement
- Explain the various types of productivity and ways to increase it
- Analyse the need for project performance evaluation
- Understand project control

11.2 PERFORMANCE MEASUREMENT

With any business initiative, there's an expectation that performance is monitored and measured to gauge return on investment and to determine if goals were achieved.

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Different project managers have different definitions of success depending on the environment they work in, their experience and knowledge. For some, the indicator of success can be something tangible while for others it can be intangible. For example, for few number of projects completed in a given time could be a basis of performance; at the same time for others, the criteria for success could be effective communications, stakeholder involvement, increased collaboration. In either case, there are various ways the performance of a project can be measured.

Let us understand why it important to define and measure the performance of a project.

As we know ‘what gets measured gets managed’. By measuring the success of a project, one can check how far the objectives have been achieved and how the project can be improved further. Measuring project performance when it is in the execution phase is the best way to keep an eye on performance aspects. It gives project some scope for corrective action and also increases your chances of project success.

The next question that arises is ‘what should be measured?’ Identifying measures which help in decision-making and provide insight into organization objective is the key. The following points may be considered for measuring the project performance:

- **Return on investment:** When you compare the benefits of the project against the project goals as well as the costs of the project you can calculate a return on investment. This is usually a critical measurement for project stakeholder and company executives. A component of project success is certainly related to stakeholders’ perceptions of the project value.
- **Resources:** Knowing how much time team members are spending on a project is important for some organisations, especially to ensure that resource utilization is as efficient as possible. Once you know how resources were utilized against the plan, your team can use that data to inform future projects.
- **Solve the issue:** It is important to assess whether the project is able to solve the problem or improve the process that was the impetus for the project. This is one of the most important measures to know whether the project was successful.
- **Financial:** Another measure of performance is cost; project manager needs to monitor, whether the project is sailing within the budget or not. Organizations would always like to keep the project cost low and hence tracking becomes far more important. When you are on top of your financial performance throughout the project, you are able to adjust things before you end the project out of budget.

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- **Project impact:** The projects are started as it is expected to add some value to the organization. Project impact includes such things as better customer service, improved quality, new functionality, reduced costs and more. Your specific project impact depends on the project you are running, and you should be able to compare your business before the project began and after it ended to determine the project impact.
- **On-time:** Another criterion for success of a project is the on-time completion of projects. Most of the time completing deadlines is the criteria for success of the projects. Also, if a project runs over on time estimates, it also often exceeds the budget.
- **Quality:** A quality review of the final deliverables and project management practices is also important for many organizations. It's good to segment your project into phases so you can evaluate your project quality while there's still time to make adjustments before you get to the end.

Ultimately, the best way to measure project performance is to establish goals ahead of time, set up measurements based on your project goals and monitor performance throughout so that you have time to adjust priorities and actions.

There are also many permutations and combinations to evaluate the performance of a project. But the efficacy of these methods are dependent on the project as each project is different. The success of the project can be analyzed either on the basis of the outcome of one project or on the collective outcome of all the projects undertaken. For effective performance measurement, following points must be considered:

- The measure should inherit from organization goals.
- When detailed project planning is done at the beginning of planning phase, a baseline of this plan should be saved so that you may compare planned vs actual performance.
- Insight on how well the project has met its objectives.
- Performance measurement tracking should be set either weekly or fortnightly so that insight can be gained on a timely basis and corrective actions can be taken if needed.
- The manager should know the clear difference between measuring the team's performance versus individual performance and the project performance. When project's performance is measured, the impact of the project on organization goal, at a fixed period is measured whereas when team's performance is measured, the impact of team's performance on organization goal is measured.

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11.2.1 Productivity

Productivity is a measure of the efficiency of a person completing a task. Productivity in project work is determined by observing the relationship between final results and cost or time. Productivity can also be seen as the product of effectiveness and efficiency. Efficiency represents the measurement of task performance in terms of cost or time, based on a given methodology. Effectiveness, on the other hand, relates directly to the final result and its application towards meeting desired objectives. The product of effectiveness and efficiency results in the productivity index.

$$\text{Productivity} = \text{Efficiency} \times \text{Effectiveness}$$

There are two types of productivity:

- **Personal productivity:** It is the relevant output of an individual in a certain period.
- **Workforce productivity:** It is the total amount of goods and services workers produce in a certain period.

We do not have control over workforce productivity but personal productivity can be surely controlled. If project manager wants to improve collective productivity, one must improve personal productivity. Thus we can say project productivity is a measure of labor productivity for a project.

Following are few ways to achieve high productivity:

- **Communicate the objectives effectively:** It is very important to clearly communicate the project objectives to all the stakeholders. It can be done using the right combination of written, visual, participative, and didactic approaches.
- **Establish clear objectives:** For a given objective to be reached, it needs to be clearly outlined and be consistent with overall organizational goals.
- **Involve those who perform the work:** We all feel motivated when our inputs are taken for decision making and the same is true in case of a project as well. Consensus decision making and joint-planning efforts are required to stimulate team members to achieve project goals.

Measuring productivity in absolute terms is an impossible task since the resulting number is meaningless, unless compared with other information, such as:

- Industry indices (local, national or international)
- Data collected from prior experiences
- Productivity of direct competitors.

There are multiple productivity indices that directly apply to projects. Here are some samples of indices used in project-related work:

- Actual versus scheduled time
- Budget cost for work scheduled
- Budget cost for work performed
- Actual cost for work scheduled
- Performance of final product versus specified
- Design engineers
- Man-hours per activity
- Applied versus programmed labor
- Applied versus programmed equipment
- Applied versus programmed materials
- Cost per unit of work

Causes of Low Productivity on Projects

There could be multiple reasons that could lead to fall in productivity; few of these are given below:

- **Lack of Information:** Due to missing communication link, there could be delay in passing information and hence could result in reduced productivity.
- **Lack of ideas:** Productivity could also go down due to lack of creativity of conducive atmosphere. The solution is to invite suggestions and encourage techniques like brainstorming and interchanging professionals with other groups.
- **Lack of time:** Projects could miss out time due to two reasons, first, because of poor estimating of the time required to carry out project tasks, and second, because of faulty performance in carrying out programmed tasks. In both the cases it is required to be rectified.
- **Poor attitude:** Attitude plays a very important role in productivity. The upbeat approach, coupled with solid planning, organization, direction and control can work marvels.

Lots of project management tools (or PM tools) and software are available in today's modern business world to help in improving the productivity. They come with the following features:

- Team Collaboration Features
- File Sharing and Storage
- Accountability Towards Goals and Tasks
- Task Management Features

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- Mobile Apps
- Security

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Check Your Progress

1. How is return on investment calculated?
2. Why should one segment their project into phases?
3. What are the two types of productivity?
4. What is workforce productivity?

11.3 PROJECT PERFORMANCE EVALUATION

The primary objective of project evaluation is to determine the effectiveness of a project. Project evaluation is the process of considering or examining something in order to judge its value, quality, importance, extent or condition. Evaluation helps in determining whether a project is accomplishing its goals or not. Project evaluation is a careful appraisal of a project. It identifies the weaknesses and strengths of a programme and areas of the programme that need revision. The Joint Committee on Standards for Educational Evaluation (The Program Evaluation Standards, 2nd Edition, 1994) defines evaluation as ‘the systematic investigation of the worth or merit of an object.’

There are two types of project evaluation which help in gathering the information. They are:

- Formative evaluation
- Summative evaluation

Formative Evaluation

Formative evaluation involves gathering information during the early stages of the project or programme with a focus on finding out whether your efforts for gathering information are going in the right way as planned or facing obstacles or barriers. It is a structured way to provide the programme staff with additional feedback about their work. Formative evaluation is conducted for providing information to the programme staff that helps improve programme implementation. Some information may also be reported in summative evaluation of programme, for example, collecting continuous feedback from the participants in a programme in order to revise the programme as needed.

Formative evaluation has two components which are:

- **Implementation evaluation:** Implementation evaluation implies whether a programme is proceeding according to the plan or not. Information about ways in which a programme is not proceeding according to the plan can be used to revise programme. Where the work is not proceeding according to the plan, the project managers can use an implementation evaluation to ask themselves why things are not going according to the plan and adjust the plan accordingly.
- **Progress evaluation:** Progress evaluation assesses the progress of a programme. The project's unique goal serves as a benchmark for measuring the progress. Information gathered from progress evaluation can later be used in summative evaluation. If the data collected as part of progress evaluation fail to show expected changes, this information can be used to improve or terminate the project. While evaluating progress, the following questions could be asked:
 - o Are the participants moving toward achieving the goals of the project or programme?
 - o Which of the activities and strategies are aiding the participants to move toward the goals?

Summative Evaluation

Summative evaluation determines whether or not the programme's objectives have been met and looks at the learners' performance to see how well a group performed on a learning task that utilized specific learning materials and methods. If the learners attained the objectives, then the instructional design was successful. Summative evaluators are also interested in user satisfaction and its possible outcomes. Outcomes may be either positive or negative. On the positive side, for example, students might improve their class attendance and develop a continuing interest in the topic. Negative outcomes include classroom management problems or a dislike for the subject matter.

Project Evaluation Techniques

Project evaluation techniques are used for checking whether or not the objectives of a project are achieved. It also enables you to take the required corrective actions if there is any problem in the project. Project evaluation techniques such as PERT or CPM are used for reviewing a project. PERT is a method which is used to analyze the tasks involved in completing a given project, especially the time needed to complete each task and identifying the minimum time needed to complete the total project. The CPM is a mathematically based algorithm for scheduling a set of project activities.

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11.3.1 Benefits and Challenges of Performance Measurement and Evaluation

If a project is well formulated and thoroughly appraised, a good follow-through on the subsequent stages of the project cycle will ensure the achievement of its goals. Evaluation involves a cautious examination of the basic data, assumptions and methodology used in project preparation; an assessment of the project's organizational and management aspects; an in-depth review of the work plan, cost estimates and proposed financing; and finally the validity of the financial, economic and social benefits expected from the project.

On the basis of these assessments, it can be ascertained whether the project is financially reasonable, technically sound and viable from the viewpoint of the economy as a whole. The exercise of project evaluation simply means the 'assessment of a project in terms of its economic, commercial, market, social and financial viability in terms of returns and risk'. This exercise basically is aimed at determining the viability of a project and sometimes also in reshaping the project so as to upgrade its viability.

In other words, it aims at sizing up the quality of projects and their long-term profitability. Evaluation of projects by funding institutions is an important exercise for the financial institutions and investing companies in credit decisions. The art of project evaluation puts more emphasis on the economic and technical soundness of the project and its earning potential than on the adequacy and liquidity of the security offered.

Hence, the process of evaluation requires a dynamic approach as it is linked with the present and future. Project evaluation is a scientific tool. It follows specific pattern. Evaluation can be referred to as ex-ante, on-going and ex-post.

The effectiveness of a project may be determined in several ways. It may range from a one-off assessment, through a periodic independent review, to an on-going project management overview. As there exist many possibilities in the testing of the effectiveness of a project, it will be suitable to use the term project evaluation. The particular project circumstances determine the type of evaluation to be chosen.

Need for Project Evaluation

Project evaluation is a practical, constructive and essential diagnostic tool available for enhancing the capability of the sponsoring organization's project management team. It is helpful in providing information ranging from an informal enquiry to an extensive analysis of the effectiveness of every aspect of the project process. In the latter context it can be conducted to ferret out common failings of many project management arrangements.

Thus, project evaluation is helpful in:

- Identification of the strengths of current practices in a project management organization, or on an existing project
- Establishment of various groups' perception of the organization's effectiveness in managing projects
- Examination of the effectiveness of project communication and documentation, and clarification of the relationships between project scope, quality, time and cost
- Identification of barriers to better performance, or critical skills needed by project managers or their supporting teams to increase their effectiveness
- Immediate identification of specific aspects which require improvement and hence speed the achievement of results
- Facilitation of an exchange of ideas, information, problems, solutions and strategies with project team members, which leads to development of a plan of action for carrying out improvements
- Creation of a supportive environment focusing on project success, and the professional growth of project team members

Thus, project evaluation in a timely and favorable manner helps in identifying potential difficulties and bringing them out into the open for appropriate corrective action. Further, it may avoid potential problems altogether, if the concept and timing of project evaluation is built into the project plan from the outset.

Identifying projects whose evaluation should be conducted

Project evaluation is most suitable for the projects involving significant risk of potential difficulties. It assumes that the sponsoring organization has recognized the potential for risk on the project, and has, or will include risk management as a standard functional component of the project management effort. The sponsor involves the project evaluator in the project risk identification stage of the project planning phase.

Intent of project evaluation

The intent of the project evaluation should be to avoid useless and unnecessary costs in the future. Since avoided costs are not reflected in normal accounting procedures, it is often difficult to justify this additional expenditure until management knows that it is already in trouble.

Thus, the actual extent of an evaluation is determined by the following factors:

- The size and complexity of the project

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- The extent of the concern that management has with the project
- The duration for which the project has been running and the time it is expected to take to complete
- Whether or not previous enquiries have already been conducted

It is significant to the success of project evaluation that it be structured on the basis of serving to advance the prospect of success of the project. Simply finding fault and pointing the finger at those responsible does not help.

11.4 CONTROLLING THE PROJECTS

Project control includes the resources, processes and tools used for planning, managing and reducing cost and schedule issues, and any risk events that may have an impact on a project. It begins early in the project with planning and ends late in the project with post-implementation review, having a thorough involvement of each step in the process.

The information provided in the detailed project report (DPR) regarding work packages, time schedule and cost budget is utilized in the control process. The relative importance of quality, time and cost for each work package should be identified at the planning stage so that the project team members might use their judgement regarding what can be compromised and what cannot be.

Cost monitoring is an important element of project control. It gives an idea about the effort that has gone into a project. It enables easy comparison of the planned and actual expenditure. Control reports and review meetings are also important as they bring to the notice of the decision makers impending problems, if any.

In project management, quality control requires the project manager and the project team to inspect the accomplished work to ensure its alignment with the project scope. In practice, projects typically have a dedicated quality control team which focuses on this area. Post-completion audit (PCA) of capital projects is also an important component of project control. It is an attempt at assessing the actual profile of the given project in terms of results, vis-à-vis the intended profile of it besides focussing on whatever matters the senior management desires.

Check Your Progress

5. What is project evaluation?
6. What are the two types of project evaluation?
7. What are the components of formative evaluation?

11.5 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

*Project Performance
Measurement and
Evaluation*

1. When you compare the benefits of the project against the project goals as well as the costs of the project you can calculate a return on investment.
2. It's good to segment a project into phases so you can evaluate the project quality while there's still time to make adjustments before you get to the end.
3. There are two types of productivity: personal productivity and workforce productivity.
4. Workforce productivity is the total amount of goods and services workers produce in a certain period.
5. Project evaluation is the process of considering or examining something in order to judge its value, quality, importance, extent or condition.
6. There are two types of project evaluation which help in gathering the information. They are formative evaluation and summative evaluation.
7. Formative evaluation has two components which are implementation evaluation and progress evaluation.

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11.6 SUMMARY

- Different project managers have different definitions of success depending on the environment they work in, their experience and knowledge. By measuring the success of a project, one can check how far the objectives have been achieved and how the project can be improved further. Measuring project performance when it is in the execution phase is the best way to keep an eye on performance aspects.
- The best way to measure project performance is to establish your goals ahead of time, set up measurements based on your project goals and monitor your performance throughout so that you have time to adjust priorities and actions.
- The success of the project can be analyzed either on the basis of the outcome of one project or on the collective outcome of all the projects undertaken.
- Productivity is a measure of the efficiency of a person completing a task. Productivity can also be seen as the product of effectiveness and efficiency.
- Efficiency represents the measurement of task performance in terms of cost or time, based on a given methodology. Effectiveness, on the other hand, relates directly to the final result and its application towards meeting desired

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objectives. The product of effectiveness and efficiency results in the productivity index.

- There are two types of productivity: personal productivity and workforce productivity. We do not have control over workforce productivity but personal productivity can be surely controlled.
- The primary objective of project evaluation is to determine the effectiveness of a project. Project evaluation is the process of considering or examining something in order to judge its value, quality, importance, extent or condition.
- There are two types of project evaluation which help in gathering the information. They are Formative evaluation and Summative evaluation.
- Formative evaluation involves gathering information during the early stages of the project or programme with a focus on finding out whether your efforts for gathering information are going in the right way as planned or facing obstacles or barriers.
- Formative evaluation has two components which are implementation evaluation and progress evaluation.
- Summative evaluation determines whether or not the programme's objectives have been met and looks at the learners' performance to see how well a group performed on a learning task that utilized specific learning materials and methods.
- Project evaluation techniques are used for checking whether or not the objectives of a project are achieved. It also enables you to take the required corrective actions if there is any problem in the project. Project evaluation techniques such as PERT or CPM are used for reviewing a project.
- The exercise of project evaluation simply means the 'assessment of a project in terms of its economic, commercial, market, social and financial viability in terms of returns and risk'.
- Project evaluation is a practical, constructive and essential diagnostic tool available for enhancing the capability of the sponsoring organization's project management team. It is helpful in providing information ranging from an informal enquiry to an extensive analysis of the effectiveness of every aspect of the project process.
- Project evaluation in a timely and favorable manner helps in identifying potential difficulties and bringing them out into the open for appropriate corrective action. The intent of the project evaluation should be to avoid useless and unnecessary costs in the future.
- Project control includes the resources, processes and tools used for planning, managing and reducing cost and schedule issues, and any risk events that may have an impact on a project. It begins early in the project with planning

and ends late in the project with post-implementation review, having a thorough involvement of each step in the process.

- Cost monitoring is an important element of project control. It gives an idea about the effort that has gone into a project.

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11.7 KEY WORDS

- **Productivity:** Productivity is a measure of the efficiency of a person completing a task. It can also be seen as the product of effectiveness and efficiency.
- **Personal productivity:** It is the relevant output of an individual in a certain period.
- **Project evaluation:** It is a practical, constructive and essential diagnostic tool available for enhancing the capability of the sponsoring organization's project management team.

11.8 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are some of the ways of achieving productivity?
2. Mention the reasons for fall in productivity.
3. What is formative evaluation?
4. Write a short note on project control.

Long-Answer Questions

1. Explain the reasons why it is important to measure the performance of a project.
2. Discuss the process of project evaluation.
3. Analyse the importance of performance measurement and project evaluation.

11.9 FURTHER READINGS

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BLOCK - IV
EXECUTION & CONTROL, CLOSE OUT,
SOFTWARE OF PROJECT MANAGEMENT

*Project Execution and
Control*

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**UNIT 12 PROJECT EXECUTION
AND CONTROL**

Structure

- 12.0 Introduction
- 12.1 Objectives
- 12.2 Project Execution and its Purpose
- 12.3 Project Control Process and its Purpose
 - 12.3.1 Preventive Control Techniques
 - 12.3.2 Periodic Control Techniques
- 12.4 Answers to Check Your Progress Questions
- 12.5 Summary
- 12.6 Key Words
- 12.7 Self Assessment Questions and Exercises
- 12.8 Further Readings

12.0 INTRODUCTION

The execution of a project involves several people and teams who have varied skills and are engaged in activities and operations of the organization. Proper system of execution and control of projects ensures that mistakes are minimised and there is no delay in project completion. Project control refers to the processes for planning and managing the project data to keep the schedule on track. It begins with the planning of a project and ends after the implementation of the project. This unit will discuss the purpose of project execution and project control. Preventive control techniques and periodic control techniques will also be discussed.

12.1 OBJECTIVES

After going through this unit, you will be able to:

- Explain the characteristics, goals and purpose of project execution
- Discuss project control and its purpose
- Examine preventative control techniques and periodic control techniques

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12.2 PROJECT EXECUTION AND ITS PURPOSE

Project execution involves several people and teams with different skills, ability and priorities, constant co-ordination and adjustment in planned activities, conflict with routine operations of business because of overlapping retail project organization structure and several such issues.

Key Characteristics of Project Execution

Project execution is different from routine operations. Important characteristics of project execution are listed as follows:

High Degree of Activity: Plenty of hectic activities are visible in the project execution. Most of them are non-repetitive. Project activities are the result of planned action. Project planning therefore, should be based on realistic assumptions. Planning of activities requires a good database and a high degree of expertise.

Interrelated activities: Large numbers of retail project activities are interdependent. A cascading effect on retail project viability may be very severe if one activity goes out of control. The application of effective management tools for planning of interdependent activities and for measuring the impact of interrelations are vital aspects of retail project management. The project team has to be good at crisis management so that cascading effects are minimized.

High Level of Uncertainty: A large number of variables, the non-repetitive nature of activities and a long time frame of project execution contribute towards the risk. A high level of risk can be effectively encountered if the project team is prepared to deal with the deviations.

High Degree of Interaction with Agencies: A project team's interface with other agencies within the company and outside is very frequent. Rather, the functioning of project team depends entirely on interface management. Purchase, stores, finance, manpower planning, internal audit, engineering, maintenance and host of other (virtually all) departments of the firm have to be activated by the project team. External agencies may include vendors, transporters, installation teams, contractors, banks, railway, government and others. Strong man-management and co-ordination is the essence of success.

High Stake Involved in the Retail project: The success of retail project is very essential for good financials, employee morale and company prestige. These are long-term implications. Success may not be remembered for long, but failure will be. Therefore, the completion of a retail project as per the plan is highly essential. The cost of failure is heavy in financial terms as well as in others terms. Strong control mechanism during the project execution stage can avoid high cost.

Goals of Project Execution

The execution of a project must aim at:

Efficient co-ordination among all sub-units of project teams and their activities

Enabling changes in project design appropriate for the final outcome of the retail projects

Discouraging those changes in a project design that may not be essential for the final outcome of the project

Completing the project within the targeted cost and time

Minimizing variations in the standards of performance

Action

Each project sub-team is on action at this stage. Resources are acquired and collected at the site in time, the project sub-teams follow the schedule guidelines,

build the work package assigned to them and keep records as expected from them. More of technical tasks and resource acquisition tasks are done at this stage.

Possible Mistakes during Execution

The complexities of activities, their interdependence for time, cost and performance and empowered sub-units of project teams often create situations where some unintended mistakes may be made during the execution stage. Many of these mistakes may not be noticed until it is too late. The following is a list of potential mistakes often made during the execution of the projects:

Design change of non-essential nature, which may cause delay and extra costs.
Adding new features and provisions, though they may not have much added value. This occurs more often in support and peripheral assets of the project and not so much in the core assets of the project.
Slow response to unfolding unexpected event, which may delay the project and add to the cost.
Too fast responses to unfolding events, even if the activity is not on the critical path and there is enough slack time.
Too much cost consciousness that may cause adverse impact on completion time and project performance.

These common mistakes can be minimized through better project organization and through a proper system for execution and control of projects.

Expensive Overruns

Overruns are a major problem eclipsing the viability of the project experienced by many firms. Experiences elsewhere are no different, though may not be acute. Delay in project completion is expensive. Still, many projects get delayed due to various reasons.

(i) Cost of delay

Delay in project has many costs, some of which are listed as follows:

Interest on invested capital increases
Overhead expenses like wages, salary, insurance, materials carrying cost etc increases
General price escalation
Compensation to consultants and contractors, especially if it is based on time
Loss of competitive edge, resulting into recurring loss of sales during the life of the retail project
Reputation of company is damaged in the eyes of public
Ill effects on employee morale

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(ii) Overruns and effect on PBP

Delay in completion time, cost overrun and poor-quality standards in project construction jointly prolong the payback period (recovery of invested capital). These affect project viability. Hence, projects must be monitored well with a view to ensure that they can generate the intended benefits. Otherwise, the direct operational benefits that would accrue from the project (if it is completed in scheduled time) are lost. The time overrun means additional interest expense and also the loss revenue, though. The entire project may become unviable if the payback period may exceed the life of the project, or the breakeven point may exceed the maximum capacity.

(iii) Causes of overrun

Numerous factors are responsible for overruns: delay in sanction and disbursement of capital, time taken in getting approvals from various government agencies, land litigation, non-availability of resources, infrastructure constraints, failure of vendors and transporters, design changes, changes in retail project parameters, review, faulty planning, unexpected events and so on.

One of the major causes of overrun is the fact that payment from the company are not made on time to the vendors, especially those who are small. They cannot bring in additional working capital on their own and over a period of time, this delays the availability of quality labour/ equipment into the project.

Check Your Progress

1. State any two characteristics of project execution.
2. List any two potential mistakes made during project execution.

12.3 PROJECT CONTROL PROCESS AND ITS PURPOSE

Project control includes the resources, processes and tools used for planning, managing and reducing cost and schedule issues, and any risk events that may have an impact on a project. It begins early in the project with planning and ends late in the project with post-implementation review, having a thorough involvement of each step in the process.

The information provided in the detailed project report (DPR) regarding work packages, time schedule and cost budget is utilized in the control process. The relative importance of quality, time and cost for each work package should be identified at the planning stage so that the project team members might use their judgement regarding what can be compromised and what cannot be.

Cost monitoring is an important element of project control. It gives an idea about the effort that has gone into a project. It enables easy comparison of the planned and actual expenditure. Control reports and review meetings are also

important as they bring to the notice of the decision makers impending problems, if any.

In project management, quality control requires the project manager and the project team to inspect the accomplished work to ensure its alignment with the project scope. In practice, projects typically have a dedicated quality control team which focuses on this area. Post-completion audit (PCA) of capital projects is also an important component of project control. It is an attempt at assessing the actual profile of the given project in terms of results, vis-à-vis the intended profile of it besides focussing on whatever matters the senior management desires.

Purposes, Approaches, Process and Techniques

The information provided in the detailed project report (DPR) regarding work packages, time schedule and cost budget is utilized in the control process. It is likely that some work packages are not complete on the date a DPR is produced making it necessary to estimate their percentage of completion to compare the actual time with scheduled time. A similar procedure must be used for cost comparisons.

Management is concerned with the following three basic questions during the execution stage:

1. Completion of project within scheduled time
2. Fulfilment of the conditions recommended at the launch of project
3. Termination of project within estimated cost

In any case, a project control system must be structured for effective handling of these three dimensions.

It is desirable to identify the relative importance of quality, time and cost for each work package at the planning stage so that the project team members might use their judgement regarding what can be compromised and what cannot be.

In addition to the key areas, there has to be a provision for reports and review meetings in the project control exercise.

Key areas of monitoring

Key areas of monitoring are the same as the key elements of projects described earlier: (i) time, (ii) cost and (iii) performance. Performance has two dimensions: quantity and quality.

Review Meetings and Reports

Objectives of review meetings

- Control of multi-disciplinary activity at the higher level
- Involvement of all key personnel
- Comprehensive understanding of project situation and potential problem
- Cross validation of current data for the true picture of project status

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- Interactive mode, therefore, early identification of potential problem
- Determination of corrective action
- Synergism, unifying force

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Types of reviews:

- *Technical review*: This review is carried out at the task level. The task leader calls a technical review meeting regularly and it is attended by all task force members. Task status review is the main purpose of technical review. It checks the appropriateness of technology and equipment, so that if need be, some specifications can be changed with a view to make the project viable.
- *Design review*: This review meeting is held at the sub-system and system level. The existing constraints of land, building, local environment, non-availability of equipment, change in raw material specifications, local weather conditions, energy supply condition, quality of water available, change in government regulations, etc. may require the project team to consider mid-term changes in design.
- *Programme review*: This review involves key personnel from all functional areas to review the suitability of the project in the total scheme of the firm in terms of capacity and need.

Corrective Actions

Control reports and review meetings bring to the notice of the decision-makers impending problems, if any. The necessary corrective actions must be initiated without loss of time; otherwise, it may prove costly. Irrespective of the type of project organization and other procedures, the most important is speed and quality of corrective actions. The following are the prerequisites for achieving effectiveness in decision-making in this matter:

• Critical aspects of project

The firm identifies the critical aspects of a project at the planning stage. For each work package and its component, the firm must identify what is most crucial, i.e. slack time available, cost-implications of delay vs cost of alternate course of action for timely completion of a work package and cost implications of the changed quality of work. The knowledge of the critical path and the activities on it, idea about the total cost implication together with the right degree of delegation of power can facilitate better management of overruns. This facilitates dynamic response expected from the project team to the external factors.

• Dynamic response cycle

Control encompasses all phases of the project from conception to completion. It is a cycle, which begins with setting objectives and ends only when the last activity

has been completed. Throughout each phase of the operation, the system must provide the management with the capacity to respond to any situation.

The first element in the cycle is the preparation of the PERT chart and identification of critical paths: At this stage, various options of priorities and restraints are identified and divided. These are then combined to produce a range of plans reflecting various expenditures of time and money. These plans are summarized on the total project cost curves, showing direct and indirect, and combined time and costs. When the management has selected one of these, the resource needs and the order of commitment will be known. At this point, resources are allocated to the project activities in order to produce a schedule.

Once the management has approved a schedule, a time scale diagram is produced which provides immediate visual assimilation of the project for all levels of management. Progress reports can be superimposed onto the diagram at regular intervals. The actual results are compared with the estimates. The management is thus, equipped with specific knowledge of the situation and is in a position to act. The project team is also equipped with sufficient powers for handling the crisis situation.

The company management should also develop some decision norms regarding design change. The proposals for changes come from all the levels and in all types of assets. The policy of review of change in design or change in core assets (plants and equipment) can be developed with its strong linkage with the objective parameters. Review and decision are found to be weak with regards to the proposed changes in non-core assets. These changes cannot be evaluated on objective basis. This type of changes should be discouraged in general. Some companies make the mistake of delegating decision powers regarding the changes in non-core assets. The purpose behind it is to ensure that the senior management can focus on the crucial aspects of the project. But, unwanted changes in non-core assets can cause a lot of worries later.

Systems of planning, scheduling and dynamic control are the tools. Much depends on the managers who use them. They help in providing information on which to base decisions. The team concerned will quickly take an alternative course of action, even at extra cost, keeping in mind the criticality of the matters: for example, in one case, a sub-team was incharge of getting machines fabricated and installed at the site of the project. This activity was on the critical path. Soon after the machine fabrication started, the workers at the fabricator's factory went on strike. The team was watching the fabricator and drew conclusion that the strike may last longer jeopardizing the delivery schedule. They used the contract term and shifted the semi-fabricated work to other fabricators and got it done within time.

In yet another case, some machinery was to be transported from a US port in California. Around the time of shipment, the port was closed down due to glitch in the union negotiation. The strike was expected to take long, followed by dock

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congestion problem, which could delay the shipment of machinery and the whole project. The project team swung into action and diverted the machinery to another port, negotiated with another shipping company for immediate pick-up and transportation of the machinery and avoided time delay though they spent some more cost. The contract terms in both the cases were clearly defined to handle such eventualities, which made the job a little easier. Thus, two issues are important: (i) contract terms to deal with unexpected events and (ii) creative alternate solutions as the dynamic response cycle, if the activity does not have enough cushion of time.

Diaries: Objectives and Outcomes

A project diary is a written documentation of important activities, events or processes that take place during the life of a project.

Diaries can enable a project manager to keep a daily log of what is happening. This will further enable him/her to keep a record of problems, issues and progress. Not only the project manager, but the project staff should also keep some sort of diary to record their views and experiences during the planning and implementation of a project. These insights are important for collecting and reflecting upon for improving the operations and management of future projects.

Diary keeping can also be combined with regular meetings. This will help project teams and other relevant stakeholders to reflect on what is working well and what needs to be improved, and decide on what should be done to advance the project.

The management information system must evolve to generate the required reports so that cost, time and work can be monitored. Different levels of the management require different reports at varying frequencies. Figure 12.1 gives the pictorial idea about the report requirement at various levels.

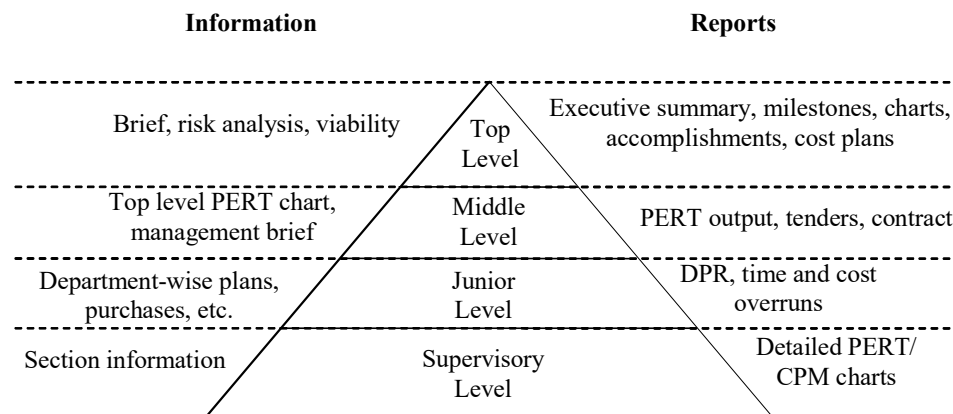


Fig. 12.1 Management Levels and Required Information/Reports

12.3.1 Preventive Control Techniques

Controls are required to check whether the project is performing as per the plan chalked out by the organization. The principle of preventive control is based on the idea that the majority of the negative deviations from standards can be taken care by following management fundamentals.

The primary responsibility of the project management team and team leader is to determine exactly how the project should move forward, the specific tasks that should be completed and the manner in which they should be completed. The project manager should essentially think forward. There will be times when certain tasks or steps may look like they will present a hurdle to the project in general. In such cases, the project manager/team will have to employ preventive action.

Preventive action would refer to any action or act wherein the project management team and or project management team leader provides documented direction as to how an activity should be performed in order to bring down the probability of negative consequence as associated with project risk.

Preventive control is also referred to as the precautionary approach. According to this approach, if an action has a suspected risk of bringing some harm to the project as such, then the right authorities should take certain discretionary decisions.

The key to preventive control lies in developing excellent managers. In fact, the principle of preventive control is that the more high-quality managers you have, the lesser will be the need for any kind of direct control.

The principle of preventive control assumes the following:

- (i) If the managers are qualified, there will be minimum errors
- (ii) Performance is measured using management fundamentals
- (iii) Evaluation can be performed of the management fundamentals that have been applied

Preventive control has several benefits, such as the following:

- (i) It facilitates more accuracy
- (ii) It is possible for managers to understand their responsibility and make voluntary corrections
- (iii) It is possible to eliminate the burden of direct control

Preventive controls include all standards, methods, practices as well as tools and techniques that will result in systems of high quality and reliability. They reduce the number of irregularities, possibility of errors and omissions.

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Preventive control is different from periodic control. The latter comprises regularly scheduled meetings and reports which are formal in nature. The main drawback is that periodic control takes place after the problem has occurred. Preventive control helps anticipate problems so that the problem is resolved at the earliest. Preventive techniques are not as formal. They are ad hoc in nature. They vary from project to project. For example, a project manager will have to set up his own cost-tracking system to control costs. He will have to record the costs as and when they occur and not wait till 'accounting' captures them. This helps team members remain accountable for their assigned items/tasks. So, one preventive technique could be to keep item-wise cost control. There should be a project cost track mechanism capable of progressively comparing an item's projected cost to its budgeted cost so that it is well within limit. The excesses in balance must be negotiated with the deficits in a disciplined way.

Features of controls

Controls will be effective only if they are checked for their:

- Appropriateness
- Practicality
- Reliability
- Simplicity
- Completeness
- Cost-effectiveness
- Timeliness
- Meaningfulness

Finding Potential Problems

Before trying to find potential problems, the project leader / team should perform the following steps:

- (i) Make a list of risks and problems that can affect the project
- (ii) Do an impact and probability rating
- (iii) Make a priority list starting with the most serious risks and going down to the least serious.
- (iv) Brainstorm to come up with strategies to minimize the risks or eliminate them altogether.

Risk review should be done regularly throughout the project because as the project unfolds and progresses, new risks will keep coming up. Here, there is a need to differentiate between risks and issues. Risks can be anticipated but issues are not predictable. For example, you can anticipate not finding qualified people

to do certain tasks but if the staff becomes seriously ill in the middle of the project, that is an issue.

Such issues need to be logged and handled systematically. For this there should be:

- A systematic method of raising issues
- A system for tracking and assigning the responsibility for each issue to specific team members
- A technique for analysing and prioritizing issues
- A record of all resolutions of issues for future reference and learning.
- A monitoring system to keep an eye on the health and status of the overall project

Problems can be of various types:

- (i) Technical problems
- (ii) Problems related to the business process
- (iii) Change-related issues (environmental changes, change in customers, etc.)
- (iv) Resource-related issues
- (v) Vendor/Supplier-related issues

Keeping the Commitments Alive

People committed to the goals of their project should be more concerned about achieving them. They should not be deterred by hindrances. They must stay focused on their goal. The role of the project leader becomes all the more important in this case. They have to lead from the front. Their commitment to the project's goals should be unquestionable, so that he succeeds in inculcating the same spirit among his subordinates. Every one should be reminded of their goal. Team members are basically focused on their goal. However, they may sometimes need to be reminded their commitment would ultimately result in the realization of larger goal of the project. It is necessary to differentiate between what is an immediate priority for the project and what is a high priority.

Though preventive control techniques are more important, the periodic control mechanism is unavoidable. Since several people and parties work together on one activity of a project, the real scenario is often known only when all data for a period and/or activity is collected and put in juxtaposition with the periodic control techniques. The main disadvantage of the periodic control report is that it reports the event, incidence or discrepancy after they have occurred. As a consequence the overrun and quality deterioration may happen. Therefore, the frequency of periodic control must be carefully determined and provide for daily report, weekly report and monthly reports. This is the reason why unlike preventive

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techniques, the periodic control techniques are more formal in format, frequency, reporting authority, and follow up.

12.3.2 Periodic Control Techniques

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There are many reports and information is sought on a regular as well as need basis. A small list of the three types of reports is given as follows:

1. Cost reports
 - (a) Activity cost report
 - (b) Cost flow report
 - (c) Variance report
2. Time and effort reports
 - (a) Time activity report
 - (b) Time analysis report
 - Programme schedule and work efforts are highly interrelated
 - These reports provide PERT/CPM-type information
3. Work status report
 - Status index report (this report attempts to combine all the three—cost, time and work—into a single index).
 - Earned value project management report.

Alternatively, the types of reports can be listed in six parts as follows:

1. Financial reports:
 - (a) Monthly commitment and expenditure
 - (b) Monthly cash flow forecast
 - (c) Monthly bank guarantee position
 - (d) Monthly outstanding payments to consultants, suppliers and contractors
 - (e) Weekly documents retired through bank
2. Procurement monthly reports
 - (a) Order placement details
 - (b) Pending ordering schedule
 - (c) Bids processing status
 - (d) Delivery forecast
3. Inspection expediting reports
 - (a) Weekly vendor-wise status report
 - (b) Constraints report—technical and commercial

- (c) Exception report
- (d) Sub-ordering report
- 4. Engineering reports
 - (a) Documents release and balance status report (monthly)
 - (b) Bid's technical scrutiny and recommendation report
 - (c) Construction drawings release and status report
 - (d) Operation manual
 - (e) Model
- 5. Construction and erection report
 - (a) Weekly job-wise, contractor-wise report
 - (b) Monthly detailed progress review
 - (c) Exception report
- 6. Project management
 - (a) Monthly overall review covering the above aspects
 - (b) Exceptions and recommendations

The frequency and the details of project control reports are very need specific and therefore, will vary from firm to firm and from project to project. Some general points regarding the reports are outlined as follows.

Earned Value Analysis

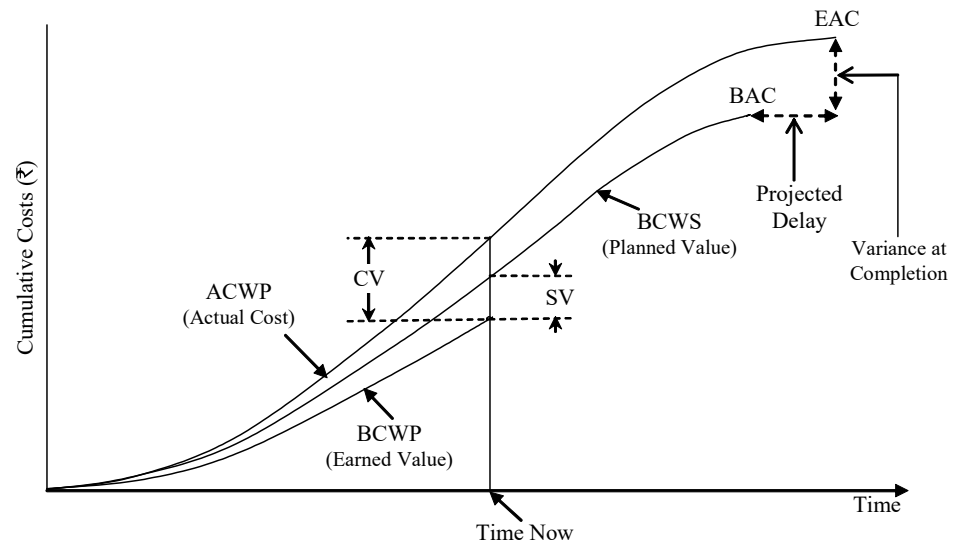
Earned value can provide any project manager with an early warning tool that sends out a signal as early as the 15 per cent completion of a project. This signal allows project managers to forecast the final required funds needed to finish the project within a narrow range of values. The forecast results enable the project manager judge whether they are acceptable or not, so that if the forecast results are unacceptable, immediate actions can be initiated.

The perusal of Figure 12.2 would aptly explain the significance of the earned value management system. It is a graphic presentation for conceptual understanding of the earned value reporting. ACWP comes from the project information system, BCWS, BCWP and BAC are obtained from the initial plans (detailed project report), EAC is estimated based on the current data and SV and CV are calculated from these information.

The earned value chart gives a snapshot of the projected delay, schedule variance, cost variance and estimated variance on completion. If the variance at completion is alarming for the viability of the project, then the project manager needs to initiate actions for the control of time and cost overruns, depending upon what seems to be a more significant contributor in rendering the project unviable and what is controllable at that point of time.

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Abbreviations:

BCWS = Budgeted cost of work scheduled (planned value)

BCWP = Budgeted cost of work performed (earned value)

ACWP = Actual cost of work performed (actual)

BAC = Budget at completion

EAC = Estimate at completion

SV = Schedule variance (BCWP – BCWS)

CV = Cost variance (BCWP – ACWP) (positive is favourable)

Fig. 12.2 Project Status Chart Using Earned Value

Like any other system, earned value reporting will work only if some prerequisites are observed. Fleming and Koppelman gave ‘ten musts’ to implement earned value on all projects. These ‘ten musts’ are as follows:

1. *Define work scope*: Using the works breakdown structure, all the works of a project must be defined.
2. *Create an integrated bottom-up plan*: An integrated bottom-up plan of detailed measurement cells is called control account plans (CAPs), which combines critical processes including defined work scope, schedule of activities and resource plans. The performance measure takes place within the detailed CAPs which are then added to get the total project’s performance.
3. *Formally schedule CAPs*: Each defined CAP must be planned and scheduled with a formal scheduling system with a specific time frame.
4. *Assign each CAP to an executive for performance*: Each CAP must be assigned to a project sub-team with a leader, who should also be empowered according to the criticality of the CAP.
5. *Establish a baseline that summarizes CAPs*: A total baseline against which a project performance may be measured is formed at this stage.

6. *Measure performance against schedule*: The values of the work scheduled and accomplished in a given time frame are collected for performance measurement.
7. *Measure cost efficiency against costs incurred*: The difference between the value of work performed and the costs incurred to accomplish the work is the measure of cost efficiency.
8. *Forecast final costs based on performance*: Periodically, during project execution, using the zero base approach, one must forecast the total estimated cost at completion.
9. *Manage remaining work*: The expenses incurred on the project up to the point of a review time are a sunk cost but future activities must be reviewed for improvement, if any.
10. *Manage baseline changes*: The baseline must be adjusted for any changes made in the remaining work.

This earned value management concept method of status index number encompasses all the three dimensions of monitoring in one single index PERT/Cost in the 1960s. It began with the US Department of Defence mandating in 1967, the use of cost/schedule control systems criteria on all private industrial firms participating in major government systems. Now this is practised by most firms for monitoring their projects, including software projects.

Quality Control

In project management, quality control requires the project manager and the project team to inspect the accomplished work to ensure its alignment with the project scope. In practice, projects typically have a dedicated quality control team which focuses on this area.

Quality is assured in products by *conformance to customers' requirements*. Dimensions of quality—which should completely define and describe the state of quality—originate from this requirement of conformance to customers' specification. In order to conform to customer specification, the following parameters must be set and maintained in the quality management process, namely:

- Requirements of customers must be clearly captured, stated and defined in the form of quality specification—leaving no scope for misunderstanding
- Setting quality goals to be attained
- Planning and designing appropriate quality features in the product or services
- Measuring and checking for conformance or non-conformance to specification

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- Maintaining the quality characteristics by appropriate means and measures, and
- Dealing with non-conformance by corrective and preventive actions.

These features of quality management system are considered pre-requisites for ensuring (a) the conformance to what customers want, and (b) consistency in manufacturing for quality.

Companies all over the world are paying more and more attention to quality issues to ensure that their products and services meet the customers' needs and enjoy the confidence of customer, which is the basis of building reputations and brands in the market place.

Thus, the challenges of quality refers to planning, producing and meeting total specifications of goods or service that satisfy the customer's needs with respect to features, characteristics (properties), timelines, appropriateness, safety, maintainability, usability and affordability. Affordability implies value for the money spent to acquire the product or service, which in a competitive market scenario would mean producing at least cost without sacrificing any quality. This is, no doubt, the greatest challenge that industries are facing nowadays, but meeting this challenge has become a critical factor for the success of any business or industry. The steps for maintaining this quality are: setting quality goals after understanding the needs and specification of users, planning a cost effective process, producing as planned with least variations of properties, measuring conformance, taking corrective and preventive actions to reduce non-conformance, working for continuous improvement and delivery on time. In view of severe competitions and changing business environment, setting appropriate quality goals and designing the products and processes to meet the customers' needs and expectations have become critical for success.

Check Your Progress

3. What are the different types of reviews?
4. What is the main purpose of a technical review?
5. What is a project diary?
6. What is the primary responsibility of the project management team?
7. State the benefits of preventive control.
8. What is the measure of cost efficiency?

12.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

*Project Execution and
Control*

1. The characteristics of product execution are as follows:
 - High Degree of Activity: Plenty of hectic activities are visible in the project execution. Most of them are non-repetitive. Project activities are the result of planned action. Project planning therefore, should be based on realistic assumptions. Planning of activities requires a good database and a high degree of expertise.
 - High Level of Uncertainty: A large number of variables, the non-repetitive nature of activities and a long time frame of project execution contribute towards the risk. A high level of risk can be effectively encountered if the project team is prepared to deal with the deviations.
2. Two common mistakes made during project execution are as follows:
 - Design change of non-essential nature, which may cause delay and extra costs.
 - Adding new features and provisions, though they may not have much added value. This occurs more often in support and peripheral assets of the project and not so much in the core assets of the project.
3. The three different types of reviews are technical review, design review and programme review.
4. Task status review is the main purpose of technical review.
5. A project diary is a written documentation of important activities, events or processes that take place during the life of a project.
6. The primary responsibility of the project management team and or team leader is to determine exactly how the project should move forward, the specific tasks that should be completed and the manner in which they should be completed.
7. Preventive control has several benefits, such as the following:
 - It facilitates more accuracy
 - It is possible for managers to understand their responsibility and make voluntary corrections
 - It is possible to eliminate the burden of direct control
8. The difference between the value of work performed and the costs incurred to accomplish the work is the measure of cost efficiency.

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12.5 SUMMARY

- Project execution involves several people and teams with different skills, ability and priorities, constant co-ordination and adjustment in planned activities, conflict with routine operations of business because of overlapping retail project organization structure and several such issues.
- Overruns are a major problem eclipsing the viability of the project experienced by many firms. Delay in project completion is expensive. Numerous factors are responsible for overruns: delay in sanction and disbursement of capital, time taken in getting approvals from various government agencies, land litigation, non-availability of resources, infrastructure constraints, failure of vendors and transporters, design changes, changes in retail project parameters, review, faulty planning, unexpected events and so on.
- Project control includes the resources, processes and tools used for planning, managing and reducing cost and schedule issues, and any risk events that may have an impact on a project. It begins early in the project with planning and ends late in the project with post-implementation review, having a thorough involvement of each step in the process.
- Control reports and review meetings bring to the notice of the decision-makers impending problems, if any. The necessary corrective actions must be initiated without loss of time; otherwise, it may prove costly.
- A project diary is a written documentation of important activities, events or processes that take place during the life of a project. Diaries can enable a project manager to keep a daily log of what is happening. This will further enable him/her to keep a record of problems, issues and progress.
- Controls are required to check whether the project is performing as per the plan chalked out by the organization. The principle of preventive control is based on the idea that the majority of the negative deviations from standards can be taken care by following management fundamentals.
- Preventive action would refer to any action or act wherein the project management team and or project management team leader provides documented direction as to how an activity should be performed in order to bring down the probability of negative consequence as associated with project risk.
- Preventive controls include all standards, methods, practices as well as tools and techniques that will result in systems of high quality and reliability. They reduce the number of irregularities, possibility of errors and omissions.
- Earned value can provide any project manager with an early warning tool that sends out a signal as early as the 15 per cent completion of a project.

This signal allows project managers to forecast the final required funds needed to finish the project within a narrow range of values. The forecast results enable the project manager judge whether they are acceptable or not, so that if the forecast results are unacceptable, immediate actions can be initiated.

- In project management, quality control requires the project manager and the project team to inspect the accomplished work to ensure its alignment with the project scope. In practice, projects typically have a dedicated quality control team which focuses on this area.

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12.6 KEY WORDS

- **Payback period:** It refers to the amount of time it takes to recover the cost of an investment.
- **Project control:** It refers to the resources, processes and tools used for planning, managing and reducing cost and schedule issues, and any risk events that may have an impact on a project.
- **Project diary:** It is a written documentation of important activities, events or processes that take place during the life of a project.
- **Preventive action:** It would refer to any action or act wherein the project management team and or project management team leader provides documented direction as to how an activity should be performed in order to bring down the probability of negative consequence as associated with project risk.

12.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the causes of overruns?
2. Write a short note on project control.
3. State the objectives of review meetings.
4. Differentiate between preventive control and periodic control.
5. Write a short note on Earned Value Analysis.

Long-Answer Questions

1. Explain the characteristics and goals of project execution.
2. Discuss the benefits of preventive control techniques.

3. Examine the prerequisites for implementation of earned value on all projects.
4. Discuss the parameters that should be maintained in the quality management process.

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12.8 FURTHER READINGS

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UNIT 13 PROJECT CLOSE-OUT

Structure

- 13.0 Introduction
- 13.1 Objectives
- 13.2 Termination and Follow-Up
- 13.3 Project Close-Out and Project Termination
- 13.4 Steps for Closing the Project
- 13.5 Project Follow-Up
- 13.6 Answers to Check Your Progress Questions
- 13.7 Summary
- 13.8 Key Words
- 13.9 Self Assessment Questions and Exercises
- 13.10 Further Readings

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13.0 INTRODUCTION

The final days of a project can play a huge role on the success or failure of a project. Project close-out aims at evaluating the project and ensuring that the project is completed. During this phase, the lessons learned during the project is assessed so that better practices can be effectuated for future projects. Therefore, a step by step approach should be adopted to boost efficiency and ensure that the project does not suffer from major loopholes. This unit will discuss in detail the project close-out phase and the project termination phase. The measures taken after completion of a project will also be highlighted.

13.1 OBJECTIVES

After going through this unit, you will be able to:

- Discuss the process of project close-out and project termination
- Explain the steps taken following the completion of a project
- Examine the follow-up procedure after project completion
- Discuss the post-completion audit

13.2 TERMINATION AND FOLLOW-UP

Between the times of project completion to the time of project commissioning is a termination phase of the project. The project team runs the project first in the test conditions and then by simulating various other real conditions. Once project testing is done satisfactorily, the clean-up phase begins. The client department (which is

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the local team of the store or warehouse or a transit point) becomes involved at this stage. Training of operators and maintenance staff, transfer of stocks and transfer of responsibility are the activities involved in the termination or the cleanup phase. Sometimes, the operating team is supported by project team, so that the project team can handle the initial teething problems.

Project Completion Report (PCR)

Once the project is finished and handed over to the operations team, project review is undertaken. The end result of project review is the preparation of the Project Completion Report (PCR). PCR is a document, which would give a comparison of the actual costs and time with the originally budgeted ones. The reasons for deviations are recorded. The initial scope and level of its attainment is also documented with observations upon them. The degree of attainment of goal is also recorded in the project completion report. It is usually quite detailed and informative. The contents of a post-completion report may vary depending upon the type of the project and perceived benefits from the project review activity.

Post-Completion Audit (PCA)

Some projects require Post-Completion Audit (PCA). A project, which is constructed in phases and in anticipation of demand, needs PCA after every phase, but before the start of the next phase. The post completion audit is conducted at a stage when significant benefits have started coming in after the commissioning of the project.

Check Your Progress

1. What is a Project Completion Report (PCR)?
2. When is the post-completion audit conducted?

13.3 PROJECT CLOSE-OUT AND PROJECT TERMINATION

Project closing down phase comprises evaluating and reporting findings and results of the project and the assessment of the project team's performance (Luecke, 2004, pp. 146). In addition to this, it is also the phase in which the managers can express their appreciation towards the individuals involved and acknowledge their participation.

While the project is executed till its intended completion, the settlement of the result of the project corresponding to the specifications statement and project schedule is one of the most significant steps. According to this reconciliation, the project can essentially be closed. This process facilitates the project team to assess whether the project was successful. Usually, the team is aware whether the targets

have been achieved in time and within the range of the budget. However, this is a step about documenting the achievement and/or explaining any divergence from the intended goals. On the basis of this methodical report, the patron, the customer and any other stakeholder in charge will sign off the project and hence, the project will officially be closed. The formal project closing is varies from one project to another and the associated documentation. Nevertheless, it nearly always includes preparation of closure reports and acceptance documentation.

The scenario is not the same in the case where a project is terminated before its formal closure date. There will be no settlement of capacity deliverables to be prepared instead of reporting the causes for closure and the state of the project when the decision to terminate it was taken. This needs to be prepared, irrespective of the reason for closure and recorded for future reference. An important aspect of this process is the correct identification of the reason for termination: for instance, if the project is discontinued for shortage of funds, it needs to be determined whether the cause is the financial situation of the patron, or market trends, or faulty project's budget estimates. Determining the actual reason behind terminating a project is vital for preparing a 'lessons learned' report. It needs to be reinstated here that all of it must be systematically documented and signed off by all the concerned individuals and groups.

In case of termination of the project, a procurement closure must also be carried out. However, inevitably, process statement will not be verified, as the project has stopped before the scheduled end date. The process adopted to close contracts in this case, depends on the contractual agreements. For instance, a key point is focusing on the compensation and ways to make sure that the resources receive payment for the work they have completed. In the same way, it is also important to ensure that the resources are not paid for the work that was scheduled to be done, but was suspended.

13.4 STEPS FOR CLOSING THE PROJECT

A project is said to be complete when all its stages have ended successfully.

Project Completion

The steps comprised in the completion of a project are as follows:

1. Final inspection

When the contractors inform the project manager that work has completed, the project manager carries out a final assessment to find out whether any work remains pending. This includes a quick walk through all stages of the project and discussing with the project team members to find out anything that seems to be incomplete or half done. The project manager makes a note of all unfinished or inadequate aspects to be fixed along with an action plan to do the same.

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2. Defects liability period

The defects liability period is the time assigned for rectifying faults and resolving problems. These faults and problems are the ones that are identified during the final inspection. No alterations or additions can be made after the defects liability period is over, except of course if they are covered by warranty. The defects liability period may vary for different projects.

3. Maintenance retention sum

Throughout the defects liability period, the maintenance retention sum (as specified within the contract), is kept on hold with respect to the final payment, for ensuring that the faults and problems are resolved and rectified. If the corrective work does not finish in a reasonable time, the project manager should adopt the general dispute resolution processes. This might translate to hiring the services of another contractor to do the work, though this could affect the warranties, if any. The payment of retention is done only after all the work is completed as per the standards.

4. Final documentation

After completion of the project, the client needs all the final paperwork to close the project and pay off the retention amount. Once this is done, the project is completed, signed off and closed.

5. Guarantees, warranties and product information

Guarantees and warranties are not too different. Characteristically, product manufacturers guarantee that their products will perform in a certain way for a specified time. For instance, a roofing manufacturer may guarantee that with proper maintenance, the roof will be leak-proof for a period of 10 years. The majority of guarantees are only applicable if the product is maintained, as specified by the manufacturer. The project manager collates all the guarantee and maintenance care documents from the contractors and hands them over to the client.

6. Closing the project file

One of the final tasks is to close the project file. All the final documentation needs to part of the project file, which is to be stored securely. The file is important since it contains the relevant guarantees that are needed when the product malfunctions.

7. Discharge the project control group and project manager

The ultimate task is to release the project manager and disengage the project control group. The board appraises the work of the project manager and reviews any non-performance issues. The project manager might be bound to a service contract with the board and it is the discretion of the board, based on his/her performance, whether they would continue or end it.

Check Your Progress

3. What does the project closing down phase comprise of?
4. Why is it important to determine the actual reason behind terminating a project?
5. What is the defects liability period?

NOTES**13.5 PROJECT FOLLOW-UP**

Project review is done after the completion of the project, following which the project-completion report is generated.

The European Commission uses 'Seven-Framework-Program' for technical review of a project.

You may find several web resources if you search for 'project review template' on Google.

Post-completion Audit (PCA)

We can always learn from our past experiences so that we can do better in the future. Though, project planning is done with due care and diligence, not all things would go as planned. For being competitive in today's fast changing world, companies need to analyse the results of their capital projects after these projects have been implemented, though bygones are bygones. Post-completion audit may serve as a major vehicle for project analysis and also to help reinforce the learning curve for the organization, at least for some types of projects.

Definition

'Audit' is generally defined as 'an examination of documents and results to find out whether they are in the desired order'. Thus, PCA is an attempt at assessing the actual profile of the given project in terms of results, vis-à-vis the intended profile of it besides focussing on whatever matters the senior management desires.

Many authors have defined post-completion audit in different ways. Some such definitions lay emphasis on 'check...after the project has been operating for some period of time', or 'an audit at some point after the occurrence of transaction'.

Objectives of PCA

Post-completion audit of capital projects is supposed to accomplish at least four primary objectives.

First, post-completion audit should be an important financial control mechanism. It helps provide the means of evaluating:

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1. Financial and non-financial impact of the project on the company, whether positive or negative
2. How the actual results of the project compare to data and assumptions included in the program request
3. Future actions that are necessary or expected regarding the project.

Second, post-completion audit should provide information for future capital expenditure decisions. Through post-completion audits, managers can detect weaknesses in their estimating and forecasting techniques as well as their information systems, essentially for future use.

Third, post-completion audit aims at removing certain psychological and/or political impediments usually associated with asset control and abandonment. Recognition of post-completion audit as a formal part of capital budgeting process adds legitimacy to it. Legitimacy to PCA may eliminate some of the possible barriers to the learning process usually experienced in a corporate life. A learning organization will have fewer political processes in it. Objectivity and transparency brought by legitimate PCA would impair political processes and make them ineffective.

The fourth objective of post-completion audits is to have a psychological impact on the individuals proposing capital investments. In other words, merely knowing that a formal review of a project might occur afterwards should encourage many managerial actions beforehand.

These objectives thus, render the following benefits to the organization:

- They help provide a check on personal biases.
- They improve the quality of estimates.
- They improve productivity, as estimates become goals.
- They identify factors responsible for non-fulfilment of the project's promises.
- They give a sense of recognition to those involved in capital expenditure planning and control as it shows that the management recognizes the importance of investment decisions.
- They help improve the originator's estimating proficiency.
- They provide information for subsequent decision-making and can be used for corrective action if estimates were poor.
- They hold estimators responsible and become more careful in forecasting.

It is needless to say that the most important objective of post-completion audit is learning lessons for the future; rather than simply faultfinding or fixing blames. Precautionary care should be taken to avoid misplaced perceptions about PCA. It should be ensured that people do not consider PCA as the process for initiating punitive actions. Otherwise, that will discourage initiative and lead to excessive

conservatism and may cause managers to suppress risky projects. PCA should remain educational in nature and purpose.

Project Close-Out

Design of a PCA System

All the projects need not be audited in the same detail and PCA is always project specific. So, a few managerial decisions, related to PCA have to be taken. These decisions involve answering the following questions:

1. When to design PCA?
2. Should PCA be conducted?
3. Who should audit?
4. When should the audit take place?
5. What should be audited?
6. Should the findings of the PCA be shared?

The following factors, common to all these questions, would affect their answers:

- Whether a similar project is likely to be undertaken in a short period
- The size of the project as compared to the present size of the firm
- The stakes involved in the project
- The scope of learning from the PCA
- The strategic importance of the project to the company
- The portfolio effect of the project under consideration for PCA

1. When to design PCA

Theoretically, the post-completion audit programme should be incorporated in the plan itself. PCA should be designed at the time of preparing the final plan of capital investment. To fulfil the objective of improving the quality of future investment decisions, the original investment proposal should include a post-audit programme that identifies those variables which could be critical to the estimated Net Present Value (NPV) of the project. It may not be cost effective to track all subsequent cash flows associated with the project. Consequently, it should be the responsibility of the planners to single out those elements that have a significant effect on the estimate of NPV and have a significant potential for variation from the mean estimates employed for the analysis.

The team entrusted with the task of making a detailed project report (DPR) should be responsible for pointing to those events that might cause results to differ substantially from forecasts. Are competitors likely to come to the market with major capital innovations? What could be the likely impact of changing environmental protection rules or changing energy supplies? What could happen that might result in subsequent abandonment of the project? While this information may help the

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management in appraising the risks of the proposed project, it will also provide the auditor with clues as to the causes of variances experienced. Moreover, it permits the auditor to assess whether variances have resulted from controllable factors or non-controllable ones, whether due to predictable events or non-predictable events.

2. Conducting PCA

Should PCA be conducted or not? From a cost benefit perspective, it is impractical to think that all capital expenditures must be audited. Hence, companies must be careful when they pick and choose. One generic approach is to classify assets (projects) into operating, administrative and strategic categories and to have different decision rules for post-auditing assets within each class.

- *Operating assets* usually are the responsibility of lower level managers. They are short-run and routine in nature, involve minor resource commitments and are often repetitive. An example might be minor office equipment.
- *Administrative assets* usually are the responsibility of middle managers. They have a medium duration and require moderate resource commitments. An example would include replacements for manufacturing equipment.
- *Strategic assets* usually are the responsibility of senior managers, are long-run and non-routine in nature and require major organizational resource commitments. Example includes major plant and equipment, acquisition of an entire business, new R&D undertakings and major advertising campaigns.

These criteria appear to acknowledge that the benefits from post-auditing certain types of assets should surpass the costs in terms of money, time and effort. Also, a firm may not conduct PCA in case of a particular project if there is no scope for learning, or if similar project is unlikely to be taken up again, or if project is too small, or for some other reasons specific to the project.

3. Who should audit?

A person or a team who would conduct PCA need not be identified at the planning stage, but certain policy decisions must be taken before hand. The alternative policy decisions in this regard could be:

- The group that evaluates the project may conduct the PCA.
- The project team may conduct the PCA.
- Some other internal groups not associated with project planning and implementation can conduct PCA.
- A team representing the planning group, the execution group and the neutral members can be assigned the task.
- An external agency can be entrusted with the task.

In certain cases, a firm may decide to assign the task of performing PCA to a single person or to a team of persons. Each of these alternative policies regarding

who should conduct PCA has its own merits and demerits. We often hear the argument that individual(s) conducting a post-completion audit should not have been involved in the process leading to selection of the capital asset under review. That way, according to this line of reasoning, the project can be assessed in an unbiased manner. In contrast, others would argue that managers who are associated with investment decisions are in a better position to interpret data for audit purpose than independent reviewers. Either way, if managers have to use the post-completion audit process as a learning tool for future investments and as a control device for the existing projects (including the possibility of abandoning some projects), then those individuals who are responsible for selecting projects need to be informed about the post-completion audit process. In fact, the choice should depend on the need and the situation of the firm.

4. When to audit

How often should capital projects be post-audited and at what point in its life the post-audit should be conducted? Deciding how often to post-audit capital projects is in large part determined by the type of project under consideration: for example, because of their impact on a company, strategic projects should be post-audited over shorter intervals than either administrative or operating capital projects. The risk of an asset also should partly determine post-audit frequency. Generally speaking, the overall emphasis of a post-audit programme should be on regular and periodic reviews as opposed to one-time, post-completion reviews.

The timing of post-audit partly depends upon the purpose of the audit. If the primary purpose is to improve the quality of future investment decisions, then the trade-off between the cost of conducting the audit and the value of the lessons to be learned would suggest that the audit be delayed until an informative track record has been established. The more the information available, the less costly should be the audit process and the higher the chance that the results of the audit may contribute to the improvement of future investment decisions.

However, if it is anticipated that the audit may set in motion corrective steps to change the scope or the scale of the project, the audit should probably be moved forward in time. The costs and the errors of estimate of the audit probably decline over time. Hence, the greater the cost of audit and the greater the increase over time in the expected value of the information gained, the longer the audit should be delayed. However, the cost of corrective steps rises over time. Thus, greater the probability that a corrective step will be taken and greater the expected impact of that corrective step on the present value of the firm, the sooner the audit should be undertaken.

Moreover, multiple post-audits of investment project are justified primarily if there is a potential corrective action to be undertaken. Given the information developed in the first audit, the desirability of further audits can be envisaged based on the fact that the information gained will generate a corrective step or would provide learning value for the organization. The Indian Railways follow the

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policy of triple post-audit programme and conduct post-completion audits in the 6th, 11th and 16th years of the completion of major projects. The trend of projections coming true is the factor, which determines the next phase of the project. At the same time, as a result of the PCA, new projects of similar type also gain in terms of quality of estimates.

5. What to audit

As cited earlier, factors such as, size of the project, stake involved, scope of learning and strategic importance of the project for the organization, should be taken into account while deciding the details of the PCA. A full PCA will conduct inquiry about the strategic and policy decision along with questioning assumptions and Management Information System (MIS), so that the true reasons for the gap between the actual and the plan can be identified.

6. Sharing the findings of the PCA

Whether to share the findings of the PCA is one of the very sensitive decisions to be taken by the higher management to whom PCA report is submitted. It is not necessary that the findings of the PCA be shared with all the concerned parties. The need and sensitivity of the matter must be taken into account while deciding on this issue. There may exist a chance that the morale of the project team is badly affected if the PCA findings are revealed. Such possibilities may be avoided by maintaining secrecy, but the required action still has to be initiated by the top authority so that future plans become more realistic. But, under such circumstances, the firm should get the post-auditing done by one senior single officer who was not associated with the project work. It may not be desirable to announce the outcome of the PCA of the first modernization phase, especially if its finding is not encouraging, if the project has a strategic importance; rather than financial, and if the firm has already planned a few more phases of modernization which are in the pipeline. Strategic projects are such that financial estimates may not be reliable but still they are desirable.

PCA Procedure

The auditor of the completed project has to be very careful in carrying out the audit. The auditor must follow some procedure so that full justice is done to the work. Some points related to the PCA procedure are described as follows:

1. Collection of appropriate information

The starting point for collecting post-audit information is the project completion report. Post-completion audits generally compare the projected data with the accounting data collected through regular MIS. The MIS needs to be geared up so that projected cash flows from the original capital budget can be compared with the actual cash flows realized during the period elapsed before the PCA of

the project has started. Another point that should be kept in mind is that the auditor needs to collect information about the incremental cash flows or the cost, rather than the total cost figures. Incremental cash flow figures are readily available for green-field projects but it is not so easy for the projects in an existing plant. The data in the latter case needs to be appropriately dealt with to arrive at the incremental cost figures.

2. Recasting data

Either collected data or budgeted data should be recast before it is compared. The significant time gap and a host of factors which were not considered at the budgeting stage would warrant the recasting of data: for example, inflation should be adjusted before variances are calculated. Sales mix difference due to external factors also should be taken into account. In the absence of adjustment for those 'external' factors, the quality of audit would suffer. Inflation adjustment is explained subsequently in this section.

3. Comparison of projected financial parameters with actuals

This is the next important step in the post-completion audit procedure. There are four techniques available for the comparison of the actual with the projected financial parameters. They are explained subsequently in this unit. Comparison is the starting point from which the real audit begins. Only comparable data is compared. Adjustments are first done for inflation and external factors before comparison is carried out under any method. Methods described later are not mutually exclusive. More than one method may be applied for the comparison if there are such requirements. A broad level ROI or NPV comparison can be done initially followed by a detailed cost variance or cash flow variance analysis. Comparison is a step-by-step approach so that causes are identified systematically with minimum cost, time and energy.

4. Establish the possible causes of variance

Once the variance figures are calculated, if they are significant, the possible causes for the same are searched. An auditor goes by exceptions and from there he tries to reach the root causes of deviations. This process of investigation can be effective only if the auditor possesses skills of inquisitiveness and skills of persuasion and negotiation. A summary report of the PCA findings should also be prepared.

5. Final recommendations

Once the causes are ascertained, the post-completion auditor can give his recommendations based on which the manager may take decisions for cash flow forecasting to reinvest or abandon the ongoing project. Hopefully, after post-completion audit, cash flow prediction and project evaluation become more accurate.

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Inflation Adjustment

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Bare actual data cannot be easily compared with the original plan data because more often the planned data is at current price and do not factor the inflation in it.

The difference between the two can be partly attributed to inflation. Inflation effect must be removed from the actual before the data analysis is further carried out. How is inflation effect removed? A foolproof methodology for the adjustment of inflation is not available but the following suggestions can be considered.

1. For a broad level analysis, inflation can be adjusted by calculating profits for actual period at base level margin. Alternatively, base level profit can be calculated at actual period margin. One Indian company conducted a post-completion audit in 1986–87 for a project which was planned in 1980–81. As per common practice, inflation was ignored completely at the planning stage and all budget data was based on current price. Data collected for the PCA purpose was:

Gross margin of 1986–87	₹ 21,135 lakh
Gross margin of 1980–81	₹ 5,122 lakh
Capital expenditure	₹ 36,849 lakh
ROI without inflation adjustment	43.46% $(21,135 - 5,122) \div 36,849$

Inflation can be adjusted in either the base value or in the current value to bring both the values at the same time. If we adjust inflation in the base value to bring it to the current value, then we need to compound the base value at the rate of inflation for the number of years. In this example, if we assume an inflation of 10 per cent, the number of years is six (1986–87 less 1980–81).

ROI with inflation adjustment:

Gross margin of 1986–87 profit at 1980–81 profitability, using the present value equation:

$$PV = \frac{FV}{(1+i)^n} \quad \dots(13.1)$$

$$PV = \frac{21,135}{(1+0.1)^6} = 11,930$$

$$ROI = (11,930 - 5,122) \div 36,849 = 18.48\%$$

Gross margin of 1980–81 profit at 1986–87 profitability using the future value equation:

$$FV = PV \times (1+i)^n \quad \dots(13.2)$$

$$= 5,122 \times (1+0.10)^6 = 9,074$$

$$ROI = (21,135 - 9,074) \div 36,849 = 32.73\%$$

It is the choice of the auditor whether to adjust inflation in base year values or in values of the year when the PCA was conducted. The choice has

influence on the calculation of return on investment. It is implicitly assumed in this method of inflation adjustment that, (a) the margin difference is only due to inflationary effect on income and expenses and (b) there was no change in the sales-mix during the period.

2. In-depth inflation adjustment would expect the MIS to collect item-wise prices in the plan year and in the year of the PCA, and to completely recalculate the cost of products at the prices in any one of the years. Most MISs are not geared up to provide such service. The cost incurred in making inflation adjustment may also be very prohibitive.

The problem of inflation adjustment is more difficult in the projects such as modernization, rather than expansion or green field projects. Still, the auditor cannot neglect the inflationary effect, if he wants to really find out the learning opportunity from his exercise.

PCA Techniques

There are four techniques of post-completion audit, namely (1) cost variance analysis, (2) profit variance analysis, (3) cash flow and financial criteria analysis, and (4) present value depreciation technique. These are described as follows:

1. Cost variance analysis

In this method, only project cost (actual and estimated) is studied, revenue aspect is not included in the audit. This approach is adopted when the PCA is conducted during execution or just after completion of the project.

2. Profit variance analysis

In this method, plant-wise profit analysis is carried out by the auditor; the estimated gain adjusted with inflationary effect is compared with the actual. An important point to note here is that even if the aggregate of gains (realized and estimated) is the same, there can be wide variations for individual projects indicating the need for further investigation.

3. Cash flow and financial criteria variance analysis

This method is developed around four schedules. These schedules can provide the management with the information it needs to find engineering, operational and administrative costing faults of past projects.

Profit variance analysis schedule

This schedule is prepared for calculation of profit variance between projected and actual project results. The information for the 'projected' column is obtained from the approved capital expenditure request. The information for the 'actual' column is obtained from regular accounting sources. Supplementary schedules require itemizing and explaining the basis of calculation for revenues, costs and expenses need to be given.

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NOTES***Cash flow and financial criteria variance analysis schedule***

This is used for illustrating project cash flow and return variances between the projected and the actual results. The approved capital expenditure request is again used for providing information for the 'projected' column and regular accounting sources for the 'actual' column.

Project cash flow schedule (projected and actual)

This is used for showing the projected and actual cash flows of the project. They illustrate the timing of cash flows to compute payback and to provide net cash flow information required for the Internal Rate of Return (IRR) calculation. Each cash flow entry is made according to the time it was projected to be incurred or was actually incurred. The period cash flows are for individual quarters; whereas the cumulative cash flows represent all cash flows for the project. The payback point is reached when the cumulative net cash flow equals zero.

Supplementary schedules

As mentioned earlier, supplementary schedules provide an explanation to significant variances. The detailed or supplementary schedule to it explains item-wise variances. These schedules would look just like variances of regular operating results as one finds in management accounting.

4. Present value depreciation (PVD) technique

DCF techniques give only a single value of NPV which is for the whole life of the project. IRR is the average return during the life of the project. But, at the time of conducting the PCA, the major part of the project life is not completed. Then, how can we compare the actual with the total net present value or the average internal rate of return? The concept of the present value of depreciation is used in some techniques for the calculation of year-wise NPV and IRR. 'Present value depreciation' is defined as the decline in the present value of the expected future cash flow during the year using IRR as the discount rate. Two models, namely the IRR model and the NPV model, are suggested under the technique of present value depreciation.

Check Your Progress

6. Define audit.
7. State any two objectives of a post-completion audit.
8. What are the four techniques used for post-completion audit?

13.6 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. PCR is a document, which would give a comparison of the actual costs and time with the originally budgeted ones.
2. The post completion audit is conducted at a stage when significant benefits have started coming in after the commissioning of the project.
3. Project closing down phase comprises evaluating and reporting findings and results of the project and the assessment of the project team's performance. In addition to this, it is also the phase in which the managers can express their appreciation towards the individuals involved and acknowledge their participation.
4. Determining the actual reason behind terminating a project is vital for preparing a 'lessons learned' report.
5. The defects liability period is the time assigned for rectifying faults and resolving problems. These faults and problems are the ones that are identified during the final inspection.
6. An 'audit' is 'an examination of documents and results to find out whether they are in the desired order'.
7. The objectives of a PCA are as follows:
 - Post-completion audit should be an important financial control mechanism.
 - Post-completion audit should provide information for future capital expenditure decisions.
8. There are four techniques of post-completion audit, namely (1) cost variance analysis, (2) profit variance analysis, (3) cash flow and financial criteria analysis, and (4) present value depreciation technique.

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13.7 SUMMARY

- Between the times of project completion to the time of project commissioning is a termination phase of the project. The project team runs the project first in the test conditions and then by simulating various other real conditions. Once project testing is done satisfactorily, the clean-up phase begins.
- Once the project is finished and handed over to the operations team, project review is undertaken. The end result of project review is the preparation of the Project Completion Report (PCR).
- Some projects require Post-Completion Audit (PCA). The post completion audit is conducted at a stage when significant benefits have started coming in after the commissioning of the project.

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- Project closing down phase comprises evaluating and reporting findings and results of the project and the assessment of the project team's performance. In addition to this, it is also the phase in which the managers can express their appreciation towards the individuals involved and acknowledge their participation.
- In case of termination of the project, a procurement closure must also be carried out. An important aspect of this process is the correct identification of the reason for termination: for instance, if the project is discontinued for shortage of funds, it needs to be determined whether the cause is the financial situation of the patron, or market trends, or faulty project's budget estimates.
- A project is said to be complete when all its stages have ended successfully. The steps comprised in the completion of a project are as follows:
 - o Final inspection
 - o Defects liability period
 - o Maintenance retention sum
 - o Final documentation
 - o Guarantees, warranties and product information
 - o Closing the project file
 - o Discharge the project control group and project manager
- PCA is an attempt at assessing the actual profile of the given project in terms of results, vis-à-vis the intended profile of it besides focussing on whatever matters the senior management desires.
- Theoretically, the post-completion audit programme should be incorporated in the plan itself. PCA should be designed at the time of preparing the final plan of capital investment.
- From a cost benefit perspective, it is impractical to think that all capital expenditures must be audited. Hence, companies must be careful when they pick and choose. One generic approach is to classify assets (projects) into operating, administrative and strategic categories and to have different decision rules for post-auditing assets within each class. Also, a firm may not conduct PCA in case of a particular project if there is no scope for learning, or if similar project is unlikely to be taken up again, or if project is too small, or for some other reasons specific to the project.
- Deciding how often to post-audit capital projects Project Close-Out is in large part determined by the type of project under consideration. The risk of an asset also should partly determine post-audit frequency. The overall emphasis of a post-audit programme should be on regular and periodic reviews as opposed to one-time, post-completion reviews.

- It is not necessary that the findings of the PCA be shared with all the concerned parties. The need and sensitivity of the matter must be taken into account while deciding on this issue.
- There are four techniques of post-completion audit, namely (1) cost variance analysis, (2) profit variance analysis, (3) cash flow and financial criteria analysis, and (4) present value depreciation technique.

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13.8 KEY WORDS

- **Budget:** It is an estimation of revenue and expenses over a specified future period of time and is usually compiled and re-evaluated on a periodic basis.
- **Stakeholder:** It is a party that has an interest in a company and can either affect or be affected by the business.
- **Audit:** It is 'an examination of documents and results to find out whether they are in the desired order'.
- **Inflation:** It is a general rise in the price level over a period of time.

13.9 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short note on the Project Completion Report.
2. What are the measures taken after the termination of a project?
3. What is the procedure followed by an auditor for post-completion audit?
4. Write a short note on inflation adjustment.

Long-Answer Questions

1. Discuss the steps taken after completion of a project.
2. Examine the primary objectives of post-completion audits.
3. Analyse the key considerations that affect the design of a PCA system.
4. Discuss in detail the four techniques of post-completion audit.

13.10 FURTHER READINGS

Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.

Kerzner, Harold, R. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.

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UNIT 14 PROJECT MANAGEMENT SOFTWARE

*Project Management
Software*

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Structure

- 14.0 Introduction
- 14.1 Objectives
- 14.2 Advantages of Using Project Management Software
- 14.3 Common Features Available in Most Project Management Software
 - 14.3.1 Illustrations
- 14.4 Answers to Check Your Progress Questions
- 14.5 Summary
- 14.6 Key Words
- 14.7 Self Assessment Questions and Exercises
- 14.8 Further Readings

14.0 INTRODUCTION

Project management software is an important tool used to help, organize, manage resource tools and develop resource estimates. The advantages of project management software are varied. Not only does it help in handling of different projects, but also ensures proper budgeting and real time reporting. This unit will discuss the advantages of project management software and the some of the common features available in most project management softwares.

14.1 OBJECTIVES

After going through this unit, you will be able to:

- Understand the advantages of project management software
- Discuss the features of project management software
- Explain the common features of project management software

14.2 ADVANTAGES OF USING PROJECT MANAGEMENT SOFTWARE

Project-management software packages offer facilities to accept project network data, perform resource analysis, scheduling and cost analysis, along with generating reports for monitoring of a project. Popular project management packages are MS Project, Intellisys Project, Open Mind, Project Kick Start, INSTAPLAN, PRISM and many others. The following website reviews project management software and ranks them:

*Self-Instructional
Material*

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<http://project-management-software-review.toptenreviews.com/>

Ranking is done based on several features and criteria including collaborations, resource management, project management, remote capability, help/support and system requirements. The project management feature is further divided into several aspects of project management. A print screen view of the comparison of the major project management software is given in Figure 14.1:

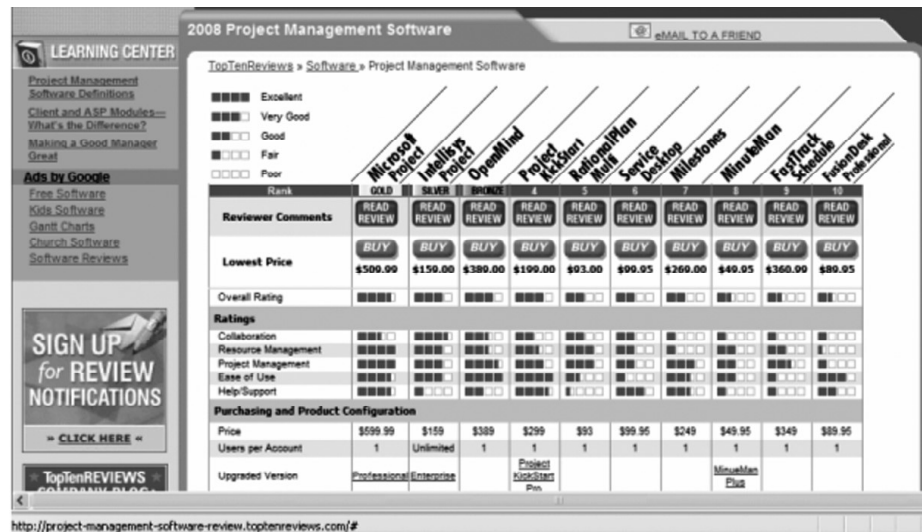


Fig. 14.1 Ranking of Project Management Software, 2008

These software programs are capable of handling multiple projects with a great degree of dynamism. However, much depends on the quality of initial data input in it. Software can do difficult mathematical and logic work and prepare network planning along with resource planning but its effectiveness is surely dependent on data input and the users of the output.

Project management software offer various features that helps to efficiently plan projects, manage resources, respond to problems, and ensure that all the stakeholders are involved. The advantages of project management software are listed below:

- Improved planning and scheduling
- Better collaboration
- Effective task delegation
- Easier file access and sharing
- Easier integration of new members
- Effective risk mitigation
- Budget management
- Remote working
- Enhanced productivity

Check Your Progress

1. What kind of facility is provided by project management software?
2. Give examples of popular project management packages.

NOTES**14.3 COMMON FEATURES AVAILABLE IN MOST PROJECT MANAGEMENT SOFTWARE**

A project manager is loaded with lots of responsibilities; along with planning and scheduling of management of resources and budgets, he/ she is busy with running meeting and analysing reports. On a busy day, the workload becomes quite overwhelming. In such a situation, enterprise software is very helpful, especially to automate task like report creation, information sharing, etc. These applications help the businesses to grow by making every project well organized. It increases workflow by keeping track of each activity and maintaining the timeline. It helps the manager to manage multiple tasks and plan the future tasks, guide the team, identify the problems and get tasks accomplished within an estimated deadline. A variety of online project management applications are available in the market to meet the need of the project manager. The following are the features that are common in each of these softwares:

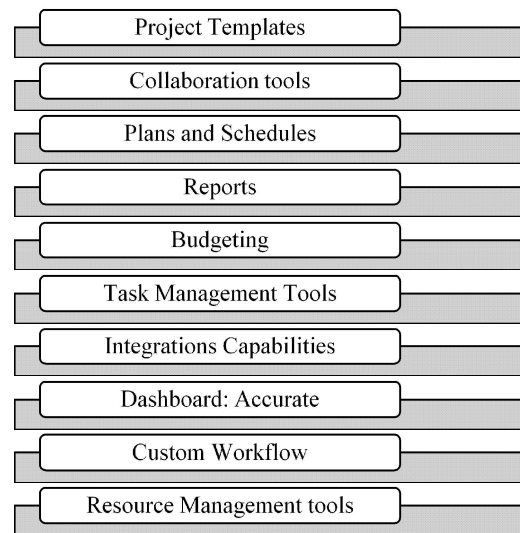


Fig. 14.2 Common Features Available in Project Management Software

Project Templates: Most of the software comes with pre-built options for various use-cases and methodologies. If this is not available, then the vendor lets the organisation create custom project templates as per the need of the client. It includes features like dashboard creation with specific formatting options like row data, matrices to track performance, notification settings and more. Once created, the templates can be saved for repeated use.

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Collaboration tools: For the success of a project, effective collaboration at the enterprise level is very important. It is because of this that all project management software comes with some collaborative features. These tools allow the team to connect and share information.

Plans and Schedules: The project management software comes with the feature to help the manager plan and schedule activities and tasks. Here users can manage milestones, events, task dates and task dependencies. This feature is present in almost every project management software. This helps the project manager to track various tasks and assignment for their progress. This helps in estimation of the time frame required to complete the project. It also provides information on pending task list, thereby helping the project manager decide on the action required to meet the deadlines.

Reports: All project management software comes with a range of pre-built templates for generating reports. These templates can be used for creating key performance indicators (KPI) for the project parameters and prioritize them. These templates can also be used for categorization of project task based on importance, impact and priority. They also provide flexibility to create custom reports. One can filter the parameters and design a report.

Budgeting: Almost all Project Management (PM) softwares provide basic budgeting features. This helps in setting a realistic budget and provides insights into expenses, invoices and other costs. Often, support integrations and plugins give you more control.

Task Management Tools: PM software provides tools that offer a variety of visually appealing formats to help organizations monitor and manage the plethora of tasks attached to a given project. If one needs to rearrange some details and create task dependencies to visualize how everything fits together, drag-and-drop features let you do so without frustration. Few of the features used include Gantt chart, Scrum boards, Kanban boards, etc.

Integrations Capabilities: These software provides integration with various other platforms or areas like e-mail integration, CRM integration, repository integration, identity management system integration, etc. For the effective execution of the project, the project team needs a centralized resource for shared documents; all project management software come with the feature to let the team members collaborate in real time. This enables them to view and edit their project documents in real time, eliminating the need for multiple conflicting versions of critical materials.

Dashboard: Accurate, timely reporting is essential for effective project and portfolio management. While project managers need to know where their team members are on their assigned tasks, the C-suite stakeholders want to have updates on budget and timeline performance for projects across the organization. It is because of these requirements that all project management software comes with real time reporting feature. This provides real time tracking facility to the project manager. This feature is very helpful for the people in senior management, who

can keep tracking of all the project related activities of multiple projects in real time and get an in-depth view of critical activities.

Custom Workflow: All project management software comes with the flexibility to customize the workflows as per the need of the organization. This helps in serving the need better. Though project management software comes with pre-built workflows but the same can be customized to makes it easy to operate and fit the need of the organization. It also provides you the flexibility to define your own rules that prompt automatic actions in response to an activity. As the project management applications can track the individual performance and identify backlogs, it helps you to evaluate work and monitor the process in an advanced way.

Resource Management tools: Large organizations have dozens of interconnected projects underway at all times. All good project management software are capable of providing present information on resource availability and budget performance for multiple projects at once. Creating task group on the software lets the manager create multiple task groups inside each team. This simplifies the task of the project manager and people can be grouped on the basis of task and better collaboration takes place.

Project management software come packed with capabilities and customizations that will work for the organization in the way desired. Once the organization have shortlisted the software, they can look into free trial options. This helps in getting firsthand experience of using the software for the purpose. Many vendors offer a free trial period so you can take the software for a test drive and see if it meets your needs. With the right software, organizations can save lots of time and keep a track of the project.

14.3.1 Illustrations

Given below are few illustrations of how project management software will provide the previews:

Project status Report format

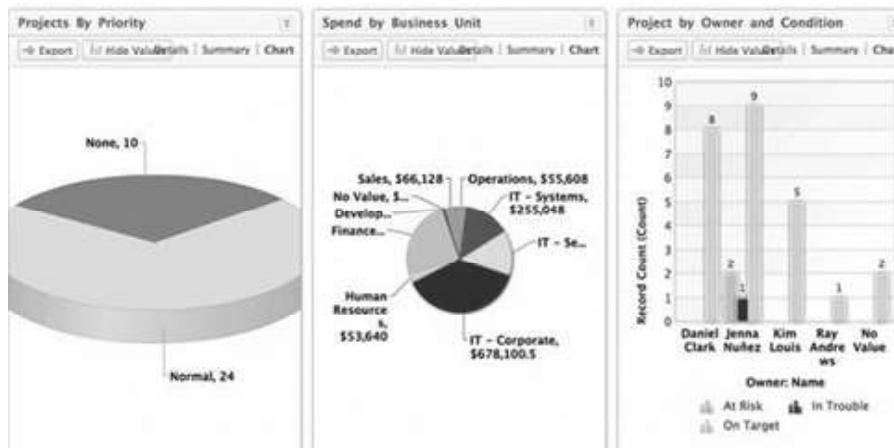


Fig. 14.3 Project Status Report Format

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Task Management format

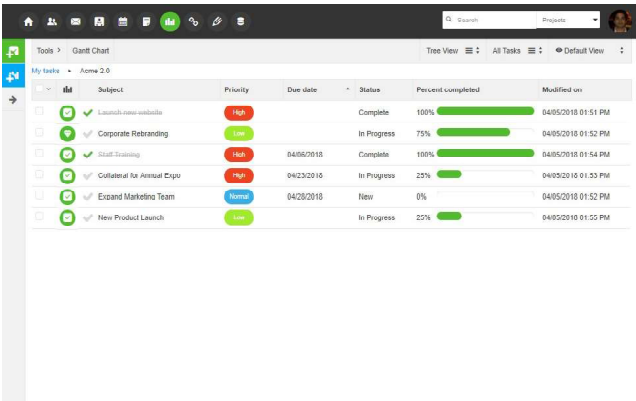


Fig. 14.4 Task Management Format

Project Schedule Management format

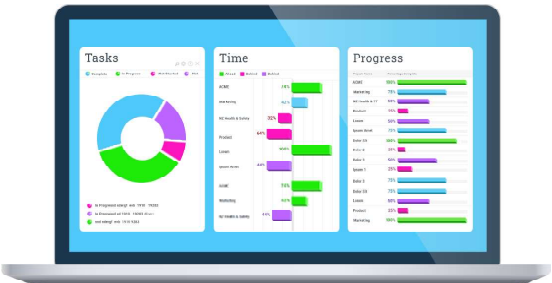


Fig. 14.5 Project Schedule Management Format

Dashboard

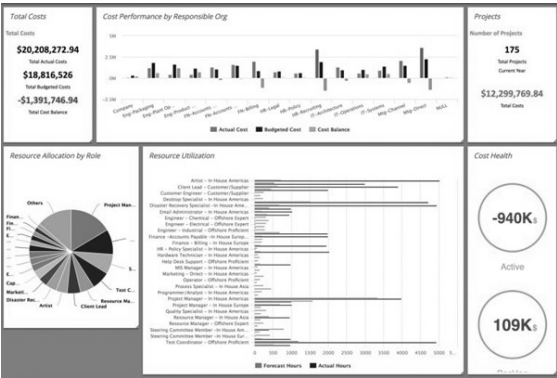


Fig. 14.6 Dashboard

Check Your Progress

3. What features are included in project templates?
4. What does the budgeting feature in project management software provide an insight into?
5. What is the advantage of real time reporting feature?

14.4 ANSWERS TO CHECK YOUR PROGRESS QUESTIONS

1. Project-management software packages offer facilities to accept project network data, perform resource analysis, scheduling and cost analysis, along with generating reports for monitoring of a project.
2. Popular project management packages are MS Project, Intellisys Project, Open Mind, Project Kick Start, INSTAPLAN, PRISM and many others.
3. Project templates includes features like dashboard creation with specific formatting options like row data, matrices to track performance, notification settings and more.
4. The budgeting feature in project management software provides an insight into expenses, invoices and other costs. Often, support integrations and plugins give you more control.
5. The real time repeating feature is very helpful for the people in senior management, who can keep tracking of all the project related activities of multiple projects in real time and get an in-depth view of critical activities.

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14.5 SUMMARY

- Project-management software packages offer facilities to accept project network data, perform resource analysis, scheduling and cost analysis, along with generating reports for monitoring of a project. Popular project management packages are MS Project, Intellisys Project, Open Mind, Project Kick Start, INSTAPLAN, PRISM and many others.
- Ranking is done based on several features and criteria including collaborations, resource management, project management, remote capability, help/support and system requirements.
- Project management software offer various features that helps to efficiently plan projects, manage resources, respond to problems, and ensure that all the stakeholders are involved.
- A project manager is loaded with lots of responsibilities; along with planning and scheduling of management of resources and budgets, he/ she had is busy with running meeting and analysing reports. On a busy day, the workload becomes quite overwhelming. In such a situation, enterprise software is very helpful, especially to automate task like report creation, information sharing, etc.
- A variety of online project management applications are available in the market to meet the need of the project manager. Following are the features that are common in each of these softwares:
 - o Project templates
 - o Collaboration tools

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- o Plans and Schedules
- o Reports
- o Budgeting
- o Task Management tools
- o Integrations capabilities
- o Dashboard
- o Custom Workflow
- o Resource Management tools

14.6 KEY WORDS

- **Project management software:** It is the software used for project planning, scheduling, resource allocation and change management.
- **Stakeholders:** It refers to a party that has an interest in a company and can either affect or be affected by the business.
- **Budget:** It is a financial plan for a defined period.

14.7 SELF ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short note on project management software packages.
2. What are the advantages of project management software?

Long-Answer Questions

1. Explain the importance of project management software.
2. Discuss the common features of project management softwares.

14.8 FURTHER READINGS

- Nagarajan, K. 2004. *Project Management*. New Delhi: New Age International.
- Kerzner, Harold, R. 2013. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.
- Singh, Narendra. 2000. *Project Management and Control*. Delhi: Himalaya Publishing House.
- Choudhury, Sadhan. 1988. *Project Management*. New Delhi: Tata McGraw-Hill.