Project Management

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UNIT - I

When you travel, you happened to see bridges being built, roads being laid, buildings being constructed and a lot of other activities, which are unique in nature and which deliver physical outputs. The same way, you might come across several activities, which deliver services like marriage contract, software development, health camp, literacy camp, etc. If you look at the above activities, they are unique in nature and they require defined time and resources. We can call these activities as projects and managing these projects has become more critical with the limited time and resources at our disposal. Thus, project management has become an important area and its application is found in almost all the business and non–business activities. Let us study in this unit, the meaning of project management, its importance, classification of projects, project portfolio management system, project management structure, steps in defining project, causes and constraints in executing project.

Unit Structure

Lesson 1.1 - Project Management – An Overview

Learning Objectives

- To understand the concept, characteristics and elements of projects.
- To understand the stages in Project Life Cycle.
- To know the classification of projects on various bases.
- To appreciate the importance of project management.
- To understand the importance of integrated approach in project management.

Concept of Project

Project is defined as temporary but interrelated tasks undertaken to give a unique product or service or result. Projects are different from other ongoing operations in an organization, because unlike operations, projects have a definite beginning and an end – they have a limited duration. Projects are critical to the realization of performing organization's business strategy because projects are a means by which the strategy of the company is implemented.

A project is a temporary endeavor, having a defined beginning and end (usually constrained by date, but can be by funding or deliverables), undertaken to meet unique goals and objectives, usually to bring about beneficial change or added value. The temporary nature of projects stands in contrast to business as usual (or operations), which are repetitive, permanent or semi-permanent functional work to produce products or services.

A project is an investment made on a package of interrelated time-bound activities; consequently, a project becomes a time-bound task. Every project has two phases basically; the first is preparation and construction, and the second, its operation. Project planning deals with specified tasks, operations or activities which must be performed to achieved the project

goals. Any project that we may consider has an objective, or a set of objectives, to achieve. It has to be operated within a given set of rules, regulations, constraints and restrictions. Implementation of projects needs resources or inputs. Every project converts the given inputs into outputs through a process of implementation. The outputs in the short run lead to outcomes, which, in the long run, should result in impact.

A project can be defined as a complex of non-routine activities that must be completed with a set amount of resources and within a set time limit. The following figure explains the basic tenets of project management.

Typical examples of projects include: construction of a house, performing a marriage, overhauling a machine, maintenance of equipment, commissioning of a factory, conducting national elections, research on developing a new technology, launching a new weapon system, conducting a war, pre-crisis planning for preventing a riot, recruitment of a project manager, etc. Each of the above cases involves investment of resources on a package of inter-related, time-bound activities, thereby constituting a project.

Projects also involve one or more elements that have not been done in the past, and are therefore unique. A product or service may be unique even if the category to which it belongs is large. For example, although several residential complexes have been built in the past, creation of a new house will be a project because each facility can have elements such as a unique – location, customized or adapted design, regionally available resources, and/or discrete owners.

Characteristics of a Project

1. **Temporary:** Projects are temporary in nature. Every project has a beginning and end. The word 'temporary' here may refer to an hour, a day or a year. Operational work is an ongoing effort which is executed to sustain the business. But projects are not ongoing efforts. A project is considered to end when the project's objectives have been achieved or the project is completed or discontinued. Only projects are temporary in characteristic and not the project's outcomes. It will not generally be applied to the product, service or result created by the project. Projects also may often have intended and unintended social, economic and environmental impacts that long last.Eg. Building Eiffel Tower was a project. The structure was built between 1887 and 1889. Project Eiffel Tower ended on 1889. But still the outcome of the project exists as a monument.

2. **Definite Beginning and Completion:** Project is said to be completed when the project's objectives have been achieved. When it is clear that the project objectives will not or cannot be met the need for the project no longer exists and the project is terminated. Thus, projects are not ongoing efforts. Thus, every project has a definite beginning and end.

3. **Definite Objective/Scope and Unique:** All the projects have their own defined scopes/objectives for which they are carried out. Every Project is undertaken to create a unique product, service, or result. Eg. Hundreds of house buildings may have been built by a builder, but each individual building is unique in itself like they have different owner, different design, different structure, different location, different sub-contractors, and so on. Thus, each house building is to be considered as a Project and each Project produces unique outcome.

4. **Defined Time and Resources:** As the projects have definite beginning and end, they are to be carried out within the time and resources constraints. Each project will have defined time and resources for its execution.

5. **Multiple Talents:** As projects involve many interrelated tasks done by many specialists, the involvement of people from several

departments is very much essential. Thus, the use of multiple talents from various departments (sometimes from different organizations and across multiple geographies) becomes the key for successful project management. For example, take the construction of house building; the expertise of very many professionals and skills of various people from various fields like architect, engineers, carpenters, painters, plumber, electrician, interior decorator, etc, are being coordinated to complete the house project.

Basic Elements of Project

There are three basic elements which must be considered in a project cycle. These are discussed below:

Operations

Operations are the activities or jobs which must be performed to meet the project objectives. These activities should be identified and arranged in a logical sequence. After determining the job sequence, the method of performing each operation must be determined in advance. The method, in turn, predetermines the time and cost required to perform each activity.

Resources

The second of the project elements, resource can be classified under manpower, money, methods, material, machines and time. Time and cost estimates are associated with the method of performance, where the cost estimate relates resource expenditure to a common measure of cost in money alone and the time estimate defines the expected duration of the resource use.

Conditions or Restraints

The third project element refers to ***externally imposed conditions or restraints,*** like supply of materials, machines, and designs by outside agencies. The delivery system should be planned carefully in co-ordination with the activities to be undertaken.

The two basic activities which normally get completed before undertaking the installation of equipment in any project are: (a) land acquisition, and (b) infrastructural development. Most of the projects are undertaken next to a river or road/railway junction, or a busy commercial centre with a view to cutting down the expenditure for developing the external infrastructure needed for the project, such as road/railway points, schools, commercial centers, and residential accommodation, which otherwise put a heavy burden on the project authorities. There is a general sentimental opposition from the landowners as well as tillers to handover their land for fear of losing their earning opportunities, and the project team must try to cope with such contingencies.

White Elephants

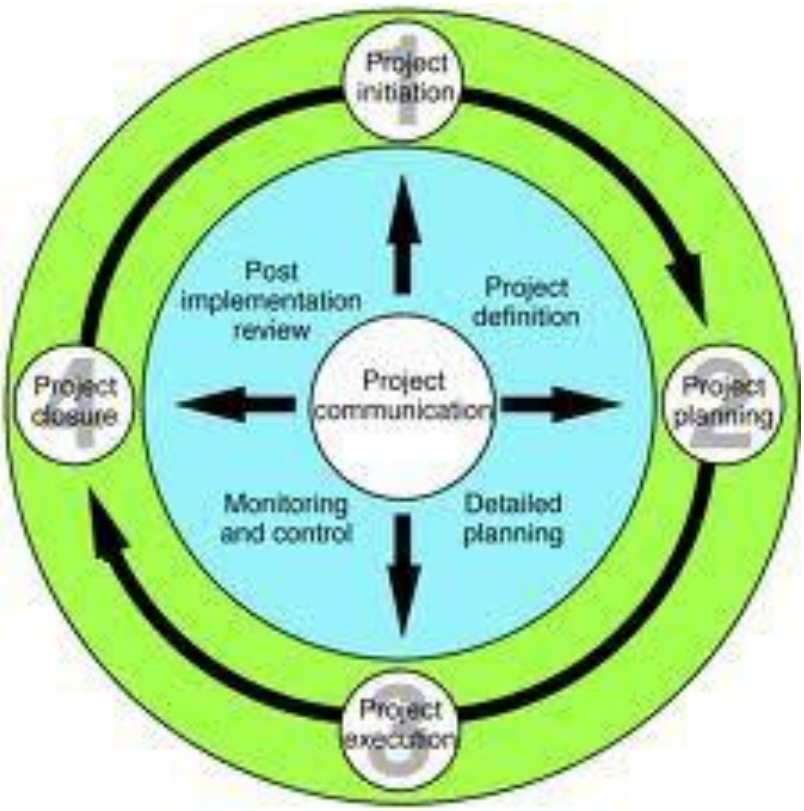
In India, almost every project in infrastructural sectors has been delayed for one reason or the other. The reports of Ministry of Project Implementation, Government of India carry alarming information on project cost and time overruns, which have become a serious economic problem. One can go on and on to show that these modern temples are becoming white elephants and it is the duty of the professional project managers to identify the reasons and try to reduce the delay in building modern India.

Stages in Project Life Cycle:

The project life cycle typically passes through four stages, viz., Initiating, planning, executing and closing. The following figure shows the Project Life Cycle.

The starting point begins the moment the project is given the go–ahead. Project efforts starts slowly, build to a peak and then declines to delivery of the project to the customer. The stages in the project life cycle are discussed below:

a) **Project Initiation Stage:** In this stage, the specifications of the project are defined along with the clear cut project objectives. Project teams are formed and their major responsibilities are assigned. More specifically, this stage defines the goals, specifications, tasks and responsibilities.



b) Project Planning Stage: In this stage, the effort level increases and plans are developed to determine what the project will entail, when it will be scheduled, whom it will benefit, what quality level should be maintained and what the budget will be. More specifically, this stage will include planning schedules, budgets, resources, risks and staffing.

c) Project Execution Stage: In this stage, a major portion of the project work takes place. The physical product is produced (For eg., house, bridge, software program, report, etc). Time, cost and specification measures are used for control. More specifically, this stage will take care of status reports, changes, quality and forecasts.

d) Project Closure stage: This is the final stage which includes two activities, viz., delivering the outcome of the project to the customer and redeploying the project resources. Delivery of the project might include customer training and transferring documents. Redeployment usually involves releasing project equipment/ materials to other projects and finding new assignments for team members. More specially, this stage will undertake activities relating to training the customer, transfer of documents, releasing resources, releasing staff and learning lessons.

Classification of Projects

The projects can be classified into various types:

1) Based on Ownership

a) *Public Projects:* These are the projects which are done by public projects. E.g. Construction of Roads & Bridges, Adult Education Programmes, etc.

b) *Private Projects:* These are the projects which are undertaken by private enterprises. Eg. Any business related projects such as a construction of houses by real estate builders, software development, marriage contracts, etc.

c) *Public Private Partnerships*: These projects which are undertaken by both government and private enterprises together. E.g., Generation of Electricity by Windmill, Garbage Collection, etc.

2) Based on Investment

a) *Large Scale Project:* These projects involve a huge outlay or investments, say, crores. Eg. Real Estate Projects, Road Construction of manufacturing facilities, Satellite sending projects of ISRO, Unique Identification Number project of India, etc.

b) *Medium Scale Project:* These projects involve medium level investment and are technology oriented. Example: Computer industry and electronic industry.

c) *Small Scale Project:* These projects involve only a lesser investments. E.g., agricultural projects, manufacturing projects.

3) Based on Research in Academia

a) *Major Projects*: In academia, the major projects are those projects which involve more than one year to 3 or 5 years and minimum funding of ` 3 lakhs in case of social sciences and ` 5 lakh in case of sciences.

b) *Minor Projects:* The minor projects in academia are those projects which will be completed within a year and have a maximum funding of ` 1 lakh in social science and ` 3 lakh in case of sciences.

4) Based on Sector

a) *Agricultural Projects:* These are the projects which are related to agricultural sector like irrigation projects, well digging projects, manuring projects, soil upgrading project, etc.

b) *Industrial Projects:* These are the projects which are related to the industrial manufacturing sectors like cement industry, steel industry, textile industry, etc. For example, technology transfer project, marketing project, capital issue project like IPO, etc.

c) *Service Projects:* These are the projects which are related to the services sectors like education, tourism, health, public utilities, etc. For example, adult literacy project, medical camp, general health check up camp, etc.

5) Based on Objective

a) *Commercial Projects*: These projects are undertaken for commercial purpose and return on investment is expected out these projects. For example, Toll roads based on BOLT – Build Own Lease Transfer Model or BOOT – Build Own Operate and Transfer Model, Product Launching project.

b) *Social Projects*: These projects are undertaken for social purposes and welfare of the people is the aim of these projects. These projects are undertaken either by the Government or Service oriented Non-Governmental Organizations. For example, Polio immunization Project, Child Welfare Projects, Adult Literacy Projects, etc.

6) Based on Nature

a) *Conventional Projects*: These projects are traditional projects which do not apply any innovative ideas or technology or method. For example, conventional irrigational projects, handicraft projects, etc.

b) *Innovative Projects*: These projects involve the use of technology, high R&D, development of new products and services. These innovative projects can be further classified into

i) *Technology*: Depending on the level of technological uncertainty at the time of initiation of projects, the projects can be classified

into: **Low-Tech** projects which relay on the existing and well established base technologies; **Medium-Tech** projects which rest mainly on existing base technologies but incorporate some new technology or feature; **High-Tech** projects in which most of the technologies employed are new, but existent, having been developed prior to the project's initiation; and **Super High-Tech** projects which are based primarily on new, not entirely existent technologies.

ii) *Research*: Based on the type of research, projects can be classified into: Exploratory **research projects** which may generate novel idea in the domain of knowledge**; constructive research projects** which are mainly done by many technological corporate to find new or alternative solutions to any particular crisis or problems, eg., renewable energy research or development of the capacity of optical fiber**; and Empirical research projects** are very impressive observational type of research in which testing on real life data or analysis of pattern of some specific events in order to identify the nature or the class of trend that specific phenomenon maintains**.**

iii) New product development: These projects are undertaken in the life cycle of a product. These projects can be classified into **advance development projects** which aim at inventing new science or capturing new know–how for the organization; **breakthrough development projects** which create the first generation of an entirely new product and involve significant change in the product and process technology; **platform or next generation development projects** which provide a basis for a product and process family and thus establish the basic architecture for follow–on derivative projects; **and derivative development projects** which refine and improve selected performance dimensions.

7) Based on Time

a) Long term projects: These projects take a very long duration to complete. These projects are run for many years till the objective is reached. For example, Eradication of diseases like Polio, Filaria, etc.

b) *Medium term projects*: These projects take a medium term duration like 3 to 5 years. For example, Modernization projects, computerization of operations, etc.

c) *Short term projects*: These projects are executed within a short period, normally within a year. For example, Pond cleaning project, health camps, software development, etc.

d) *Very short term projects*: By very name you can understand that these projects are completed within a very short period, say, within a day. For example, product launch project.

8) Based on Functions

Based on the functional area of management, the projects can be classified into:

a) *Marketing Projects* which are taken up in the area of marketing a product or service of an organization. Marketing road shows, implementing a marketing strategy, etc.

b) *Financial Projects* are undertaken to raise finance or restructure capital structure. For example, IPO Project, share split project, etc.

c) *Human Resources Projects* are undertaken in the area of human resources of an organization, e.g., Induction training project, campus recruitment project, etc.

d) *IT and Technology Projects* which are undertaken in the area of IT companies or IT related requirement of any organization, e.g., development of Human Resources Information System, Marketing Information System, etc.

e) *Production Projects* are undertaken in the area of production or operations. For example, overhauling projects, preventive maintenance projects, getting an ISO certification, etc.

f) *Strategic Projects* are taken by the organizations to executive a strategy, for example, mergers and acquisition projects, Core Banking Solution project introduced in banks, etc.

9) Based on Risk

a) *High Risk Projects:* These projects involve a very high degree of risk, for example, nuclear energy project, thermal energy project, satellite projects, etc. If the project is not handled properly, the effect will be very adverse. Thus, high precautionary measures are to be taken to commission these projects.

b) *Low Risk Projects:* These projects do not involve risk and they are carried out in the normal course of action. For example, road and bridge construction, house construction.

10) Based on Investment Decisions

On the basis how the projects influence the investment decision products, project can be classified into

a) *Independent Projects*: An independent project is one, where the acceptance or rejection does not directly eliminate other projects from consideration or affect the likelihood of their selection. For example, if management plans to introduce a new product line, as well as, replace a machine which is currently producing a different product. These two projects can be considered independent of each other, if there are sufficient resources to adopt both, provided, they meet the firm's investment criteria.

b) *Mutually exclusive Projects:* The mutually exclusive projects are projects that cannot be followed at the same time. The acceptance of one prevents the substitute proposal from accepting. Most of them have 'either or' decisions. You will not be able to follow more than one project at the same time. The evaluation is done on a separate basis so that one that brings the highest value to the company is chosen.

c) *Contingent Projects:* A contingent project is one where the acceptance or rejection depends on the decision to accept or reject multiple numbers of other projects. Such projects may be complementary or substitutes. Let us take the example of bio fuel plant cultivation in a large scale and the decision to set up a bio fuel manufacturing unit. In this case, the projects are complementary to

each other. The cash flows of the plant cultivation will be enhanced by the existence of a nearby manufacturing plant. Conversely, the cash flows of the manufacturing unit will be enhanced by the existence of a nearby cultivation farm.

11) Based on Output

Based on output, projects are classified into quantifiable and non-quantifiable ones.

a) *Quantifiable projects*: In these projects, the benefits / goals of which are amenable for measurement. Quantitative expression of the outcomes is possible. It is easy to understand and appreciate quantitative projects as it is easy to communicate them. For instance, enterprises engaged in the production of various goods and services come under this category.

b) *Non-quantifiable projects:* In these projects quantification of the benefits / outcome may not always be possible as the impact of the project is spread over a longer period. The benefits accrue to the intended beneficiaries in the long run. Projects concerning health, education, and environment fall under this category.

12) Based on Techno-Economic Characteristics

Based on the technology intensity, size of the investment, and scope of the project, projects are also classified as techno-economic projects. For instance, the United Nations Organization (UNO) and its various developmental agencies use the Standard Industrial Classification of all economic activities in collection and compilation of economic data regarding projects. On the basis of Techno-economic factors, projects can be further classified into a) Factor Intensity Oriented; b) Causation Oriented and c) Magnitude Oriented.

a) *Factor Intensity Projects:* It is anybody's knowledge that some projects are capital intensive while some are labour intensive. However, as technological advancements are taking place in every sector in a big way, many projects are becoming more technology intensive and less labour intensive. The gestation period of some of the projects also is quite long. Large scale investments are made

in the plant and machinery. Economies of scale and the associated cost competitiveness also prompt the establishment of large scale organizations.

b) Causation-Oriented Projects: The availability of a particular raw material in abundance in a particular region could be the reason for conceiving projects at times. To make use of the locally available raw material, skilled workforce and to promote development of a backward region, some projects are conceived and formulated. Similarly, in a few cases, where the supply of a particular good falls short of demand necessitating imports from abroad, entrepreneurial projects are conceived. Thus, in some case, the existing demand for goods and services cause the establishment of business organizations. The demand pull plays a dominant role in such projects.

c) Magnitude Oriented Projects: Based on the size of the project, projects may be classified under large, medium and small scale projects. The size of the investment, gestation period, employment generation, etc. is some of the factors that influence the size of the project.

13) Based on Financial Institutions' Classification

Financial institutions – both central and state level have classified projects into profit-oriented projects and service-oriented projects.

a) Profit-Oriented Projects: They are classified into a) New Projects; *b)* Expansion Projects or Development projects; c) Modernization Projects or Technology Projects and d) Diversification Projects.

b) Service-Oriented Projects: They are classified into a) Welfare Projects; b) Service Projects; c) Research and Development Projects and d) Educational Projects.

Project Management

Project management is the discipline of planning, organizing, securing and managing resources to bring about the successful completion of specific project goals and objectives. Project management is the application of knowledge, skills and techniques to execute projects

effectively and efficiently. It's a strategic competency for organizations, enabling them to tie project results to business goals — and thus, better compete in their markets.It has always been practiced informally, but began to emerge as a distinct profession in the mid-20th century. It is no longer a special-need management. It is rapidly becoming a standard way of doing business. Project Management Institute's *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)* identifies its recurring elements. Project management processes fall into five groups such as *initiating, planning, executing, monitoring, controlling and closing.*

Project management *knowledge* draws on nine areas, viz., integration, scope, time, cost, quality, procurement, human resources, communications and risk management. All management is concerned with these, of course. But project management brings a unique focus shaped by the goals, resources and schedule of each project. The value of that focus is proved by the rapid, worldwide growth of project management as a separate area of study and as a mode of functioning.

Project management deals with planning, scheduling, controlling and monitoring the complex non-routine activities that must be completed to reach the predetermined objectives of the project. On critical examination, we see that each project has a feedback mechanism. The elements of project management control include programmed objectives, policy restrictions, resource constraints, government regulations, process implementation, review of output, feedback, and revision of objectives. Thus, project management involves the coordination of group activity, wherein the manager plans, organizes staffs, directs, and controls to achieve an objective, with constraints on time, cost and performance, of the end product. Network techniques are primarily used for project planning and controlling. Planning is the process of preparing for the commitment of resources in the most economical manner. Controlling is the process of making events conforms to schedules by coordinating the action of all parts of the project to achieve the objective.

Importance of Project Management

Project management is the art of managing the project and its deliverables with a view to produce finished products or service. There are many ways in which a project can be carried out and the way in which

it is executed is project management. Project management includes: identifying requirements, establishing clear and achievable objectives, balancing the competing demands from the different stakeholders and ensuring that a commonality of purpose is achieved. It is clear that unless there is a structured and scientific approach to the practice of management, organizations would find themselvesaimless and hence would be unable to meet the myriad challenges that the modern era throws at them. Hence, the importance of project management to organizations cannot be emphasized more and several reasons why project management is important is discussed below.

a) Reduction in the Product Life Cycle

The product life cycle is one of the most significant driving forces behind the demand for project management. As the lives of the products are shortened, time to market for new products with short life cycles has become increasingly important. Innovation and invention becomes the key for success and speed to innovate or invent becomes a competitive advantage. More and more organizations are depending on cross–functional project teams to get new products and services to the market as quickly as possible.

b) Global Competition

In the globally competitive today's market, customers want cheaper products and services with better quality at cheaper prices. This had led to the emergence of the quality movement across the world in International Standards Organization certification requirements for doing business. Quality management and improvement essentially requires project management. As the basic elements of project management concentrate on time, cost and quality, project management has become style of managing business.

c) Knowledge Explosion

The knowledge explosion world over has increased the complexity of managing projects. Product complexities have increased and demanded integration of divergent technologies. To manage all this, project management is the only way.

d) Corporate Downsizing

Restructuring of organizations in the recent years has resulted into the downsizing or rightsizing. Downsizing and sticking to core competencies have become essential for survival for many organizations.

e) Increased Customer Focus

Increased competition has increased the expectation of customers. Customers expect customized products and services instead of generic ones. The customization of products and services required better understanding of the customers' needs by project team members. The customers are more aware and their changing needs are to be taken into account to survive in the market.

f) Managing Small Projects

In today's competitive world, a situation has emerged in the organizations that many projects are run concurrently. This resulted into the multi-project environment and also plethora of new problems. Sharing and prioritizing resources across a portfolio of projects is a major challenge for top management. In the course of managing many projects, large projects are given more importance than the small projects. Small projects typically carry the same or more risk as do large projects. Small projects are perceived as having little impact on the bottom line because they do not demand large amount of scarce resources and/or money. Unfortunately, many small projects soon add up to large sums of money and their inefficiency would result into adverse impact.

g) Upsurge of Third World and Closed Economies

The gradual opening of emerging economies has created an explosion of demand for goods and services within these economies for their development. Thus, new markets emerge in the scenario. The developed markets have started introducing their products and services into these markets. Many firms are using project management techniques to establish distribution channels and foreign bases of operations.

An Integrated Approach to Project Management

Many project managers have tried many tools, techniques and systems to manage projects. These piecemeal systems fail to integrate the overall strategies of the organizations and connect the selected projects to resources. They also fail to balance the application of project planning and control methods with appropriate adjustments in the organization's culture to support project activities. Thus, today's project management environment requires an integrated approach. Integrated project management process focuses all project efforts towards the strategic plan of the firm and reinforces mastery of both the project management tools or techniques and interpersonal skills necessary to achieve successful project completion. Integration of project management has two key areas.

a) Integration of Projects with Strategic Plan

Strategic plans are written by one group of managers, projects are selected by another group and the projects are implemented by another group. This resulted in unsatisfied customer. Thus, integration of projects with the strategic plans is very essential. Strategies are implemented through projects. The key is selecting from the many proposals those projects that make the largest and most balanced contribution to the objectives and strategies of the organization. This means prioritizing projects so that scarce resources are allocated to the right projects.

b) Integration within the Process of Managing Actual Projects

The integration within the process of managing projects has two dimensions. The first dimension is the technical side of the management process which consists of the formal, disciplined, pure logic part of the process. It relies on the formal information system and it includes planning, scheduling and controlling of projects. The second dimension is the socio-cultural side and this centers on creating a temporary social system within a larger organizational environment that combines the talents of a divergent set of professionals working to complete the project.

Conclusion

Without a scientific approach to the task of managing the projects and achieving objectives, it would be very difficult for the organizations to successfully execute the projects within the constraints of time, scope and quality and deliver the required result. In other words, there has to be a framework and a defined way of doing things to ensure that there is a structure to the art of project management. Thus, project management is about creating structure and managing the project commitments and the delivery of agreed upon results. Thus, Project Management is both necessary and essential to the success of the project. In conclusion, integrated project management and the practice of the same have become indispensable to the modern day project manager. The technical side of the project represents the science of project management and the socio-cultural side represents the art of managing the project.

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Lesson 1.2 - Project Portfolio Management System and Structure

Learning Objectives

- To understand the concept of Project Portfolio Management System.
- To appreciate the need for Project Portfolio Management System
- To understand the design of the Project Portfolio Management System.
- To understand the various project management structures.
- To know the considerations in choosing appropriate project management structure
- To know about Project Management Office as a modern business practice.

Project Portfolio Management System

Project Portfolio Management System (PPM) is a term used by project managers and project management (PM) organizations, (or PMO's), to describe methods for analyzing and collectively managing a group of current or proposed projects based on numerous key characteristics. The fundamental objective of PPM is to determine the optimal mix and sequencing of proposed projects to best achieve the organization's overall goals – typically expressed in terms of hard economic measures, business strategy goals, or technical strategy goals – while honoring constraints imposed by management or external real-world factors. Typical attributes of projects being analyzed in a PPM process include each project's total expected cost, consumption of scarce resources (human or otherwise) expected timeline and schedule of investment, expected nature, magnitude and timing of benefits to be realized, and relationship or inter-dependencies with other projects in the portfolio.

Thus, Project Portfolio Management is about more than running multiple projects. Each portfolio of projects needs to be assessed by its business value and adherence to strategy. The portfolio should be designed

to achieve a defined business objective or benefit. Project management guru Bob Buttrick summarized it when he said; "Directing the individual project correctly will ensure it is done right. Directing 'all the projects' successfully will ensure we are doing the right projects." Project portfolio management organizes a series of projects into a single portfolio of reports that capture project objectives and other critical factors. While at individual project level it is important to know how each project is performing, the impact of each project on the portfolio is also important. The following questions should be asked:

- Does each project contribute to the overall achievement of the portfolio?
- How well is each project performing?
- Will any project have a negative impact on other projects to come?
- What projects in the portfolio are dependent on others?
- Will the successful delivery of all projects deliver the desired objective or benefit?

Working at portfolio level is about working with summary or key data. It is important to avoid information overload. The detail of each project should be kept at the project team level, managed by the individual project managers. Key information should be rolled up and presented at each level within the organization as appropriate. Within most project portfolio management systems there is a project evaluation process. This process is used to evaluate the projects at various points during their life cycle. At the beginning of each stage (often called a "gate") the responsible party evaluates the business case, asking whether it is still relevant and able to deliver the organizations' objectives. If the answer is no, then the project should be stopped. This way the organization can ensure they stay focused on delivering a strategy, goal or other benefit, and that resources are used where they will offer the best return.

Project portfolio management asks the following questions:

- Are we doing the right things?
- Are we doing them the right way?
- Are we doing them well?
- Are we getting the benefits?

If the answer to any of these questions is no, immediate action is needed to bring the portfolio back on track.

Need for an Effective Project Portfolio Management System

There are three problems or reasons why we need project portfolio management system. They are

a) Implementation Gap

In many organizations, top management formulates strategy and functional management implements. For implementation, the functional managers develop objectives based on the strategies. As the strategies and objectives are developed at different levels by top management and executive management respectively, implementation gap arises. It may lead to frequent conflict among functional managers, conduct of frequent meetings to establish or renegotiate priorities, people frequently shifting from one project to another, depending on current priority and employees getting confusion about which projects are important. As clear linkages do not exist, the organizational environment becomes dysfunctional, confused and ripe for ineffective implementation of organization strategy and hence, projects. The implementation gap refers to the lack of understanding and consensus of organization strategy among top and middle level managers. Hence, project portfolio management system will help the organization to minimize the implementation gap.

b) Organizational Politics

When criteria and processes for selecting projects are ill–defined and non–aligned with the mission of the firm, projects suffer from not getting priority and resources. The term 'sacred cow' is used to refer to the worthless projects which are advocated by higher officials. Similarly, project sponsor can play a significant role in the selection and successful implementation of projects. Politics can play a role not only in project selection but also in the aspirations behind the projects. Individuals can enhance their powers within the organization by managing extraordinary and critical projects. Thus, project portfolio management system will help in reducing the organizational politics.

c) Resource conflicts and multitasking

When more projects are carried out, it leads to resource conflicts and multitasking. Resource sharing also leads to multitasking. People working on several projects concurrently are found to be inefficient. Multitasking adds to delay and costs, i.e., both time and cost overruns. Thus, project portfolio management system will help in optimum allocation of scarce resources.

Design of Project Portfolio Management System

Design of project portfolio management system should include the following:

a) Classification of Project

Most of the organizations may have three kinds of projects in their portfolio, viz., compliance and emergency projects, operations projects and strategic projects. Compliance and emergency projects are compulsory in nature to meet the regulatory conditions. Operational projects are those that are needed to support operations and are designed to improve efficiency of delivery system, reduce product costs, and improve performance. Strategic projects are those that are directly support the organizations' long run mission. The strategic value of a project should be determined before it is placed in the project portfolio. However, compliance projects may also be undertaken to avoid regulatory problems.

b) Selection Criteria

Selection criteria for projects may be divided into financial and nonfinancial. Financial criteria are the most preferred method to evaluate projects. Common financial methods include payback method and net present value method. Payback method is a method in which the projects which pays back the original investment in a shorter period are given priority.

In case of net present value method, the project which gives positive NPV is selected. NPV is the excess of present value of cash inflows over present value of cash outflows. Non-financial criteria may include the

following: a) restoring corporate image or b) enhancing brand image. Many organizations are committed to corporate citizenship and support community development projects. Thus, the social desirability of the projects is also equally important as financial viability.

c) Sources of Project Proposals

Projects should originate from anyone who believes their project will add value to the organization. Many organizations restrict proposals from specific levels or groups within the organization. This could be an opportunity lost. Thus, project ideas should be solicited from all internal and external sponsors.

d) Evaluation and Selection of Project Proposals

Evaluating many project proposals and selecting the projects which add value to an organization is important. Data and information are collected to assess the value of the project to the organization. Given the selection criteria and current portfolio of projects, the priority team rejects or accepts the project. If the project is accepted the priority team set implementation in motion.

e) Managing the Project Portfolio System

Managing portfolio takes the selection system one step higher in that the merits of a particular project are assessed within the context of existing projects. At the same time, it involves monitoring and adjusting selection criteria to reflect the strategic focus of the organization. The priority system can be managed by a small group of key employees in a small organization or in a large organizations, it can be managed by the project office or enterprise management group. Management of a portfolio system requires two major inputs from senior management, viz.,
a) senior management must provide guidance in establishing selection criteria that strongly align with the current organizational strategies; and
b) senior management must annual decide how they wish to balance the available organizational resources among the different types of projects. Given these inputs, the priority team or project office can carry out its many responsibilities, which include supporting project sponsors and representing the interest of the total organization.

f) Balancing the portfolio for risks and types of projects

A major responsibility of the priority team is to balance projects by type, risk and resource demand. This requires a total organization perspective. Hence, a proposed project that ranks high on most criteria may not be selected because the organizational portfolio already includes too many projects with the same characteristics. Balancing the portfolio is as important as project selection. David and Jim Matheson developed a project portfolio matrix for R&D Organizations, based on technical feasibility and commercial potential, which contains four quadrants, viz., bread and butter (high technical feasibility with low NPV), pearl (high technical feasibility with high NPV), oyster (low technical feasibility with high NPV) and white elephants (Low technical feasibility with low NPV). Organizations often have too many white elephants and too fee pearls and oysters.

Conclusion

Implementing PPM at the enterprise level faces a challenge in gaining enterprise support because investment decision criteria and weights must be agreed to by the key stakeholders of the organization, each of whom may be incentivized to meet specific goals that may not necessarily align with those of the entire organization. But if enterprise business objectives can be manifested in and aligned with the objectives of its distinct business unit sub-organizations, portfolio criteria agreement can be achieved more easily. In addition to managing the mix of projects in a company, Project Portfolio Management must also determine whether (and how) a set of projects in the portfolio can be executed by a company in a specified time, given finite development resources in the company. This is called pipeline management. Fundamental to pipeline management is the ability to measure the planned allocation of development resources according to some strategic plan. To do this, a company must be able to estimate the effort planned for each project in the portfolio, and then roll the results up by one or more strategic project types.

Project Management Structures

Organizational structure consists of activities such as task allocation, coordination and supervision, which are directed towards the achievement of organizational aims. It can also be considered as

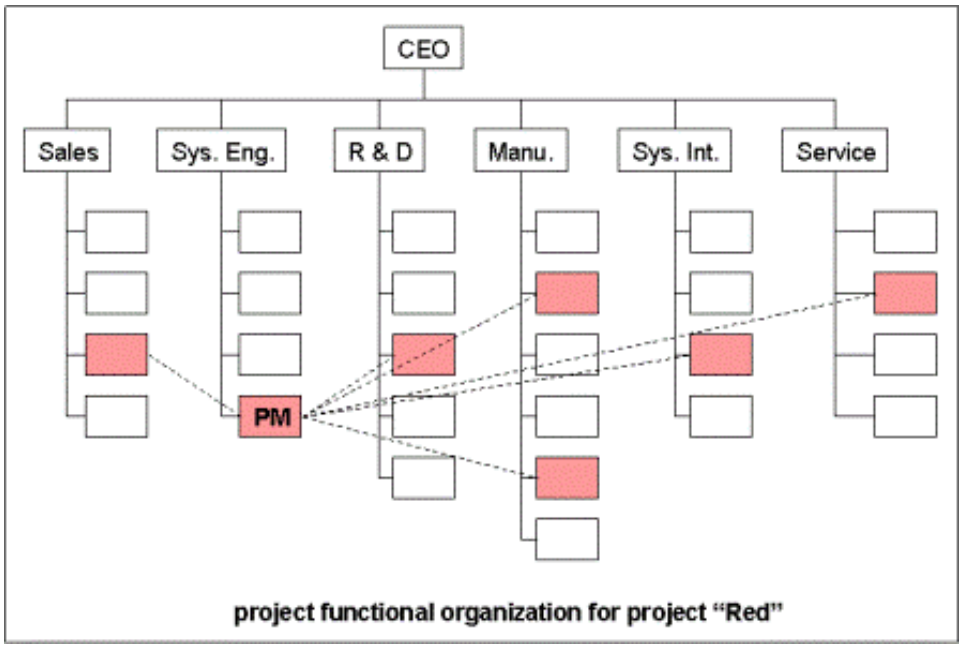
the viewing glass or perspective through which individuals see their organization and its environment. An organization can be structured in many different ways, depending on their objectives. The structure of an organization will determine the modes in which it operates and performs. Organizational structure allows the expressed allocation of responsibilities for different functions and processes to different entities. Organizational structure affects organizational action in two big ways. First, it provides the foundation on which standard operating procedures and routines rest. Second, it determines which individuals get to participate in which decision-making processes, and thus to what extent their views shape the organization's actions.

A project management structure provides a framework for launching and implementing project activities within a parent organization. A good structure appropriately balances the needs of both the parent organization and the project by defining the interface between the project and parent organization in terms of authority, allocation of resources, and eventual integration of project outcomes into mainstream operations. Many organizations have struggled with creating a system for organizing projects while managing ongoing operations. One of the major reasons for this struggle is that projects contradict fundamental design principles associated with traditional organizations as the projects are unique in nature. Second reason is that most projects are multidisciplinary in nature because they require the coordinated efforts of a variety of specialists to be completed. Let us understand how projects are organized in different organizational structures.

a) Organizing Projects within the Functional Organization

Employees within the functional divisions of an organization tend to perform a specialized set of tasks. This leads to operational efficiencies within that group. However it could also lead to a lack of communication between the functional groups within an organization, making the organization slow and inflexible. As a whole, a functional organization is best suited as a producer of standardized goods and services at large volume and low cost. However, once management decides to implement a project, the different segments of the projects are delegated to the respective functional units with each unit responsible for completing its segment of the project. Coordination is maintained through normal

management channels. The functional organization is also commonly used when, given the nature of project, one functional area plays a dominant role in completing the project or has a dominant interest in the success of the project. Under these circumstances, a high ranking manager in that area is given the responsibility of coordinating the project. The following figure shows how project is managed within the functional organization.



project functional organization for project "Red"

The advantages in using the existing functional organization include

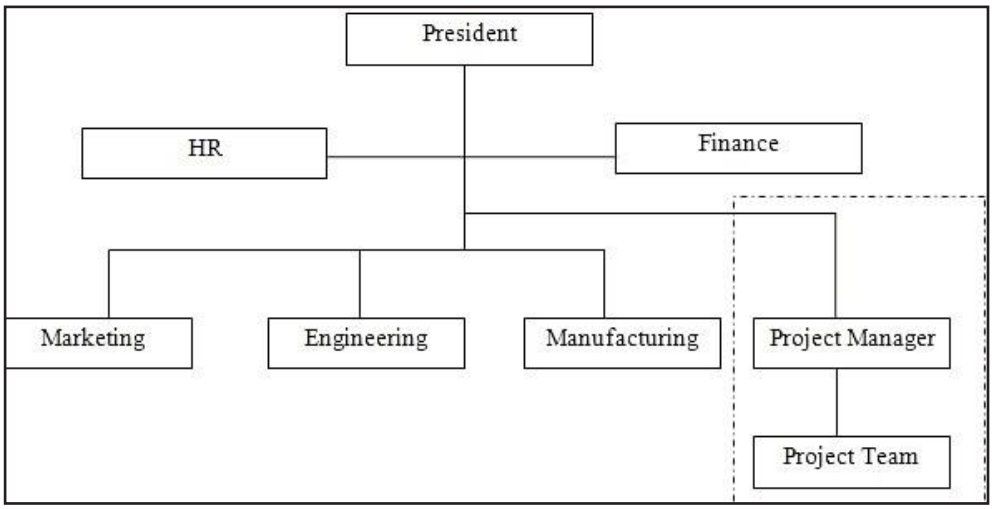
- No change in the design and operation of parent organization.
- Maximum flexibility in the use of staff.
- In-depth expertise of the functional department can be used for projects
- Post-project transition is easy.

The disadvantages in using the existing functional organization include

- Lack of focus on the part of functional departments as they have their own routine work.
- Integration across functional units is very difficult.
- Projects may take longer time due to slow response by functional departments.
- Motivation level among the people assigned to the project is very weak as they lack ownership.

b) Organizing Projects as Dedicated Teams

In this structure, a dedicated independent project teams are created. These teams operate as separate units from the rest of the parent organization. Usually, a full time project manager is designated to pull together a core group of specialists who work full time on the project. The project manager recruits necessary personnel from both within and outside the parent company. Project managers get maximum freedom in this structure. The following figure shows how projects are organized with dedicated teams.



Managing Projects as dedicated teams

The advantages of dedicated team structure include

- It is very simple to establish.
- Fast completion of the projects is ensured.
- High level cohesiveness would emerge.
- Cross functional integration is possible.

The disadvantages of dedicated team structure include

- It is expensive
- It creates internal strife in the organization. It is referred as Projectitis (a gap gets created between the project teams and the people in the parent organization and project members feel they are only important for the organization).

- Sometimes, the technological expertise of the specialized project teams may be very limited and that will affect the project outcomes.
- Post project transition is very difficult as after the completion of the project, a dilemma of what to do with personnel arises.

c) Organizing Projects within a Matrix Structure

Matrix management is a hybrid organizational form in which a horizontal project management structure is overlaid on the normal functional hierarchy. In matrix system, there are two chains of command, one along functional lines and the other along project lines. Instead of delegating segments of a project to different units or creating an autonomous team, project participants report simultaneously to both functional and project managers. Matrix structure is designed to optimally utilize resources by having individuals work on multiple projects as well as being capable of performing normal functional duties. At the same time, the matrix approach attempts to achieve greater integration by creating and legitimizing the authority of a project manager. The following figure shows how projects are managed in matrix structure.

	Marketing	**Operations**	**Finance**	**HRM**
	Marketing Manager	*Operations Manager*	*Finance Manager*	*HR Manager*
Project A (Team Leader)	Marketing Team (A)	Operations Team (A)	Finance Team (A)	HR Team (A)
Project B (Team Leader)	Marketing Team (B)	Operations Team (B)	Finance Team (B)	HR Team (B)
Project C (Team Leader)	Marketing Team (C)	Operations Team (C)	Finance Team (C)	HR Team (C)
Project D (Team Leader)	Marketing Team (D)	Operations Team (D)	Finance Team (D)	HR Team (D)

Managing Projects within a Matrix Structure

There are different forms of matrix systems depending on the relative authority of the project and functional manager. Functional, lightweight or weak matrix is titles given to matrices in which the balance of authority strongly favors the functional manager. Balanced or middleweight matrix is used to describe the traditional matrix

arrangement. Project, heavy weight, or strong matrix is used to describe a matrix in which the balance of authority is strongly on the side of the project manager.

Weak/Functional Matrix

A project manager with only limited authority is assigned to oversee the cross– functional aspects of the project. The functional managers maintain control over their resources and project areas.

Balanced/Functional Matrix

A project manager is assigned to oversee the project. Power is shared equally between the project manager and the functional managers. It brings the best aspects of functional and projective organizations. However, this is the most difficult system to maintain as the sharing power is delicate proposition.

Strong/Project Matrix

A project manager is primarily responsible for the project. Functional managers provide technical expertise and assign resources as needed.

Among these matrixes, there is no best format; implementation success always depends on organization's purpose and function.

The advantages of matrix structure include

- Efficient allocation of resources to multiple projects is possible
- Strong project focus can be ensured.
- Post project transition is relatively easier.
- Flexibility in utilization of resources and expertise is possible.

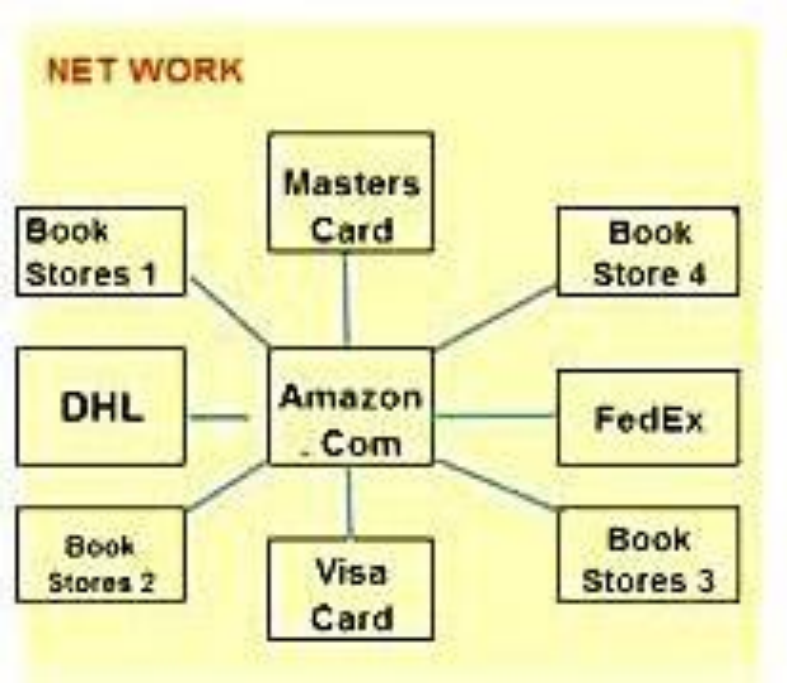
The disadvantages of matrix structure include

- Dysfunctional conflict may arise between function managers and project managers.
- Infighting may occur among project managers who are primarily interested in what is best for their project.

- As the management principle unity of command is violated, project participants have two bosses at the least and hence it will create stressful situations.
- In case of balanced matrix form, the projects get slow down.

d) Organizing projects within network organizations

There have been a lot of changes in the organizational structures and the recent one being the network structure. Corporate downsizing and cost control have combined to provide what we call network organizations. Network organization is an alliance of several organizations for the purpose of creating products or services for customers. This collaborative structure typically consists of several satellite organizations bee hived around a hub or core firm. The following figure shows the network structure of Amazon.com, a networked organization.



Network of Amazo.com, a Networked Organization

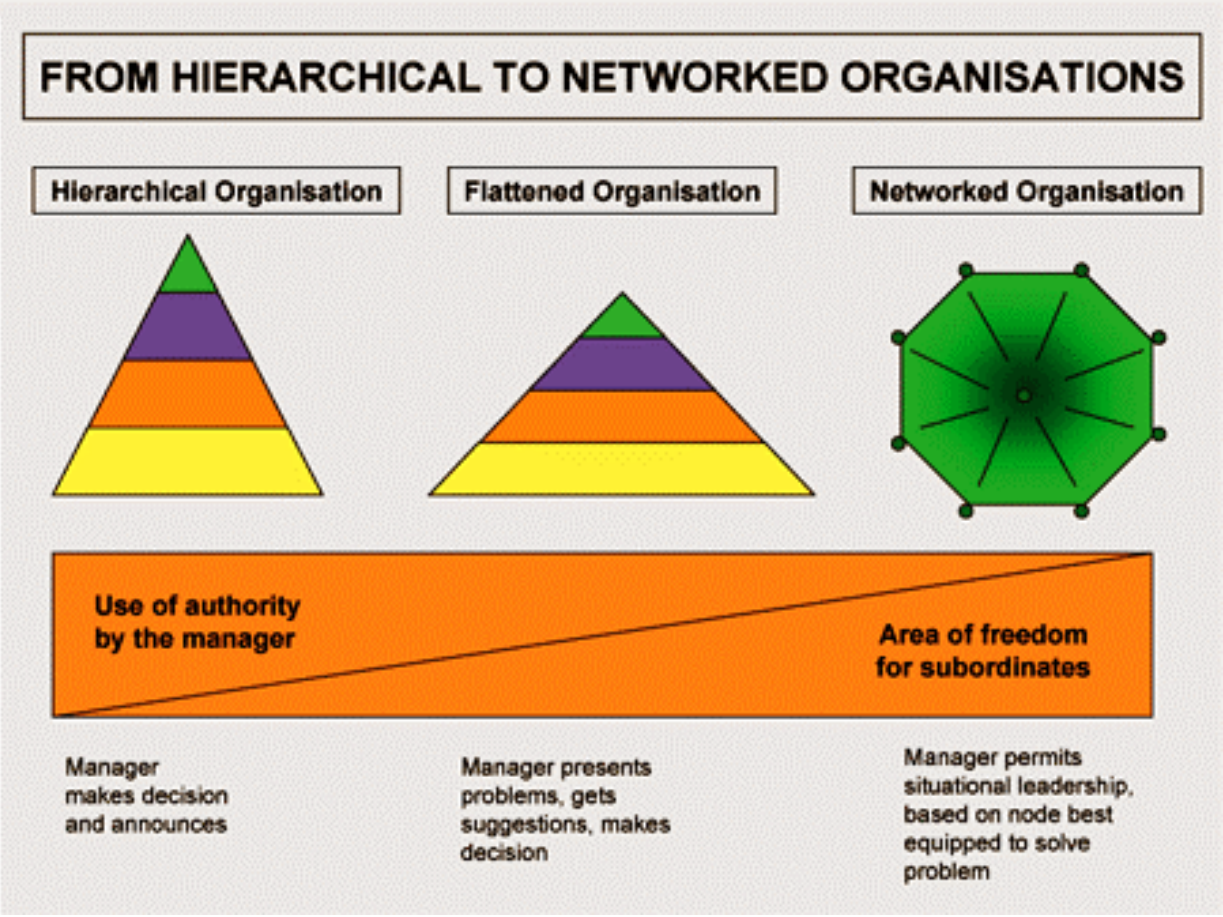
Another example is the film industry where studios such as MGM, Warner Brothers, and 20th Century Fox owned large movie lots and employed thousands of full time specialists. Today movies are made by a collection of individuals and small companies who come together to make films project by project. This structure allows each project to be staffed with the talent most suited to its demands rather than choosing from only those people the studio employs.

The advantages of networked organizations include

- It reduces cost as overhead costs are dramatically cut.
- High level of expertise and technology can be brought by outsourcing and it will have positive impact on the project.
- Lot of flexibility is there as the organizations are no longer constrained by their own resources but can pursue a wide range of projects by combining their resources with talents of other companies.

The disadvantages of networked organizations include

- Coordination breakdown may result when coordinating professionals from different organizations.
- Control may be lost on the projects as the core team depends on other organizations on which they do not have direct authority.
- Interpersonal conflicts may arise as project participants do not share the same values, priorities, and culture.



Thus, managing projects has witnessed a lot of changes depending on the changes in the organizational structure from hierarchical to networkedorganizations which are shown in above figure.

Thus, the project characteristics and organizational structure can be related and the same is shown in the following figure.

Organization Structure / Project Characteristics	Functional	Matrix			Projectized
		Weak Matrix	Balanced Matrix	Strong Matrix	
Project Manager's Authority	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Resource Availability	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Who controls the project budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager
Project Manager's Role	Part-time	Part-time	Full-time	Full-time	Full-time
Project Management Administrative Staff	Part-time	Part-time	Part-time	Full-time	Full-time

Project Characteristics and Organizational Structure

Choosing Appropriate Project Management Structure

Project success directly depends on the level of autonomy and authority project managers have over their projects. There are two types of considerations to be taken into account while choosing the appropriate project management structure. They are:

a) Organizational considerations and
b) Project considerations.

a) Organizational Considerations

Depending on how important the project management is to the success of organization, it should consider a fully projectized organization. If an organization has both standard products and projects, then a matrix arrangement would appear to be appropriate.

- ***Number of Projects:*** If an organization has very few projects, then a less formal arrangement is sufficient. Temporary task forces can be created on need based and the organization could outsource project work also.
- ***Resource Availability:*** Another important consideration is the resource availability. If matrix structure is used for managing projects, resources are to be shared across multiple projects and functional domains. If organizations do not afford to tie up critical personnel on individual projects, a matrix system would appear to be appropriate. Alternatively, a dedicated team can be created and outsourcing can be done when resources are not available internally.

b) Project Considerations

Depending on the autonomy the project needs to complete successfully, the project considerations include the following:

- Size of the project
- Strategic importance
- Novelty and need for innovation.
- Need for integration (number of departments involved)
- Environmental complexity (number of external interfaces).
- Budget and time constraints.
- Stability of resource requirements.

Higher the levels of these seven factors, the more autonomy and authority the project manager and project team need to be successful. This would lead to using of either a dedicated project team or a project matrix structure.

Project Management Office

The Project Management Office (PMO) is widely recognized as one of the most effective business practices used by successful organizations.

Understand the Impact of Culture on a PMO

Every organization has a unique culture, created through years of leadership and staffed with individuals who share common values and work ethics. Matching the right project office structure with organizational culture is critical for success. PMOs are not "one size fits all" solutions. In fact, PMO structures include an entire spectrum of options each with different structures, roles and responsibilities, reporting lines, resources, and levels of authority.

A successful project office can range from simple project data reporting to a centralized structure that takes the lead on every aspect of project management. Deciding on your organization's PMO requires evaluating the characteristics of your organization, as well as clarifying your expectations of the project office.

Key questions to ask include:

- What resources are you able to dedicate full or part time to the project office?
- Do you currently follow a standard project management methodology?
- How well do your different business units or departments work together?
- How many projects does your organization typically complete in a year?
- What problems is your organization facing when managing projects?
- What are those problems costing your organization?

Expectations for the success of PMO need to match the maturity of organization in each of these key areas.

Options for PMO Structures

In a decentralized structure, the PMO would provide a valuable reporting service for project status data. Project managers typically continue to report within their departmental units. There are roles in the project office for more than just project managers, including schedulers who can

implement and track quality project schedules, and facilitators, who can help guide projects in conjunction with a project manager.

Often these roles remain in the project office even in a decentralized structure to provide consistency and support for the individual departments. In this decentralized role, the project office functions primarily in an advisory role for project management methodology standards and for project issue resolution.

A decentralized structure is often a lower cost solution with lower headcount and fewer impacts on the organizational structure. The heads of the departments remain heavily involved in the projects, continue making decisions, and keep their employees engaged in the success of the work.

Many organizations begin with a decentralized structure when implementing a PMO. However, under this type of structure, organizations move slower to full project management methodology adoption and do not gain the full benefits of a project office. In a more highly controlling, centralized PMO structure, project managers typically report directly to the head of the PMO, who facilitates project decisions and resolves issues. Resources for projects are matrix-managed for the duration of the project, and the PMO has the authority to set and enforce standards. Schedulers and facilitators would also report within the project office.

This centralized structure allows organizations to more rapidly adopt project management methodologies. Issue resolution is simplified with a single escalation path to the top decision maker, and project managers gain support from working closely with each other. It is important to remember that while this structure gives more responsibility and authority to the PMO, it should not do so at the expense of teamwork and communication. The project office needs to maintain cooperative working relationships across all departments in order to be successful.

Managing all project work through the PMO provides a single source for data and a complete picture of the portfolio of projects. The downside of this structure is that it can cause the leaders of the functional units to disengage with key project work.

The PMO can also get a "project police" reputation, which may not encourage good project practices outside of the project office. This structure is effective when an organization is working with a large number of complex projects and only if the culture of the organization includes well-developed communication and teamwork skills.

Two structures that every organization should try to avoid: a de-centralized structure with highly controlling responsibilities and a centralized structure with responsibility only for status reporting. A de-centralized PMO structure could have difficulty performing a strong role when using matrix-managed resources, so limit the level of central responsibility if you choose that structure. A centralized structure that does nothing more than report status will add too much overhead to your organization, so if the role of your PMO will be limited, leave the office de-centralized. The more responsibility assigned to project office, the higher it should report in the organization. The most robust structure usually requires reporting directly to the President or CEO of the organization for maximum effectiveness.

Conclusion

No matter what structure your organization chooses, the implementation process itself is the key to the success of your project office. A champion should be identified to assist in promoting the benefits of good project management and helping to clear roadblocks to change. The champion will often create a cross functional steering team to help with the PMO implementation steps. Culturally, most organizations should begin with a less controlling, de-centralized project office, at least until the staff becomes comfortable working in a matrix-managed environment. A well-defined, effective project management office can be an important step to greater success for your organization.

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Lesson 1.3 - Steps in Defining Project and Project Delays

Learning Objectives

- To understand the steps in defining project.
- To understand the process of creating work breakdown structure (WBS)
- To know the pitfalls in creating WBS.
- To understand the role of Project Rollup and Responsibility Matrices (RMs).
- To understand the external causes of project overruns.
- To understand the internal constraints of project overruns

Steps in Defining Project

In this lesson, let us understand the steps in defining the project. One of the best ways to meet the needs of the customer and major project stakeholders is to use an integrated project planning and control system that requires selective information. Following are the steps in defining projects.

Step 1: Defining the Project Scope

The first step in defining the project is defining its scope. Project scope is a definition of the end result or mission of the project – a product or service for the customer or client. The primary objective is to define as clearly as possible the deliverables for the end user and to focus project plans. The scope should be developed under the direction of the project manager and customer. The project manager is responsible for seeing that there is agreement with the owner on project objectives, deliverables at each stage of the project and technical requirements. The project scope definition is a document that will be published and used by the project owner and project participants for planning and measuring project success. Scope describes what the organization expects to deliver to the

customer when the project is complete. The project scope should define the results to be achieved in specific, tangible and measurable terms.

To ensure that the scope definition is complete, the following project scope checklist may be used:

a) **Project Objectives:** The first step of project definition is to define the overall objective to meet the customers' needs. The project objective answers the questions of what, when and how much.

b) **Deliverables:** The next step is to define major deliverables – the expected outputs over the life of the project. For example, deliverables in the early design phase of a project might be a list of specifications.

c) **Milestones:** A milestone is a significant event in a project that occurs at a point in time. The milestone schedule show only major segment of work. It represents first, rough estimates of time, cost and resources for the project. The milestone schedule is built using the deliverables as a platform to identify major segments of work and an end date. IT should ne natural, important control points in the project and should be easy for all the project participants to recognize.

d) **Technical Requirements:** Technical requirements to complete the project successfully should be clearly spelt out.

e) **Limits and exclusions:** The limits of scope should be defined. Failure to define limits can lead to false expectations and to expending resources and time on the wrong problem. Exclusions further define the boundary of the project by starting what is not included.

f) **Reviews with customer:** Completion of the scope checklist ends with a review with the customer – internal and external. The main concern here is the understanding and agreement of expectations. The main concern is the understanding and agreement of expectations.

The above checklist is generic and different industries and companies will develop unique checklists and templates to fit their needs

and specific kinds of projects. Many projects suffer from scope creep, which is the tendency for the project scope to expand over time – usually by changing requirements, specifications, and priorities.

Step 2: Establishing Project Priorities

Quality and the ultimate success of a project are traditionally defined as meeting and/or exceeding the expectations of the customer and/or upper management in terms of cost (budget), time (schedule), and performance (scope) of the project. The interrelationship among these criteria varies. One of the primary jobs of a project manager is to manage the trade-offs among time, cost and performance. To do so, project managers must define and understand the nature of the priorities of the project. They need to have a candid discussion with the project customer and upper management to establish the relative importance of each criterion. One technique that is useful for this purpose is completing a priority matrix for the project that identifies which criterion is constrained, which should be enhanced and which can be accepted.

Constrain

The original parameter is fixed. The project must meet the completion date, specification and scope of the project or budget.

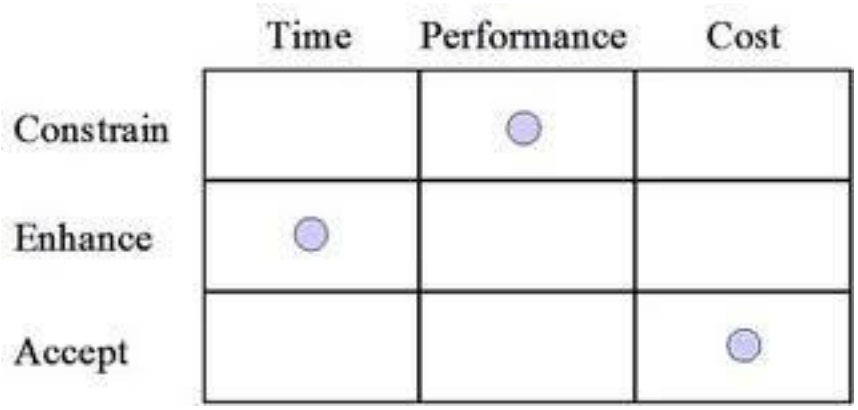
Enhance

Given the scope of the project, which criterion should be optimized? In case of time and cost, this means either reducing cost or shortening schedule. In case of performance, enhancement means adding value to the project.

Accept

When trade-offs have to be made, it will be decided which will be accepted like slipping of schedule or reduce the scope and performance or go over budget.

The following figure shows the project priority matrix in which performance is constrained with time optimization and cost overrun is accepted.



Project Priority Matrix

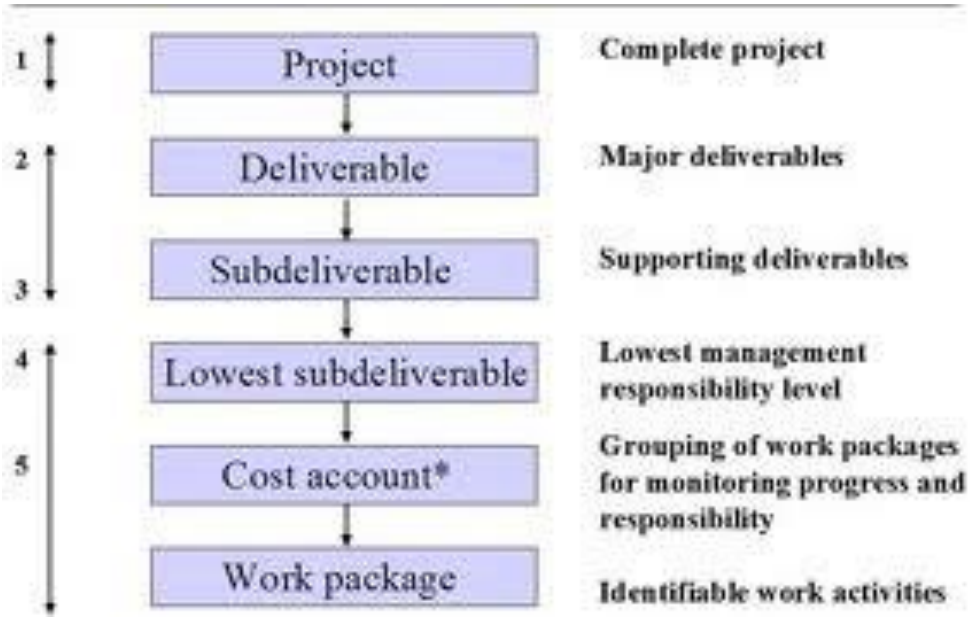
Step 3: Creating the Work Breakdown Structure

The Work Breakdown Structure (WBS) is a tree structure, which shows a subdivision of effort required to achieve an objective; for example a program, project, and contract. The WBS may be hardware, product, service, or process oriented. A WBS can be 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 WBS 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. Work Breakdown Structure (WBS) is defined by PMBOK Guide as: "A deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables." The following figure shows the hierarchical breakdown of the WBS.

Purpose for Creating a WBS for Projects

There are three reasons to use a WBS in your projects.

a) The first is that is helps more accurately and specifically define and organize the scope of the total project. The most common way this is done is by using a hierarchical tree structure. Each level of this structure breaks the project deliverables or objectives down to more specific and measurable chunks.



Hierarchical Breakdown of the WBS

b) The second reason for using a WBS in your projects is to help with assigning responsibilities, resource allocation, monitoring the project, and controlling the project. The WBS makes the deliverables more precise and concrete so that the project team knows exactly what has to be accomplished within each deliverable. This also allows for better estimating of cost, risk, and time because you can work from the smaller tasks back up to the level of the entire project.

c) Finally, it allows you double check all the deliverables' specifics with the stakeholders and make sure there is nothing missing or overlapping.

Process of Creating a WBS

There are several **inputs** you will need to get you off on the right foot:

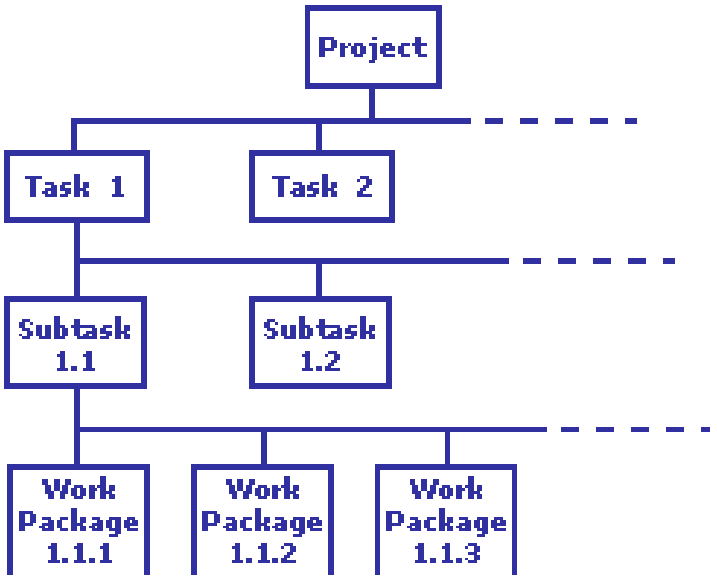
- The Project Scope Statement
- The Project Scope Management Plan
- Organizational Process Assets
- Approved Change Requests

These inputs should give you all the information you and your team needs to create your WBS. Along with these inputs, you will use

certain tools as well. Finally, using these inputs and tools you will create the following **outputs:**

- Work Breakdown Structure
- WBS Dictionary
- Scope Baseline
- Project Scope Statement (updates)
- Project Scope Management Plan (updates)
- Requested Changes

The first step to creating your WBS is to get all your team, and possibly key stakeholders, together in one room. Although your team is not listed as an input or tool in the above sections, they are probably your most vital asset to this process. Your team possesses all the expertise, experience, and creative thinking that will be needed to get down to the specifics of each deliverable. Next, we have to get the first two levels setup. The first level is the project title, and the second level is made up of all the deliverables for the project. At this stage it is important to function under the 100% Rule. This rule basically states that the WBS (specifically the first two levels) includes 100% of all the work defined in the project scope statement and management plan. Also, it must capture 100% of all the deliverables for the project including internal, external, and interim. In reality the WBS usually only captures between 90-95%, and 100% is our goal. The following diagram shows the WBS.



Work Breakdown Structure

Work Packages

Once we have completed the first two levels set, it is time to launch into our decomposition. Decomposition is the act of breaking down deliverables in to successively smaller chunks of work to be completed in order to achieve a level of work that can be both realistically managed by the project manager and completed within a given time frame by one or more team members. This level of breakdown and detail is called the **work package**. Work packages are the lowest level of the WBS and are pieces of work that are specifically assigned to one person or one team of people to be completed. This is also the level at which the project manager has to monitor all project work. Most project managers concur that the work package can usually be measured using the 8/80 Rule. The 8/80 Rule says that no work package should be less than 8 hours or greater than 80 hours.

Most Project Management Offices (PMOs) have basic **WBS templates** that can be used for starting. Another great technique to make project easier is the **Post-It Note** Technique. It actually works very well. In this technique you simply write each deliverable on a post-it note and stick them at the top of a wall. Then you and your team start to break down each deliverable into components and write each component on its own post-it note. This way, as you place them on the wall and start to create your tree structure, everyone can easily see what has been accomplished and where you are headed. Also this technique allows for easy movement of components around within the WBS.

Many projects will also find it necessary to create a **WBS Dictionary** to accompany their WBS. The WBS Dictionary is simply a document that describes each component in the WBS. This helps clarify any specifics later on when team members completing the work or stakeholders viewing the deliverables have questions. Also, when creating the WBS for very large, lengthy, or complex projects, all the deliverables' specifics might not be known up front and, therefore, it is difficult to create a full WBS. In cases such as these many people use what is called **Rolling Wave Planning**. This is when you plan down to the level of detail currently known and go back to plan deeper once more information is acquired. Usually rolling wave planning needs to stay as least 2-3 months ahead of the actual work being done, but of course this varies slightly by industry.

Pitfalls to Creating WBS

Let's understand the five common pitfalls in creating a WBS. If you can keep these few possible issues in mind when you are creating your WBS, you and your team will be much more successful at creating a useful and accurate Work Breakdown Structure.

- **Level of Work Package Detail:** When deciding how specific and detailed to make your work packages, you must be careful to not get too detailed. This will lead to the project manager to have to micromanage the project and eventually slow down project progress. On the other hand, work packages whose details are too broad or large become impossible for the project manager to manage as a whole.

- **Deliverables Not Activities or Tasks**: The WBS should containa list of broken down deliverables. In other words, what the customer/stakeholder will get when the project is complete. It is NOT a list of specific activities and tasks used to accomplish the deliverables. How the work is completed (tasks and activities) can vary and change throughout the project, but deliverables cannot without a change request, so you do not want to list activities and tasks in the WBS.

- **WBS is not a Plan or Schedule**: The WBS cannot be used as a replacement for the project plan or schedule. A WBS is not required to be created in any type of order or sequence. It is simply a visual breakdown of deliverables.

- **WBS Updates Require Change Control:** The WBS is a formal project document, and any changes to it require the use of the project change control process. Any changes to the WBS change the deliverables and, therefore, the scope of the project. This is an important point to help control scope creep.

- **WBS is not an Organizational Hierarchy**: The WBS and Organizational Hierarchy chart is never the same thing. Although often similar in appearance, these two documents are very different. The Organizational Hierarchy shows things like chain of command and lines of communication, but the WBS is restricted simply to a project and shows only the deliverables and scope of that project.

The WBS is an extremely valuable tool to the project management methodology. It can make or break a project. It sets the foundation for the rest of the project planning. A solid WBS helps ensure proper project baselines, estimating, resource use, scheduling, risk analysis, and procurement.

Step 4: Integrating the WBS with the organization

An integral part of WBS is to define the organizational units responsible for performing the work. In practice, the outcome of the process is the **organization breakdown structure (OBS).** The OBS depicts how the firm has organized to discharge work responsibility. The purpose of the OBS are to provide a framework to summarize organization unit work performance, identify organization units responsible for work packages and tie the organizational unit to cost control accounts. Cost accounts group similar work packages. The OBS defines the organization sub-deliverables in a hierarchical pattern in successively smaller and smaller units.

As in the WBS, the OBS assigns the lowest organizational unit the responsibility for work packages within a cost account. The intersection of work packages and the organizational unit creates a project control point (cost account) that integrates work and responsibility. Control can be checked from two directions – outcomes and responsibility. In the execution phase of the project, progress can be tracked vertically on deliverables (client's interest) and tracked horizontally by organizational responsibility (management's interest).

Step 5: Coding the WBS for the Information System

Coding system is very important to gain the maximum benefit of a work breakdown system. The codes are used to define levels and elements in the WBS, organization elements, work packages, budget and cost information. The codes allow reports to be consolidated at any level in the structure. The most commonly used scheme is numeric indention. Some organizations use alphabet letters and most of the organizations use the combination of both.

Project Roll-Up

The intersection of WBS and OBS represents a control point called cost account by project managers. The work packages and cost accounts serve as a database from which all other planning, scheduling and controlling processes are coordinated. Cost accounts include one or more work packages.

Each work package has time, budget, resource, responsibility and control points that can be used to track project progress. Starting with the work package, costs and resources can be rolled up into higher elements which are referred as project rollup. The ability to consolidate and integrate using the rollup process demonstrates the potential value of the WBS for managing the project.

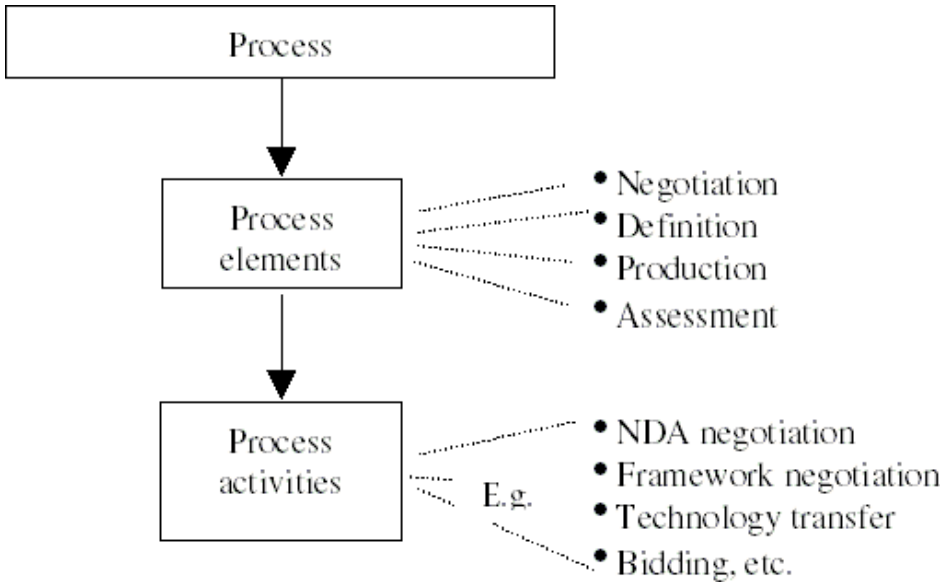
Role of Project Rollup in Identifying Project Cost and Schedule Problems

A project rollup is a very complete breakdown of a project's current status as it illustrates results in terms of deliverables, organizational units and cost accounts. This allows a project manager to quickly determine project status at all levels of WBS and Organizational Breakdown Structure.

Process Breakdown Structure

The WBS is best suited for design and builds projects that have tangible outcomes. The project can be decomposed or broken down into major deliverables, sub-deliverables, and further sub-deliverables and ultimately to work packages. It is more difficult to apply WBS to less tangible, process-oriented projects in which the final outcome is a project of a series of steps or phases.

Here, the difference is that the project evolves over time with each phase affecting the next phase. IT project typically fall in this category. Project projects are driven by performance requirements, not by plan/ blueprints. The following figure shows the process breakdown structure.



Process Breakdown Structure

Responsibility Matrix

A Responsibility Matrix (RM) describes the participation by various roles in completing tasks or deliverables for a project or business process. It is especially useful in clarifying roles and responsibilities in cross-functional/departmental projects and processes.

Role Distinction: There is a distinction between a role and individually identified people: a role is a descriptor of an associated set of tasks; may be performed by many people; and one person can perform many roles. For example, an organization may have 10 people who can perform the role of project manager, although traditionally each project only has one project manager at any one time; and a person who is able to perform the role of project manager may also be able to perform the role of business analyst.

Description of the Responsibility Matrix

Setting up a Responsibility Matrix is about establishing "what", "who", and level of participation. The following Figure, activities are listed on the rows and resources are in the columns and note that resources may be persons, roles, groups, or vendors.

	Resource 1	Resource 2	Resource 3	Resource 4
Activity 1				
Activity 2				
Activity 3				
Activity 4				

The intersection points are used to describe each resource's level of participation for the activity. The participation type codes are inserted in these cells. A legend is included to define the codes. The following figure shows the example of a Responsibility Matrix with Participation Codes.

	Person 1	Person 2	Person 3	Network Staff
Review Resumes		R	S	
Interview Applicants	I	R	S	
Hire Personnel	R	I		I
Purchase Equipment	A			R

R=Responsible, A=Approve, I=Inform, S=Support/Assist

As shown in the figure, resources might not have a participation type code for every activity. Every activity should have one resource designated as the one responsible for the activity.

Also, it is recommended that each role for each activity receive just one participation type code. When more than one code is used, it implies that resource's role has not yet been fully resolved, which can impede the value of this technique in clarifying the level of responsibility for the task.

Because the purpose of the matrix is to gain clarity and agreement on who does what, the columns and rows can be defined with as much detail as makes sense.

For example, a high-level RM can identify what project team group is responsible for each component of the work breakdown structure, while lower-level RMs can be used to designate the participation level of specific group members for specific activities.

RACI

There are a number of ways to create a Responsibility Matrix using different participation types. One common version is called the RACI matrix. **RACI** is an acronym derived from the four key responsibilities most typically used: Responsible, Accountable, Consulted and Informed. It is used to show the connections between work that needs to be done and project team members. This is a highly versatile tool that can be easily modified to suit multiple project needs. RMs can be developed at various levels of detail, from high to low. It can be used during any project phase, including the post-implementation support phase, and is especially useful when activities require coordination between several different groups, agencies, or vendors. Following Figure is a sample RACI chart.

Activity	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Investigate	R	A	I	C	C	
Design Software	I	A	C			R
Develop UAT Plan	R	A	I			C
Obtain Signoff	R	A	I	C	C	C

R=Responsible, A=Accountable, C=Consulted, I=Informed

Here is a detailed explanation of the participation types used in the RACI matrix:

- Responsible – The person or role who is assigned to achieve the task. There is only one resource given this category type. Others may be required to assist in the work but they are either given another participation code, such as Assist, or are not included as the RM may only list the key people for the activities.
- Accountable – This person or role must sign off on work that *Responsible* provides. They are ultimately accountable for the correct and thorough completion of the deliverable or task, and the one to whom *Responsible* is accountable. There **must** be only one *Accountable* specified for each task or deliverable.

- Consulted – Those whose opinions are sought and with whom there is two-way communication.
- Informed – Those who are kept up-to-date on progress, often only on completion of the task or deliverable, and with whom there is just one-way communication (informational only).

Following table is an example of a Responsibility Matrix for the development of project deliverables.

	Project Sponsor	Functional Manager	Project Manager	Project Team	Steering Committee
Project Definition	A	A	C	R	A
Communication Plan	A	R	C	R	A
Business Requirements	A	R	R	C	A
Status Reports	R	R	C	R	R

A=Approve, R=Review, C=Create

It lists the deliverables as activities and uses roles instead of specific individuals. It also uses different participation types that may be more appropriate for this activity.For this matrix, the participation codes used are:"A" means that the person (or role) approves the deliverable; "R" means that the person (or role) reviews the deliverable and "C" means that the person (or role) creates the deliverable. Usually there is only one person who is responsible for creating a deliverable, although many people may provide input. From the figure, it is clear that the Project Definition is created by the project manager; approved by the project sponsor, functional manager and the Steering Committee; and reviewed by the project team. The Business Requirements are created by the project team; reviewed by the project manager and the functional manager; and approved by the project sponsor and Steering Committee.

Developing a Responsibility Matrix (RM)

Step One: Define Your Deliverables

A Work Breakdown Structure (WBS) is a project planning tool used to break a project down into smaller, more manageable pieces

of work (deliverables). It's not a list of every task: rather, it's a "tree" structure showing the meaningful groups of activities that make up the main segments of the project.

Step Two: Identify the People Involved

Map out who is on your project team. By creating a chart of individuals who are available, you can then delegate work assignments based on expertise, and you can recruit talent that you're missing. This step is often called an "Organization Breakdown Structure" because it creates an organizational chart for your team.

Step Three: Create Your Responsibility Matrix

Draw a matrix. The deliverables are the column headings, and the people are the row titles. Determine responsibilities and levels of involvement for each item/person in your Work Breakdown Structure.

Step Four: Assign Roles

For each group responsible for an activity, assign roles and responsibility.

Step Five: Communicate

When your Responsibility Assignment Matrix is complete, communicate it to all stakeholders. It's a good idea to post it in an area where people will see it. Used effectively, the RM helps people understand what they should be doing at all stages of the project..

Project Delays (Overruns)

The project delays happen when they take more time than what is estimated and it is called as time overrun. You may recall, this phenomenon is referred in the first unit as white elephants, i.e., most of the government projects are time overrun. When projects are time overrun (i.e., delayed), cost overrun will be the result. Cost overrun happen when the projects consumer more resources than what is estimated. It is natural when the projects are delayed, more resources, in terms of material, money, manpower, will be required and thus, the cost overruns happen.

Let us understand the external causes and internal constraints of project delays.

External Causes of Delay

There are several reasons, including socio-political, economic, technological, macro and micro-global reasons, for the delay of several projects according to the response of several project managers. Professional project managers need to identify the real reasons in order to prevent such delays in future. Some illustrative, not exhaustive, causes of delay are given below, categorized external and internal.

The external causes arise due to the following reasons:global and macro-level government policies influenced by social, economic, political, regional or global pressures affecting currency fluctuations, trade relations, foreign aid, etc. Typical examples: Indo-China confrontation, Indo-Pakistan disputes, Arab-Israel crises, Iran-Iraq war, Gulf crises, etc., Kudremuk Iron-ore project and gas-based fertilizers are typical instances of such projects.

The external factors include uncontrollable factors, such as:

- Government policies
- Import regulations
- Panic taxation
- Resource constraints
- Defense expenditure
- Political situation
- Inflation
- Non-development expenditure
- Budgetary deficits
- Economic stagnation
- Natural disasters, like earthquakes, floods, etc.
- Labour unrest
- Law and order problems
- Social turmoil like terrorists' menace, communal vandalism, etc.
- Unscheduled mid-term elections

- Global recession, or unrest, and
- Interference from unexpected quarters.

Internal Constraints

The internal constraints, which can be anticipated, planned and controlled relate to the programmes and policies of the company. Some of the important causes for such restraints are listed below. These can be broadly classified into *people, funds*, and *organisation*. The corporate culture and the style of leadership are the key areas, as the project manager is not appointed at the conception of the project and is, therefore, not totally involved in the formulation of objectives. Sufficient authority is not delegated to the project team because it does not have the total confidence of the top management, and has to refer to the headquarters very often. The other internal constraints may be listed as under:

- Inappropriate choice of site
- Disputes with local agencies
- Inadequacy of foreign collaboration agreements
- Monopoly of technology
- Technical incompetence
- Lack of skilled workers
- Inadequate project planning preparation
- Change of scope because of government regulations
- Resource constraints because of limitation of funds
- Vendor delivery problems
- Inferior quality of materials
- Foreign exchange curbs
- Lack of infrastructure of water and electricity
- Low motivation of the project team for want of job-guarantee after completion
- Inadequacy of basic conceptual and technical inputs
- Zero date not being specified
- Lack of coordination/cohesion between team members
- Frequent transfers of the project manager and other key personnel
- Late clearance of project schedules by different agencies

- Price escalation because of change in exchange rates
- Delay in obtaining import licences
- Inadequate or improper liaison with customs, excise, sales tax, police, octroi, etc.,
- Poor monitoring and control, and
- Infrequent monitoring and review amongst members and contractors

The causes of delay can be summarised as being due to site-selection, technology-choice, vendor difficulties, transport bottlenecks, labour, resistance from local and government authorities, lack of infrastructure and political turbulence. Other causes include the following:

- Delays in receiving information on changes, clarifications, etc., finalising tenders, modifications, rework, and inspection results
- Unavoidable statutory controls
- Over ambitious scheduling targets
- Frequent changes in design, and technological up gradation that hold-up project execution
- Inadequate consideration of the choice of technology and design at planning and development stages
- Weak monitoring and control
- Not being equipped with *force majeure* to operate in contingencies
- Resistance to the use of innovative techniques and management principles
- Allowing project duration to expand, leading to improper resource allocation and increased costs, and
- Inability to distinguish between critical and non-critical activities, and inadequate monitoring

Self Assessment Questions

1) Define 'Project'. What are its characteristics and elements?
2) Explain the stages in project life cycle.
3) Explain the classification of projects on various bases.

4) What is project management?
5) Explain the importance of project management.
6) Explain the integrated approach to project management.
7) What is project portfolio management system?
8) Explain the need for project portfolio management system.
9) Explain the design of project portfolio management system.
10) What is pipeline management?
11) Write short notes on
    a) White elephants
    b) Pearls
    c) Oysters
    d) bread and butter projects
12) Explain the various organization structure used in managing projects.
13) How to manage projects in functional organizations?
14) How to manage projects within matrix structure?
15) Explain the various forms of matrix organizational structure for managing projects.
16) How to manage projects in networked structure?
17) How to manage projects using dedicated project teams?
18) Explain the considerations used while choosing appropriate project management structure.
19) Explain the options available for project management office structure.
20) Explain the steps in defining project.
21) What is work breakdown structure?
22) What are work packages?
23) Explain the process of creating work breakdown structure.
24) Explain the pitfalls to work breakdown structure.
25) What is responsibility matrix?
26) Explain the steps in developing the responsibility matrix.
27) What is project roll up?
28) What are project overruns?
29) What is time overrun?

30) What is cost overrun?

31) What are white elephants?

32) Explain the external causes of project delays.

33) Explain the internal constraints of project delays.

CASE STUDY
AmeriHealth Mercy Driving Results and Increasing Competitive Advantage

Through Organization Project Management

In 2007, the AmeriHealth Mercy Family of Companies sought to improve its ability to systematically deliver its strategy. Facing new competition in the managed health care industry and facing substantial changes due to federal health care reform, the organization determined that its existing results could not sustain the growth needed to face an increasingly competitive landscape. The new Project Management Organisation (PMO) director, Ruth Anne Guerrero, was familiar with the concept of organization project management (OPM) and determined that the OPM approach would serve as a roadmap for advancing the organization. In September 2008, under Guerrero's direction, AmeriHealth Mercy conducted an Organization Project Management Maturity Model (OPM3)® assessment in conjunction with Project Management Institute (PMI). The assessment helped the organization map its existing organization project management capabilities and identify improvements that needed to be made in order for the organization to further improve business performance. OPM3 is a global best practice standard used to measure and improve an organization's ability to deliver its strategy with the use of program, portfolio and project management. Created by PMI, OPM3 assessments compare the existing capabilities of the organization to the best practices of organization project management. Once the team understood the results of the AmeriHealth Mercy 2008 OPM3 assessment, the PMO immediately built an improvement plan to implement the changes that were most important to the organization. Using a building block approach, the PMO developed a high-level plan that detailed, quarter by quarter, the expected accomplishments. The AmeriHealth Mercy Family of Companies strives to continue to grow, support operations and

invest in its people. That's what drives us," says Ms. Guerrero. She adds, "Since we've made the right investments to improve organization project management, we've seen the company meet its strategic and operating plans. The benefits that we're reaping from the enhanced PMO are being used to fund additional project work, including future improvements. The PMO has truly become a strategic operations center for the organization. According to Joanne McFall, Chief of Staff for AmeriHealth Mercy's Chief Operation Officer, "Our success in achieving our strategic goals is directly linked to the effectiveness of our overall portfolio management function. By continuing to enhance our use of organization project management practices, we expect to see even greater benefits in future years." Analyse the importance of PMO.

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UNIT - II

The pre-investment phase is a crucial phase where a series of studies and investigation, starting with the project idea and progressively leading to elaborate examination of all relevant details are undertaken before the decision is taken to proceed with the implementation of the project. These studies follow the successive stages given below:

- Preliminary, initial or opportunity studies;
- Intermediate or pre-feasibility studies; and
- Ultimate or techno-economic feasibility studies.

While carrying out the above studies, with progressive increase in depth, detail and analysis, a number of supporting or functional studies should be undertaken, depending upon the nature of the project. Let us learn about these studies in this unit.

Unit Structure

Lesson 2.1 - Various Stages and Components of Project Feasibility Studies

Learning Objectives

- To know about opportunity studies.
- To know about pre-feasibility studies.
- To know about the functional or support studies.
- To understand the components of techno-economic feasibility studies.
- To know about the detailed project report

Introduction

The various stages in the project feasibility studies include

a) Opportunity studies
b) Pre-feasibility studies
c) Techno-economic feasibility studies

Let us know the details of opportunity studies and pre-feasibility studies in this lesson.

Opportunity Studies

Identifying suitable opportunities for investment is an intricate and involved exercise in developing countries. A variety of constraints, complexities, risks and uncertainties have to be reckoned with, and their implications on the project implementation and its subsequent success in the operational phase have to be carefully and thoroughly examined before the resources are committed. Efforts in identifying these opportunities pursued at different levels. The enterprise management is expected to take all initiative to convince itself about the prospects of the project that it wishes to launch.

Governmental agencies, development financial institutions and other industrial promotion or development corporations are also continuously engaged in identifying worthwhile investment opportunities. For instance, the Industrial and Technical Consultancy Organization of Tamil Nadu Ltd. (ITCOT), a joint venture of national and state level financial institutions, has brought out a collection of papers presented by various central research laboratories and other technology information and financing sources, at two technology seminars, and a guide book, providing information on technology and project opportunities.

Where national economic planning is a fairly organized effort, the planning process spell out national and state priorities for development and investment, and also provides the relevant economic and other indicators. The promoters or concerned entrepreneurs can then make their choices from among the priority sectors or probable production gaps in commercially attractive areas. The opportunity studies help in spotting investment opportunities or project ideas, which can be subjected to further detailed scrutiny, if initially found viable. For this preliminary assessment, a quick analysis of the following aspects is necessary:

- Availability of requisite natural resources suitable for processing and manufacture;
- The pattern of agricultural activity and scope for agro-based industries;
- Categories of consumer products that have prospects of growing demand in response to population growth or improvements in standard of living;
- Scope and areas for import substitution;
- Manufacturing lines that have been found to be successful by other entrepreneurs;
- Possible inter linkages with other industries in the country or abroad;
- Scope for forward or backward integration with existing activities of the enterprise;
- Scope for diversification into related lines;
- Scope for expansion of existing capacity for achieving economies of scale or for maintaining or improving market share;

- The prevailing and expected investment climate in the country;
- The industrial policies in vogue;
- The availability and the cost aspects of factors of production;
- Opportunities for export.

Broad indications on these and other relevant aspects are obtained with the help of the preliminary studies. These rely on aggregate estimates that are readily available. Rough cost data are obtained from comparable projects, if any, or are estimated in broad terms.

The opportunity studies can be general or specific in nature.

a) General Opportunity Studies

The government and development institutions carry out these general studies for the benefit of potential investors. These general studies could be:

Area Studies

Identifying locations that require development and investment initiatives, such as backward areas, export zones, etc.

Sub-Sectoral Studies

The focus of attention being sub sectoral areas, such as consumer durables, construction materials, etc.

Resource-Based Studies

These involve a survey of the availability of natural resources that can be processed for making immediate or final products.

b) Specific Project Opportunity Studies

After identification of general investment opportunities, whereby products that have potential for domestic manufacture get noted, the next step is to prepare an investment profile for the chosen line. Industrial

promotion and development agencies often provide this information for prospective investors. The Gujarat Industrial Development Corporation, the Gujarat Industrial Investment Corporation and the Gujarat State Financial Corporation have an appreciable degree of coordination in extending all assistance to prospective investors, in terms of information on available locations, market situation, infrastructural facilities, etc. and help in launching projects.

The specific opportunity study enables the project idea to graduate into an investment proposition. Government policies, incentives and other supports are aspects on which information would be needed as they have a bearing on the profitable functioning of the project. A broad investment profile should be an output of the study, in order to elicit investor response. Since the study confines itself to aggregates and summary data for a quick understanding of the investment prospects, it should not be very expensive. At a moderate cost it should be possible to get the salient facts.

Pre-Feasibility Studies

The project idea requires to be expanded with the help of a more detailed examination of all relevant information, as also by gathering additional essential information. A thorough techno-economic feasibility study is very expensive and there is need to be convinced about the worth of launching such an elaborate and costly exercise. The pre-feasibility study is thus an intermediate effort, following the identification of a project idea, to determine whether the proposal deserves to be pursued further for project formulation and implementation. The following aspects come for consideration at this stage.

- Whether, on the basis of the elaborate information obtained during the pre-feasibility study, the investment prospect is promising enough to be processed into an investment decision.
- Whether, in the light of the information obtained, it is found justifiable to go for a very comprehensive scrutiny and analysis of the project prospects.
- There could be some critical aspects pertaining to the specific project idea which require a very thorough examination and in

depth analysis, through further support or functional studies. Market surveys may be necessary, or laboratory tests may have to be carried out to establish the attributes that the product is claimed to possess. The production process may have to be tried out through pilot plant tests.

- The outcome of the pre-feasibility study might also be the realization that the project idea is not with pursuing further.

The conversion of the project idea into a commercial reality could possibly be achieved through a variety of choices in terms of plant size, location, technology, product mix, marketing approaches, etc. Before the ultimate feasibility study is taken up, there should be clarity about the choices from among these possibilities or alternatives. Alternatives will have to be considered in respect of the following:

Market size and plant capacity: The market scope and size have to be assessed, taking note of the prevailing and prospective demand. The sales organization, the marketing network and distribution channels that will be appropriate, the plant capacity to be installed and the production processes to be adopted are all aspects on which a reasonable degree of clarity is needed before the feasibility study can be taken up.

Material inputs: the raw materials and other critical stores items that are needed and the alternatives or substitutes in respect thereof, the different sources for their procurement and the related economics of purchase should be examined and suitable options chosen.

Location and site: Alternative locations available with adequate infrastructure facilities, or with proximity to supplies of materials or to the markets for outputs have to be considered and a proper choice made.

Project engineering: Technology and equipment sources have to be identified and compared before a decision is taken. Their suitability to the local or domestic conditions have to be examined carefully and the availability of requisite skills for their proper maintenance to be ensured.

Overheads: The organization structure will determine the nature and amount of overheads to be incurred in respect of manufacturing, selling and administrative functions. Building and equipment layout, the

choice of having a sales network or distributing through wholesale outlets, etc. are aspects on which, at least. Tentative decisions should be taken to guide the feasibility study.

Manpower: Ready availability of semi-skilled and skilled labour as also casual or unskilled labour, competent and qualified supervisory and general staff, the training facilities that are needed and related matters need to be considered and appropriate choices made.

Project implementation: Whether the implementation will be departmentally carried out or whether it will be entrusted entirely to specialist contractors are questions that have to be resolved at the pre-feasibility stage.

Financial analysis: Fairly reliable, though aggregate, estimates have to be made on the capital costs of equipment, buildings, etc, and on the choices from among alternative sources or modes of financing the project. Reliable assessment of costs and revenues during operating phase will have to be made at this stage and the profitability examined.

Where the investment possibilities and prospects are widely known to be good, because of the nature of the product or very favourable market factors, there may be no need for a pre-feasibility study. Even in such instances, in order to decide on the location, size, etc., there may be a need for pre-feasibility studies on related aspects, by way of functional or support studies, before the eventual decision on investment is taken.

Functional Studies or Support Studies

These are confined to selected aspects of the project being contemplated, and may be found necessary by way of support for pre-feasibility or feasibility studies, particularly in the case of large projects with multi-division, multi-product characteristics. The following types of studies are found to be common:

Market studies: The thrust is on examining the market prospects of the products proposed to be manufactured. Demand estimates have to be prepared and, in addition, scope for market penetration or creation of a new demand through suitable market strategies have to be assessed.

Materials input studies: The ready availability of raw materials and other essential inputs has to be examined, and reliable sources for these supplies have to be identified. Need for developing proximate sources of supply for critical items or components through vendor development initiatives have to be assessed, as this would involve additional project outlays. The prevailing and anticipated price trends for these items have also to be studied.

Location studies: Where transportation costs are high in relation to the high volume, low cost raw material requirements (or finished products), or where transport bottlenecks pose major constraints; location becomes a critical decision factor, and special studies may be required to arrive at optimal decision in this regard.

Capacity studies: Technology choice is often motivated by the expectation of reaping economies of scale. But these will have to be established with reference to the market conditions, infrastructure facilities available, government policies on duties and levies, and the inflation effects on equipment and other major input costs. Researchers on costs and prices of manufactured products have questioned the belief that higher volume or capacity means lower cost per unit. The impact of inflation on capital costs and costs of operational inputs have had the effect of cancelling out the benefits that are expected to result from larger size. Switching to high–capacity plants in cement and fertilizers has not yielded us the benefit of lower unit costs. It is also likely that different technologies have different optimal capacities, and comparative studies of capacities and costs specific to these technology alternatives are essential before specific is taken.

Equipment selection studies: Very large projects with multiple divisions and products have to procure equipment from diverse sources. Certain common services like central tool room or common annealing, heat treatment, plating, metallurgical testing and other services can be planned, if found feasible, with substantial savings on capital costs. These possibilities have to be examined through special studies.

Laboratory and pilot plant tests: To prove the suitability of raw materials or components or processes, laboratory tests or pilot plant tests may have to be resorted to.

The functional or support are investigative in nature, with reference to the specific areas of scrutiny and the conclusions there from provide clear guidance for proceeding with the subsequent stages of project preparation. The support studies can precede or follow a pre-feasibility study or a feasibility study. It is the outcome of the felt need to examine, in depth, certain aspects that are found to be critical, calling for closer investigation. Such requirements may arise even after feasibility studies have been completed.

Components of Project Feasibility Studies

Introduction

The United Nations Industrial Development Organization (UNIDO) has published in the *Manual for the Preparation of Industrial Feasibility Studies* to help the standardization of industrial feasibility studies, which have often found to be incomplete and inadequately prepared. It will be useful to trace the components, or contents, of the feasibility studies through the framework provided by UNIDO.

Components of Techno-Economic Feasibility Studies

Following are the contents of techno-economic feasibility studies:

(a) Project background and history
(b) Demand and market study
(c) Demand projections
(d) Forecasting techniques
(e) Export projections
(f) Market penetration
(g) Sensitivity analysis
(h) Sales forecast and marketing
(i) Production programme
(j) Plant capacity
(k) Materials and inputs
(l) Supply programme
(m) Project location

(n) Plant site, within the location

(o) Local conditions

(p) Layout and physical coverage of project

(q) Technology and equipment

(r) Civil engineering

(s) Plant organization

(t) Overhead costs

(u) Labour

(v) Staff

(w) Implementation scheduling

(x) Financial evaluation

(y) Economic evaluation

a) Executive Summary

The feasibility study, being the final scrutiny, analysis, and projections prior to the decision to commit resources, has to provide definite conclusions on all basic issues of the project. In the course of the project opportunity study and the prefeasibility study, various alternatives would have been considered and precise decisions would have been arrived at on critical aspects such as location, capacity, technology, etc. The summary of the conclusions and recommendations should be provided in the form of an executive summary to facilitate a quick grasp of the essentials of the project. The table of contents in feasibility study given above provides the sequence of presentation of information. On each aspect, a brief write-up on the essential information should be given. At the end of the technical, operational and financial data, the major advantages of the project, the major drawbacks of the project and the prospects of implementing the project should be highlighted.

b) Project Background and History

The success of any project is dependent, among other things, on its consonance with the country's economic setting and its state of industrial development. The economic, industrial, financial and other relevant policies should be briefly described. There should also be information on the project promoters or sponsors and the reasons for their specific

interest in the project. The nature of preliminary and subsequent studies that have proceeded from the feasibility study should be mentioned, giving the highlights and the costs incurred.

c) Demand and Market Study

After identifying the data requirements of the demand and market study, an appropriate method of data collection and evaluation will have to be chosen from among the alternative approaches available. Then the demand and market size for the products, and by-products, if any, will have to be determined and projected for the life time of the project. Estimations about the extent of market penetration by products should also be given.The proposed sales programme has to be spelt out, indicating the progress expected during the project life. The marketing strategy that has been chosen should be elaborated, presenting its rationale. Information on product pricing, promotional efforts planned, the proposed pattern of organization structure for distribution and sales, and decisions on the discounts and commissions on sales, and the extent and nature of after sales services intended to be provided should be given.

Estimated revenue from sales and the estimated costs of marketing and distribution need to be shown. Taking note of the policy on stocks of finished goods to be maintained, the production programme will have to be drawn up. Details that go into these computations include the inventory requirements, plant capacity factors, quality specifications, annual production targets, wastes and effluents, and the costs related thereto.

In developing countries, where the projects are geared to import substitution, the secondary or published data on imports and consumptions provides near-total information on the market demand for the concerned products. But in the case of the other categories of products, the secondary data may not be adequate, and it may be necessary to generate a fair amount of primary data. This could mean additional costs on preliminary and support studies.

The projected sales and income are critical factors affecting the viability of the project. Optimistic estimates may help launching a project sooner, but it is an act of self-deception, as the ambitious assumptions fail

to materialize and the project slides down to disaster. We have innumerable examples of such projects that had looked splendid paper, but could either produce the quantities promised, or failed to find the market anticipated.

The demand analysis should aim at providing the following essential information:

- The geographical boundaries of the market for the product and the size and composition of the present demand.
- The market segments in terms of a) The end use (e.g. consumers); b) Consumer groups (e.g. high income, middle income); and c) Geographical division (e.g. regional, national, foreign);
- Demand projections of the overall market and of its segments, covering, say, a ten year period of project life;
- The market share that the project is likely to achieve, taking note of the anticipated trends in domestic and international competition and shifts in consumer needs or preferences.
- The pricing structure that is being adopted which is the basis for the expectations of market penetrations.

d) Demand Projections

Demand projections should take note of domestic potential as also export possibilities. These projections should cover the following aspects:

- The estimate of the potential demand for the product or products;
- The estimates of the potential supplies;
- The degree of market penetration that the project is expected to achieve.

While projecting domestic demand, the following logical steps are involved:

- Gather and analyze available information on current consumption and the rate of changes in the past;
- Classify such consumption data by market segments;

- Identify the major factors that have influenced past demand, and assess the extent of their influence;
- Project the expected impact of these factors on future demand; and
- Forecast the demand through extrapolation of the influencing factors.

Growth in demand for consumer products may be linked to expected increase in income levels. But if the chances are that inflation or hikes in taxes will overtake the income rises, the demand growth may not occur, or even if it does, it may be marginal. Population growth is another factor that is equally relevant. A careful assessment of the counteracting influences of these factors is a precondition for purposeful demand projections.

e) Forecasting Techniques

There are different forecasting techniques that can be adopted and an appropriate choice has to be made depending on the nature of the products and markets. The demand forecasting techniques that are normally used are:

- The trend method, also referred to as extrapolation method;
- The consumption level method (taking note of the income and price elasticities of demand);
- The end–use method, also known as the consumption coefficient method;
- The leading indicator method;
- Regression models;
- Market survey

f) Exports Projections

The information requirements for assessing export market potential are:

- The present volume of export of the product or products;
- The unit export prices for these products;
- Countries to which these products have been, or are being, exported;

- Special aspects concerning these products, such as quality stipulations, special selling arrangements, etc.
- Other countries with export assistance or export incentive provided by the home country, and the prospects of their being continued or improved.
- Risk of violent shifts in demand due to rapid technological changes, or changes in political situations.

g) Market Penetration

The market penetration that the proposed product can achieve is assessed with reference to the following factors:

- The degree of domestic and/or foreign competition;
- The consumer preferences or responses; and
- The scope for substitution that exists, or might develop.

There are also strategic levers that can be employed for achieving market penetration. These include:

- Product quality;
- Packaging;
- Marketing and distribution methods, and;
- The after-sales services provided.

h) Sensitivity Analysis

There are bound to be a large number of assumptions on a variety of aspects relating to the project. These assumptions can get vitiated by unpredictable events or there could be inadequacies or inherent errors in the project data inputs. The common deviations that occur are:

- Errors in the base data;
- An analysis based on inadequate data;
- Unforeseen economic and socio-political developments;
- Certain essential parameters being overlooked or some relevant factors and relationships being unknown or being suppressed;

- Unrealistic assumptions being made with no proper justifications;
- Rapid technical and technological changes.

The projections also have to reckon with a number of uncertainties. Among them are:

- Unpredictable shifts in the rates of increase of national and per capita incomes;
- Emergence or disappearance of a dominant competitor;
- Changes in transportation costs;
- Trade agreements within trade blocks;
- Introduction of new sources of raw materials or substitutes;
- Changes in tariff policies;
- New application possibilities for the product.

To reduce the uncertainties from these diverse possibilities to a minimum, statistical sensitivity analysis provides a systematic approach. This technique can be used to assess the impact on costs and revenue, when the factors influencing demand turn out to be less or more favorable to demand than was assumed. Where the sensitivity analysis has to take note of a combination of changes of different factors, computer facilities can be employed with advantage to provide a range of forecasts in the categories, pessimistic and realistic.

i) Sales Forecast and Marketing

The demand analysis gets transformed into sales forecasts. Simultaneously, decisions are taken on the modes of distribution, market promotion strategy, pricing strategy etc. Analysis of sales and sales income is thus a follow–up of market study and demand analysis. The specific sales volumes, product by product, for the periods of the operating phase has to be projected and the corresponding sales income estimated.

Volume of production and sales have a critical bearing on the production and selling costs and, therefore, these estimates have to be carefully prepared, after considering possible interruptions, delays, etc. that affects production volume. Choice of promotional methods and distribution systems, have significant implications for product costs and

these have to be clearly defined and properly estimated. It is not uncommon to come across project estimates where the sales quantities and prices are overstated thereby boosting up the revenues, intentionally or otherwise.

j) Production Programme

Having arrived at the sales projections for the different stages of production in the operating phase of the project, the feasibility study should spell out the detailed production programme. The levels of output and capacity utilization during the specified periods should be clearly indicated. Within the available plant capacity, the levels of output can vary substantially, from time to time, for a variety of reasons, and prepare the materials flow diagram to show the materials and utilities balances at various stages of production. The costs on inputs have to be worked out in detail for the different categories. The production programme provides the basis on which the cash flow projections for the production periods can be drawn up.

k) Plant Capacity

For determination of costs and revenues, the assumptions on plant capacity are very critical. The UNIDO manual defines two capacity terms, as below:

Feasible Normal Capacity

This represents the capacity that is achievable under normal working conditions taking into account not only the installed equipment and technical conditions of the plant, such as normal stoppages, downtime, holidays, maintenance, tool changes, desired shift patterns and indivisibilities of major machines to be combines, but also the management system applied. Thus, the feasible normal capacity is the number of units produced during one year under the above conditions. This capacity figure should correspond to the demand figure derived from the market study.

Nominal Maximum Capacity

This is technically feasible capacity and frequently corresponds to the installed capacity as guaranteed by the supplier of the plant. To

reach maximum output figure, overtime as well as excessive consumption of factory supplies, utilities, spare parts, and wear and tear, will inflate the normal level of production costs. With reference to the nature of operations, technology and also the resource and input constraints, the feasible normal plant capacity has to be determined and the production costs computed on that basis.

Matching Projected Sales and Plant Capacity

In the case of products that have rapid growth potential, the initial production capacity should be higher than the initial demand and sales so as to be able to cover subsequent demand growth. Care should, however, be taken to see that the planned underutilization of capacity does not fall below the break-even level. Where expansion can be taken up fast to meet the demand growth, the initial production should match the demand and creation of idle capacity should be avoided. In keeping with the feasible normal capacity selected, the input requirements of materials, manpower, services, etc. should be worked out in detail.

l) Materials and Inputs

As for the requirements of material and other inputs, detailed information has to be provided about their nature, quantities, sources of procurement, and their costs. Materials and inputs can be classified into:

- Raw materials;
- Processed industrial materials (intermediates or components);
- Manufactured (subassemblies):
- Auxiliary materials;
- Factory supplies;
- Utilities.

The major items of materials have to be described, mentioning possible alternatives, and justifying the selection. Information should also be provided on their qualitative aspects and quantities available, sources of supplies, and the prevailing and projected costs.

m) Supply Programme

The procurement plan should be linked to the anticipated production and inventory levels and the annual costs of consumption determined for the classified groups of materials and inputs. The utilities required have to be assessed in detail, taking note of the location, technology, and plant capacity. Their availability and proximity of sources of supply are critical for the success of the project. Supply programmes for these should also be drawn up. The general tendency is to take utilities or off-site facilities for granted, and underestimate their significance, time frame for installation and costs. Electricity, water, steam, compressed air, fuel and effluent disposal are project components that require planned and detailed attention o avert project cost and time overruns and to avoid capacity constraints during the operating phase for want of support services.

n) Location

Specific requirements that the locations have to fulfill for smooth plant operations have to be spelt out. Alternatives locations that are likely to be suitable should be identified. The reasons for the choice of the optimal location from among considered alternatives should be substantiated.

o) Plant Site

Choice of site, in a given location, for erecting the plant involves selection from available alternatives, with due consideration for the terrain, transport facilities, water supply, power supply, manpower availability, etc. Site preparation and development, in some instances, can be a very expensive proposition and this aspect has to be assessed carefully. The cost estimates should take note of the magnitude of work involved in preparing the site for plant erection.

p) Local Conditions

A good understanding if the local conditions in terms of infra-structure and socio-economic environment is very essential and the rel-evant information has to be gathered for the feasibility study. Infrastruc-tural investment is a very essential precondition for the operation of any

project. It is interesting to note that some of the State Industrial Development Corporations, that build international estates and invite promoters to set up units, work on the premise that it is sufficient of the land for the factory structure is made available initially and that the infrastructure facilities such as roads, water, drainage, transports, etc., can be developed in due course as the number of units in the estate increases. The consequence has been that the earlier units in these industrial estates were starved of essential infrastructure facilities and had to struggle for survival.

The socio-economic environment is another factor that has to be considered. Waste disposal, if not properly organized, will pose an environmental hazard and it is essential that the location study determines the extent of effluents and the possible manner of disposal in the locational alternatives under consideration. There are State legislations on effluent disposal, and the required investments for effluent treatment and disposal have to be planned and incorporated in the project estimates.

q) Layout and Physical Coverage of the Project

Just as it is important to determine the composition and cost of equipment, materials, services, land, etc., in great detail, it is also necessary to consider the requirements or structures and civil works for the considerable construction and erection work that has to be undertaken during project implantation. Such constructions/erections have to be defined and their costs estimates prepared.

Project layouts have to be determined with reference to:

- The production programme;
- The procurement programme for materials, supplies and services;
- The technology chosen;
- The equipment selected;
- The civil work involved; and
- Significant factors, if any, with reference to the local conditions.

Alternative project layouts should be considered, and the optimal layout chosen. To highlight the scope of the project and project components, the physical layout drawings have to be drawn up.

r) Technology and Equipment

The feasibility study should also describe the technologies considered and the rationale for the ultimate choice of technology. The costs of technology in terms of investments, or lump sum payment of technology fees, or royalty or annualized payments have to be determined and detailed. Equipment have to be categorized as belonging to the production, infrastructure or other categories, the basis of their choice elaborated and their costs estimated, with appropriate details of quantities and rates.

s) Civil Engineering

Civil engineering includes the creation of manufacturing facilities required for the project. Proper blue print of the infrastructure required for the project should be created.

t) Plant Organization

Organizational planning is as important as project engineering. Effective implantation is difficult if the organizational structure is vague; there is likely to be overlap of functions and duplication of responsibilities, causing delays and interruptions in project construction. The consequences are cost and time overruns. There should be a proper grasp of the types of operations involved and the nature of services required for achieving the production objective. Production cost centers and service cost centers should be identified and defined in the organizational framework. Similarly, administration and finance cost centers should also be incorporated in the structure.

u) Overhead Costs

If the plant is organized into production, service and administrative cost centres,it should be possible to obtain realistic assessment of overhead costs. The tendency is generally, is to calculate overhead as percentage surcharge on material cost, or on direct labor cost, or on the sum of the two. This is too broad an approximation and is inadequate for a proper assessment of project feasibility.The cost items accruing in the different production, service and other cost centers should be identified, listed

and the expenditure under the individual items estimated. Depreciation charges and financing cost should also be duly reckoned.

v) Labour

After deciding on the projected production capacity and the layout, process, etc. The requisite personnel at various levels of operations have to be assessed. The cost of recruitment, training, employment, and promotions have to be estimated and reckoned for working out the economics of the project.

Keeping the organizational layout in view, the labour requirements in the skilled, semi-skilled and unskilled categories have to be assessed, and the availability of work-force in the required categories are examined. Depending on the number of production and service cost centers and the organization pattern of the selling and the distribution functions, the man-power inventory should be planned, and grouped into direct and indirect categories. The corresponding rates of wages and salaries and perquisites have to be worked out in detail and the direct and indirect labour costs and variable and fixed costs classifications identified and projected an-nually, for the project period. Training and other personnel related costs, such as provident fund contributions welfare expenditure commitments, etc., also have to be estimated, year by year, for the project period.

w) Staff

Lack of qualified and competent supervisory and managerial staff has very often been a major handicap for many a project. Advance planning and action is necessary to determine the manpower needs for supervisory and managerial positions, for the proposed organization structure and plant layout, and for requiting, inducting and training the key personnel in order to ensure smooth and efficient operations from the commencement of commercial production. While determining the manpower requirements during the production phase, the necessity to requite operators and managerial staff for certain operations and functions, well in advance, for training and familiarization with technology and related aspects even during the construction stage should not be overlooked. At the same time,the size of such workforce and stuff should be optimal, in order to avoid excessive pre-production costs.

Where foreign collaboration is involved is involved, the commitments on foreign experts as per agreed terms and the cost of training of selected employees at the collaborator's plant have to be duly reckoned and included in the estimates. The arrangements for training should not be confined to preproduction phase, but should be planned and organized even during the operation phase, since the upgrading of skills and management development is a continuous process.

x) Implementation Scheduling

The implementation phase commences from the time the decision to invest is taken, and extends upto commencement of commercial production. From the process plant initial concept, it proceeds through the stages of design, quotations, bid analysis orders and site contracts, scope variations work completion and startup. If these stages are not properly planned and managed, delays omissions and commissions will proliferate and cause avoidable and substantial cost and time overruns. Planning and executing project construction is no less important than planning and procuring equipment, facilities and services.

The feasibility study should spell out the project implementation programme and time schedule and describe the proposed action plans and time frames for acquisition of technology, detailed engineering of equipment, tendering, evaluation of bids and awards of contact thereof. Similarly, the arrangements for financing for project construction and the stages in which will be organized to be available for smooth flow of project work, the arrangements for phased recruitment of personnel at different levels for varying functions, for necessary and timely sanctions or approvals, clearances, etc., from the government, financial institutions or other agencies, for procurement of supplies and for marketing will have to be elaborated.

Though due attention is paid to the determination of the periods required for the various implementation activities, continued methodical and systematic review is essential to ensure that the project schedule is well knit and co-ordinate. Bar Charts, CPM, PERT techniques can be of immense help in effective implementation planning and management. Yet it is necessary to review the implementation schedule from time to time to initiate midcourse corrections or revisions promptly.

y) Financial evaluation

The feasibility study elaborates, as we have seen, element by element, from the project conception to the terminal stage of the project life, the status, the prospects the choices, the selection, the process, the specifications, the quantum, the price, the time schedule, the costs and the benefits. The building blocks should thus be well- defined and established. Unfortunately, this is where we seem to grossly underestimate the role of the techno-economic feasibility study and its comprehensiveness and credibility for the successful implementation and subsequent functioning of the project. Experimentation with pyrites and coal as feed stock for fertilizers after confirming, in the Detailed Project Report and the Techno-economic Feasibility Report, that they have been found suitable, has cost the nation dearly in terms of costs.

Conceding that the estimates and projections have been well and adequately prepared, the final acts in the feasibly study are the financial and economic valuations of the project. The inter-relationship between the estimated capital costs, the estimated annual revenues have to be analyzed to see whether the project is likely to pay its keep and leave a reasonable surplus for further growth. The discounted cash flow analysis and the sensitivity analysis are very useful tools to be applied at this stage of evaluation of financial and economic aspects of the project.

z) Economic Evaluation

In the case of the projects, it is particularly necessary to evaluate the contribution of the projects to the national economy. Rising of aggregate consumption could be one of the basic objectives in the project evaluation. Redistribution of income could be another. These different objectives will have to be weighted and combined to establish the net contribution of the project to the national economy.

Detailed Project Report (DPR)

Detailed Project Report is one which contains the complete details of the project and it is required to be submitted to banks and financial institutions for obtaining the financial assistance. Usually, all the contents of techno-economic feasibility studies will be covered in the DPR.

Detailed project report is a complete document for investment decision-making, approval. Detailed project report is base document for planning the project and implementing the project. Preparation of detailed project report is a step in firming up the proposal. When an investment proposal has been approved on the basis of functional report and the proposal is a major proposal, it would be necessary for detailed project report to firm up the proposal for the capital cost as well as the various facilities. It includes:

- Examination of technological parameters.
- Description of the technology to be used.
- Broad technical specification.
- Evaluation of the existing resources.
- Schedule plan.
- General layout.
- Volume of work.

Feasibility-cum Detailed Project Report (FDPR)

The interested promoter should submit a Feasibility-cum-Detailed Project Report (FDPR) covering following aspects for getting financial assistance from banks and financial institutions:

1. Availability of raw materials and tie up (MOU document)/ willingness certification
2. Availability of land and tie up (Lease document)/ willingness certification
3. Organization type and structure like (Entrepreneur/ Proprietary, Private limited, Entrepreneur/ Public limited, Co-operative, NGO etc.
4. Brief project description
5. Tie up with technology, equipment suppliers
6. Financial analysis and profitability study.
7. Incentives, concessions expected from other Government and public bodies for demonstration and future multiplications.

8. Initial contribution in terms of finance, technology development, technical and equipment tie up by the promoter and user agency (mention separately).
9. Organizations to operate and maintain the demonstration project.
10. Organization to replicate the project in a specific region or throughout India.
11. Fulfillment of statutory requirements (like PCB clearance, environmental clearance/ safety, etc.

Conclusion

The Detailed Project Report (DPR) is an essential building block for the projects and enabling sustainable quality service delivery. The DPR is to be prepared carefully and with sufficient details to ensure appraisal, approval, and subsequent project implementation in a timely and efficient manner. This document provides a reference format for preparing DPRs/ Project Reports across sectors.

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Lesson 2.2 - Phases of Project, Project Life Cycle Stages and Constraints

Learning Objectives

- To know the various investment phases from project planning to project completion.
- To understand the various stages in Project Life Cycle
- To learn about project constraints.

Investment Phases of a Project

Project life cycle is a complex process consisting of different steps arranged in a sequential order. Different authors have described these steps in different sequential manner but the concept of the cycle is almost similar in each case. According to United Nations Guidelines for Rural Centre Planning, there are 7 steps in the project life cycle such as project identification and appraisal, pre-feasibility study, feasibility study, detailed design project implementation, operation maintenance, monitoring and evaluation.

Rondineli, Dennis &ApsyPalia in their book—Project Planning and implementation in Developing countries—identified the following 12 steps in the project life cycle. Project identification and definition, project formation, preparation and feasibility analysis, project design, project analysis, project selection, project activation and organization, project implementation and operation, project supervision (monitoring and control) project completion or termination, output diffusion and transition to normal administration, project evaluation, follow-up and action.

World Bank Guidelines reveals the following six major steps in the project life cycle. Conception (identification), Formation (preparation), Analysis (appraisal), Implementation (Supervision), operation and evaluation.

All the steps given in different studies can be grouped into three main phases viz.,

- Pre-investment phase
- Investment/Implementation phase and
- Operational phase

A brief description of each of these phases is given below:

a) Pre-investment Phase

The first phase of the cycle describes the preliminary evaluation of an idea. It consists of identification of investment opportunities, preliminary project analysis, feasibility study and decision-making. Project idea emanates from the following problems:

- Potential and the needs of the people of an area;
- Plan priorities when planning is done by the government demand and supply projection of various goods and services;
- Pattern of imports and exports over a period of time;
- Natural resource which can serve as the base for potential manufacturing activity;
- Scope of extending existing lines of activity consumption pattern in other countries at comparable stages of economic stage of economic development.

On the basis of the investment opportunities, it is possible to conceive a number of projects out of which a particular project may be consistent with development objectives of the area. During this phase, the following aspects of the project must be carefully designed so as to enable implementation.

- Project infrastructure and enabling services
- System design and basic engineering package
- Organization and manpower
- schedules and budgets

- Licensing and governmental clearances
- Finance
- Systems and procedure
- Identification of project manager
- Design basis, general condition for purchase and contracts
- Construction resources and materials.
- Work packaging

This phase is involved with preparation for the project to take out smoothly. Once a project opportunity is conceived, it needs to be examined. Preliminary project analysis concerns with marketing, technical financial and economic aspects of the project. It seeks to determine whether the project is prima facie worthwhile to justify a feasibility study and what aspects of the projects are critical to its viability and hence call for an in depth investigation.

More details, through and complete feasibility study results in a reasonably adequate formulation of the projects in terms of location, production capacity production technology and material inputs. The feasibility study contains fairly specific estimates of project cost, means of financing sales revenues, production costs, financial profitability and social profitability. Based on the thorough feasibility study the project owner or sponsors or financiers can decide whether to accept or reject a particular project. In other words, the decisions whether investment on the project should be made or not has to be made at this stage.

b) Implementation Phase

The implementation phase of an industrial project involves setting up of manufacturing facilities. After judging the worthiness, project needs to be designed for implementation. Drawings, blue prints and the sequences in which the various activities concerning the project need to be carried out. The main activities under this phase are:

Project and Engineering Design

It consists of site probing and prospecting; preparation of blue prints, plant design, plant engineering, selection of machinery, equipment.

Negotiations and Contractions

It covers the activities like project financing, acquisition of technology, construction of building and civil works, provision of utilities supply of machine and equipment, marketing arrangement etc.

Construction

This step involves the activities like site preparation, construction of building, erection and installation of machinery and equipment. Training engineers, technicians and workers.

c) Operation Phase

It is the longest phase in terms of time span. It begins when the project is commissioned and ends when the project is wound up. This is a transition phase in which the hardware built with the active involvement of various agencies is physically handed over for production. This phase is basically a clean up phase for project personnel. The main concern of this phase is on smooth and uninterrupted operation of machinery and plant, development of suitable norms of productivity, establishment of a good quality for the product and securing the market acceptance of the product. It aims to realize the projections made in the project regarding sales, production, and cost of profits. Project monitoring and project evaluation are two vital activities under this phase.

Project monitoring is a step towards achieving properly identified objectives through a carefully laid down strategy. Each activity in the project implementation should be carefully watched so that, the progress may be measured and any deviation from the expected progress be identified in time.

Project evaluation refers to post–investment analysis. It aims at finding out whether the project has achieved the objectives for which it was taken up and whether it has created the anticipated or intended impact. This helps in developing an insight for future investment and better planning. Thus the life cycle of a project narrates the methodology of developing maintaining and controlling an investment proposal at its various phases in the life cycle.

Project Life Cycle

The project life cycle serves to define the beginning and the end of a project. For example, when an organization identifies an opportunity to which it would like to respond, it will often authorize a needs assessment and/or a feasibility study to decide if it should undertake the project. The project life-cycle definition will determine whether the feasibility study is treated as the first project phase or as a separate, standalone project.

The project life-cycle definition will also determine which transitional actions at the beginning and the end of the project are included and which are not. In this manner, the project life-cycle definition can be used to link the project to the ongoing operations of the performing organization.

The phase sequence defined by most project life cycles generally involves some form of technology transfer or handoff such as requirements to design, construction to operations, or design to manufacturing. Deliverables from the preceding phase are usually approved before work starts on the next phase. However, a subsequent phase is sometimes begun prior to approval of the previous phase deliverables when the risks involved are deemed acceptable. This practice of overlapping phases is often called *fast tracking*.

Project life cycles generally define:

- What technical work should be done in each phase (e.g., is the work of the analyst part of the definition phase or part of the execution phase)?
- Who should be involved in each phase (e.g., resources that need to be involved with requirements and design)?

Project life-cycle descriptions may be very general or very detailed. Highly detailed descriptions may have numerous forms, charts, and checklists to provide structure and consistency. Such detailed approaches are often called project management methodologies.

Most project life-cycle descriptions share a number of common characteristics:

- Cost and staffing levels are low at the start, higher toward the end, and drop rapidly as the project draws to a conclusion. This pattern is illustrated in the figure below:
- The probability of successfully completing the project is lowest, and hence risk and uncertainty are highest, at the start of the project. The probability of successful completion generally gets progressively higher as the project continues.
- The ability of the stakeholders to influence the final characteristics of the project's product and the final cost of the project is highest at the start and gets progressively lower as the project continues. A major contributor to this phenomenon is that the cost of changes and error correction generally increases as the project continues.
- Project life cycle defines phases that connect beginning and end of the project. After each phase deliverables are reviewed for the completeness in time, accuracy according to defined objectives and their final approval (approval for acceptance) before moving to the next phase.
- In the beginning, phases can be overlapped to save time and to have fast tracking on the life cycle. This technique is used to compress the whole schedule (if required resources are available or manageable).
- There is no way to define Project Life Cycle ideally. Because of this every project management team can define its own way to work on the project. They can use best common practices and can learn new ways of dealing projects by their experiences in detail or in general. Only three phases are always certain to be performed; conceptualization, intermediate phase(s), and closure.
- Cost and staffing level is defined for every single phase.
- Project may have sub-project(s) and sub-projects may have their own project life cycle.
- The typical project life cycle – initiating, implementing and closing – has critical decision points where the project may continue, be changed, or be abandoned.

Care should be taken to distinguish the *project* life cycle from the *product* life cycle. For example, a project undertaken to bring new banking software to market is but one phase or stage of the product life cycle.

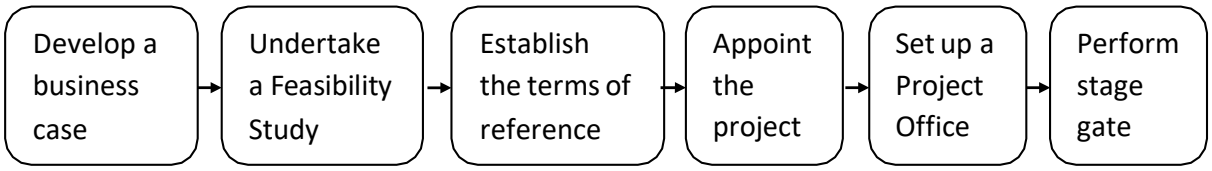
Stages of Project Life Cycle

The stages of project life cycle are detailed below:

a) Project Initiation

The first of a project is the initiation phase. During this phase a business problem or opportunity is identified and a business case providing various solution options is defined. Next, a feasibility study is conducted to investigate whether each option addresses the business problem and a final recommended solution is then put forward. Once the recommended solution is approved, a project is initiated to deliver the approved solution. Terms of reference are completed outlining the objectives, scope and structure of the new project, and a project manager is appointed.

The project manager begins recruiting a project team and establishes a project office environment. Approval is then sought to move into the detailed planning phase."Within the initiation phase, the business problem or opportunity is identified, a solution is defined, a project is formed and a project team is appointed to build and deliver the solution to the customer. The following figure shows the activities undertaken during the initiation phase:



The Project Initiation activities

Develop a business case: The trigger to initiating a project is identifying a business problem or opportunity to be addressed. A business case is created to define the problem or opportunity in detail and identify a preferred solution for implementation. The business case includes:

- A detailed description of the problem or opportunity;
- The Project Management Life Cycle
- A list of the alternative solutions available;
- An analysis of the business benefits, costs, risks and issues;

- A description of the preferred solution;
- A summarized plan for implementation.

"An identified project sponsor then approves the business case and the required funding is allocated to proceed with a feasibility study. Undertake a feasibility study: At any stage during or after the creation of a business case, a formal feasibility study may be commissioned. The purpose of a feasibility study is to assess the likelihood of each alternative solution option achieving the benefits outlined in the business case. The feasibility study will also investigate whether the forecast costs are reasonable, the solution is achievable, the risks are acceptable and the identified issues are avoidable.

Establish the terms of reference: After the business case and feasibility study have been approved, a new project is formed. At this point, terms of reference are created. The terms of reference define the vision, objectives, scope and deliverables for the new project. They also describe the organization structure and activities, resources and funding required for undertaking the project. Any risks, issues, planning assumptions and constraints are also identified.

***Appoint the project team*:** the project teams are now ready to be appointed. Although a project manager may be appointed at any stage during the life of the project, the manager will ideally be appointed prior to recruiting the project team. The project manager creates a detailed job description for each role in the project team, and recruits people into each role based on their relevant skills and experience

Set up a project office: The project office is the physical environment within which the team is based. Although it is usual to have one central project office, it is possible to have a virtual project office with project team members located around the world. A project office environment should include:

- Equipment, such as office furniture, computer equipment, station-ery and materials;
- Communications infrastructure, such as telephones, computer network, e mail, Internet access, file storage, database storage and backup facilities;

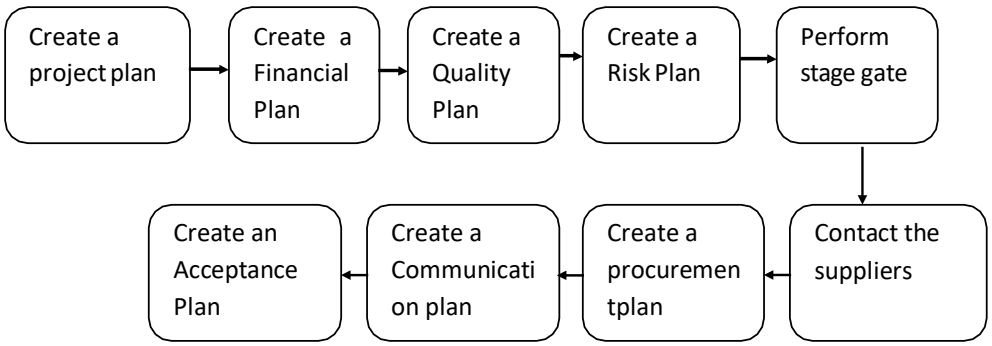
- Documentation, such as a project methodology, standards, processes, forms and registers;
- Tools, such as accounting, project planning and risk modeling software.

"Perform a phase review: At the end of the initiation phase, perform a phase review. This is basically a checkpoint to ensure that the project has achieved its objectives as planned."

b) Project Planning

- Once the scope of the project has been defined in the terms of reference, the project enters the planning phase. This involves creating a:
- Project plan outlining the activities, tasks, dependencies and timeframes;
- Resource plan listing the labor, equipment and materials required;
- Financial plan identifying the labor, equipment and materials costs;
- Quality plan providing quality targets, assurance and control measures;
- Risk plan highlighting potential risks and actions to be taken to mitigate those risks;
- Acceptance plan listing the criteria to be met to gain customer acceptance;
- Communications plan describing the information needed to inform stakeholders;
- Procurement plan identifying products to be sourced from external suppliers.

At this point the project will be planned in some detail and is ready to be executed. By now, the project costs and benefits have been documented, the objectives and scope have been defined, the project team has been appointed and a formal project office environment established. It is now time to undertake detailed planning to ensure that the activities performed during the execution phase of the project are properly sequenced, resourced, executed and controlled. The activities shown in the following figure are undertaken.



Project Planning Activities

Create a project plan: The first step in the project planning phase is to document the project plan. A 'work breakdown structure' (WBS) is identified which includes a hierarchical set of phases, activities and tasks to be undertaken to complete the project. After the WBS has been agreed, an assessment of the level of effort required to undertake each activity and task is made. The activities and tasks are then sequenced, resources are allocated and a detailed project schedule is formed. This project plan is the key tool used by the project manager to assess the progress of the project throughout the project life cycle. Create a resource plan: Immediately after the project plan is formed, the level of resource required to undertake each of the activities and tasks listed within the project plan will need to be allocated. Although generic resource may have already been allocated in the project plan, a detailed resource plan is required to identify the:

- Type of resource required, such as labor, equipment and materials;
- Quantity of each type of resource required;
- Roles, responsibilities and skill sets of all human resource required;
- Specifications of all equipment resource required;
- Items and quantities of material resource required.

A schedule is assembled for each type of resource so that the project manager can review the resource allocation at each stage in the project.

Create a financial plan: A financial plan is created to identify the total quantity of money required to undertake each phase in the project (in other words, the budget). The total cost of labor, equipment and materials is calculated and an expense schedule is defined which enables the project manager to measure the forecast spend versus the actual spend throughout

the project. Detailed financial planning is an extremely important activity within the project, as the customer will expect the final solution to have been delivered within the allocated budget.

Create a quality plan: Meeting the quality expectations of the customer can be a challenging task. To ensure that the quality expectations are clearly defined and can reasonably be achieved, a quality plan is documented. The quality plan:

- Defines the term 'quality' for the project.
- Lists clear and unambiguous quality targets for each deliverable. Each quality target provides a set of criteria and standards to be achieved to meet the expectations of the customer.
- Provides a plan of activities to assure the customer that the quality targets will be met (in other words, a quality assurance plan).
- Identifies the techniques used to control the actual quality level of each deliverable as it is built (in other words, a quality control plan).

Not only is it important to review the quality of the deliverables produced by the project, it is also important to review the quality of the management processes that produced them. A quality plan will summarize each of the management processes undertaken during the project, including time, cost, quality, change, risk, issue, procurement, acceptance and communications management.

Create a risk plan: The next step is to document all foreseeable project risks within a risk plan. This plan also identifies the actions required to prevent each risk from occurring, as well as reduce the impact of the risk should it eventuate. Developing a clear risk plan is an important activity within the planning phase, as it is necessary to mitigate all critical project risks prior to entering the execution phase of the project.

Create an acceptance plan: To deliver the project successfully, you will need to gain full acceptance from the customer that the deliverables produced by the project meet or exceed requirements. An acceptance plan is created to help achieve this, by clarifying the completion criteria for each deliverable and providing a schedule of acceptance reviews. These reviews

provide the customer with the opportunity to assess each deliverable and provide formal acceptance that it meets the requirements as originally stated.

Create a communications plan: Prior to the execution phase, it is also necessary to identify how each of the stakeholders will be kept informed of the progress of the project. The communications plan identifies the types of information to be distributed to stakeholders, the methods of distributing the information, the frequency of distribution, and responsibilities of each person in the project team for distributing the information.

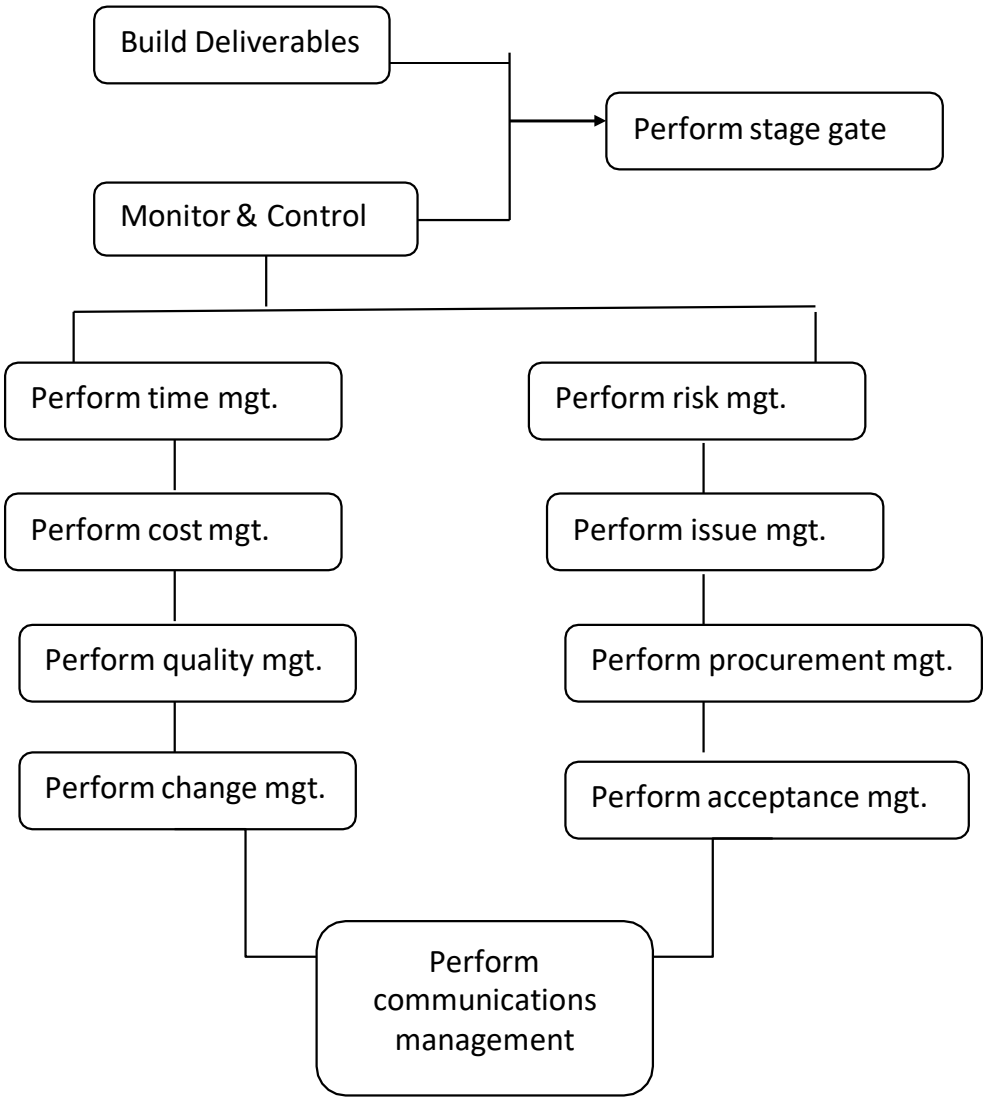
Create a procurement plan: The last planning activity within the planning phase is to identify the elements of the project to be acquired from external suppliers. The procurement plan provides a detailed description of the products (that is, goods and services) to be acquired from suppliers, the justification for acquiring each product externally as opposed to from within the business, and the schedule for product delivery. It also describes the process for the selection of a preferred supplier (the tender process), and the ordering and delivery of the products (the procurement process).

Contract the suppliers: Although external suppliers may be appointed at any stage of the project, it is usual to appoint suppliers after the project plans have been documented but prior to the execution phase of the project. Only at this point will the project manager have a clear idea of the role of suppliers and the expectations for their delivery. A formal tender process is undertaken to identify a short list of capable suppliers and select a preferred supplier to initiate contractual discussions with. The tender process involves creating a statement of work, a request for information and request for proposal document to obtain sufficient information from each potential supplier and select the preferred supplier. Once a preferred supplier has been chosen, a contract is agreed between the project team and the supplier for the delivery of the requisite products.

Perform a phase review: At the end of the planning phase, a phase review is performed. This is a checkpoint to ensure that the project has achieved its objectives as planned.

c) Project Execution

This phase involves implementing the plans created during the project planning phase. While each plan is being executed, a series of management processes are undertaken to monitor and control the deliverables being output by the project. This includes identifying change, risks and issues, reviewing deliverable quality and measuring each deliverable produced against the acceptance criteria. Once all of the deliverables have been produced and the customer has accepted the final solution, the project is ready for closure. The activities of this phase are shown in the following figure.



Project Execution activities

The execution phase is typically the longest phase of the project in terms of duration. It is the phase within which the deliverables are physically constructed and presented to the customer for acceptance.

To ensure that the customer's requirements are met, the project manager monitors and controls the activities, resources and expenditure required to build each deliverable. A number of management processes as shown are undertaken to ensure that the project proceeds as planned.

Build the deliverables: This phase involves physically constructing each deliverable for acceptance by the customer. The activities undertaken to construct each deliverable will vary depending on the type of project being undertaken.

Activities may be undertaken in a 'waterfall' fashion, where each activity is completed in sequence until the final deliverable is produced, or in an 'iterative' fashion, where iterations of each deliverable are constructed until the deliverable meets the requirements of the customer. Regardless of the method used to construct each deliverable, careful monitoring and control processes should be employed to ensure that the quality of the final deliverable meets the acceptance criteria set by the customer.

Monitor and control: While the project team is physically producing each deliverable, the project manager implements a series of management processes to monitor and control the activities being undertaken by the project team. An overview of each management process follows.

Time Management: Time management is the process of recording and controlling time spent by staff on the project. As time is a scarce resource within projects, each team member should record time spent undertaking project activities on a timesheet form. This will enable the project manager to control the amount of time spent undertaking each activity within the project. A timesheet register is also completed, providing a summary of the time spent on the project in total so that the project plan can always be kept fully up to date.

Cost management: Cost management is the process by which costs/expenses incurred on the project are formally identified, approved and paid. Expense forms are completed for each set of related project

expenses such as labor, equipment and materials costs. Expense forms are approved by the project manager and recorded within an expense register for auditing purposes.

Quality management: Quality is defined as the extent to which the final deliverable conforms to the customer requirements. Quality management is the process by which quality is assured and controlled for the project, using quality assurance and quality control techniques. Quality reviews are undertaken frequently and the results recorded on a quality review form.

Change management: Change management is the process by which changes to the project scope, deliverables, timescales or resources are formally requested, evaluated and approved prior to implementation. A core aspect of the project manager's role is to manage change within the project. This is achieved by understanding the business and system drivers requiring the change, identifying the costs and benefits of adopting the change, and formulating a structured plan for implementing the change. To formally request a change to the project, a change form is completed. The status of all active change forms should he recorded within a change register.

Risk management: Risk management is the process by which risks to the project are formally identified, quantified and managed. A project risk may be identified at any stage of the project by completing a risk form and recording the relevant risk details within the risk register.

Issue management: Issue management is the method by which issues currently affecting the ability of the project to produce the required deliverable are formally managed. After an issue form has been completed and the details logged in the issue register, each issue is evaluated by the project manager and a set of actions undertaken to resolve the issue identified.

Procurement management: Procurement management is the process of sourcing products from an external supplier. Purchase orders are used to purchase products from suppliers, and a procurement register is maintained to track each purchase request through to its completion.

Acceptance management: Acceptance management is the process of gaining customer acceptance for deliverables produced by the project. Acceptance forms are used to enable project staff to request acceptance for a deliverable, once complete. Each acceptance form identifies the acceptance criteria, review methods and results of the acceptance reviews undertaken.

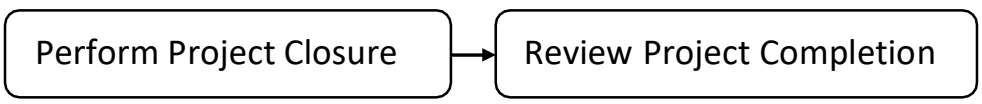
Communications management: Communications management is the process by which formal communications messages are identified, created, reviewed and communicated within a project. The most common method of communicating the status of the project is via a project status report. Each communications message released is captured in a communications register.

Perform a phase review: At the end of the execution phase, a phase review is performed. This is a checkpoint to ensure that the project has achieved its objectives as planned."

d) Project Closure

Project closure involves releasing the final deliverables to the customer, handing over project documentation to the business, terminating supplier contracts, releasing project resources and communicating the closure of the project to all stakeholders. The last remaining step is to undertake a post implementation review to quantify the level of project success and identify any lessons learnt for future projects. Following the acceptance of all project deliverables by the customer, the project will have met its objectives and be ready for closure. Project closure is the last phase in the project life cycle, and must be conducted formally so that the business benefits delivered by the project are fully realized by the customer.

The activities outlined in the following figure are undertaken.



The project closure activities

Perform project closure: Project closure, or 'close out', essentially involves winding up the project. This includes:

- Determining whether all of the project completion criteria have been met;
- Identifying any outstanding project activities, risks or issues;
- Handing over all project deliverables and documentation to the customer;
- Canceling supplier contracts and releasing project resources to the business;
- Communicating the closure of the project to all stakeholders and interested parties.

A project closure report is documented and submitted to the customer and/or project sponsor for approval. The project manager is responsible for undertaking each of the activities identified in the project closure report, and the project is closed only when all the activities listed in the project closure report have been completed.

Review project completion: The final activity within a project is the review of its success by an independent party. Success is determined by how well it performed against the defined objectives and conformed to the management processes outlined in the planning phase. To determine how well it performed, the following types of questions are answered:

- Did it result in the benefits defined in the business case?
- Did it achieve the objectives outlined in the terms of reference?
- Did it operate within the scope of the terms of reference? 0 Did the deliverables meet the criteria defined in the quality plan?
- Was it delivered within the schedule outlined in the project plan?
- Was it delivered within the budget outlined in the financial plan?

To determine how well the project conformed, an assessment is made of the level of conformity to the management processes outlined in the quality plan. These results, as well as a list of the key achievements and lessons learnt, are documented within a post-implementation review and presented to the customer and/or project sponsor for approval.

Project Constraints

Defining Project Constraints

To prioritize and define the scope of the application deployment project, gather information about the constraints of your project. Constraints often include:

Resources: Identify the equipment, software, staff, and space that are available for the project.

Time: Identify the date by which the application deployment project must be completed, and how the application testing process fits into the larger deployment project.

Organizational issues: If the project will not involve the entire organization, identify which groups in your organization will be affected by it. Additionally, determine if a particular group in the organization needs the new operating system sooner than others. If so, you might decide to perform a staged rollout.

Access to developers: Identify applications that were developed in-house or especially for your organization. Access to the developers of these applications is critical during the testing and issue resolution phases of the project. Such access also can be an invaluable aid with retail applications. The primary impact of project constraints is the likelihood of delaying the completion of the project. There are three types of project constraints: technological, resource and physical.

The technological constraints relate to the sequence in which individual project activities must be completed. For example, in constructing a house, pouring the foundation must occur before building the frame.

Resource constraints relate to the lack of adequate resources which may force parallel activities to be performed in sequence. The consequence of such a change in network relationships is delay in the completion date of the project. We will examine the nature of resource constraints in much greater detail in the next section.

Physical constraints are caused by contractual or environmental conditions. For example, due to space limitations an activity such as painting a wall may have to be performed by only one person (Gray and Larson, 2003).

In general, from a scheduling perspective, projects can be classified as either time constrained or resource constrained. A project is classified as time constrained in situations where the critical path is delayed and the addition of resources can bring the project back on schedule and the project completed by the required date. However, the additional resource usage should be no more than what is absolutely necessary. The primary focus, for purposes of scheduling, in time constrained projects is resource utilization. On the other hand, a project is resource constrained if the level of resource availability cannot be exceeded. In those situations where resources are inadequate, project delay is acceptable, but the delay should be minimal. The focus of scheduling in these situations is to prioritize and allocate resources in such a manner that there is minimal project delay. However, it is also important to ensure that the resource limit is not exceeded and the technical relationships in the project network are not altered.

Identifying Risk Factors

By identifying risk factors, you can identify the potential barriers to a successful deployment and assess the cost of failure for each potential blocking issue. With this information in hand, you can create contingency plans to help mitigate or avoid blocking issues. For application compatibility testing, it is important to think about the project risks early in the project rather than later, during the test planning phase. The main risk for any application testing and deployment project is the business impact of application failure. For business-critical applications, a failure in deployment could have severe financial repercussions for the organization, whereas the failure to properly deploy an application that is used infrequently by a few users might have very little effect. Assess the financial impact that could be caused by a failure at any time during the deployment project.

Self Assessment Questions

1) What are opportunity studies? Explain.
2) What are the various types of opportunity studies?
3) What are general opportunity studies?
4) What are specific opportunity studies?
5) What are pre-feasibility studies?
6) What are the various types of information for which the pre-feasibility studies are undertaken?
7) List and explain the components of techno-economic feasibility studies.
8) What is DPR? How does it differ from feasibility report?
9) What is FDPR?
10) Explain the various investment phases from project planning to project completion.
11) Explain the various stages in Project Life Cycle.
12) What are project constraints? Explain its types.

CASE STUDY
Feasibility Study on Hainan Project

The idea of this project is to conduct a feasibility study for client Lippo Group. Lingshai, Hainan is located in South-west China, a small island with its tropical location advantage, it is one of the fastest growing economic city in China as well as the high level growing of tourist visited in recent years. Client Lippo Group has been working with Licon (Holdings) Limited for several years.

Lippo is one of the fastest growing multinational companies. Lippo has several branches in Indonesia, Singapore, China and Philippine and it headquarter is located in Hong Kong. Lippo is an Asian conglomerate with decades of experience in capturing and profiting from investment opportunities in the region and the company is focusing on 2 key sectors: Property and Retail.

Notes

More about the company, Lippo is one of the major business conglomerates in Asia with businesses geographically diversified in Hong Kong, Singapore, China, Korea, Macau, Philippines, Malaysia, Thailand, and other countries. Property and retailing are the key focus. Lippo also has interests in other businesses, e.g., hotels, food business, securities broking and banking. The Client proposes is to build a unique mixed use development in a landmark building in Lingshui area. The project focused on four main property markets: Residential; Serviced apartment; Hotel and Retail (Shopping malls including dining and retail facilities).

Submit feasibility report which will give client a complete understanding more about the project background and conditions as well as provide a repositioning analysis for the subject site, based on market feasibility studies.

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UNIT - III

Project Evaluation

The main purpose of project evaluation or investment appraisal procedure is simply the comparison of uncertain future cash inflows with cash outflows which might also be uncertain. The basic techniques used by economists and financial analysts for this comparison purpose are most often internal rate of return and net present value techniques. This practice has been so generally accepted that the whole procedure of evaluating the profitability of an investment based on the concept of discounting is often referred to as the discounted cash flow techniques. In this chapter, let us understand the tradition and sophisticated (or discounted cash flow) techniques used for evaluating the projects under certainty; techniques used for evaluating projects under uncertainty; and Project Evaluation methodology including Social Cost Benefit Analysis.

Unit Structure

Lesson 3.1 - Project Evaluation under Certainty and Uncertainty

Learning Objectives

- To understand the tradition techniques of evaluating projects financially.
- To understand the sophisticated techniques of evaluating projects financially.
- To understand the general techniques of evaluating projects under risky conditions.
- To understand the quantitative techniques of evaluating projects under risky conditions.

Method of Project Evaluation under Certainty

There are several methods for evaluating and ranking the capital investment proposals. In case of all these methods the main emphasis is on the return which will be derived on the capital invested in the project. In other words, the basic approach is to compare the investment in the project with the benefits derives there from.

Following are the main methods generally used:

1) Traditional Methods
   a) Pay-back Period Method
   b) Accounting Rate of Return Method.
2) Sophisticated/Discounted Cash Flow Methods
   a) The Net Present Value Method
   b) Present Value Index Method/Benefit-Cost Ratio Method
   c) Internal Rate of Return (IRR)

1) Traditional Methods

a) Pay-back Period Method

In Case of Even Cash Flows

The term pay-back (or pay-out or pay-off) refers to the period in which the project will generate the necessary cash to recoup the original investment.

For example, if a project need ` 40,000 as initial investment and it will generate an even annual cash inflow of ` 10,000 for ten years, the pay-back period will be 4 years, calculated as follows:

$$\text{Pay-back period} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}}$$

$$= \frac{\text{` } 40{,}000}{\text{` } 10{,}000}$$

The annual cash inflow is calculated by taking into account the amount of net income on account of the asset (or Project) before depreciation but after taxation. The income so earned, if expressed as a percentage of initial investment, is termed as "unadjusted rate of return". In the above case, it will be calculated as follows:

$$\text{Unadjusted rate of Return} = \frac{\text{Annual Return} \times 100}{\text{Initial Investment}}$$

$$= \frac{\text{` } 10{,}000}{\text{` } 40{,}000} \times 100 = 25\%$$

In Case of Uneven Cash Inflows

In case the cash flow is not even, i.e., if each year's cash inflows are different, cumulative cash inflows will be calculated and by interpolation, the exact pay-back-period can be calculated. For example, if the project needs an original investment of ` 1,00,000 and the annual cash inflows for 5 years are ` 30,000, ` 40,000, ` 25,000, ` 20,000 and ` 20,000 respectively, the pay-back-period will be calculated as follows:

Year	Cash Inflows (`)	Cumulative Cash Inflows (`)
1	30,000	30,000
2	40,000	70,000
3	25,000	95,000
4	20,000	1,15,000
5	20,000	135,000

The above table shows that in three years ` 95,000 has been recovered. ` 5,000 is left out of initial investment. In the fourth year the cash inflow is ` 20,000. It means the pay-back period is between three to four years, which is calculated as below:

$$\text{Pay-back period} = 3 \text{ years} + \frac{5{,}000}{20{,}000} = 3.25 \text{ years}$$

Decision Criterion

The decision rule is

a) Shorter the payback Period – Accept the project

b) Longer the payback period – Reject the project

The pay-back period can be used as a criterion to accept or reject an investment proposal. A project whose actual pay-back period is more than what has been pre-determined by the management will be straight-away rejected. The fixation of the maximum acceptable pay-back period is generally done by taking into account the reciprocal of the cost of capital.

The pay-back period can also be used as a method of ranking in case of mutually exclusive projects. The projects can be arranged in an ascending order according to the length of their pay-back periods. The project having the shortest pay-back period or highest unadjusted rate of return will be preferred provided it meets the minimum standard that has been established.

Example: A company is considering purchase of a new machine. There are two alternative models X and Y. Prepare a statement of profit-ability showing the pay-back period from the following information:

Details	Machine X	Machine Y
Estimated life of machine	4 years (`)	5 years (`)
Cost of machine	18,000	36,000
Estimated saving in scrap	1,000	1,600
Estimated saving in Direct Wages	12,000	16,000
Additional cost of maintenance	1,600	2,000
Additional cost of supervision	2,400	3,600

Ignore taxation.

Solution

Statement Showing Annual Cash Inflows		
	Machine X (`)	Machine Y (`)
Estimated saving in scrap	1,000	1,600
Estimated saving in Direct Wages	12,000	16,000
Total Savings (1)	13,000	17,600
Additional cost of maintenance	1,600	2,000
Additional cost of supervision	2,400	3,600
Total additional costs (2)	4,000	5,600
Net cash inflow (1 – 2)	9,000	12,000

$$\text{Pay-back period} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}}$$

Machine X

$$= \frac{18,000}{9,000}$$

= 2 years

Machine Y

$$= \frac{36,000}{12,000}$$

= 3 years

Machine X has a shorter pay-back period; hence it should be preferred to Machine Y.

Advantages of Payback Method

The pay-back method has the following advantages:

- The method is very useful in evaluation of those projects which involve high uncertainty. Political instability, rapid technological development of cheap substitutes, etc., are some of the reasons which discourage one to take up projects having long gestation period. Pay-back method is useful in such cases.
- The method makes it clear that no profit arises till the pay-back period is over. This helps new companies in deciding when they should start paying dividends.
- The method is simple to understand and easy to work out.
- The method reduces the possibility of loss on account of obsolescence as the method prefers investment in short-term projects.

Disadvantages of Payback Method

The pay-back method has the following disadvantages:

- The method ignores the returns generated by a project after its pay-back period. Projects having longer gestation period will never be taken up if this method is followed though they may yield high returns for a long period.
- The method does not take into account the time value of money.

Suitability of Payback Method

In spite of the above limitations, the pay-back method can profitably be used in each of the following cases:

- Firms having to take up projects in uncertain situations will prefer payback method.
- Firms suffering from liquidity crisis will consider payback method more appropriate as it gives importance for recouping the original investment.
- Firms which aim at short term earning performance will prefer pay back method.

b) Accounting or Average rate of Return (ARR) Method

In this method, the capital investment proposals are judged on the basis of their relative profitability. For this purpose, capital employed and related income is determined according to commonly accepted accounting principles and practices over their entire economic life of the project and then the average yield is calculated. Such a rate is termed as Accounting Rate of Return. It may be calculated according to any of the following methods:

$$\frac{\text{Annual Average Net Earnings}}{\text{Original Investment}} \times 100$$

Or

$$\frac{\text{Annual Average Net Earnings}}{\text{Average Investment}} \times 100$$

The term "average annual net earnings" is the average of the earnings (after depreciation and tax) over the whole of the economic life of the project and is calculated by using the formula

$$\frac{\text{Increase in expected future annual net earnings}}{\text{Initial increase in required investment}} \times 100$$

The amount of "average investment" can be calculated according to any of the following methods.

a) $\frac{\text{Original Investment}}{2} \times 100$

b) $\frac{\text{Original Investment} - \text{Scrap value of the asset}}{2}$

c) $\frac{\text{Original Investment} - \text{Scrap value of the asset}}{2}$

+ Addl. Net Working Capital + Scrap value

Decision Criterion

The Decision Rule is

- Higher the ARR or ARR above minimum expected rate of return – Accept the project
- Lower the ARR or ARR below minimum expected rate of return – Reject the project

Normally, business enterprises fix a minimum rate of return. Any project expected to give a return below the rate will be straightaway rejected. In case of several projects, where a choice has to be made, the different projects may be ranked in the ascending or descending order of their rate of return. Projects below the minimum rate will be rejected. In case of projects giving rates of return higher than the minimum rate, obviously projects giving a higher rate of return will be preferred over those giving a lower rate of return.

Advantages of ARR Method

The following are the advantages of ARR method:

- The method takes into account savings over the entire economic life of the asset. Hence, it provides a better comparison of the projects as compared to the pay–back method.
- The method embodies the concept of 'net earnings' while evaluating capital investment projects, which is absent in case of all other methods.

Disadvantages of ARR Method

The following are the disadvantages of this method:

- The method does not take into account the time value of money. Thus, it has the same fundamental defect as that of pay–back method.
- There are different methods for calculating the Accounting Rate of Return due to diverse concepts of investments as well as earnings.

Each method gives different results. This reduces the reliability of the method.

On account of the above disadvantages, the Accounting Rate of Return Method is not much in use these days.

2. Sophisticated or Discounted Cash Flow Methods

The discounted cash flow technique is an improvement on the pay-back period method. This method considers the time value of money. It takes into account both the interest factor as well as the return after the pay-back period. The method involves three stages:

- Calculation of cash flows, *i.e.,* both inflows and outflows (preferably after tax) over the full life of the asset.
- Discounting the cash flows so calculated by a discount factor.
- Aggregating of discounted cash inflows and comparing the total with the discounted cash outflows.

Discounted cash flow technique thus recognizes that ` 1 of today (the cash outflow) is worth more than ` 1 received at a future date (cash inflow).

Discounted cash flow methods for evaluating capital investment proposals are of three types.

a) The Net Present Value (NPV) Method.

This method is considered to be the best method for evaluating the capital investment proposals. In this method, cash inflows and cash outflows associated with each project are first worked out. The present value of these cash inflows and outflows are then calculated at the rate of return acceptable to the management. This rate of return is considered as the cut-off rate and is generally determined on the basis of cost of capital suitably adjusted to allow for the risk element involved in the project. Cash outflows represent the investment and commitments of cash in the project at various points of time. The working capital is taken as a cash

outflow in the year the project starts commercial production. Profit after tax before depreciation represents cash inflows. The Net Present Value (NPV) is the difference between the total present value of future cash inflows and the total present value of future cash outflows.

The formula for calculating the NPV in case of conventional cash flows can be put as follows:

$$NPV = \frac{\sum NCF_t}{(1+k)^t} - I_0$$

In case of non-conventional cash inflows (*i.e.,* where there are a series of cash inflows as well cash outflows) the equation for calculating NPV is as follows:

$$NPV = \sum_{f=1}^{T} \left[\frac{NCF_i}{(1+k)^f}\right] - \sum_{j=1}^{T} \left[\frac{I_i}{(1+k)^f}\right]$$

Where: NPV = Net Present Value, NCF = Cash Inflows at different time periods, k = Cost of Capital or Cut-off Rate, I = Cash Outflows at different time periods.

Decision Criterion

The Decision Rule is

- NPV is Positive – Accept the project
- NPV is Zero or Negative – Reject the project

The Net Present Value can be used as an 'accept or reject' criterion. In case the NPV is positive (*i.e.,* present value of cash inflows is more than present value of cash outflows) the project should be accepted. However, if the NPV is negative (*i.e.,* present-value of cash inflows is less than the present value of cash outflows) the project should be rejected.

Example

A company is considering the purchase of a new machine. Two alternative machines (X and Y) have been suggested, each having an initial

cost of ` 20,00,000 and requiring ` 1,00,000 as additional working capital at the end of 1st year. Earnings after taxation are expected to be as follows:

Year	Cash flows (`)	
	Machine X	Machine Y
1	2,00,000	6,00,000
2	6,00,000	8,00,000
3	8,00,000	10,00,000
4	12,00,000	6,00,000
5	8,00,000	4,00,000

The company has target of return of capital of 10% and on this basis, you are required to prepare the profitability of the machines and state which alternative you consider financially preferable using NPV method.

Note: the following table gives the present value of ` 1 due in 'n' number of years.

Year	1	2	3	4	5
PV of ` 1 at 20%	.91	.83	.75	.68	.62

Solution

Statement Showing the Profitability of the Two Machines					
Year	Discount Factor	Machine X (`)		Machine Y (`)	
		Cash Inflow	Present Value	Cash Inflow	Present Value
1	.91	200000	182000	600000	546000
2	.83	600000	498000	800000	664000
3	.75	800000	600000	1000000	750000
4	.68	1200000	816000	600000	408000
5	.62	800000	496000	400000	248000
Total PV of Cash inflows		3600000	2592000	3400000	2616000
Total PV of cash outflows (` 2000000 + ` 100000*.91)			2091000		2091000
Net Present Value			501000		525000

Recommendations

Machine Y is preferable to Machine X. Though total cash inflow of Machine X is more than that of Machine Y by ` 2,00,000, the net present value of the cash inflows of machine Y is more that of Machine X. Moreover, in case of Machine Y cash inflow in the earlier years is comparatively higher than that in case of Machine X.

b) Benefit Cost Ratio or Excess present Value Index

This is a refinement of the net present value method. Instead of working out the net present value, a present value index is found out by comparing the total of present value of future cash inflows and the total of the present value of future cash outflows. This can be put in the form of the following formula:

$$\text{Excess Present Value Index (Or Benefits Cost (B/C) Ratio)} = \frac{\text{PV of future cash inflows}}{\text{PV of future cash outflows}} \times 100$$

Excess Present Value Index provides ready comparison between investment proposals of different magnitudes.

Decision Criterion

The Decision Rule is

- PI or NPV Index or BC Ratio is greater than 1 – Accept the project
- PI or NPV Index or BC Ratio is lesser than 1 – Reject the project

Example: A company has ` 30,00,000 allocated for capital budgeting purposes. The following proposals and associated profitability indices have been determined:

Project	Amount	Profitability Index
1	9,00,000	1.22
2	4,50,000	0.95
3	10,50,000	1.2

Project	Amount	Profitability Index
4	1350000	1.18
5	600000	1.2
6	1200000	1.05

Which of the above investments should be undertaken? Assume that projects are indivisible and there is no alternative use of money allocated for capital budgeting.

Solution

Statement of Ranking of Projects on the Basis of Profitability Index			
Project	**Amount**	**Profitability Index**	**Rank**
1	900000	1.22	1
2	450000	0.95	5
3	1050000	1.2	2
4	1350000	1.18	3
5	600000	1.2	2
6	1200000	1.05	4

Since projects are indivisible and there is no alternative use of the money allocated for capital budgeting on the basis of Profitability Index, the company is advised to undertake investment in projects 1, 3 and 5. However, in case of alternative projects, the allocation should be made to the project which, adds the most to the shareholder' wealth. The NPV method in such a case will give the best results.

Calculation of NPV				
Project	**Amount (in `)**	**Profitability Index**	**Cash inflows of project (`)**	**NPV of Project (in `)**
A	B	C	D = A * B	E= D – B
1	9,00,000	1.22	10,98,000	1,98,000
2	4,50,000	0.95	4,27,500	–22,500
3	10,50,000	1.2	12,60,000	2,10,000
4	13,50,000	1.18	15,93,000	2,43,000

Project	Amount (in `)	Profitability Index	Cash inflows of project (`)	NPV of Project (in `)
A	B	C	D = A * B	E= D – B
5	6,00,000	1.2	7,20,000	1,20,000
6	12,00,000	1.05	12,60,000	60,000

The above table shows that the allocation of funds to the projects 1, 3 and 5 (as selected according to P.I.) will give NPV of ` 5,28,000 (198000 + 210000 + 120000) and ` 4,50,000 [3000000 – (900000 + 1050000 + 600000) will remain unspent. However, the NPV of the project 3, 4 and 5 is ` 573000which is more than the NPV of projects 1, 3 and 5. Moreover, by undertaking projects 3, 4 and 5 no money will remain unspent. Hence, the company is advised to undertake investment in projects 3, 4 and 5.

c) Internal Rate of Return

Internal Rate of Return is that rate at which the sum of discounted cash inflows equals the sum of discounted cash outflows. In other words, it is the rate which discounts the cash flows to zero. It can be stated in the form of a ratio as follows:

$$\frac{\text{Cash Inflows}}{\text{Cash Outflows}} = 1$$

Thus, in case of this method the discount rate is not known but the cash outflows and cash inflows are known. Rate of Return is calculated as follows:

$$I = R / I + r$$

Where I = Cash Outflow *i.e.,* Initial Investment,

R = Cash Inflow, r = Rate of return yielded by the Investment (or IRR).

Decision Criterion

The Decision Rule is

- IRR is greater than the cut-off rate – Accept the project
- IRR is lesser than the cut-off rate – Reject the project

Internal Rate of return is the maximum rate of interest which an organization can afford to pay on the capital invested in a project. A project would qualify to be accepted if IRR exceeds the cut-off rate. While evaluating two or more projects, a project giving a higher internal rate of return would be preferred. This is because the higher rate of return, the more profitable is the investment.

Where cash inflows are uniform

In the case of those projects which result in uniform cash inflows, the internal rate return can be calculated by locating the factor in Annuity The factor is calculated is as follows:

$$F = I / C$$

Where F = Factor to be located, I = Original Investment and C = Cash inflow per year.

Where cash inflows are not uniform

When cash inflows are not uniform, the internal rate of return is calculated by making trial calculations in an attempt to compute the correct interest rate which equates the present value of cash inflows with the present value of cash outflows. In the process, cash inflows are to be discounted by a number of trial rates. The first trial rate may be calculated on the basis of the same formula which is used for determining the internal rate of return when cash inflows are uniform, as explained above. However, in this case 'C' stands for 'annual average cash inflow', in place of 'annual cash inflow'.

After applying the first trial rate the second trial rate is determined when the total present value of the cash inflows is greater or less than the

total present value of cash outflows. In case the total present value of cash inflows is less than the total present value of cash outflows. In case the total present value of cash inflows is less than the total present value of cash outflows, the second trial rate taken will be lower than the first rate. In case the present total value of cash inflows exceeds the present total value of cash outflows, a trial rate higher than first trial rate will be used. This process will continue till the two flows more or less set off each other. This will be the 'internal rate of return'.

Example

A company has to select one of the following two projects:

	Project A (`)	Project B (`)
Cost	22,000	20,000
Cash inflows:		
Year 1	12,000	2,000
Year 2	4,000	2,000
Year 3	2,000	4,000
Year 4	10,000	20,000

Using the Internal Rate of Return method suggests which project is preferable.

Solution

The cash flows are not uniform and hence the Internal Rate of Return will have to be calculated by the Trial and Error Method. In order to have an approximate idea about such rate, it will be better to find out the "Factor". The factor reflects the same relationship of investment and 'cash inflows' as in case of pay–back calculations. Thus,

$$F = I / C$$

Where F = Factor to be located, I = Original Investment and C = Average cash inflow per year.

The factor in case of Project A would be:

$$F = \frac{22000}{7000}$$

= 3.14; [where the average cash inflow

= (12000+4000+2000+10000)/4]

The factor in case of Project B would be:

$$F = \frac{22000}{7000}$$

= 2.86; [where the average cash inflow

= (2000+2000+4000+20000)/4]

The factor thus calculated will be located in Present Value Table on the line representing number of years corresponding to estimated useful life of the asset. This would give the estimated rate of return to be applied for discounting the cash inflows for the internal rate of return.

In case of Project A, the rate comes to 10% while in case of Project B it comes to 15%.

Project A

Year	Cash inflow (`)	Discounting Factor at 10%	Present Value (`)
1	12,000	.909	10,908
2	4,000	.826	3,304
3	2,000	.751	1,502
4	10,000	.683	6,830
Total Present Value			22,544
Cash outflow			22,000
Net Present Value			+544

The present value at 10% comes to ` 22,544. The initial investment is ` 22,000. Internal rate of Return may be taken approximately at 10%.

In case more exactness is required another trial rate which is slightly higher than 10% (since at this rate the present value is more than initial investment) may be taken. Taking a rate of 12%, the following results would emerge:

Year	Cash inflow (`)	Discounting Factor at 12%	Present Value (`)
1	12,000	.893	10,716
2	4,000	.797	3,188
3	2,000	.712	1,424
4	10,000	.636	6,360
Total Present Value			21,688
Cash outflow			22,000
Net Present Value			−312

The internal rate of return is thus more than 10% but less than 12%. The exact rate may be calculated as follows:

$$\text{IRR} = \text{Lower Rate} + \frac{\text{PV of lower \% − Required Net cash outlay}}{\text{Difference between the present values of both rates}} \times \text{Difference in rate}$$

$$= 10\% + \frac{22544 - 22000}{22544 - 21688} \times 2$$

$$= 10\% + \frac{544}{856} \times 2 = 10\% + 1.27\% = 11.27\%$$

Alternatively, the exact internal rate of return can also be calculated as follows:

$$\text{IRR} = \text{Lower Rate} + \frac{\text{NPV of lower rate}}{\text{NPV of both rates}} \times \text{Difference in rate}$$

At 10% the Net present value is + 544.

At 12% the Net present value is − 312.

The internal rate would, therefore, be between 10% and 12% calculated as follows:

$$= 10 + \frac{544}{544+312} \times 2$$

$$= 10 + 1.3 = 11.27\%$$

Project B

Year	Cash inflow (`)	Discounting Factor at 15%	Present Value (`)
1	2,000	.870	1,740
2	2,000	.756	1,512
3	4,000	.658	2,632
4	20,000	.572	11,440
Total Present Value			17,324
Cash outflow			20,000
Net Present Value			−2676

Since present value at 15% comes only to ` 17,324, a lower rate of discount should be tried. Taking a rate of 10%, the following will be the results:

Year	Cash inflow (`)	Discounting Factor at 10%	Present Value (`)
1	2,000	.909	1,818
2	2,000	.826	1,652
3	4,000	.751	3,004
4	20,000	.683	13,660
Total Present Value			20,134
Cash outflow			20,000
Net Present Value			+134

The present value at 10% comes to ` 20,134 which is more or less equal to the initial investment. Hence, the internal rate of return may be taken as 10%.

In order to have more exactness, the internal ret of return can be interpolated as done in case of Project A.

At 10% the present value is + 134

At 15% the present value is – 2,676

$$10\% + \frac{134 \times 5}{134 + 2676}$$

$$= 10 + 0.24 = 10.24\%$$

IRR of Project A is 11.27%

IRR of Project B is 10.24%

Thus, Internal Rate of Return in case of Project A is higher as compared to Project B. Hence Project A is preferable.

Advantages of Discounted Cash Flow Method

The advantages of discounted cash flow method are as follows:

- Discounted cash flow technique takes into account time value of money.
- The method takes into account directly the amount of expenses and revenues over the project's life.
- The method automatically gives more weight to those money values which are nearer to the present period than those which are farther from it.
- The method makes possible comparison of projects requiring different capital outlays, having different lives and different timings of cash flows, at a particular moment of time because of discounting of all cash flows.

Disadvantages of Discounted Cash Flow Method

The disadvantages of discounted cash flow method are as follows:

- The method is difficult to understand and work out.
- The method takes into account only the cash inflows on account of a capital investment decisions. As a matter of fact, the profitability or otherwise of a capital investment proposal can be judged only when the net income (and not the cash inflow) on account of operations is considered.

- The method is based on the presumption that cash inflow can be invested at the discounting rate in the new projects. However, this presumption does not always hold well because it all depends upon the available investment opportunities.

Project Evaluation under Uncertainty

Incorporation of Risk Factor

The firm must take into consideration the risk factor while determining return/cash flows from a project or taking capital budgeting decisions. However, incorporation of risk factor in capital budgeting decisions is a difficult task. Some of the popular techniques used for the purpose are as follows:

1) General techniques
   - Risk Adjusted Discount Rate
   - Certainty equivalent coefficient
2) Quantitative techniques
   - Sensitivity analysis
   - Probability assignment
   - Standard Deviation
   - Coefficient of variation
   - Decision Tree

General Techniques

a) Risk Adjusted Discount Rate

The risk adjusted discount rate is based on the presumption that investors expect a higher rate of return on risky projects as compared to less risky projects. The rate requires determination of:

(i) Risk-free rate and

(ii) Risk premium rate. Risk-free rate is the rate at which the future cash inflows should be discounted had there been no risk.

Risk premium rate is the extra return expected by the investor over the normal rate (i.e., the risk–free rate) on account of the project being risky. Thus, risk adjusted discounted rate is a composite discount rate that takes into account both the time and risk factors. A higher discount rate will be used for more risky projects and lower rate for less risky projects.

Advantages of Risk Adjusted Discount Rate Method

- It is simple to calculate and easy to understand.
- It incorporates the risk–averse attitude of investors.

Disadvantages of Risk Adjusted Discount Rate Method

- The determination of appropriate discount rates keeping in view the differing degrees of risk is arbitrary. It may, therefore, not give objective results.
- The method results in compounding of risk over time, since the premium is added to the discount rate. This means that the method presumes that the risk necessarily increases with time which may not be correct in all cases.
- The method presumes that the investors are averse to risk. Of course, this is true in most of the cases. However, there are investors who are risk–seekers and are prepared to pay premium for taking risk. In their case the discount rate should be reduced rather than increased with increase in degrees of risk.

In spite of these disadvantages the method is most widely used on account of its simplicity.

b) Certainty Equivalent Coefficient

According to this method the estimated cash flows are reduced to conservative level by applying a correction factor termed as certainty equivalent coefficient. The correction factor is the ratio of riskless (or certain) cash flows to risky cash flows.

$$\text{Certainty equivalent coefficient} = \frac{\text{Riskless cash flow}}{\text{Risky cash flow}}$$

Riskless cash flow means the cash flow which the management is prepared to accept in case there is no risk involved. Naturally, this will be lower than the cash flow which will be there in case the project is risky. Certainty equivalent coefficients can be calculated for estimated cash flows of each year. They are then multiplied with the cash flows to ascertain cash flows which may be used for the purpose for determining IRR or NPV for capital budgeting decisions.

Quantitative Techniques

a) Sensitivity Analysis

While using general techniques, since only cash flows for each year are considered, there are chances of estimation errors. The sensitivity analysis approach takes care of this aspect by providing more than one estimate of the future return of a project. It is thus, superior to one figure forecast since it gives a more precise idea about the variability of the return. Usually sensitivity analysis provides information about cash flows under three assumptions:

- Pessimistic,
- Most likely, and
- Optimistic out-comes associated with the project.

It explains how sensitive the cash flows are under these different situations. The larger is the difference between the pessimistic and optimistic cash flows, the more risky is the project and *vice versa*.

b) Probability Assignment

Sensitivity analysis suffers from a limitation. No doubt it provides different cash flow estimates under the three assumptions; it however does not provide chances of occurrence of each of these estimates. Probability means the likelihood of happening of an event. Probability may be objective or subjective. An objective probability is based on a large number of observations under independent and identical conditions repeated over a period of time. A subjective probability is based on personal judgment since there are no large numbers of independent and identical observations. In capital budgeting decisions, the probabilities are of a subjective type since they are based on a single event.

c) Standard Deviation

The probability assignment approach for risk analysis in capital budgeting does not provide the decision maker with a precise value indicating about the variability of cash flows and therefore the risk. This limitation is overcome by adoption of standard deviation approach. Standard deviation is a measure of dispersion. It may be defined as the square root of squared deviations calculated from the mean. In case of capital budgeting, this measure is used to compare the variability of possible cash flows of different projects from their respective mean or expected values. A project having a larger standard deviation will be more risky as compared to a project having a smaller standard deviation.

The following steps are taken for calculating the standard deviation of the possible cash flows associated with a project:

- Mean value of possible cash flows is computed;
- Deviations between the mean value and the possible cash flows are found out;
- Deviations are squared;
- Squared deviations are multiplied by the assigned probabilities which give weighted squared deviations;
- The weighted squared deviations are totaled and their square root is found out. The resulting figure is the standard deviation;

d) Coefficient of Variation

Standard deviation is an absolute measure. It is unfit for comparison particularly where projects involve different cash outlays or different expected (or mean) values. In such a case, relative measure of dispersion should be calculated. Coefficient of variation is one of such measures. It is calculated as follows:

$$\text{Coefficient of variation} = \frac{\text{Standard Deviation}}{\text{Expected (or Mean) Cash flow}}$$

(e) Decision Tree Analysis

Decision Tree Analysis is another technique which is helpful in tackling risky capital investment proposals. Decision tree is a graphic display of relationship between a present decision and possible future events, future decisions and their consequences.

The sequence of event is mapped out over time in a format resembling branches of a tree. In other words, it is pictorial representation in tree form which indicates the magnitude, probability and interrelationship of all possible outcomes.

An outstanding feature of decision tree analysis technique is that it links events chronologically with forecasted probabilities and thus gives systematic appearance of decisions and their forecasted results.

Constructing a Decision Tree

The following steps are taken for constructing a decision tree:

a) **Definition of the proposal:** The proposal is defined, i.e., what is exactly required under the proposal, e.g., entering a new market, introducing a new product line, etc.

b) **Identification of Alternatives**: Every proposal will have at least two alternatives – accept or reject. However, there may be more than two alternatives also.

c) **Graphing the Decision Tree:** The decision tree is then laid down showing decision point (i.e., the cash outlay), decision branches (i.e., alternatives available and other data).

d) **Forecasting Cash Flows**: The forecasted cash flows regarding each decision branch are also shown along with the branch. Probabilities are also assigned to each cash flow. Expected values of future returns are calculated and the total expected value for the decision is determined.

e) **Evaluating Results:** Having determined the expected value for each decision, the results are analysed. Some alternatives may look

to be acceptable while others may be weak or unacceptable. The firm may proceed with the profitable alternative or alternatives or may decide to reconsider them because of incomplete data or other reasons.

The technique of decision tree analysis has the advantages of giving an overall view of all the possibilities associated with a project. The management can take a decision keeping the entire picture in mind. However, it has one big disadvantage. Its format may become unwieldy and complex if the project has a long life with different possibilities of cash flows. In such a situation, it becomes almost impossible to understand and derive a proper conclusion from the decision tree analysis.

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Lesson 3.2 - Appraisal of Project Evaluation, Commercial and Social Cost Benefit Analysis

Learning Objectives

- To know the parameters of technical evaluation of projects.
- To know the parameters of commercial evaluation of projects.
- To know the parameters of financial evaluation of projects.
- To know the parameters of economic evaluation of projects.
- To know the parameters of management evaluation of projects.
- To understand the difference between commercial vs. national profitability of projects.
- To get insight into the Social Cost Benefit Analysis Method.

Project Evaluation Methodology

The financial institutions have a detailed appraisal of the project proposal in the following components:

- Technical Evaluation
- Commercial Evaluation
- Financial Evaluation
- Economic Evaluation
- Management Evaluation
- Government Consents

a) Technical Evaluation

The financial institutions have a closer look at the various technical parameters concerning the project.

- The proposed product range and the technical specifications pertaining to them, the extent of scrap generation and disposal, etc, should have been spelt out.

- It is essential to get information on the process know how and that is available, as also the basic engineering package and the associated technical services covering the quality control, pollution control effluent and wastage disposal, collaboration arrangements for the process licence and the consultant services for detail engineering.
- Plant locational aspects also deserve detailed attention, and include soil testing with reference to housing, education, health, recreation, etc., infrastructural facilities for power, water, transport and communication.
- Proper scrutiny is needed in respect of the source of supply of plant and machinery, their quotations, prices, delivery schedules, payment terms, performance guarantee terms, inspection, post supply services, spares, import licenses, installed and production capacities, phasing of production, etc,.
- Raw material requirements, availability, cost, items to imported, consumables needed and availability of alternative materials are also factors that have to be ascertained.
- Detailed information is also sort on the requirements of building for factory and office, and arrangements for architecture, service and supplies.

The project team of the financial institution may consult specialist on the technical matters. Site visits and detailed discussions with the key technical personnel connected with the project are essential steps in the technical evaluation process.

b) Commercial Evaluation

The projected market demands for the products proposed to be manufactured have to be reviewed and verified for reliability, as they have a critical influence on the projects viability. The action plans in respect of advertising, sales promotion, warehousing, and distribution and other relative marketing aspects to be examined.

The market projections in the project could also be cross checked with

- Demand forecast of industry associations;
- The capacity licensed and utilised in the industry;

- Market surveys done on the specific products;
- Forecast of the planning commission
- Projections of the directorate of technical development and other specialised bodies

Where the review establishes the need, the promoter may be asked to revise the estimates of the cost, time and other technical significant parameters.

c) Financial Evaluation

Financial evaluation has the objective of ascertaining the financial viability of the project by close scrutiny of the capital cost, operating cost and revenue projections. Following are the parameters of the financial evaluation of the project:

Debt-equity ratio: the equity shareholding in the total capital structure of the company is determined by the agreed debt equity ratio. While the institutions have the stipulated norms for the debt equity compositions for different categories of industries, these are not very rigid.

Promoters' contribution: The promoter is expected to bring in his share of cost, representative his financial stake in the project. This is referred to as the promoters' contribution. The financial institutions stipulate the quantum of such contributions as a precondition to their project financing. Industries located in the specified categories of backward areas are eligible for central investment subsidies which get reckoned as part of equity.

Debt-service coverage: The cash flow represented but the profit after tax but before depreciation and interest on terms of loans is related to the sum of the instalment due on the principal and the interest on the term loan outstanding. If the cash flow is 1.5 to 2 times the total amount due as above, the project is deemed to be sound and viable.

Repayment schedule: Usually, the institutions allow a moratorium of 2 years from the commencement of commercial production before the repayment of the loan starts. The loan repayment is generally expected to be completed in 8 – 10 years of the commencement of the commercial production.

Syndication: where a group of institutions participate in financing the project, they come to an understanding on the proportion in which they will be providing funds. IDBI is generally expected to take a substantial share in such joint financing.

Conversion: The financial institutions stipulate that they will have a discretion or option to convert term loan and/or debentures into equity on agreed terms. However, such conversion will not lead to equity holding of the institutions being in excess of 40% of the companies issued capital and conversion option will be available only after three years of commencement of production.

Nominee directors: Nominee directors should be appointed on the boards of all the MRTP companies assisted by the institutions in respect of the non MRTP companies, the nominee directors are to be appointed on the selective basis. One or more of the following conditions should be found to exist for having their nominee directors appointed in such instances

- The unit has run into rough weather and is likely to become sick.
- The financial institution holds more than 26% of the share capital.
- Where the stake of the financial institution by way of loan/ investments exceeds ` crores.

Operating Costs and Revenue: Projects of operating costs and revenues, on an annual basis have to be made for a 10 year period, which is scrutinised by the project team of the financial institution. The assumption pertaining to quantities, rates, availability of inputs and services, market demands, price realisation and expectation of capacity utilisation are all subjected to close review.

Extent of financing: The amount and modes of financing depend on the nature and size of the project, the accepted norms in respect of promoter's contribution, debt–equity ratio, debt service coverage, etc. besides factors such as the resources of the financial institution and requirement in respect of listing of securities in the Stock Exchanges

Returns: Financial institution use the different techniques of financial evaluation including pay–back period, internal rate of return,

return on investment etc. depending on the nature of projects being reviewed. It is expected that the project will have a debt service ratio ranging from 1.5 to 2 and will be able to pay a dividend on equity of not less than 10 % within three years of commencement of production

Risks: Careful assessment of the risk is associated with the project is a prime necessity associated may be industry-specific, particular project, its product, the concerned market conditions, the company's capital structure and the nature securities offered by it.

Eventually financial evaluation of project has 4 important aspects

- The appropriateness of the capital cost estimate;
- The reliability of the estimates of the operating costs, revenues and surpluses;
- The adequacy of return on investment to service equity and debt; and
- The matching of financing pattern to the project's requirements.

d) Economic Evaluation

The acceptability of the project from a national perspective also has to be ascertained. From this stand point, the economic evaluation carries out the social cost benefit analysis of the project. The financial costs of the various inputs into the project get converted into social costs with the use of appropriate shadow prices, border prices (international prices), and so also the financial revenues get restated in terms of social gains or border prices. While the above bases are adopted for tradable inputs and outputs, prescribed conversion factors are used for non-tradable items.

Applying the stipulated social rate of discount, the NPV is determined, and if it is positive, the project is considered to be socially desirable. The commonly used method of economic analysis is known as partial Little-Mirrleesmethod. Discounted cash flow analysis with reference to social cause and social benefits and determination for the internal rate of return on these values will give the economic rate of return. If this is in excess of the social rate of discount, the project merits acceptance.

e) Management Evaluation

Management capabilities that will guide the project need also to be assessed, as this constitutes the core requirement for project success. Promoter's past experience in managing enterprises, financial soundness, technical background, etc., are the factors to be examined for getting an appreciation of how effective the project management may be. His/her stake in the project in terms of the capital contributed and commitment to its immediate and long term goals have to be ascertained. The competence and capabilities of key management personnel are to be closely looked at. The specific development plans for improving and sustaining the technical and managerial skills have tobe studied and the assignment of project construction and administrative responsibilities to key project personnel have to be reviewed and approved. Financial institutions also decide on having their nominee directors on the company board.

Government Consents

The financial institutions would also insist on confirmation that the various licences are consents required for the projects have been obtained, among them being:

- Letter of intent
- Industrial licence
- Capital goods clearance
- Import licence
- Foreign exchange permission
- Approval of technical/financial collaboration
- Clearance under MRTP Act
- Consent of the controller of capital issues (SEBI)

Commercial Vs. National Profitability

Public projects like road, railway, bridge and other transport projects, irrigation, projects, power projects, etc for which socio-economic considerations play a significant part, rather than mere commercial profitability. Such projects are analyzed for their net socio-economic benefits and the profitability analysis of such projects is known as social

or national profitability analysis which is nothing but the socio–economic cost benefit analysis done at the national level.

Steps Involved in Determination of Social or National Profitability

1) Real Direct Cost and Real Direct Benefits

National/Social profitability analysis takes into account the real cost of direct costs and real benefit of direct benefits. For instance, some of the inputs may be subsidized. Only the subsidized prices of input is what is relevant for assessing commercial profitability. However, the national profitability analysis takes into account the real cost of inputs i.e. cost of input had they not been subsidized. Accordingly the required adjustment to direct cost of input are made for national profitability analysis.

2) Indirect Costs and Indirect Benefits

National/Social profitability analysis takes into account the indirect costs and indirect benefits to the nation. While a nation bears the indirect cost, the people of the nation enjoy the indirect benefit. Hence, indirect costs and benefits are given due recognition and accounted for in social cost benefit analysis. It is however difficult to assess exactly the quantum of indirect costs and indirect benefits.

Suppose construction of a bridge over a river is taken up. Its indirect benefits may include improved communication facilities reduction in transportation costs, reduction in traveling time, etc., while the indirect cost may include acquisition of private land by the state, removal of industrial, commercial, agricultural activities that prevailed in the land that was acquired, disturbance of ecological balance etc.

National/Social profitability analysis can thus be regarded as a refinement over commercial appraisal taking the hidden factors into account. National/Social profitability analysis is mainly used for evaluating public investment projects. From the society's standpoint, the project should maximize the aggregate consumption or the addition to the flow of goods and services in the economy. While the individual investor looks for maximization on his individual basis, the society's interest should look for maximization of the total output of the economy. The need thus

arises to have an analysis done of social costs and social benefits. The various inputs required for the project are drawn out of the resources of the economy and constitute social costs. The outputs of the project represent the social benefits. The inputs of goods and services and the outputs should be valued with reference to their relative value to society.

Commercial or Financial Profitability

From the national development point of view, there are always more projects compared to the availability of resources and hence the necessity to appraise projects for selection arises. While the obvious choice will be the projects with higher returns, the complexity arises because of the need to appraise projected outcome based on forecasts in a world of uncertainly, particularly in the context of endemic inflation. In the case of large projects, particularly public sector projects involving the building up of infrastructure it is essential to assess the social merits of the investment proposals.

Projects emanate from diverse and dispersed sources, such as individuals firms or institutions, and government at the state and central levels. In situations where the state government is not the owner of the business, the traditional yard stick of commercial or financial profitability is used for selection of projects for implementation. The financial benefits get related to the financial costs of the project and if there is a net surplus the project merit choice. While the process of selection of individual projects thus meets the profit criteria of the individual investors or promoters, the combination of choices may not necessarily result in the most socials profitable allocation of resources. For developing economies this is the very important factor but it cannot be ignored.

Commercial or financial profitability as the sole deciding factor has two major limitations viz.

a) Financial or market values seldom match with social values and
b) What is beneficial to one segment of society may not necessary be so to the entire society.

In financial analysis the market values of input and outputs are reckoned and compared. And since market distortions are many, these

values fail to reflect the relative worth on the society's value scale. From society's stand point, goods and services should be valued in terms of relative contributions to consumption. In the same manner the social value of resource should be reckoned in terms of its opportunity cost, represented by the output or consumption value that it is capable of yielding in its next best alternative use.

In a free market economy the dominance of the forces of demand and supply has the effect of the market prices being kept close to social valuation. In a developing economy however there are several distortions entering into the market prices and they are far removed from their social valuation. The distortions arise from the monopolistic status of many large enterprises a system of administered prices in a controlled economy and from various government policy measures such as taxes, duties, controls and foreign exchange regulations.

A project may confer considerable good to society that does not get reflected in financial projections. Others though financially very rewarding may have some harmful effects on society that the financial results fail to interpret. These effects that are outside the purview of financial projections are known as **externalities** and are essential ingredients in the social profitability computations. The emphasis in social cost benefit analysis is the import on the whole society and not one segment.

Social Cost Benefit Analysis (SCBA)

Cost–benefit analysis is a process for evaluating the merits of a particular project or course of action in a systematic and rigorous way. Social cost–benefit analysis refers to cases where the project has a broad impact across society and, as such, is usually carried out by the government. While the cost and benefits may relate to goods and services that have a simple and transparent measure in a convenient unit (e.g. money), this is frequently not so, especially in the social case. In its essence cost–benefit analysis is extremely, indeed trivially, simple: evaluate costs C and benefits B for the project under consideration and proceed with it if, and only if, benefits match or exceed the costs.

Social Cost Benefits Analysis means to analyze the social cost and total social benefits if we accept any project. We all know that for

completing the big project, we need big investment. In social cost benefit analysis (SCBA), we see whether return or benefits on this investment are more than its cost from point of view of society in which we are living. In public investment, we analyze and compare government expenditure with total benefits to society through SCBA. It is also a good technique of financial evaluation of a project because we reject those projects whose benefits to society are less than their total cost because all the resources are drawn from the society.

The market prices, in the case of developing countries particularly, are substantially at variance with their appropriate social prices. The social costs and benefits will be presented in terms of the domestic currency equivalent of the foreign exchange value, also referred to as unit of account or numeral.

Rationale for SCBA

a) ***Market imperfection:*** **The** following factors are to be considered to understand the market imperfection.

- *Rationing factor:* It means some of raw material prices are controlled by Government and hence, project cost may increase but its social benefits will go to poor community.
- *Regulation for providing minimum wage factor:* It also affects social cost and benefits of any project.
- *Foreign Exchange Regulations factor:* Sometime, projects involve foreign currency transactions. Hence, we should analyze this point also.

b) ***Externalities:*** Externalities are non-cash or benefits which an organization suffer or get if it starts the project. For example, if government lays road near your project plant, you can get this facility without any payment. On the other side, if any other organization is polluting and spreading diseases, it will create adverse impact due to absence of employee because they go to hospitals.

c) ***Tax and Subsidies:*** Tax is levied on the earning of the project and it will reduce the overall benefits. On the other hand, if government gives us subsidy for operating any project, it will count for our cost benefit analysis.

Arriving Net Benefit of Project to Society

With United Nations Development Organization (UNIDO) approach, we can evaluate net benefit from any project. Formula is given below:

	Amount (IN $)
Estimated profitability from a project	XXXXX
Add Net benefits of project in the term of economy	XXXXX
+/- Adjustment for the impact of project on saving and investment	XXXXX
+/- Adjustment for the impact of project on income distribution	XXXXX
Total Net Benefits to Society with the Project	XXXXX

Factors which Complicate SCBA

There are a variety of factors which make SCBA complicate:

- Benefits and costs may accrue to different sets of people. If this is so we need some way to aggregate and compare different benefits and costs across people.
- Benefits and costs may occur at different points in time. In this case we need to compare the value of outcomes at different points in time.
- Benefits and costs may relate to different types of goods and it may be difficult to compare their relative values. This usually occurs when one of the goods does not have an obvious and agreed upon price. For example, we may be spending standard capital goods today in order to obtain environmental benefits tomorrow.
- Benefits and costs may be uncertain.
- Benefits and costs may be difficult to calculate and, as a result, there may be widely differing views about their sizes. One might

think this could be considered under uncertainty, however the two points are rather different: two people agreeing that an outcome follows some probability distribution are different from them arguing about its mean and variance.

The Basic Model

We are considering a project with known (though perhaps uncertain) benefit B and cost C. Our task is to decide whether it is worthwhile. As already discussed, if B and C were denominated in exactly the same terms (i.e. the same good, at the same time) for a single person and with no uncertainty, things would be straightforward. To check whether B is more than C, it involves converting benefits and costs into values that can be easily compared. Equivalently we need to have benefits and costs denominated in terms of some standard good or measure of value. We shall term this good or measure of value as 'numeraire'. In theory, this numeraire could be anything: apples, years of life, acres of rainforest etc. However, given that many (though by no means all) goods are already denominated in terms of money, it is often natural to use a numeraire that is money-metric. We also need to specify money in whose hands. For the purposes of social cost benefit analysis a very natural numeraire is (uncommitted) government funds, i.e., the money the government has but is not yet allocated to any given project. This is a natural numeraire, since it is likely to be government funds which are used for financing the project being considered.

Importance of Social Cost-Benefit Analysis

The elements of costs and benefits are identified both from the point of view of undertaking, implementation and managing the project, and from the point of view of the society. The Project Appraisal Division of the Planning Commission is the main agency that scrutinizes and evaluates all projects after the Public Investment Board has carried out the scrutiny from the financial angle. Together, these two agencies have the responsibility for the planned and the coordinated development of the country.

Maximization of social welfare is the national objective. Public Enterprises constitute an instrument for achieving this objective and, as

such, the selection of their projects requires to be synchronized with the national plan. This synchronization process has two stages.

- First, the sectoral allocation of the resources has to be effected on the basis of approved sectoral plans.
- Then, within the sectoral plans, appropriate projects have to be identified for funding.

Projects are the building blocks of the sectoral investment plans. Social Cost Benefit Analysis is an important method of synchronization of the project's aims with national objectives.

Government investments aim at:

- Growth
- Equitable distribution of gains
- Self-reliance

Social cost benefit analysis enables the qualification of the gains of these objectives and aggregates them into a common numeraire or composite index for determining the acceptability of projects and for assigning priority to any given project in relation to acceptable projects.

The Methodologies used for SCBA

The most favoured among the methods of Social Cost-Benefit Analysis (SCBA) are:

- Little and Mirrlees (L-M) method;
- UNIDO method.

a) Little and Mirrlees (L-M) Method

The Project Appraisal Division (PAD) has adopted a modified simpler version of the Little and Mirrlees method. The focus in Little and Mirrlees method is in identifying the forces which distort the market prices and carrying out the necessary corrections. It defines the numeraire in terms of savings in foreign exchange.

b) UNIDO Method

The UNIDO approach has emphasis in incorporating non–economic objectives in SCBA, and defines the numeraire in terms of Shadow Exchange Rate. Shadow pricing is a technique used when market prices are not available for any good or service.

SCBA Considerations for Various Categories of Investments/Projects

The investment could be in any of three categories:

- Capital intensive industrial investment;
- Infrastructural investment;
- Agriculture, rural development and related projects.

a) Capital Intensive Industrial Projects

The prime consideration in appraising industrial projects in this category is efficiency. The Little and Mirrlees method gives equal weightage to the principle of equity, but with the thrust on efficiency, a modified version is used in evaluating industrial projects. The steps involved are:

- *Eliminate all transfer cost items*, i.e., taxes and duties, including indirect taxes;
- *Value all tradable inputs and outputs at border prices or international resource costs.* This is based on the logic that domestic prices are distorted.
- *All non-tradable items, such as power, transport, etc., are to be evaluated on the basis of marginal cost.* The aim is to eliminate the distortion between the market tariffs and the marginal costs.
- *Foreign exchange involved in the inputs or outputs are valued at specific premia and there should also be a sensitivity analysis* carried out to assess the impact of variations in the premium on foreign exchange.
- The *average social return on capital or the Social Discount rate (SDR) to be used* for evaluation is 12 per cent and the costs and the benefits are to be discounted at this rate.

b) Infrastructural Investment

In the case of infrastructure projects, the classical SCBA is adopted with due emphasis on externalities. The gains to the users of the facilities and the gains to the project are assessed. In enumerating the gains to the users, the attempt is made to understand the gains to society accruing from the project on a multiplier basis.

c) Agriculture, Rural Development and Related Projects

As distinct from the 'growth' projects referred to above, these constitute the 'equity' projects. Though the economic factor is the main consideration in the choice of agricultural projects, importance is also given to the identification of external or consequential benefits accruing from the project to the consumers and other sections of society. A functional distribution of gains is attempted, classifying by occupational and income categories. Priorities for projects with gains to the lowest income strata can thus be determined.

The Social Rate of Discount

The choice of the social rate of discount is a matter of debate. A high rate of discount will favour projects with immediate net benefits, the emphasis being on present consumption. On the other hand, a low rate of discount will favour present saving and future consumption. There is a subjective element in the choice of the discount rate.

Conclusion

*S*CBA has equal validity for large private sector projects too. It should be a discipline that applies to all major investments, in the public or the private sector, to make the system of national planning systematic and effective. There is the need to create the awareness in the private sector of the logical necessity for using SCBA in project appraisal.

Self Assessment Questions

1) What are the traditional methods of evaluating projects financially?

2) Explain the method of evaluating projects financially.

3) What are the sophisticated methods of evaluating projects financially?

4) What is Payback method? What are its advantages and disadvantages?

5) What is ARR method? What are its advantages and disadvantages?

6) What is NPV method?

7) What is PI or BC ratio?

8) What is IRR method?

9) Evaluate the discounted cash flow methods.

10) The initial cost of the project is ` 5000. What is the payback period for this investment if the projected cash flows from a proposed investment are ` 1000, ` 2000 and ` 5000 in the 1st, 2nd and 3rd years respectively.

11) Following are the details of two projects, calculate NPV and PI at 10% and rank them using both the methods. Also calculate IRR of both the projects and rank them.

	Project A (`)	**Project B (`)**
Cost	1,10,000	1,00,000
Cash inflows:		
Year 1	60,000	10,000
Year 2	20,000	10,000
Year 3	10,000	20,000
Year 4	50,000	1,00,000

12) What is risk adjusted discount rate?

13) What is certainty equivalent coefficient?

14) What is sensitivity analysis?

15) What is probability assignment?

16) What is standard deviation?

17) What is coefficient of variation?

18) What is decision tree analysis?

19) What are the steps in decision tree analysis?

20) Explain the project evaluation methodology followed by financial institutions.

21) What are the dimensions of technical evaluation of projects?

22) What are the dimensions of financial evaluation of projects?

23) What are the dimensions of economic evaluation of projects?

24) What are the dimensions of management evaluation of projects?

25) What is commercial/financial profitability?

26) What are the steps involved in determination of social or national profitability?

27) What are externalities?

28) What is social cost benefit analysis?

29) Explain the rationale for SCBA?

30) How to arrive at net benefit of project to the society?

31) Explain the factors which complicate SCBA.

32) Explain the importance of SCBA.

33) Explain the methodologies used for SCBA.

34) Explain the SCBA considerations used for appraising various categories of investments/projects.

CASE STUDY
Financial Evaluation of Projects

The following information belongs to four investment opportunities:

	1	2	3	4
Funds needed	(960,000)	(720,000)	(540,000)	(900,000)
Present value of cash inflows	1,134,540	866,800	672,280	1,045,940
Net present value	$174,540	$146,800	$132,280	$145,940
Project life	6 years	12 years	6 years	3 years
Internal rate of return (IRR)	16%	14%	18%	19%

Due to limited funds, all projects cannot be accepted.

Required

1. Compute profitability index (present value index) for all the projects.
2. Rank the four investment projects according to (a). net present value (b). profitability index (c). internal rate of return

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UNIT - IV

The project network tool is used for planning, scheduling and monitoring project progress. The network is developed from the information collected for the WBS and is a graphic flowchart of the project job plan. The network shows the project activities that must be completed, the sequences (steps), the interdependencies (how individual steps rely on other steps for completion), and in most cases the times for the activities to start and finish along the longest path through the network – the critical path. In this unit let us understand how to a) develop and construct network for projects using Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM); b) crash project network; do resource leveling and allocation; and how to avoid cost and time overruns. This unit also explains the steps in the project appraisal process, project control process and project audit process besides evaluation of team, team members and project manager.

Unit Structure

Lesson 4.1 - Developing Project Network Using PERT and CPM

Learning Objectives

- To learn how to develop the project networks
- To know the basic rules of constructing network diagrams.
- To know how to construct project networks using PERT
- To learn how to construct project network using CPM

Developing the Project Network

The project network is the tool used for planning, scheduling, and monitoring project progress. The network is developed from the information collected for the WBS and is a graphic flow chart of the project job plan. The network depicts the project activities that must be completed, the logical sequences, the inter dependencies of the activities to be completed, and in most cases the times for the activities to start and finish along with the longest path(s) through the network—the critical path. The network is the framework for the project information system that will be used by the project managers to make decisions concerning project time, cost, and performance.

The network is the framework that will be used by the project managers to make decisions concerning project time, cost and performance. Once the network is developed, it is very easy to modify or change when unexpected events occur as the project progresses. Developing the project networks takes time for someone or some group to develop; therefore, they cost money. Are networks really worth the struggle? The answer is definitely yes, except in cases where the project is considered trivial or very short in duration. The network is easily understood by others because the network presents a graphic display of the flow and sequence of work through the project. Once the network is developed, it is very easy to modify or change when unexpected events occur as the project progresses. For example, if materials for an activity are delayed, the impact can be quickly assessed and the whole project revised in only a few minutes

with the computer. These revisions can be communicated to all project participants quickly (for example, via e–mail or project Web site).

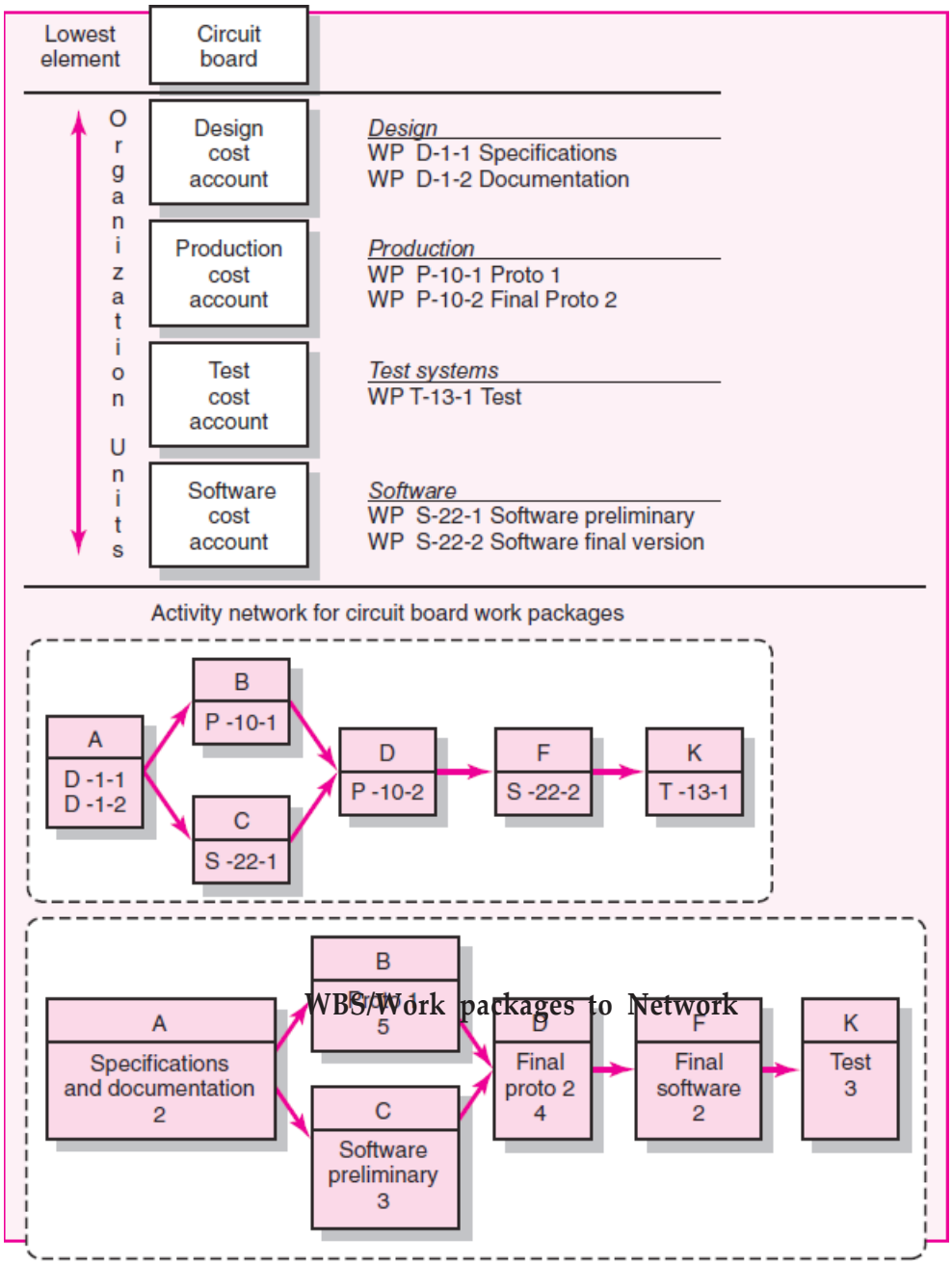
Objectives of Project Network

The project network provides invaluable information and insights above the following:

- Basis for scheduling labour and equipment;
- Enhances communication that brings together all managers and groups in meeting the time, cost, and performance objectives of the project;
- Provides an estimate of the time the project will take (duration);
- gives the times when activities can start or finish and when they can be delayed;
- Provides the starting point for budgeting the cash flow (when money needs to be received and spent on various elements) of the project.
- Identifies which activities are "critical" and, therefore, should not be delayed if the project is to be completed as planned.
- Highlights which activities to consider if the project needs to be compressed to meet a deadline.

Basically, project networks minimize surprises by getting the plan out early and allowing corrective feedback. A commonly heard statement from practitioners is that the project network represents three–quarters of the planning process. Perhaps this is an exaggeration, but it signals the perceived importance of the network to project managers in the field. Project networks are developed from the WBS. *The project network is a visual flow diagram of the sequence, interrelationships, and dependencies of all the activities that must be accomplished to complete the project.* An **activity** is an element in the project that consumes time—for example, work or waiting. Work packages from the WBS are used to build the activities found in the project network. An activity can include one or more work packages. The activities are placed in a sequence that provides for orderly completion of the project. Networks are built using **nodes** (boxes) and **arrows** (lines). The node depicts an activity, and the arrow

shows dependency and project flow. The following diagram shows the WBS/ Work packages to network for a software project:



WBS/Work packages to Network

The figure shows a segment of the WBS example and how the information is used to develop a project network. The lowest level deliverable in the figure is "circuit board." The cost accounts (design, production, test, software) denote project work, organization unit responsible, and time phased budgets for the work packages. Each cost account represents one or more work packages. For example, the design cost account has two work packages (D–1–1 and D–1–2)—specifications and documentation. The software and production accounts also have two

work packages. Developing a network requires sequencing tasks from all work packages that have measurable work.

The figure also traces how work packages are used to develop a project net work. You can trace the use of work packages by the coding scheme. For example, activity A uses work packages D-1-1 and D-1-2 (specifications and documentation),while activity C uses work package S-22-1. This methodology of selecting work packages to describe activities is used to develop the project network, which sequences and fix times for the project activities. Care must be taken to include all work packages. The manager derives activity time estimates from the task times in the work package. For example, activity B (proto 1) requires five weeks to complete; activity K (test) requires three weeks to complete. After computing the activity's **early and late times,** the manager can schedule resources and time-phase budgets(with dates).

Integrating the work packages and the network represents a point where the management process often fails in practice. The primary explanations for this failure are that

(1) Different groups (people) are used to define work packages and activities and

(2) The WBS is poorly constructed and not deliverable/output-oriented.

Integration of the WBS and project network is crucial to effective project management. The project manager must be careful to guarantee continuity by having some of the same people who defined the WBS and work packages develop the network activities.

Networks provide the project schedule by identifying dependencies, sequencing, and timing of activities, which the WBS is not designed to do. The primary inputs for developing a project network plan are work packages. Remember, a work package is defined independently of other work packages, has definite start and finish points, requires specific resources, includes technical specifications, and has cost estimates for the package. However, dependency, sequencing, and timing of each of these factors are not included in the work package. A network activity can include one or more work packages.

Constructing a Project Network

Terminology

Every field has its jargon that allows colleagues to communicate comfortably with each other about the techniques they use. Project managers are no exception. Here are some terms used in building project networks.

Activity: For project managers, an activity is an element of the project that requires time. It may or may not require resources. Typically an activity consumes time—either while people work or while people wait. Examples of the latter are time waiting for contracts to be signed, materials to arrive, drug approval by the government, budget clearance, etc. Activities usually represent one or more tasks from a work package. Descriptions of activities should use verb/noun format: for example, develop product specifications.

Merge activity: This is an activity that has more than one activity immediately preceding it (more than one dependency arrow flowing to it).

Parallel activities: These are activities that can take place at the same time, if the manager wishes. However, the manager may choose to have parallel activities not occur simultaneously.

Path: A sequence of connected, dependent activities.

Critical path: When this term is used, it means the path(s) with the longest duration through the network; if an activity on the path is delayed, the project is delayed the same amount of time.

Event: This term is used to represent a point in time when an activity is started or completed. It does not consume time.

Burst activity: This activity has more than one activity immediately following it (more than one dependency arrow flowing from it).

Two Approaches

The two approaches used to develop project networks are known as **Activity-On-Node(AON)** and **Activity-On-Arrow (AOA).** Both methods use two building blocks—the arrow and the node. Their names derive from the fact that the former uses anode to depict an activity, while the second uses an arrow to depict an activity. From the first use of these two approaches in the late 1950s, practitioners have offered many enhancements; however, the basic models have withstood the test of time and still prevail with only minor variations in form. In practice, the Activity–On–Node (AON) method has come to dominate most projects. Hence, this lesson will deal primarily with AON.

There are good reasons for students of project management to be proficient in both methods. Different departments and organizations have their "favorite" approaches and are frequently loyal to software that is already purchased and being used. New employees or outsiders are seldom in a position to govern choice of method. If subcontractors are used, it is unreasonable to ask them to change their whole project management system to conform to the approach you are using. The points that a project manager should feel comfortable moving among projects that use either AON or AOA.

Basic Rules in Developing Project Networks

The following eight rules apply in general when developing a project network:

1. Networks flow typically from left to right.
2. An activity cannot begin until all preceding connected activities have been completed.
3. Arrows on networks indicate precedence and flow. Arrows can cross over each other.
4. Each activity should have a unique identification number.
5. An activity identification number must be larger than that of any activities that precede it.
6. Looping is not allowed (in other words, recycling through a set of activities cannot take place).

7. Conditional statements are not allowed (that is, this type of statement should not appear: If successful, do something; if not, do nothing).
8. Experience suggests that when there are multiple starts, a common start node can be used to indicate a clear project beginning on the network. Similarly, a single project end node can be used to indicate a clear ending.

Activity-on-Node (AON) Fundamentals

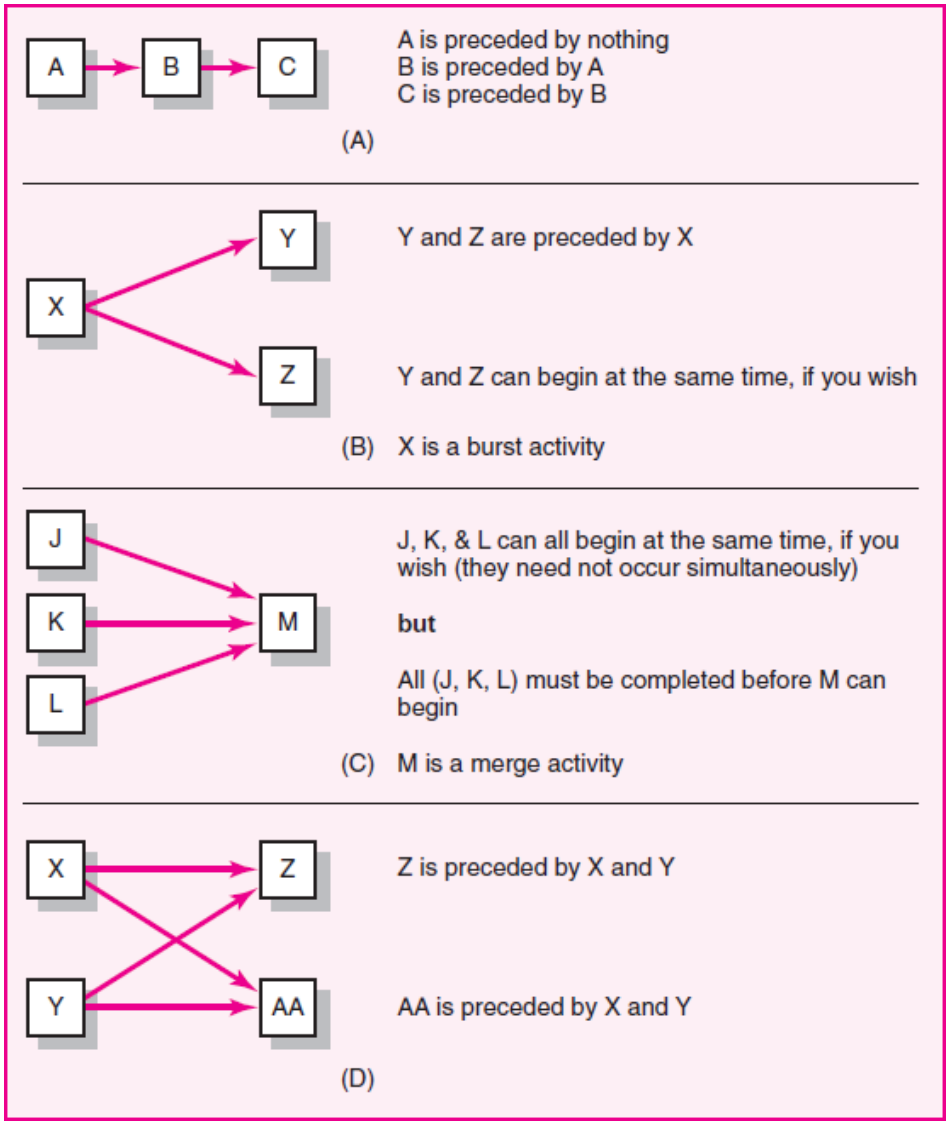
The wide availability of personal computers and graphics programs has served as an impetus for use of the activity-on-node (AON) method (sometimes called the precedence diagram method). An **activity** is represented by a node (box). The node can take many forms, but in recent years the node represented as a rectangle(box) has dominated. The dependencies among activities are depicted by arrows between the rectangles (boxes) on the AON network.

The arrows indicate how the activities are related and the sequence in which things must be accomplished. The length and slope of the arrow are arbitrary and set for convenience of drawing the network. The letters in the boxes serve here to identify the activities while you learn the fundamentals of network construction and analysis. In practice, activities have identification numbers and descriptions.

The following figure shows a few typical uses of building blocks for the AON network construction.

There are three basic relationships that must be established for activities included in a project network. The relationships can be found by answering the following three questions for each activity:

1) Which activities must be completed immediately before this activity? These activities are called predecessor activities.
2) Which activities must immediately follow this activity? These activities are called successor activities.
3) Which activities can occur while this activity is taking place? This is known as a concurrent or parallel relationship.



Activity-on-Node Network Fundamentals

Sometimes a manager can use only questions 1 and 3 to establish relationships. This information allows the network analyst to construct a graphic flow chart of the sequence and logical interdependencies of project activities.

Part A of the figure is analogous to a list of things to do where you complete the task at the top of the list first and then move to the second task, etc. This figure tells the project manager that activity A must be completed before activity B can begin, and activity B must be completed before activity C can begin. Part B of the figure tells us that activities Y and Z cannot begin until activity X is completed. This figure also indicates that activities Y and Z can occur concurrently or simultaneously if the project manager wishes; however, it is not a necessary condition. For example,

pouring a concrete driveway (activity Y) can take place while landscape planting (activity Z) is being accomplished, but land clearing (activity X) must be completed before activities Y and Z can start. Activities Y and Z are considered parallel activities. Parallel paths allow concurrent effort, which may shorten time to do a series of activities. Activity X is sometimes referred to as a burst activity because more than one arrow bursts from the node. The number of arrows indicates how many activities immediately follow activity X.

Part C of the figure shows the activities J, K, and L can occur simultaneously if desired, and activity M cannot begin until activities J, K, and L are all completed. Activities J, K, and L are parallel activities. Activity M is called a Merge activity because more than one activity must be completed before M can begin. Activity M could also be called a milestone—a significant accomplishment.

In Part D of the figure, activities X and Y are parallel activities that can take place at the same time; activities Z and AA are also parallel activities. But activities Z and AA cannot begin until activities X and Y are both completed.

Network Analysis Techniques

A convenient analytical and visual technique of **PERT** and **CPM** prove extremely valuable in assisting the managers in managing the projects.

PERT stands for *Project Evaluation and Review Technique* and developed during 1950's.The technique was developed and used in conjunction with the planning and designing of the Polaris missile project.

CPM stands for *Critical Path Method* which was developed by DuPont Company and applied first to the construction projects in the chemical industry.

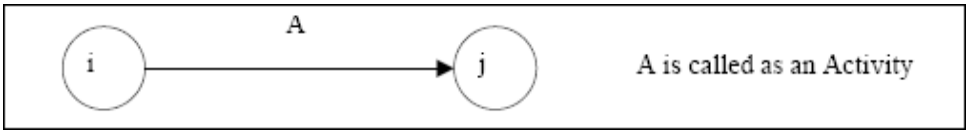
Though both PERT and CPM techniques have similarity in terms of concepts, the basic difference is that the CPM has single time estimate and PERT has three time estimates for activities and uses probability theory to find the chance of reaching the scheduled time.

Components of PERT/CPM Network

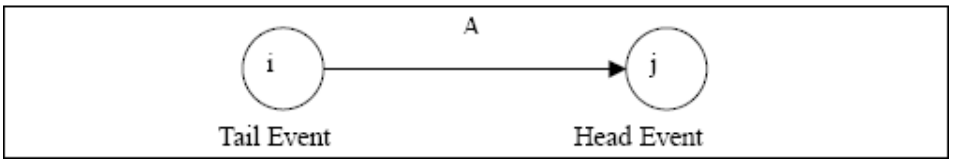
PERT / CPM networks contain two major components:

- Activities, and
- Events

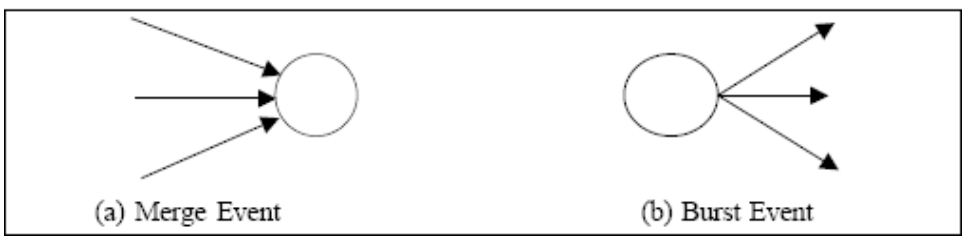
Activity: An activity represents an action and consumption of resources (time, money, energy) required to complete a portion of a project. Activity is represented by an arrow.



Event: An event (or node) will always occur at the beginning and end of an activity. The event has no resources and is represented by a circle. The i^{th} event and j^{th} event are the tail event and head event respectively.

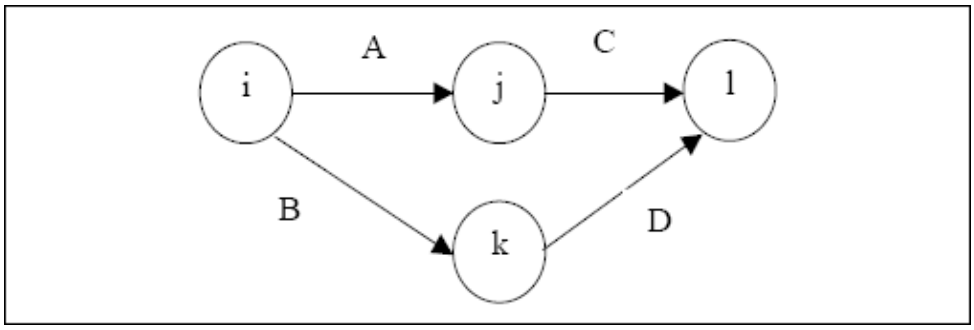


Merge and Burst Events: One or more activities can start and end simultaneously at an event.

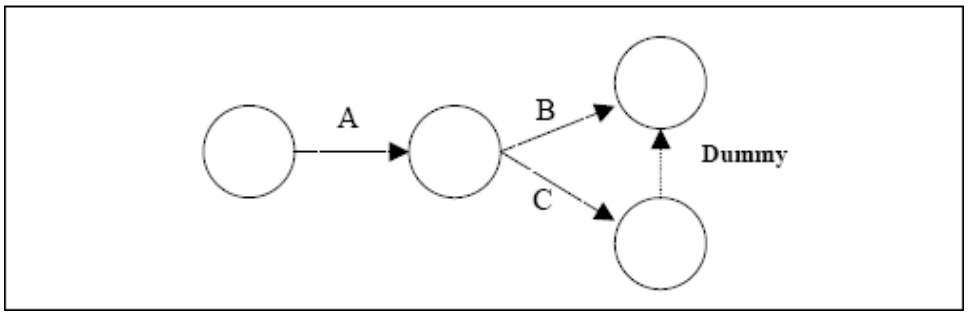


Preceding and Succeeding Activities: Activities performed before given events are known as preceding activities, and activities performed after given events are known as succeeding activities.

In the following figure, Activities A and B precede activities C and D respectively.



Dummy Activity: An imaginary activity which does not consume any resource and time is called a dummy activity. Dummy activities are simply used to represent a connection between events in order to maintain logic in the network. It is represented by a dotted line in a network, see the following figure:



Critical Path Analysis

The critical path for any network is the longest path through the entire network. Since all activities must be completed to complete the entire project, the length of the critical path is also the shortest time allowable for completion of the project. Thus, if the project is to be completed in that shortest time, all activities on the critical path must be started as soon as possible. These activities are called critical activities.

If the project has to be completed ahead of the schedule, then the time required for at least one of the critical activity must be reduced. Further, any delay in completing the critical activities will increase the project duration. The activity, which does not lie on the critical path, is called non-critical activity. These non-critical activities may have some slack time. The slack is the amount of time by which the start of an activity may be delayed without affecting the overall completion time of the project. But a critical activity has no slack. To reduce the overall project

time, it would require more resources (at extra cost) to reduce the time taken by the critical activities to complete.

c) Scheduling of Activities: Earliest Time (TE) and Latest Time (TL)

Before the critical path in a network is determined, it is necessary to find the earliest and latest time of each event to know the earliest expected time (TE) at which the activities originating from the event can be started and to know the latest allowable time (TL) at which activities terminating at the event can be completed.

- Procedure for Forward Pass Computations (to calculate Earliest Time – TE)

Step 1: Begin from the start event and move towards the end event.

Step 2: Put TE = 0 for the start event.

Step 3: Go to the next event (i.e., node 2) if there is an incoming activity for event 2, add to calculate TE of previous event (i.e., event 1) and activity time.

Note: If there are more than one incoming activities, calculate TE for all incoming activities and take the maximum value. This value is the TE for event 2.

Step 4: Repeat the same procedure from step 3 till the end event.

- Procedure for Backward Pass Computations (to calculate Latest Time TL)

Step 1: Begin from end event and move towards the start event. Assume that the direction of arrows is reversed.

Step 2: Latest Time TL for the last event is the earliest time, TE of the last event.

Step 3: Go to the next event, if there is an incoming activity, subtract the value of TL of previous event from the activity duration time. They arrived value is TL for that event. If there are more than one incoming activities, take the minimum TE value.

Step 4: Repeat the same procedure from step 2 till the start event.

d) Determination of Float and Slack Times

As discussed earlier, the non-critical activities have some slack or float. The float of an activity is the amount of time available by which it is possible to delay its completion time without extending the overall project completion time. Consider,

t_{ij} = duration of activity

TE = earliest expected time

TL = latest allowable time

ES_{ij} = earliest start time of the activity

EF_{ij} = earliest finish time of the activity

LS_{ij} = latest start time of the activity

LF_{ij} = latest finish time of the activity

Total Float TF_{ij}: The total float of an activity is the difference between the latest start time and the earliest start time of that activity.

$$TF_{ij} = LS_{ij} - ES_{ij} \quad \text{.....(1)}$$

or

$$TF_{ij} = (TL - TE) - t_{ij} \quad \text{.....(2)}$$

Free Float FF_{ij}: The time by which the completion of an activity can be delayed from its earliest finish time without affecting the earliest start time of the succeeding activity is called free float.

$$FF_{ij} = (E_j - E_i) - t_{ij} \quad \text{.....(3)}$$

FF_{ij}= Total float – Head event slack

Independent Float IF_{ij}: The amount of time by which the start of an activity can be delayed without affecting the earliest start time of any immediately following activities, assuming that the preceding activity has finished at its latest finish time.

$$IF_{ij} = (E_j - L_i) - t_{ij} \quad \text{.....(4)}$$

IF_{ij}= Free float – Tail event slack

Where tail event slack = $L_i - E_i$

The negative value of independent float is considered to be zero.

Critical Path: After determining the earliest and the latest scheduled times for various activities, the minimum time required to complete the project is calculated. In a network, among various paths, the longest path which determines the total time duration of the project is called the critical path. The following conditions must be satisfied in locating the critical path of a network.

An activity is said to be critical only if both the conditions are satisfied.

1. TL – TE = 0
2. $TL_j - t_{ij} - TE_j = 0$

Example: A project schedule has the following characteristics as shown in Table below:

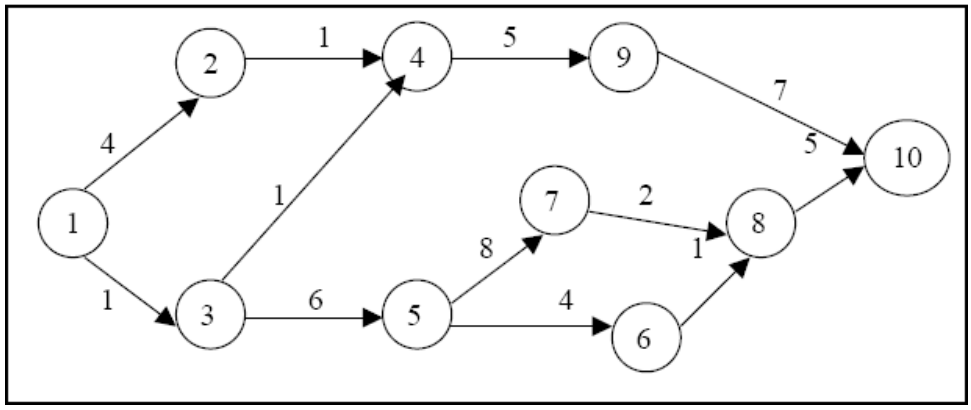
Activity	Name	Time	Activity	Name	Time (days)
1-2	A	4	5-6	G	4
1-3	B	1	5-7	H	8
2-4	C	1	6-8	I	1
3-4	D	1	7-8	J	2
3-5	E	6	8-10	K	5
4-9	F	5	9-10	L	7

a) Construct PERT network.

b) Compute TE and TL for each activity.

c) Find the critical path.

a) From the data given in the problem, the activity network is constructed as shown in Figure given below



b) To determine the critical path, compute the earliest time TE and latest time TL for each of the activity of the project. The calculations of TE and TL are as follows:,

To calculate TE for all activities

TE1 = 0

TE2 = TE1 + t1, 2 = 0 + 4 = 4

TE3 = TE1 + t1, 3 = 0 + 1 =1

TE4 = max (TE2 + t2, 4 and TE3 + t3, 4)

= max (4 + 1 and 1 + 1) = max (5, 2)

= 5 days

TE5 = TE3 + t3, 6 = 1 + 6 = 7

TE6 = TE5 + t5, 6 = 7 + 4 = 11

TE7 = TE5 + t5, 7 = 7 + 8 = 15

TE8 = max (TE6 + t6, 8 and TE7 + t7, 8)

= max (11 + 1 and 15 + 2) = max (12, 17)

= 17 days

TE9 = TE4 + t4, 9 = 5 + 5 = 10

TE10 = max (TE9 + t9, 10 and TE8 + t8, 10)

= max (10 + 7 and 17 + 5) = max (17, 22)

= 22 days

To calculate TL for all activities

TL10 = TE10 = 22

TL9 = TE10 – t9,10 = 22 – 7 = 15

TL8 = TE10 – t8, 10 = 22 – 5 = 17

TL7 = TE8 – t7, 8 = 17 – 2 = 15

TL6 = TE8 – t6, 8 = 17 – 1 = 16

TL5 = min (TE6 – t5, 6 and TE7 – t5, 7)

= min (16 – 4 and 15 –8) = min (12, 7)

= 7 days

TL4 = TL9 – t4, 9 = 15 – 5 =10

TL3 = min (TL4 – t3, 4 and TL5 – t3, 5)

= min (10 – 1 and 7 – 6) = min (9, 1)

= 1 day

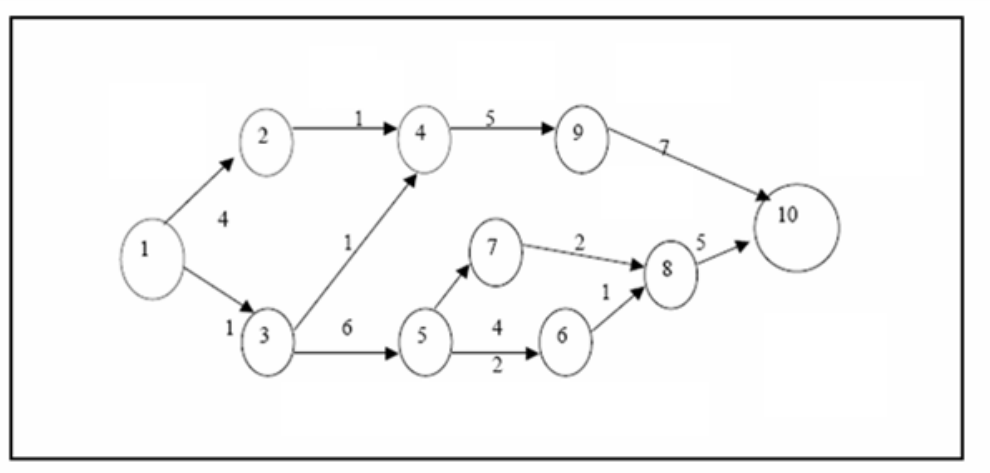
TL2 = TL4 – t2, 4 = 10 – 1 = 9

TL1 = Min (TL2 – t1, 2 and TL3 – t1, 3)

= Min (9 – 4 and 1 – 1) = 0

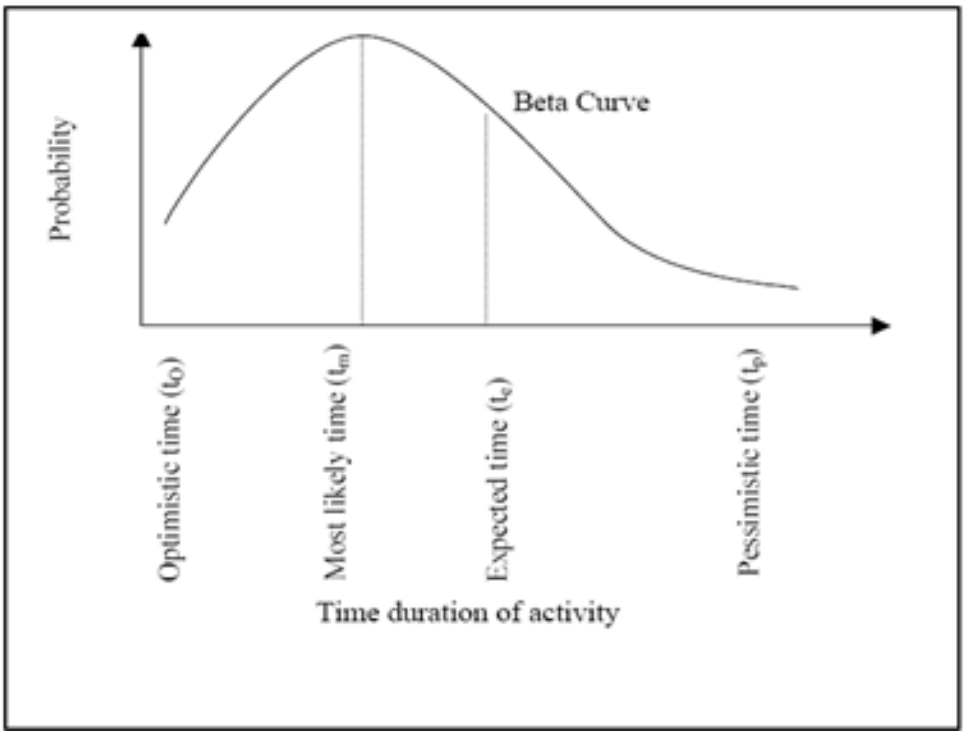
Activity	Activity Name	Normal Time (t_{ij})	Earliest Time (TE)		Latest Time (TL)		Total Float
			Start(ES)	Finish(EF)	Start(LS)	Finish(LF)	
1–2	A	4	0	4	5	9	5
1–3	B	1	0	1	0	1	0
2–4	C	1	4	5	9	10	5
3–4	D	1	1	2	9	10	8
3–5	E	6	1	7	1	7	0
4–9	F	5	5	10	10	15	5
5–6	G	4	7	11	12	16	5
5–7	H	8	7	15	7	15	0
6–8	I	1	11	12	16	17	5
7–8	J	2	15	17	15	17	0
8–10	K	5	17	22	17	22	0
9–10	L	7	10	17	15	22	5

c) From the Table, we observe that the activities 1 – 3, 3 – 5, 5 – 7, 7– 8 and 8 – 10 are critical activities as their floats are zero.



Project Evaluation Review Technique (PERT)

In the critical path method, the time estimates are assumed to be known with certainty. In certain projects like research and development, new product introductions, it is difficult to estimate the time of various activities. Hence, PERT is used in such projects with a probabilistic method using three time estimates for an activity, rather than a single estimate, as shown in the following figure.



Optimistic time (t_O): It is the shortest time taken to complete the activity. It means that if everything goes well then there is more chance of completing the activity within this time.

Most likely time (t_m): It is the normal time taken to complete an activity, if the activity were frequently repeated under the same conditions.

Pessimistic time (t_p): It is the longest time that an activity would take to complete. It is the worst time estimate that an activity would take if unexpected problems are faced.

Taking all these time estimates into consideration, the expected time of an activity is arrived at. The average or mean (T_a) value of the activity duration is given by,

$$T_a = \frac{t_0 + 4tm + tp}{6}$$

$$= \frac{4 + 4(6) + 8}{6} = \frac{36}{6} = 6 \text{ days for activity A}$$

The variance of the activity time is calculated using the formula,

$$\sigma_i^2 = \left(\frac{t_p - t_0}{6} \right)^2$$

Probability for Project Duration

The probability of completing the project within the scheduled time (Ts) or contracted time may be obtained by using the standard normal deviate where Te is the expected time of project completion.

$$Z_0 = \frac{T_s - T_e}{\sqrt{\Sigma\sigma^2 \text{ in critical path}}}$$

Probability of completing the project within the scheduled time is,

$$P(T \leq T_s) = P(Z \leq Z_0) \text{ (from normal tables)} \quad \text{.....(8)}$$

Example

An R & D project has a list of tasks to be performed whose time estimates are given in the Table as follows.

a) Draw the project network.

b) Find the critical path.

c) Find the probability that the project is completed in 19 days. If the probability is lessthan20%, find the probability of completing it in 24 days.

Activity i j	Activity Name	T_0	t_m (in days)	t_p
1-2	A	4	6	8
1-3	B	2	3	10
1-4	C	6	8	16
2-4	D	1	2	3
3-4	E	6	7	8
3-5	F	6	7	14
4-6	G	3	5	7
4-7	H	4	11	12
5-7	I	2	4	6
6-7	J	2	9	10

Solution

Time expected for each activity is calculated using the formula (5):

$$T_a = \frac{t_0 + 4tm + tp}{6}$$

Similarly, the expected time is calculated for all the activities.

$$= \frac{4 + 4(6) + 8}{6} = \frac{36}{6} = 6 \text{ days for activity A}$$

The variance of activity time is calculated using the formula:

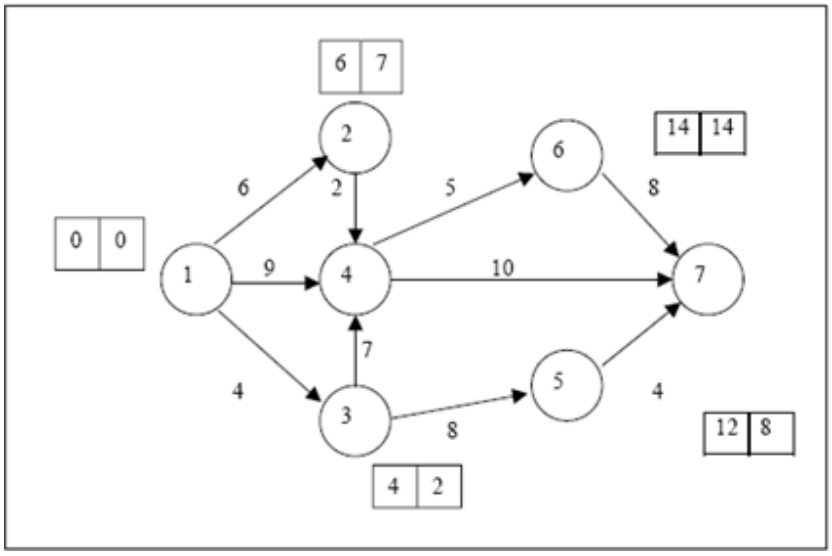
$$\sigma_i^2 = \left(\frac{t_p - t_0}{6} \right)^2$$

Similarly, variances of all the activities are calculated.

$$= \left(\frac{8-4}{6} \right)^2 = 0.444$$

Activity	T_o	T_m	T_p	T_s	σ^2
1-2	4	6	8	6	0.444
1-3	2	3	10	4	1.777
1-4	6	8	16	9	2.777
2-4	1	2	3	2	0.111
3-4	6	7	8	7	0.111
3-5	6	7	14	8	1.777
4-6	3	5	7	5	0.444
4-7	4	11	12	10	1.777
5-7	2	4	6	4	0.444
6-7	2	9	10	8	1.777

The Network Diagram:



Calculate the time earliest (TE) and time Latest (TL) for all the activities.

From the network diagram Figure, the critical path is identified as1–4, 4–6, 6–7, with project duration of 22 days.

The probability of completing the project within 19 days is given by, P ($Z<Z_0$):

To find Z_0,

$$Z_0 = \left(\frac{T_s - T_e}{\sqrt{\Sigma\sigma \text{ in critical path}}} \right)$$

$$= \left(\frac{19 - 22}{\sqrt{2.777 + 0.444 + 1.777}} \right)$$

$$= \left(\frac{-3}{\sqrt{5}}\right) = -1.3416$$

We know, P (Z <Z Network Model 0) = 0.5 – z (1.3416) (from normal tables, z (1.3416) = 0.4099)= 0.5 – 0.4099

= 0.0901

= 9.01%

Thus, the probability of completing the R & D project in 19 days is 9.01%.

Since the probability of completing the project in 19 days is less than 20% as in question, we find the probability of completing it in 24 days.

$$Z_0 = \frac{T_s - T_e}{\sqrt{\Sigma\sigma \text{ in critical path}}}$$

$$= \left(\frac{24-22}{\sqrt{5}}\right) = \left(\frac{2}{\sqrt{5}}\right) = 0.8944 \text{ days}$$

$$P(Z \leq Z_0) = 0.5 - Y\ (0.8944) \quad \text{(from normal tables, } Y\ (0.8944) = 0.3133)$$

$$= 0.5 + 0.3133$$

$$= 0.8133$$

$$= 81.33\%$$

****

Lesson 4.2 - Crashing and Resource Levelling of Projects

Learning Objectives

- To learn how to crash project networks
- To learn the technique of resource leveling
- To learn the technique of resource allocation.

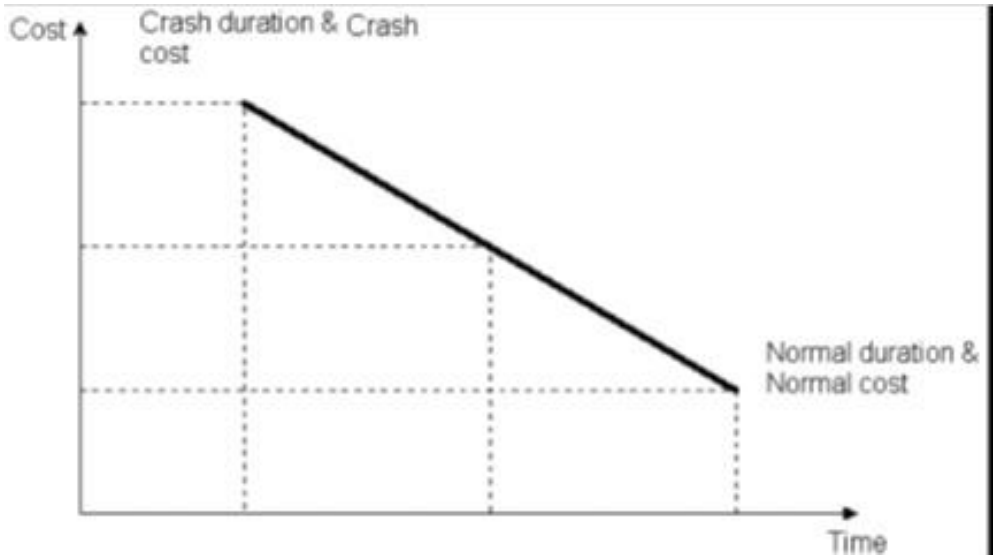
Crashing of Project Network

Crashing refers to a particular variety of project schedule compression which is performed for the purposes of decreasing total period of time (also known as the total project schedule duration). The diminishing of the project duration typically take place after a careful and thorough analysis of all possible project duration minimization alternatives in which any and all methods to attain the maximum schedule duration for the least additional cost.The objective of crashing a network is to determine the optimum project schedule. Crashing may also be required to expedite the execution of a project, irrespective of the increase in cost. Each phase of the project consumes some resources and hence has cost associated with it. In most of the cases cost will vary to some extent with the amount of time consumed by the design of each phase. The total cost of project, which is aggregate of the activities costs will also depends upon the project duration, can be cut down to some extent. The aim is always to strike a balance between the cost and time and to obtain an optimum project schedule. An optimum minimum cost project schedule implies lowest possible cost and the associated time for the project management.

Activity Time-Cost Relationship

A simple representation of the possible relationship between the duration of an activity and its direct costs appears in the following figure. Shortening the duration on an activity will normally increase its direct cost. A duration which implies minimum direct cost is called the normal duration and the minimum possible time to complete an activity is called

crash duration, but at a maximum cost. The linear relationship shown above between these two points implies that any intermediate duration could also be chosen.



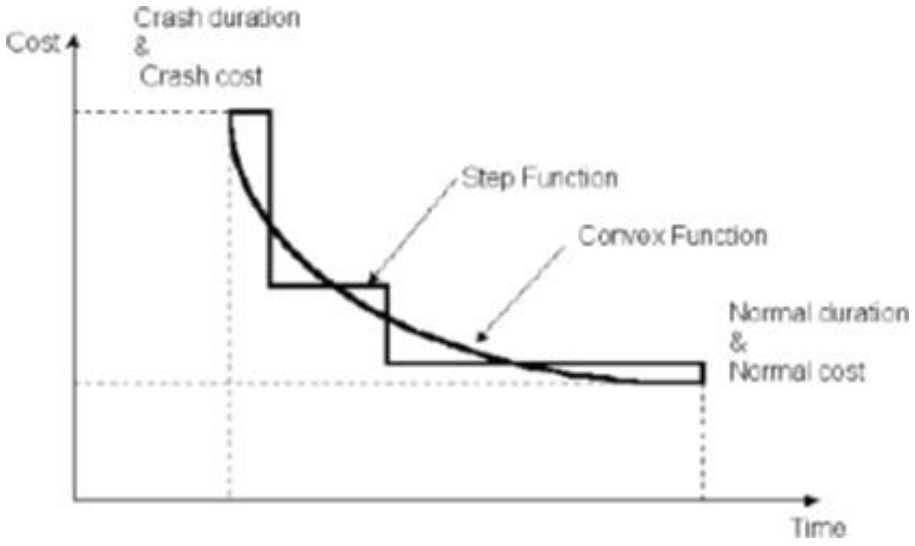
Linear time and cost trade-off for an activity

It is possible that some intermediate point may represent the ideal or optimal trade–off between time and cost for this activity. The slope of the line connecting the normal point (lower point) and the crash point (upper point) is called the cost slope of the activity. The slope of this line can be calculated mathematically by knowing the coordinates of the normal and crash points:

Cost slope = (crash cost–normal cost)/ (normal duration crash duration)

As the activity duration is reduced, there is an increase in direct cost. A simple case arises in the use of overtime work and premium wages to be paid for such overtime.

Also overtime work is more prone to accidents and quality problems that must be corrected, so indirect costs may also increase. So, do not expect a linear relationship between duration and direct cost but convex function as shown in the following figure.



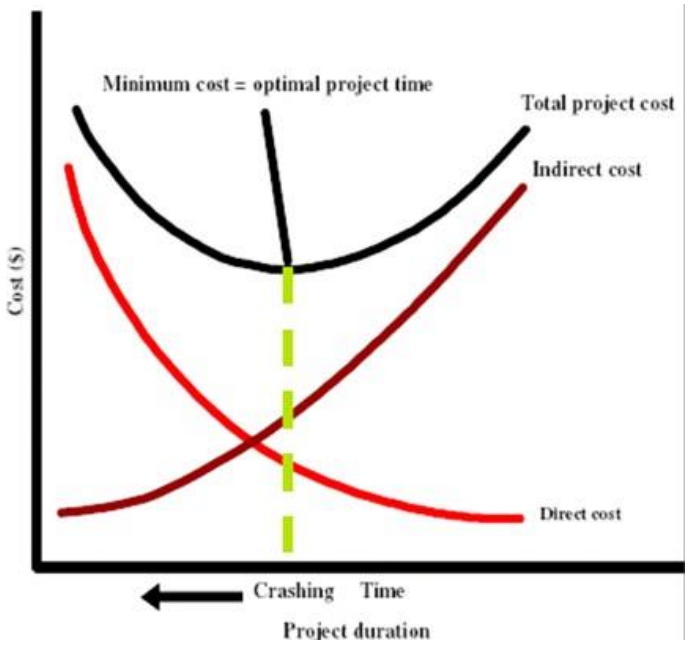
Non-linear time and cost trade-off for an activity

Project Time-Cost Relationship

Total project costs include both direct costs and indirect costs of performing the activities of the project. If each activity of the project is scheduled for the duration that results in the minimum direct cost (normal duration) then the time to complete the entire project might be too long and substantial penalties associated with the late project completion might be incurred. At the other extreme, a manager might choose to complete the activity in the minimum possible time, called crash duration, but at a maximum cost.

Thus, planners perform what is called time cost trade–off analysis to shorten the project duration. This can be done by selecting some activities on the critical path to shorten their duration. As the direct cost for the project equals the sum of the direct costs of its activities, then the project direct cost will increase by decreasing its duration. On the other hand, the indirect cost will decrease by decreasing the project duration, as the indirect cost are almost a linear function with the project duration.

The below figure shows the direct and indirect cost relationships with the project duration. The project total time–cost relationship can be determined by adding up the direct cost and indirect cost values together. The optimum project duration can be determined as the project duration that results in the least project total cost.



Project time-cost relationship

Materials and Method:

Step1: Calculate Earliest time Estimates for all the activities. It is calculated as

T_E = Maximum of all ($T_E^j + t_E^{ij}$) for all i , j leading into the event.
where T_E^j is the earliest expected time of the successor event j.
T_E^i is the earliest expected time of the predecessor event i. and
t_E^{ij} is the expected time of activity ij.

Step 2: Calculate Latest time Estimates for all the activities. It is calculated as

T_L = Minimum of all ($T_L^i - t_E^{ij}$) for all i, j leading into the event
where T_L^i is the latest allowable occurrence time for event i.
T_L^j is the latest allowable occurrence time for event j and
t_E^{ij} is the expected time of activity ij.

Step 3: After knowing the TE and TL values for the various events in the network, the critical path activities can be identified by applying the following conditions:

1) T_E and T_L values for the tail event of the critical activity are the same i.e., $T_E^i = T_L^i$.
2) T_E and T_L values for the head event of the critical activity are the same i.e., $T_E^j = T_L^j$.
3) For the critical activity, $T_E^j - T_E^i = T_L^j - T_L^i$

Step 4: Find the project cost by the formula

Project cost = (Direct cost + (Indirect cost*project duration)

Step 5: Find the minimum cost slope by the formula

Cost slope = (Crash cost – Normal cost)/(Normal time – Crash time)

Step 6: Identify the activity with the minimum cost slope and crash that activity by one day. Identify the new critical path and find the cost of the project by formula

Project Cost = ((Project Direct Cost + Crashing cost of crashed activity) + (Indirect Cost*project duration))

Iteration Step

Step 7: In the new Critical path select the activity with the next minimum cost slope, and crash by one day, and repeat this step until all the activities along the critical path are crashed up to desired time.

Step 8: At this point all the activities are crashed and further crashing is not possible. The crashing of non critical activities does not alter the project duration time and is of no use.

Step 9: To determine optimum project duration, the total project cost is plotted against the duration time given by figure.

Further Modification: Un-Crashing

Step10: Now see if the project cost can be further reduced without affecting the project duration time. This can be done by un-crashing the activities which do not lie along the critical path. Un-crashing should start with an activity having the maximum cost slope. An activity is to be expanded only to the extent that it itself may become critical, but should not affect the original critical path.

Proposed Work

Step 1: Find earliest time estimates for all the activities, it is denoted as TE

Step 2: Find latest time estimates for all the activities, it is denoted as TL

Step 3: Determine the Critical Path.

Step 4: Compute the cost slope (i.e., cost per unit time) for each activity according to the following formula:Cost slope = (Crash cost–Normal cost)/(Normal time–Crash time)

Step 5: Among the critical path identify the activity with the minimum cost slope, and crash the activity by 1 day.

Step 6: Calculate the project cost. Identify new critical path. Project Cost= [(Project Direct Cost + Crashing cost of crashed activity) + (Indirect Cost*project duration)]

Step 7: Now in the new critical path select the activity with the next minimum cost slope, and crash by one day.

Step 8: Repeat this process until all the activities in the critical path have been crashed by 1 day.

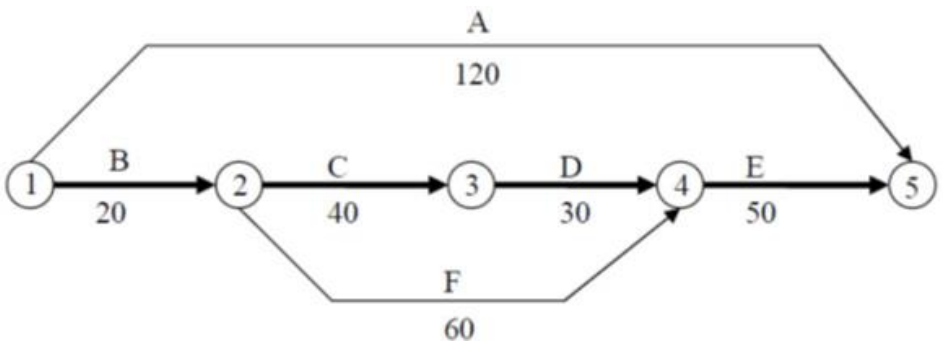
Step 9: Once all the activities along the critical path are crashed by one day, repeat the process again i.e., goes tostep5.

Step 10: Find the minimum project cost and identify the activities which do not lie along the critical path

Step 11: Now perform un crashing, i.e., un crash the activities which do not lie along the critical path.

Crashing Example: The network and durations given below shows the normal schedule for a project. You can decrease (crash) the durations at an additional expense.

The Table given below summarizes the time–cost information for the activities. The owner wants you to finish the project in 110 days. Find the minimum possible cost for the project if you want to finish it on 110 days. (Assume that for each activity there is a single linear, continuous function between the crash duration and normal duration points).



Activity	Normal duration (days)	Crash Duration (days)	Normal Cost	Crash Cost
A	120	100	12000	14000
B	20	15	1800	2800
C	40	30	16000	22000
D	30	20	1400	2000
E	50	40	3600	4800
F	60	45	13500	18000

Solution

Assume that the duration–cost relationship for each activity is a single linear, continuous function between the crash duration and normal duration points. Using the normal duration (ND), crash duration (CD), normal cost (NC), and crash cost (CC), the crash cost slope for each activity can be determined as follows:

$$S_A = \frac{CC - NC}{ND - CD}$$

$$S_A = \frac{14000 - 12000}{120 - 100} = ` 100/day$$

$S_B = ` 200/day$

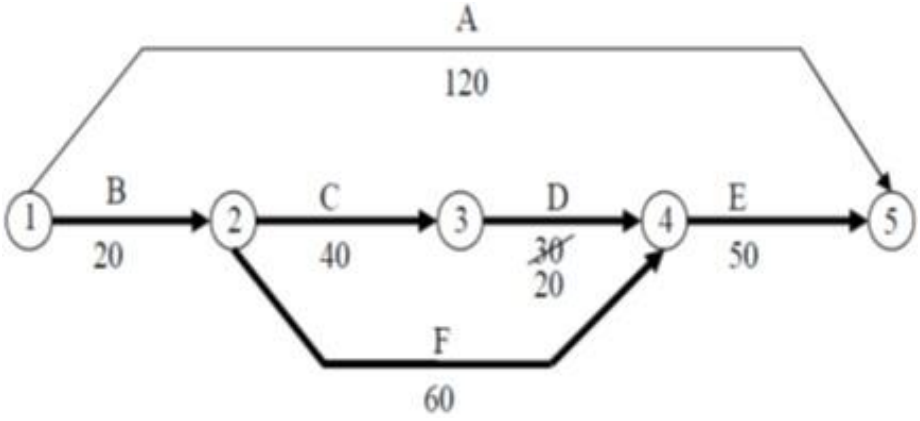
$S_C = ` 600/day$

$S_D = ` 60/day$

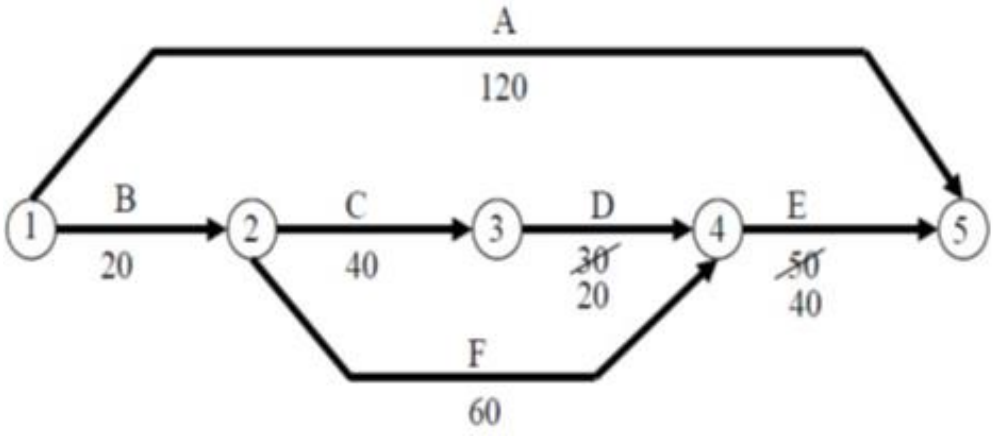
$S_E = ` 120/day$

$S_F = ` 300/day$

The normal cost for the project is the sum of a normal cost for each activity. The normal cost for the project is ` 48300 and the normal duration is 140 days. The activity which should be crashed is the one on the critical path which will add the least amount to the overall project cost. This will be the activity with the flattest or least-cost slope. The duration can be reduced as long as the critical path is not changed or a new critical path is created. In addition, the activity duration cannot be less than the crash duration.SD = ` 60/day (least-cost slope) Maximum of 10 days can be cut from this schedule by reducing the duration of activity D to the crash duration of 20 days.



Overall duration is 130 days and there are multiple critical paths (B–F–E and B–C–D–E). Total project cost at this duration is the normal cost of ` 48300 plus the cost of crashing the activity D by 10 days (60 * 10 =` 600) for a total of ` 48900.The next activity to be crashed would be the activity E, since it has the least-cost slope (` 120per day) of any of the activities on the critical path. Activity E can be crashed by a total of 10 days. Crashing the activity E by 10 days will cost an additional ` 120 per day or ` 1200.

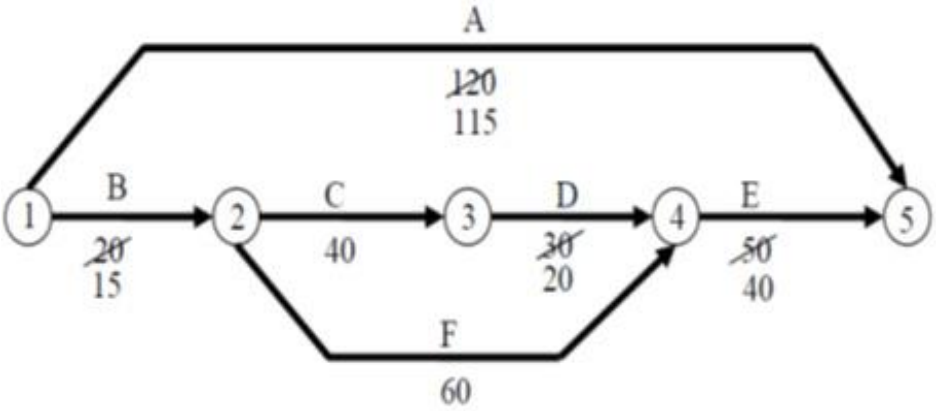


The project duration is now 120 days and the total project cost is ` 50100. There are now three critical paths (A, B–C–D–E, and B–F–E). The next stage of crashing requires a more thorough analysis since it is impossible to crash one activity alone and achieve a reduction in the overall project duration. Activity A is paired with each of the other activities to determine which has the least overall cost slope for those activities which have remaining days to be crashed.

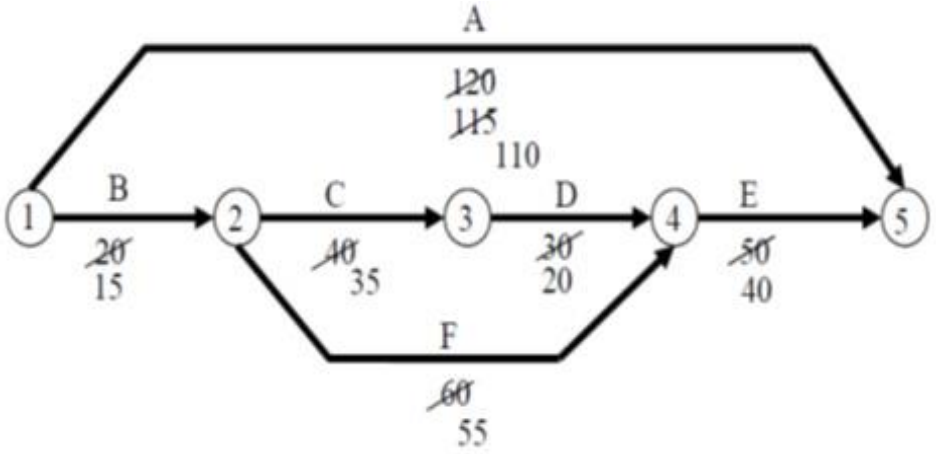
Activity A (` 100) + activity B (` 200)

Activity A (` 100) + activity C (` 600) + activity F (` 300)

The least-cost slope will be activity A + activity B for a cost increase of ` 300 per day. Reducing the project duration by 5 days will add 5*300 = ` 1500 dollar crashing cost and the total project cost would be ` 51600. Activity B cannot be crashed any more.



Final step in crashing the project to 110 days would be accomplished by reducing the duration of activity A by 5 days to 110 days, reducing activity C by 5 days to 35 days, and reducing activity F by 5 days to 55 days. The combined cost slope for the simultaneous reduction of activity A, activity C, and activity F would be ` 1000 per day. For 5 days of reduction this would be an additional ` 5000 in total project cost. The total project cost for the crashed schedule to 110 days of duration would be ` 56600.



Resource Leveling and Resource Allocation

Resource Leveling

Resource Leveling is a project management technique used to examine unbalanced use of resources (usually people or equipment) over time, and for resolving over-allocations or conflicts. When performing project planning activities, the manager will attempt to schedule certain

tasks simultaneously. When more resources such as machines or people are needed than are available, or perhaps a specific person is needed in both tasks, the tasks will have to be rescheduled concurrently or even sequentially to manage the constraint. Project planning resource leveling is the process of resolving these conflicts. It can also be used to balance the workload of primary resources over the course of the project[s], usually at the expense of one of the traditional triple constraints (time, cost, scope). When using specially designed project software, leveling typically means resolving conflicts or over allocations in the project plan by allowing the software to calculate delays and update tasks automatically. Project management software leveling requires delaying tasks until resources are available. In more complex environments, resources could be allocated across multiple, concurrent projects thus requiring the process of resource leveling to be performed at company level. In either definition, leveling could result in a later project finish date if the tasks affected are in the critical path.

Resource Leveling is also useful in the world of maintenance management. Many organizations have maintenance backlogs. These backlogs consist of work orders. In a "planned state" these work orders have estimates such as 2 electricians for 8 hours. These work orders have other attributes such as report date, priority, asset operational requirements, and safety concerns. These same organizations have a need to create weekly schedules. Resource-leveling can take the "work demand" and balance it against the resource pool availability for the given week. The goal is to create this weekly schedule in advance of performing the work. Without resource-leveling the organization (planner, scheduler, supervisor) is most likely performing subjective selection. For the most part, when it comes to maintenance scheduling, there are very few logic ties and therefore no need to calculate critical path and total float.

Resource Allocation

Resource allocation is used to assign the available resources in an economic way. It is part of resource management. In project management, resource allocation is the scheduling of activities and the resources required by those activities while taking into consideration both the resource availability and the project time. In strategic planning, resource allocation is a plan for using available resources, for example human

resources, especially in the near term, to achieve goals for the future. It is the process of allocating resources among the various projects or business units. The plan has two parts: Firstly, there is the basic allocation decision and secondly there are contingency mechanisms. The basic allocation decision is the choice of which items to fund in the plan, and what level of funding it should receive, and which to leave unfunded: the resources are allocated to some items, not to others. There are two contingency mechanisms. There is a priority ranking of items excluded from the plan, showing which items to fund if more resources should become available; and there is a priority ranking of some items included in the plan, showing which items should be sacrificed if total funding must be reduced.

Ways to Avoid Time and Cost Overruns

Correct identification of the causes of delays can help the project team to eliminate the same, as per the adage, a problem well formulated is half solved. The most important reason for delay in cost and time overrun: planning, organising and monitoring; hence, the need to plan the resources adequately and estimate the need scientifically. Right choice of project manager, project oriented organisation, project team and delegation of authority commensurate with responsibility will go a long way to reduce the overruns. Proper project management information system and effective coordination with all concerned will ensure timely project completion. The other reasons that help completing the project without delay are listed hereunder. These are:

- Detailed planning and implementation schedule
- Sound monitoring
- Resource–planning based on time schedules and anticipated progress
- Ensuring safety measures while preparing contracts
- Reward and incentive schemes for the project staff
- Selection of appropriate, feasible technology
- Listing engineering parameters and designs
- Mobilising community participation in planning and implementation
- Decentralised decision–making for fast implementation

- Continuity of the project manager, at least till the start of the plant
- Adequate training of the workers, supervisors involved
- Anticipating omissions, mistakes and preparing the organisation to face crisis
- Minimising managerial lapses
- Identifying transport bottlenecks by proper liaison
- Communication, and following-up with vendors and subcontractors to know the latest status and location of project material
- Regular follow-up with local, national and international financial agencies
- Innovative attitude and skills of the project team
- Adequate project information system
- Maintaining ecological balance and avoiding environmental pollution
- Clarity of scope on project objectives
- Lucid description of team and sub-team tasks
- Lucid financial cost estimates
- Milestone charts and project audit reports, and
- Minutes of the co-ordination committees' meetings with contractors and government agencies

Conclusion

The completion of projects without overruns and delays is probably the most important current problem area for cost engineers and project managers as well as for the image of the whole professional area of Cost Engineering / Project Cost Control not to mention the owners/contractors and users themselves. Commercial Risk Analysis is therefore one of the basic sub-procedures used by cost engineers.

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Lesson 4.3 - Project Appraisal and Control Process

Learning Objectives

- To understand the meaning of project appraisal.
- To know the steps in project appraisal process by banks and financial institutions
- To know the steps in project control process.
- To know the various types of key programme/project monitors, controls and reports.
- To appreciate the project control issues.

Project Appraisal

Project appraisal management is an essential stage of any project, regardless of its nature, type and size. This stage represents the first point of the pre-planning or initiation phase. Without having appraised a project, it is financial and technically unreasonable to proceed with further planning and development. No matter whether you are going to purchase a new car (e.g. my neighbour's project), constructing a building, improving a business process, updating a network system, conducting a marketing campaign, building a garage, or any other initiative, you should make a preliminary assessment and appraisal of your undertaking in order to be sure that that you will do a required and necessary change to your environment.

Project Appraisal Process by Banks and Financial Institutions

Banks and Financial institutions such as IDBI Bank, ICICI Bank, and the Industrial Finance Corporation of India (IFCI), and the State Industrial Development Corporations (SIDCs) and State Financial Corporations (SFCs) of different States, as also Investment Finance Institutions such as the Life Insurance Corporation (LIC), the General Insurance Corporation (GIC) and the Unit Trust of India (UTI) have for long been actively involved in promoting industrial projects and

participating in their operational phases and have emerged as major stockholders in most enterprises. They participate in and underwrite equity and debentures and provide medium and long–term loans, often accounting for the major part of funds employed in enterprises. Before they commit their funds, they have to necessarily satisfy themselves about the feasibility of the projects to be assisted.

The Application

The applicant for institutional finance has to provide a com–prehensive statement of the nature and purpose of the assistance being sought the cost of the project, the financing mix contemplated the market prospects for the product or products, the expected profitability and the managerial and technical arrangements effected for operating the project. Over the years, the leading financial institutions, IDBI, ICICI and IFCI, have evolved a common format for the application form, which is being used by most State level industrial development and financial institutions.

The application form provides for very elaborate information to be given on all relevant aspects of the project, and the delay in furnishing the requisite details can cause delay in appraisal.

The Appraisal Process

Small projects get assistance from a single institution, and in the case of larger projects, the institutions extend assistance jointly through syndication.

Single Institution Assistance - The Process

The evaluation proceeds in the following sequence, where a single financial institution is involved:

- Application is received from the promoter.
- The institution deputes a financial expert and technical expert to carry out the project appraisal;
- After a preliminary review, the team submits its report to the management, recommending acceptance or rejection. If accepted

in principle, further details for closer scrutiny are obtained from the promoter.

- The crucial aspects of the project proposal are subjected to in-depth study. Elaborate discussions are held with the promoter, and the underlying assumptions get certified and substantiated. Comparisons with similar projects, assessment of the technical suitability of the basic engineering package, verification of the collaboration agreements, scrutiny of price bids of contractors and suppliers' quotations, verification of market studies, inspection of the site, and seeking expert opinions where required are all essential steps in this in-depth analysis.
- Detailed evaluation of the technical, commercial, financial, economic and management aspects are taken up for ascertaining the project's viability, and its acceptability for project financing.
- The senior executives of the institution have a close look at the proposal, with reference to available reports and comments.
- Further discussions are held with the promoter and necessary modifications are agreed upon.
- The final appraisal memorandum is prepared and submitted to the managing director.
- The final appraisal memorandum goes to the board of directors for approval.
- The promoter is informed of board's approval.

Loan Syndication – The Process

Where the project, of a magnitude that calls for joint financing by a group of institutions, is under consideration, the evaluation proceeds on following lines:

- The project application is received by the financial institution.
- The institution's project team carries out the preliminary review of the technical, commercial, financial, economic and management aspects of the proposal.
- The appraisal team holds further discussions with the promoter and obtains required clarifications.

- The appraisal team prepares flash report on the project and circulates it to the senior executives of the participating institutions for their consideration.
- The acceptability of the project is discussed at the Senior Executive Meeting (SEM).
- At the SEM, the lead institution is identified from among the participating institutions.
- The lead institution takes up a detailed evaluation of the project appraisal. It has elaborate discussions with the promoter, getting evidences and clarifications to support the critical assumptions in the proposal. This detailed evaluation will involve an in depth examination of the diverse aspects of the project proposal, by comparison with similar projects, site inspection, scrutiny of the collaboration agreements, obtaining expert opinion as may be necessary and such other procedures that can help in proper assessment of the project's viability and desirability.
- The lead institution prepares the evaluation report and circulates it to the participating institutions for consideration.
- At the Inter-Institutional Meetings (IIM), the project is jointly evaluated, and discussions are held with the promoter, and site inspections are carried out. Project up to ` 10 crores have their evaluation reports considered by SEM, and those that exceed ` 10 crores get considered at IIM.
- Changes or modifications that are found necessary are effected with the consent of the promoter.
- Approvals for financing the project are obtained from the respective sanctioning authorities of the participating institutions.
- The lead institution takes over the administrative responsibilities and informs the promoter of the approval of the project.

The SEM or IIM, as the case may be, decides on the extent of participation by the member institutions of the syndicate, as also the extent of assistance from the concerned commercial banks and terms of assistance. The commitment of assistance by each institution can be formalized through the scheme of participation certificates. Over the years, the institutions have been able to evolve uniform approaches to

the methods of appraisal and approval, though there can be variations in emphasis on specific aspects depending on the nature of the project.

Project Control Process

Project Controls

It is a management action, either planned to achieve the desired result or taken as a corrective measure prompted by the monitoring process. Project controls are mainly concerned with the metrics of the project, such as quantities, time, cost and other resources. Apart from these, project revenues and cash flow can also be part of the project metrics under control.

The successful performance of a project depends on appropriate planning. The execution of a project is based on a robust project plan and can only be achieved through an effective schedule control methodology. The development of a suitable Project Control system is an important part of the project management effort. Furthermore, it is widely recognized that planning and monitoring plays a major role as the cause of project failures. It has been proved time and again that Project performance can be improved if dedicated Project Controls systems are in place.

Project Control Process

Control is the process of comparing actual performance against plan to identify deviations, evaluate possible alternative courses of actions, and take appropriate corrective action. The steps in the project control process for measuring and evaluating project performance are listed below:

- Setting a baseline plan.
- Measuring the actual performance
- Comparing actual with baseline plans.
- Taking corrective action.

Step 1: Setting a Baseline Plan

The baseline plan provides with the elements for measuring performance. The baseline is derived from the cost estimates; information

relating to duration is derived from the work breakdown structure (WBS) database; and time-sequence data are derived from the network and resource scheduling decisions. The WBS defines the work in discrete work packages that are tied to deliverables and organization units. In addition, each work package defines the work, duration, and budget. From the WBS, the project network schedule is used to phase all work, resources, and budgets into a baseline plan.

Step 2: Measuring the Actual Performance

Time and budgets are quantitative measures of performance that readily fit into the integrated information system. Qualitative measures such as meeting customer technical specifications and product function are most frequently determined by on-site inspection or actual use. Measurement of time performance is relatively easy and obvious. Examples: the critical path, early on schedule or late; is the slack of near critical-paths decreasing to cause new critical activities, etc. For measuring performance, earned value is necessary to provide a realistic estimate of performance against a time-phased budget. Earned value will be defined as the budgeted cost of the work performed (EV).

Step 3: Comparing Actual with Baseline Plan

All the baseline plans seldom materialize as expected and hence, it becomes imperative to measure deviations from plan to determine if action is necessary. Periodic monitoring and measuring the status of the project allow for comparisons of actual versus expected plans. It is crucial that the timing of status report be frequent enough to allow for early detection of variations from plan and early detection of causes. Usually, status reports should take place every one to four weeks to be useful and allow for proactive correction.

Step 4: Taking Corrective Action

If deviations from plans are significant, corrective actions will be needed to bring the project back in line with original or revised plan. In some cases, conditions or scope can change, which, in turn, will require a change in the baseline plan to recognize new information.

Key Programme/Project Monitors, Controls and Reports

Following are the various types of project controls and reports:

a) **Business Case:** The Business Case effectively describes what is the value of project outcome to the sponsoring organization. Managing the Business Case is about value management of benefits, costs, timescales and risks.

b) **Project Plan:** A comprehensive plan which clearly defines the products to be produced, resources and time needed for all activities, any dependencies between activities and points at which progress will be monitored and controlled with any agreed tolerances.

c) **Project Initiation Document (PID):** This document defines all major aspects of the project and forms the basis for its management and the assessment of overall success. There are two primary uses of the document:

- To ensure that the project has a complete and sound basis before there is any major commitment to the project
- To act as a base document against which the project can assess progress, change management issues, and ongoing viability questions.

For construction projects, the content of the Project Initiation Document is set out in the Project Execution Plan.

d) **Stage Plan:** Provides detail of how and when the objectives for the stage are to be met by showing the deliverables, activities and resources required. The Stage Plan provides a baseline against which stage progress will be measured and is used as the basis of management control throughout the stage.

e) **Work Package:** Sets out all information needed to deliver one or more specialist products. The necessary information is collated by the Project Manager and used to formally pass responsibility for work or delivery to a team leader or member.

f) **Change Control Strategy:** The Strategy documents the procedure to ensure that the processing of all Project Issues is controlled, including the submission, analysis and decision making.

g) **Highlight Reports: The highlight reports are used to** provide the Project Board (and possibly other stakeholders) with a summary of the stage status at intervals defined by them and to monitor stage and project progress. The Project Manager also uses it to advise the Project Board of any potential problems or areas where the Project Board could help.

h) **Checkpoint Report:** From the Team Manager to the Project Manager at a frequency defined in the stage plan and/or work package detailing the status of work for each member of a team.

i) **Project Issue Log:** A project issue is a generic term for any matter that has to be brought to the attention of the Project Team and requires an answer. An issue can have a negative or positive impact on the project and includes items such as requests for change, off-specifications (this is an item not included in the original specification or errors or omissions found in work already completed which would result in the agreed specification or acceptance criteria not being met), questions and statements of concern.

j) **Risk Management Log:** Risks can be threats to the successful delivery of the Project. Usually they are recorded in a risk register which is used to manage the project's exposure to risk that is the probability of specific risks occurring and the potential impact if they did.

k) **End Stage Report:** It Summarizes progress to date and provides an overview of the project as a whole, including impact of the stage on the project plan, the business case and identified risks. The project board uses the information to decide what action to take with the project; approve the next stage; ask for revised plans, amend the project scope or stop the project.

l) **End Project Report:** A report sent from the Project Manager to the Project Board, which confirms the hand-over of all deliverables, provides an updated business case, and an assessment of how well the project has done against its Project Initiation Document.

m) **Lessons Learned Report:** A report which describes the lessons learned in undertaking a project and which includes statistics from the quality control of the project's management products. It is

approved by the Project Board then held centrally for the benefit of future projects. If the project is one of a number attached to a programme this document will also be used as input to the programme review.

n) **Post Project Review:** Documents whether business benefits have been realized and recommendations for future improvements have been recorded. This is viewed as part of the project evaluation review which includes the End Project Report and Lessons Learned Report.

Project Control Issues

a) Monitoring Time Performance

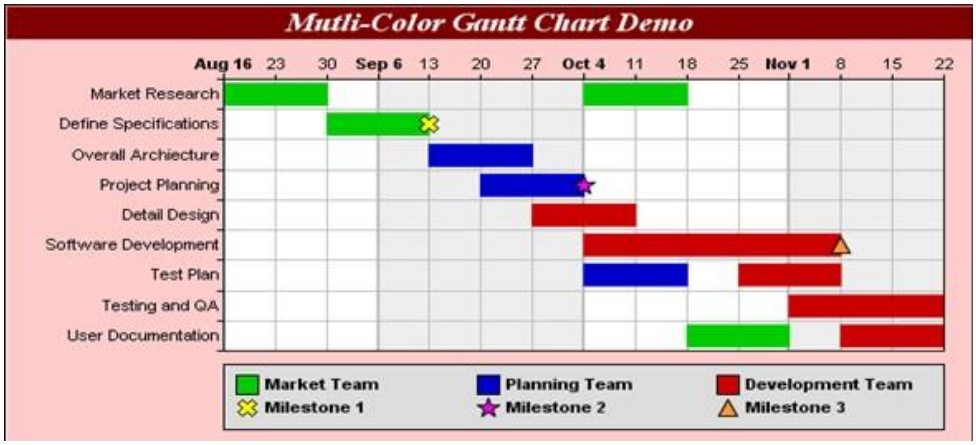
A major goal of progress reporting is to catch any negative variances from plan as early as possible to determine if corrective action is necessary. Fortunately, monitoring schedule performance is relatively easy. The project network schedule, derived from the WBS/OBS, serves as the baseline to compare against actual performance. Gantt charts (bar charts) and control charts are the typical tools used for communicating project schedule status.

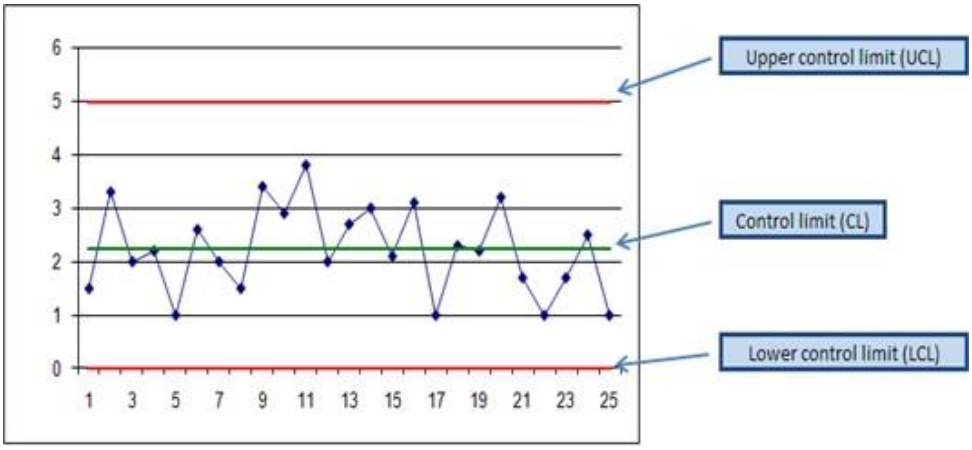
Gantt Charts

Gantt and control charts serve well as a means for tracking and trending schedule performance. Their easy-to-understand visual formats make them favorite tools for communicating project schedule status-especially to top management who do not usually have time for details. Adding actual and revised time estimates to the Gantt chart gives a quick overview of project status on the report date. The following figure shows the sample of multi-color Gantt chart.

Control Charts

Control chart is another tool used to monitor past project schedule performance and current performance and to estimate future schedule trends. Control charts are also frequently used to monitor progress toward milestones, which mark events and as such have zero duration. The following figure shows the sample control chart.





b) Need for an Integrated Information System

There are many customized monitoring and control systems used in practice. The disparity among monitoring systems is usually found in the lack of connections with a time-phased baseline plan. Such systems fail to compare actual work completed for any time period against budgeted scheduled costs for the same time period. Without matching time-phased budgets to actual cost of work completed, it is impossible to reliably measure cost performance.

Development of an Integrated Cost/Schedule System

The earned value cost/schedule system uses several acronyms and equations for analysis. Following five careful steps ensures that the cost/ schedule system is integrated.

- Define the work using a WBS. This step involves developing documents that include the following information about Scope,

Work packages, Deliverables, Organization units, Resources and Budgets for each package.

- Develop work and resource schedules. This is done by scheduling resources to activities and time-phasing work packages into a network.
- Develop a time-phased budget using work packages included in an activity. The cumulative values of these budgets will become the baseline and will be called the planned time-phased baseline of the value of the work scheduled (PV).
- At the work package level, collect the actual costs for the work performed. These costs will be called the actual cost of the work completed (AC).
- Compute the schedule variance using the formula, Schedule Variance = Earned Value – Planned time-phased base line of the value of the work scheduled (SV = EV – PV).
- Compute the cost variance using the formula, Cost Variance = Earned Value – Actual cost of the work completed (CV = EV – AC).

Development of Project Baselines

The baseline (PV) serves as an anchor point for measuring performance. The baseline is a concrete document and commitment; it is the planned cost and expected schedule performance against which actual cost and schedule are measured. It can also serve as a basis for developing cash flows and awarding progress payments. Development of the project baseline is part of the planning process. The baseline is the major input to the cost/schedule system to be described.

Costs to be included in Baselines

The baseline PV is the sum of the cost accounts, and each cost account is the sum of the work packages on the cost account. Three costs are typically included in baselines, viz., labour, equipment, and materials. Sometimes project direct overhead costs are also included.

Rules for Placing Costs in Baselines

The major reasons for creating a baseline are to monitor and report progress and to estimate cash flow. Therefore, it is crucial to integrate the baseline with the performance measurement system. Costs are placed in the baseline exactly as managers expect them to be "earned".

This approach facilitates tracking costs to their point of origin. In practice, the integration is accomplished by using the same rules in assigning costs to the baseline as those used to measure progress using earned value. Percent Complete Rule is the best method for assigning costs to the baseline in order to establish frequent check points over the duration of the work package and assign completion percentages in monetary terms.

Methods of Variance Analysis

Generally the method for measuring accomplishments centers on two key computations:

- Comparing earned value with the expected schedule value;
- Comparing earned value with actual costs.

c) Indices to Monitor Progress

In corporate world, project management professionals prefer to use schedule and cost indices over the absolute values of SV and CV, because indices can be considered as efficiency ratios. Graphed indices over the project life cycle can be very illuminating and useful. The trends are easily identified for deliverables and the whole project.

Performance Indexes

There are two indices of performance efficiency. The first index measures cost efficiency of the work accomplished to date:

Cost Performance Index (CPI) = EV/AC

Scheduling Performance Index (SPI) = EV/PV

Project Percent Complete Index

There are two project percent complete indices, which are used depending on the nature of project. The first index assumes the original budget of work complete, which is the more reliable information to measure project percent complete. The second index assumes the actual costs-to-date and expected cost at completion, which is the most reliable measure for measuring project percent complete. These indices compare the up-to-date progress to the end of the project. The implications underlying the use of these indices are that conditions will not change, no improvement or action will be taken, and the information in the database is accurate.

Percent Complete Index for Budget = PCIB = EV/BAC

Percent Complete Index for Cost = PCIC = AC/EAC

Technical Performance Measurement

Measuring technical performance is equally important as measuring schedule and cost performance. The consequences of poor technical performance will be very adverse. Assessing technical performance of a system, facility, or product is often accomplished by examining the documents found in the scope statement and/or work package documentation.

Software for Project Cost/Schedule Systems

Software developers have created sophisticated schedule/cost systems for projects that track and report budget, actual, earned, committed, and index values. These values can be labour hours, materials, and/or dollars. This information supports cost and schedule progress, performance measurements, and cash flow management.

Additional Earned-Values Rules

Although the percent complete rule is the most-used method of assigning budgets to baselines and for cost control, there are two additional rules that are very useful for reducing the overhead costs of collecting detailed data on percent complete of individual work packages. These rules are the 0/100 percent rule and the 50/50 rule. These two rules are typically used for short-duration activities and/or small-cost activities.

Forecasting Final Project Cost

There are basically two methods used to revise estimates of future project costs. In many cases both methods are used on specific segments of the project. The result is confusion of terms in texts, in software, and among practitioners in the field.

- The first method allows experts in the field to change the original baseline durations and costs because new information tells them the original estimates are not accurate.
- The second method is used in large projects where the original budget is less reliable. This method uses the actual costs to–date plus an efficiency index, (CPI = EV/AC) applied to the remaining project work. When estimate for completion uses the CPI as the basis for forecasting cost at completion, acronym '(EAC)' – Estimated total cost At Completion' – is used.

d) Other Control issues

Baseline changes

Changes during the life cycle of projects are inevitable and will occur. Some changes can be very beneficial to project outcomes; changes having a negative impact are the ones to be avoided. Careful project definition can minimize the need for changes. The price for poor project definition can be changes that result in cost overruns, late schedules, low morale and loss of control. Change comes from external sources or from within. Externally, for example, the customer may request changes that were not included in the original scope statement and that will require significant changes to the project and thus, to the baseline.

Contingency Reserve

In reality, plans seldom materialize as per estimates. Identified and unidentified risks occur, estimates go wrong, customer wants changes, technology changes. Because, perfect planning does not exist, some contingency funds should be created before the project commences to cover the unexpected. The size of the contingency reserve should be related

to the uncertainties and risk of schedule and cost estimate inaccuracies. Contingency reserve is not a free lunch for all who come. Reserve funds should only be released by the project manager on a very formal and documented basis. Budget reserve contingency funds are not for scope changes. Scope changes are covered by management reserve fund.

The Costs and Problems of Data Acquisition

For large projects, there is no substitute for using a percent complete system that depends on data collected through observation at clearly defined monitoring points.

Scope Creep

Large changes in scope are easily identified. It is the 'minor refinements' that eventually build to be major scope changes that can cause problems. These small refinements are known in the field as scope creep.

Ways to Deal with Project Control Issues

Having understood the key control issues, setting up appropriate controls will help assure the project is a success. Following are some of the ways to deal with project control issue:

a) ***Change management:*** Request that a member of senior management announce the project to all stakeholders, why the project has been launched and the impact on those affected. By involving those affected, there will be a less resistance to change.

b) **Schedules:** Make sure the project starts on time and that tasks are completed on a timely basis. To help assure project completes by the planned completion date, employ the critical path method. This method defines critical and non-critical tasks that impact timely project completion.

c) **Costs:** Break down budgeted costs into easy-to-track categories. Make sure costs are recorded as soon as they are incurred so that there is a clear understanding of actual costs. Instruct project team members who are responsible for approving bills; otherwise costs can quickly escalate.

d) **Requirements:** Use a structured approach for defining requirements so that the delivered project matches the expectations of project stakeholders. Rather than waiting until the end of a project to deliver what stakeholders want, provide interim deliverables to make sure the organization and the stakeholders are in agreement with project progress. Waiting until the end of the project to share information with users could result in project cost overruns if changes must be made in what was delivered.

e) **Communications:** Make sure communications to the project team and stakeholders is clear and understandable. Breakdowns in communications can quickly derail a project and impact team members' morale.

f) **Staffing:** Make sure the project is staffed with people who have the required skills to achieve project objectives. Have weekly meetings with project staff so you can quickly address any project team or stakeholder problems.

g) **Checklist:** Prepare a checklist of all areas you need to monitor and control. Decide on what you will monitor and how often. Do not delay acting on issues that are not under control.

h) **Monitoring, Reporting & Control:** Monitoring is about assessing what work has been completed for a Project including costs, risks and issues. In addition the Board will routinely monitor if the business case continues to be viable in terms of alignment with strategic objectives. This usually takes the form of the production of documentation and reports at key stages. Reporting provides the Project Board with a summary of the status of the project at intervals defined by them.

Conclusion

Controls usually relate to stages in projects and are established to control the delivery of the project's products (outputs). In project management controls take two forms – event driven and time driven. Event driven means that the control occurs because of a specific event has taken place. Examples of event driven controls include End-Stage Reports, completion of a Project Initiation Document (PID) and creation of an

exception plan. Time driven controls are regular progress feedbacks. Examples of time driven controls include checkpoint and highlight reporting. This does not replace the need for the Board to maintain an overall view of progress. Monitoring is used to oversee progress of products, outputs, and outcomes. Reporting advises the correct people at the correct time of positive and negative events, allowing for progression or remedial action as appropriate. Controls then assist with both monitoring and reporting by provision of required review points such as End Stage Assessments.

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Lesson 4.4 - Project Audit and Evaluation of Project Team and its Manager

Learning Objectives

- To understand the meaning of project audits.
- To know the steps in project audit process.
- To understand the conditions of project closure.
- To know the steps in project closure process
- To appreciate the importance of evaluation of project team, team member and manager.

Project Audits

Project audits are more than the status reports which check on project performance. Project audits use performance measures and forecast data. But project audits are more inclusive. Project audits review why the project was selected. It includes a reassessment of the project's role in the organization's priorities. It includes a check on the organizational culture to ensure that it facilitates the type of project being implemented. It assesses if the project team is functioning well and it is appropriately staffed. Audits of projects in process should include a check on external factors that might change where the project is heading on the right path – for example, technology, government regulations, and competitive products. It includes a review of all factors relevant to the project and to managing future projects. It can be performed while a project is in process and after a project is completed. There are only a few minor differences between these audits.

In-Process Project Audits

In–process project audits allow for corrective changes, if they are needed, on the audited projects or others in progress. It concentrates on project's progress and performance and checks if conditions have changed.

Post Project Audits

These audits tend to include more detailed and depth than in–process project audits. Project audits of completed projects emphasize improving the management of future projects. These audits are more long term oriented than in–process audits. Post project audits check on the project performance, but the audit represents a broader view of the project's role in the organization.

Factors Influencing Audit Depth and Detail

The depth and detail of the project audit depends on many factors:

- Organization size
- Project importance
- Project type
- Project risk
- Project size
- Project problems

Project Audit Guidelines

The Guidelines for conducting project audits include the following:

a) The philosophy must be that the project audit is not a punishing exercise.

b) Comments about individuals or groups participating in the project should not be revealed.

c) Audit activities should be intensely sensitive to human emotions and reactions.

d) Accuracy of data should be verifiable or noted as subjective or judgmental.

e) Senior management should announce support for the project audit and see that the audit group has access to all information, project participants and project customers.

f) Objective of the project audit is to learn and conserve valuable organizational resources.

g) The audit should be completed quickly.

h) The audit leader should be given access to senior management above the project managers.

Project Audit Process

Following the steps in the project audit process:

Step 1: Initiation and Staffing

Initiation of the audit process depends primarily on organization size and project size along with the other factors. However, every effort should be made to make the project audit a normal process rather than a surprise notice. In small organizations and project where face to face contact at all levels is prevalent, an audit may be informal and only represent another staff meeting. But even in these environments, the content of a formal project audit should be examined and covered with notes made of the lessons learned.

In medium sized organizations that have several projects occurring simultaneously, initiation can come from a formal project review group, from the project priority team or be automatic. A major tenet of the project audit is that the outcome must represent an independent, outside view of the project. Maintaining independence and an objective view is difficult, given that audits are frequently viewed as negative by project stakeholders.

It is imperative that the audit leader possesses the following characteristics:

- No direct involvement or direct interest in the project
- Respect of senior management and other project stakeholders
- Willingness to listen
- Independence and authority to report audit results without fear of recrimination from special interests.
- Perceived as having the best interest of the organization in making decision.
- Broad based experience in the organization or industry.

Step 2: Data Collection and Analysis

The traditional content model for a project audit represents two perspectives. One evaluates the project from the view of the organization. The second perspective represents the project team's evaluative view. The organization perspective is developed by a small group primarily made up of persons not having a direct interest in the project. The project team perspective is developed by a group composed primarily of team members along with persons independent of the project to ensure the evaluation is objective. Each organization and project is unique. Therefore, many factors need to be considered like the industry, project size, newness of technology and project experience that can influence the nature of the audit.

Step 3: Reporting

The major goal of the audit report is to improve the way future projects are managed. Concisely, the report attempts to capture needed changes and lessons learned from a current or finished project. The report serves as a training instrument for project managers of future projects. Audit reports needs to be customized to the specific project and organizational environment. Nevertheless, a generic format for all audit reports and the managers who read and act on their content. Usually, the following items are included in the reports:

- Classification of project based on nature, type, size, number of staff and technology level.
- Analysis of information gathered such as project's mission, objectives, procedures, systems and organizational resources used.
- Recommendation of positive successes that should be continued and used in future projects.
- Lessons learned to avoid pitfalls in future.
- Appendix of data or details of analysis of the project.

Core Constituents to be analyzed during Project Audit

a) Time Management

- Time schedule development and control measures
- Activity duration analysis in terms, including inter-team dependency

b) Resource Management

- Resource planning and control in terms of allocation of resources, criteria for distribution, analysis of consumption patterns and
- Measures to control resource abuse

c) Personnel Management

- Allocation of staff and establishment of recruiting policies
- Division of responsibilities regarding team development and training needs

d) Information Management

- Policies regarding Preparing and Collecting information
- Principles used for Classifying and Distributing information
- Methods used for Filing, Updating and Retrieving information

The purpose of the audit is not just analyzing various project management resources and functionalities but also to help the organization understand the performance of each of them. For this purpose, most audit processes use a *grading system to rank each audited project constituent:*

- **Critically Deficient** – suggests a serious inability to match project guidelines.
- **Weak** – unable to entirely comply with project objectives.
- **Satisfactory** – basic project management principles are followed but the overall performance has room for improvement.
- **Good** – the compatibility with the project goals and effectiveness of management tools, both are appreciable and committed to project goal.
- **Very Good** – the process defines ideal project performance and adheres to planning/monitoring expectations and performs as per project expectations

Project Closure

Every project comes to an end eventually. On some projects the end may not be as clear as would be hoped. Although the scope statement defines a clear ending for a project, the actual ending may or may not correspond. Fortunately, a majority of projects are blessed with a well-defined ending. Regular project audits and a priority team will identify those projects that should have endings different from those planned.

Thus, closure is the final stage in the project life cycle and is triggered when the sponsor formally accepts the project. The objectives of this stage are to: transition the product, services and deliverables to operations and support; logically complete administrative and logistical close-out activities including contracts; release project resources and capture performance information that will help improve future projects.

Conditions for Project Closure

a) Normal

The most common condition for project closure is simply a completed project. In the case of 'turnkey' projects, such as building a new production facility or creating a customized information system, the finish is marked by the transfer of ownership to the customer. For many development projects, the end involves handing over of the final design to production and the creation of a new product or service line.

For other internal projects, such as system upgrades or creation of new inventory control systems, the end occurs when the output is incorporated into ongoing operations. Some modifications in scope, cost, and schedule probably occurred during implementation.

b) Premature

For a few projects, the project may be completed early with some parts of the project being eliminated. If early project closure happens, it should have the support of all project stakeholders. The decision should be left to the audit group, project priority team or senior management.

c) Perpetual

Some projects never seem to end. The project appears to develop a life of its own. Although these projects are plagued with delays, they are viewed as desirable when they are finally completed. The major characteristic of this kind of project is constant 'add-ons'. The owner or others continuously require more small changes that will improve the project outcome-product or service. These changes typically represent 'extras' perceived as being part of the original project intent.

d) Failed Project

In rare circumstances, projects simply fail, for a variety of reasons.

e) Changed Priority

The priority team continuously revises project selection priorities to reflect changes in organizational direction. Normally these changes are small over a period of time, but periodically major shifts in organization require dramatic shifts in priorities. In this transition period, projects in process may need to be altered or cancelled. Thus, a project may start with a high priority but see its rank erode or crash during its project life cycle as conditions change.

Closure Process

As the project nears the end of its life cycle, people and equipment are directed to other activities or projects. Carefully managing the closure phase is as important as any other phase of the project. Getting the project manager and team members to wrap up the odds and ends of closing down the project is sometimes difficult. The typical close-out plan includes answers to questions like:

- What tasks are required to close the project?
- Who will be responsible for these tasks?
- When will closure begin and end?
- How will the project be delivered?

Implementing the closedown plan includes several wrap-up activities. Many organizations develop lengthy lists for closing projects as they gain experience. These are very helpful and ensure everything is taken care of. Implementing closedown includes the following five major activities:

- Getting delivery acceptance from the customer.
- Shutting down resources and releasing to new ones.
- Reassigning project team members.
- Closing accounts and seeing all bills are paid.
- Evaluating the project team, project team members, and the project manager.

Team, Team Member and Project Manager Evaluation

Auditing includes performance evaluations of the project team, individual team members, and the project manager.

Team Evaluation

Some conditions should be established or agreed upon before auditing the project team. Some conditions include the following:

- Whether standards for measuring performance exist? Are the goals clear for the team and individuals? Challenging? Attainable? Lead to positive consequences?
- Whether individual and team responsibilities and performance standards are known to all team members?
- Whether team rewards are adequate? Do they send a clear signal that senior management believes in synergy of teams?
- Whether a clear career path for successful project managers is in place?
- Whether the team has discretionary authority to manage short-term difficulties?
- Whether there is a relatively high level of trust emanating from the organization culture?

Team evaluation should be beyond time, cost, and specifications. Whether there are any other conditions beyond these three criteria? The "characteristics of highly effective teams" can easily be adapted as measurements of team effectiveness.These "in-place conditions" will support any evaluation approach for teams and their members.

Team's project performance should be evaluated in one of two ways:

- Team members should evaluate themselves and each other.
- Team members should evaluate each other and team leaders should evaluate individual team members.

Do's of Team Evaluation

Each team member should also be allowed to evaluate him or her-self.To begin with, team members and leaders use the Project Team Evalu-ation Templates. Following are the guidelines for evaluating project teams:

a) **Analyze Evaluations** – Analyze how individual team members evaluated themselves and each other to get a better feel for how the team feels as a whole.

b) **Analyze the Difficulties** – How difficult have team projects been? Were tasks new or known? In either case did the team rise to the degree of difficulty? If not, why? If you feel the team lacked on certain tasks, instead of berating the team in your evaluations, discuss a past project where they performed well, point out what was different this time around.

c) **Analyze Performance** – How well did the team perform? Don't confuse performance with potential. Stick to the actual results of the team.

d) **Analyze Achievement** – Did the team achieve the project goal? If so, point out contributions and results.

e) **Life Cycle** – How well did the team perform within the life cycle of the project? Were deadlines met? If not, identify overruns. Try to analyze what happened if the life cycle of the project was longer than anticipated. What could have been done differently?

f) **Judge Individuality** – By looking at individual evaluations, analyze what each individual contributed to the project. How well did each team member do? Keep in mind that some team members succeed in some areas while others succeed in different areas. Did the individuals perform at a level that was helpful to the team as a whole?

g) **Be honest** – You probably are pleased with your team most of the time. Don't use this as your guide in evaluating your team. All employees have room for improvement including teams. Not every project is a job well done. This is by far the hardest part of evaluating your team. If negatives are identified and must be discussed, start by talking about a past project that flowed well. Next, discuss past success and compare it to the current project. How could things have been improved upon?

Do not's of Team Evaluation

Following are the not to be followed while evaluating project teams:

- Don't be too lenient. Don't be the project manager who says everything is fine when it's not.
- Everyone has room to improve. If you don't identify these areas, your team will never improve.
- Don't judge everything on an "average" basis. Some things worked and some things didn't. If a team feels they are average in performance, what are you really telling them?
- Do not judge individuals' performance based on their personality
- If a team member or the team as a whole did one wrong thing, don't make this the focus of your evaluation. Evaluate performance for the entire project.

Evaluations are not the most popular thing for project managers. Evaluating team project performance is a key if team has to succeed or improve on future projects. Keep in mind that if weak areas are not identified, your team may just think everything is fine. If you feel you need help on evaluating your team, talk with mentors, other project managers and human resources department.

Individual Team Member and Project Manager Evaluation

Team evaluation is crucial, but at some point a project manager is likely to be asked to evaluate the performance of individual members. Such an evaluation will typically be required as part of the closure process and will then be incorporated in the annual performance appraisal system of the organization. These evaluations constitute a major element of an individual's personnel file and often form the basis for making the decisions about promotions, future job assignments, merit pay increases, and other rewards.

Peer Evaluation

Peer evaluations offer an opportunity for team to comment on the performance of their peers. For example, the team may ask its members at a midpoint in the project to self-evaluate their improving team effectiveness. The goal is to provide information during the project that will allow the participants to modify their behaviour for the success of the project. In the recent times, 360 degree feedback is gaining momentum in the organizations. 360 degree feedback is a multi-rater approach and involves soliciting feedback relating to the performance of team members from all the stakeholders of the project. This includes not only the project and area managers but also peers, subordinates and customers.

Self Assessment Questions

1) What are the objectives of project network?
2) What are the rules for developing a project network?
3) What are the approaches used to develop project networks?
4) Explain the fundamentals of AON.
5) What are network analysis techniques?
6) Explain Critical Path Method with an example.
7) Explain PERT with an example.
8) What are the three time estimates used in PERT?
9) What is crashing of project network?
10) Explain the relationship between activity time and cost.

11) Explain the relationship between project time and cost.

12) Explain the crashing of project network with an example.

13) What is resource leveling?

14) What is resource allocation?

15) How to avoid cost and time overruns?

16) What is project appraisal?

17) Explain the steps in project appraisal process by banks and financial institutions.

18) What is loan syndication?

19) What are project controls? Explain the steps in Project Control Process.

20) What are the key project monitors, controls and reports used?

21) Explain the various project control issues.

22) What are the tools used for communicating project schedule status?

23) Explain the need for an integrated information system for project monitoring and control.

24) What are the steps in developing an integrated cost/schedule system?

25) What are project baselines? What are the costs included in baselines?

26) Explain the indices used to monitor progress.

CASE STUDY

Refurbishing Heathrow Airport Terminal 1, On Time, Within Budget, With No Disruptions to Travelling Public

Terminal 1 had been out of date and badly in need of refurbishment, with the 40-yearold building not seeing any significant updates since it was built in the 60s. With serious refurbishment going elsewhere at Heathrow Airport, as well as the upcoming opening of Terminal 5 and the introduction of international passengers to Terminal 1, it was in need of a major overhaul. "There were a number of factors associated

with this project that made success a big challenge. Managing multiple stakeholders, suppliers, and contractors within a strict deadline and budget would ordinarily be difficult, but doing this alongside keeping the terminal continuously open for passengers was a huge issue that required strict planning and coordination. "Risk had to be tightly managed and identified early on to ensure that a solution could be found before it turned into a major issue that would take the project off-time and off-budget. David Buisson, PMP, Project Manager ensured that communications management was strictly adhered to and regular meetings are conducted. This large-scale project had to be delivered whilst remaining completely operational for customers—challenging enough in any circumstances, but this was particularly the case for Terminal 1 at Heathrow Airport given the fact that some 20 million people a year travel through the airport. £6.3million worth of additional work was added without an increase to the original project budget.

The use of PMI software played a vital role in communications management for the project, allowing the entire project team to have visibility of all activity on the project almost in real time, minimising time wasting or duplication of work. This was a part of the commitment to good communications between the team and allowed for easier access to the project plans. Weekly coordination meetings were held to ensure that any problems or issues were picked up immediately and dealt with. Each meeting would examine a five week look ahead at the work schedule anticipating any future issues before they might happen. Project manager David Buisson would examine the top five risks every week with various contractors, visiting them onsite to determine a solution to the problem. "This project was a huge success despite considerable odds against it. It was completed on-time, within budget with no major problems and whilst remaining open to the public. The success of this project is due to excellent management. Analyse how the project was completed without time and cost overruns.

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UNIT – 5

Project Management

One of the prerequisite to become an effective project manager is building cooperative relationship among different groups of people to successfully complete the project. The success of any project depends not only on the performance of project teams but also on the contributions on top management, functional managers, customers, suppliers, contractors and others. In this chapter, let us understand the difference between managing and leading a project, how to manage the various project stakeholders, the importance of social network building, qualities of an effective project manager, stages in team development model, situational factors affecting team development and project team pitfalls.

Unit Structure

Lesson 5.1 - Project Managing Versus Leading of Projects

Learning Objectives

- To appreciate the difference between managing and leading a project.
- To understand the various stakeholders to project, both internal and external,
- To learn how to manage the project stakeholders.
- To learn the ways to build social network to succeed in projects.

Managing Vs. Leading of a Project

In a perfect world, the project manager would simply implement the project plan and the project would be completed. The project manager would work with others to formulate a schedule, organize a project team, keep track of progress and announce what needs to be done next week and then everyone would follow. But in reality, no one lives in a perfect world and not all things are going as per the plans. The following may likely to happen in reality:

a) Project Participants Get Impatient

b) Project Team Members Fail To Complement Each Other

c) Service Departments Are Unable To Fulfill Their Commitments

d) Technical Problems Arise

e) Work Completion Take Longer Time Than Expected

f) Cost May Overrun.

Differences between a Leader and Manager

Let us now take a look at the difference between a manager and leader which is presented in the following table.

Differences between a manager and leader		
Differences in	➢ Managers	➢ Leaders
Personality style	➢ Emphasize rationality and control; ➢ Problem-solvers (focusing on goals, resources, organization structures, or people); ➢ Persistent, tough-minded, hard working, intelligent, analytical, tolerant and ➢ Have goodwill toward others	➢ Are perceived as brilliant, but sometimes lonely; ➢ Achieve control of themselves before they try to control others; ➢ Can visualize a purpose and generate value in work; ➢ Imaginative, passionate, non-conforming risk-takers.
Attitude towards goals	➢ Adopt impersonal, almost passive, attitudes towards goals; ➢ Decide upon goals based on necessity instead of desire and are therefore deeply tied to their organization's culture; ➢ Tend to be reactive since they focus on current information	➢ Tend to be active since they envision and promote their ideas instead of reacting to current situations; ➢ Shape ideas instead of responding to them ➢ Have a personal orientation towards goals; ➢ Provide a vision that alters the way people think about what is desirable, possible and necessary

Conception of work	➢ View work as an enabling process; ➢ Establish strategies and makes decisions by combining people and ideas; ➢ Continually coordinate and balance opposing views; ➢ Are good at reaching compromises and mediating conflicts between opposing values and perspectives; ➢ Act to limit choice; ➢ Tolerate practical, mundane work because of strong survival instinct which makes them risk-averse.	➢ Develop new approaches to long-standing problems and open issues to new options; ➢ First, use their vision to excite people and only then develop choices which give those images substance; ➢ Focus people on shared ideals and raise their expectations; ➢ Work from high-risk positions because of strong dislike of mundane work.
Relations with others	➢ Prefer working with others; ➢ Report that solitary activity makes them anxious; are collaborative; ➢ Maintain a low level of emotional involvement in relationships; ➢ Attempt to reconcile differences, seek compromises, and establish a balance of power; ➢ Relate to people according to the role they play in a sequence of events or in a decision-making process; ➢ Focus on how things get done; maintain controlled, rational, and equitable structures; ➢ May be viewed by others as inscrutable, detached, and manipulative.	➢ Maintain inner perceptiveness that they can use in their relationships with others; ➢ Relate to people in intuitive, empathetic way; ➢ Focus on what events and decisions mean to participants; ➢ Attract strong feelings of identity and difference or of love and hate; ➢ Create systems where human relations may be turbulent, intense, and at times even disorganized.

Influence of past experience on self identify	➢ Report that their adjustments to life have been straightforward and that their lives have been more or less peaceful since birth; ➢ Have a sense of self as a guide to conduct and attitude which is derived from a feeling of being at home and in harmony with their environment; ➢ See themselves as conservators and regulators of an existing order of affairs with which they personally identify and from which they gain rewards; ➢ Report that their role harmonizes with their ideals of responsibility and duty; ➢ Perpetuate and strengthen existing institutions; display a life development process which focuses on socialization.	➢ Reportedly have not had an easy time of it; ➢ Lives are marked by a continual struggle to find some sense of order; ➢ Do not take things for granted and are not satisfied with the status quo; ➢ Report that their "sense of self" is derived from a feeling of profound separateness; ➢ May work in organizations, but they never belong to them; ➢ Report that their sense of self is independent of work roles, memberships, or other social indicators of social identity; ➢ Seek opportunities for change (i.e. technological, political, or ideological); ➢ Support change; find their purpose is to profoundly alter human, economic, and political relationships; ➢ Display a life development process which focuses on personal mastery.

Source: http://www.au.af.mil/au/awc/awcgate/sba/leadvmanage.htm

Role of Project Manager

Thus, the project manager's job is to set the project back on the right track. A manager accelerates certain activities, finds out ways to solve technical problems, acts as peacemaker when pressures arise and makes appropriate trade-offs among time, cost and scope of the project. However, in reality, project managers do a lot of things to keep the proj-

ect on track. They also innovate and adapt to ever changing situations. They often come across deviations from plans and introduce considerable changes in the scope of the project and counter the unexpected threats or opportunities.

For example, the scope of the project may have to be modified during the course of implementation, taking into consideration the change in the customer's needs. Competitors may release new products that dictate switching the time, cost, and scope priorities of the project. Working relationships among project participants may break down, requiring rejuvenating the project tem. Ultimately, there may be a wide difference between what was planned in the beginning and what was achieved at the end of the project.

The project managers are responsible for the following:

a) Integrating the resources assigned for the project.

b) Initiate changes in plans and schedules in tune with internal constraints and external unexpected problems.

c) Keeps the project going while making necessary adjustments along the way. According to Kotter, these two different activities represent the distinction between management and leadership.

Managing Vs. Leading a Project

Thus, management is about coping with complexity, while leadership is about coping with change. Good management brings about order and stability by formulating plans and objectives, designing structures and procedures, monitoring result against plans and taking corrective attention when necessary. Leadership involves recognizing and articulating the need to significantly alter the directions and operations of the project, aligning the people to new directions and motivating them to work together to overcome hurdles produced by the change and realize new objectives. Strong leadership is only desirable and is not always necessary to successfully complete a project.

Well-defined projects that encounter no significant surprises require little leadership,. Example: Constructing a conventional apartments building in which the project manager simply administrates the project

plan. In contract, more leadership is required when the degree of uncertainty encountered on projects is higher in terms of changes in project scope, technological problems, breakdown of relationship and coordination between people, etc. For example, strong leadership is required for a software development project where the parameters are always changing to meet the developments in the industry.

It is a rare mix to see a person who can perform both the role of leader and manager well. Some people may be great visionaries and inspire others but fail in the day to day management. On the other side, there are some other people, who may not inspire others but are well-organized and methodical and very successful in execution. Thus, people with good leadership qualities need the help of good managers who can oversee and manage the projects successfully. Otherwise, people with poor leadership qualities have to count the help of managers who are good in leading and help the leader in understanding the need to change and coordinating the project stakeholders. Still, one of the things that make good project managers so valuable to an organization is that they have the ability to both manage and lead a project. In this process, they recognize the need to manage project interfaces and build a social network that allows them to complete the project successful by ensure cooperation.

Managing Project Stakeholders

Project stakeholders are those entities within or outside an organization which:

1. Sponsor a project, or
2. Have an interest or a gain upon a successful completion of a project;
3. May have a positive or negative influence in the project completion.

Normally, project managers are eager to implement their own ideas and manage their people successfully to complete their project. By experience, they understand that project success depends on cooperation of a wide range of individuals, many of whom do not report to them. For example, during the course of a system integration project, a project manager was surprised by how much time she was spending negotiating and working with vendors, consultants, technical specialists and other functional managers.

When new project managers do find time to work directly on the project, they adopt a hands–on approach to managing the project. They choose this style not because they are power hungry people but eager to achieve the results. They quickly become frustrated by the slow process and non–cooperation of various groups. Unfortunately, as this frustration builds, the natural temptation is to exert more pressure and get more heavily involved in the project. These project managers quickly earn the reputation of *'micro managing'* and begin to lose sight of the real goal they play in guiding a project.

Working with a number of different groups of stakeholders is a prerequisite for any significant project. First, there is a core group of specialists assign to complete the project. This group is likely to be supplemented at different times by professionals who work on specific segments of the project. Second, there are the groups of the people within the performing organizations who are either directly or indirectly involved with the project. The most notable is top management, to whom the project manager is accountable. There are also other project managers, functional managers who provide resource and or may be responsible for specific segments of the project and administrative support service success human resources, finance etc.

Project Stakeholders

Depending on the nature of the project, there are a number of different groups outside the organization that influence the success of the project. Examples of project stakeholders include the customer, the user group, the project manager, the development team, the testers, etc. Stakeholder is anyone who has an interest in the project. Project stakeholders are individuals and organizations that are actively involved in the project, or whose interests may be affected as a result of project execution or project completion.

They may also exert influence over the project's objectives and outcomes. The project management team must identify the stakeholders, determine their requirements and expectations, and, to the extent possible, manage their influence in relation to the requirements to ensure a successful project. Each of the group of stakeholders brings different expertise, standards, priorities, and agendas to the project. The sheer

breadth and complexity of the relationships that need to be managed distinguishes project management from regular management. The project stakeholders include the following:

a) **Project Managers:** They compete with each other for the available scarce resources and the support of top management. They also have to share resources and exchange information.

b) **Project Team:** The project team manages and completes project work. Most participants want to do a good job, but they are also concerned with their other obligations and how their involvement on the project will contribute to their personal goals and aspirations.

c) **Administrative Support Group:** Administrative support groups, such as human resources, information systems, purchasing agents, and maintenance, provide valuable support services. At the same time they impose constrains and requirements on the project such as the documentation of expenditures and the timely and accurate delivery of information.

d) **Functional Managers:** Functional managers, depending on how the project is organized, can play a minor or major role toward project success. In matrix arrangement, they may be responsible for assigning project personnel, resolving technical dilemmas, and overseeing the completion of significant segments of project work. Even in dedicated project teams, the technical input from functional managers may be useful, and acceptance and completed project work may be critical to in-house project. Functional managers want to co-operate up to a point, but only up to a certain point. They are also concerned with preserving their status within the organization and minimizing the disruptions the project may have on their own operations.

e) **Top Management:** Top management approves funding of the project and establishes priorities within the organization. They define success and adjudicate rewards for accomplishments. Significant adjustments in budget, scope, and schedule typically need their approval. They have a natural vested interest in the success of the project, but at the same time want to be responsive to what is best to the entire organism.

f) **Project sponsors:** Project sponsors champion the project and use their influence to get approval of the project. Their reputation is tied to the success of the project, and they need to be kept informed of any major developments. They defend the project when it comes under attack and are a key project partner.

g) **Sub-contractors:** Subcontractors may do all the actual work, in some cases, the project team merely coordinating their contributions. In other cases, they are responsible for ancillary segments of the project scope. Poor work and schedule slips can affect work of the core project team. While contractors' reputations rest with doing good work, they must balance their contributions with their own profit margins and their commitments to other clients.

h) **Government Agencies:** Government agencies place constraints on project work. Permits need to be secured. Construction work has to be built to code. Products have to meet safety standards, for example, Occupational Safety and Health Administration standards.

i) **Other Organizations:** Other organizations, depending on the nature of the project may directly or indirectly affect the project. For example, suppliers provide necessary resources for completion of the project work. Delays, shortages, and poor quality can bring a project to a standstill. Public interest groups may apply pressure on government agencies. Customers often hire consultants and auditors to protect their interests on the project.

j) **Customers:** Customers define the scope of the project, and ultimate project success rests in their satisfaction. Project managers need to be responsive to changing customer need and requirements and to meeting their expectations. Customers are primarily concerned with getting *good deal* and this naturally breed tension with the project team.

Managing Project Stakeholders: 6 Steps to Success

To successfully manage project shareholders, following 6 steps (called as INFORM model – source: http://pmtips.net/managing-stakeholders-6-steps-success) are followed:

a) **Identify:** Who are the stakeholders on your project? A stakeholder is anyone who has a vested interest in the project – someone who wants it to succeed but equally someone who doesn't. You cannot start managing stakeholders until you know who they are. Who are the main groups or departments affected by your project? Stakeholders can also be external to your organization like the government and third party providers as well. The identification exercise should not be done in a vacuum: you will not be able to complete the list yourself, so get your project team involved too.

b) **Nominate:** In each groups you have identified, pick someone to be the key individual. Choose carefully! You may find that key people nominate themselves, which makes your role easier: it is better to work with people who want to be involved than those who you have to be dragged into the project compulsorily. Your key, nominated stakeholders should ideally be people who are directly affected, with enough authority to make decisions about things that touch their departments. They are the person who you will use to channel communication back to their group.

c) **Feel:** Begin to analyze the attitudes of the people who have been identified as your key stakeholders: those named individuals who represent each stakeholder group. Contact them and explain about the project. Get them onboard and coming to project meetings if necessary. All this will help you understand how they feel about the work you are doing. Do they support the project? Or would they rather it was stopped now? Are they ambivalent? This group can often be the hardest to manage effectively. Your initial stakeholder analysis is now complete.

d) **Observe:** Having established where your key stakeholders sit in relation to the project you can start to influence their attitudes. The aim is to watch people over time, and help them move towards a positive way of thinking: a way that will help you achieve your aims. Keep a close eye on people as their opinions will swing between positive and negative over the life of a project. A one-off analysis exercise is never enough: you have to continually monitor how people are reacting and manage accordingly.

e) **Review:** People and job roles change. So do projects. The person who put themselves forward to represent the marketing team six months ago may not be the right person today. If you notice that their influence is slipping away, or they are less inclined to come to meetings or respond to emails, then ask them if they still want to be involved. If they say no, they could suggest someone else who would be a relevant addition to the team. Make sure you brief any new stakeholder representative on their roles and responsibilities, decisions in the pipeline and what decisions you will expect of them in future.

f) **Manage:** The last step is to monitor and manage your stakeholders and their expectations as the project progresses – not just at the outset and when you need something from them. Put a note in your diary to give your key stakeholder representatives a quick call every now and then just to keep them up to date. This will help promote the project and also ensure the stakeholder concerned is mindful of the work being done. It can also help build your reputation as an excellent project manager! At the end of the project, thank them and manage them out of the team. You want a good relationship with them that could last over many projects but you don't want to be their personal helpline six months after the project has finished, so make sure they know who now has operational responsibility now the project has closed.

Social Network Building

In building the social network, there are four steps, viz., mapping dependencies, managing by wandering around, managing upward relations and leading by example.

a) Mapping Dependencies

First step to building a social network is to identify those on whom the project depends on success. The project manager and his or her key assistants need to ask the following questions,

- Whose cooperation is needed?
- Whose agreement or approval is needed?
- Whose opposition would keep us from accomplishing the project?

It is always better to overestimate rather than under estimate dependencies on too often, otherwise talented and successful project managers have been de-railed because they were blindsided by some who's position or power that they had not anticipated. After identifying who you are dependent on, you are ready to "step into their shoes", and see their project from their perspectives. To help you do that asks yourself the following questions:

- What differences exist between me and the people on whom I depend? (Goals, Values, Pressures, Risks)
- How these different people do knew the project? (supporters in different antagonists)
- What is the current status of the people I depend on?
- What sources of influence do I have relative to whose on whom I depend?

Once, you begin this analysis, you can begin to appreciate what others value and what currencies you are able to offer on the basis on which to build a mutually satisfying relationship. Likewise, you begin to realize where potential problems lie, relationships in which you have a current debit or n 0 convertible currency, furthermore, diagnosing others point of view as well as the basis for their positions will help you anticipate the reactions and feelings about your decisions and actions. This information is vital for selecting the appropriate influence strategy and tactics and conducting win-win negotiations.

b) Management by Wandering Around

Once you have established who the keep players are that will determine success. Then you initiate contact and begin to build a relationship with those players. Building this relationship requires a management style referred as management by wandering around (MBWA) to reflect that managers spend the majority of the time outside their offices. MBWA is somewhat of a misnomer in that there is a purpose or pattern behind the wandering. Through face to face interactions, project managers are able to stay in touch with what is really going on in the project and build cooperative relationship essential to project success.

Effective project managers initiate contact with key payers to keep abreast of developments, anticipate potential problems, provide encouragement and re-enforce the objectives and vision of the project. They are able to intervene to resolve conflicts and prevent stalemates from occurring. In essence, they "manage" the project. By staying in touch with the various aspects of the project, they become the focal point for information on the project. Participants turn to them, to obtain the most current and comprehensive information about the project, which re-enforces as central role as project manager.

While a significant amount of their time is devoted to the project team, effective project managers find the time to regularly interact with more important stakeholders. They keep in touch with suppliers, vendors, top management and other functional managers. In doing so, they maintain familiarity with different parties, sustain friendship, discover opportunities to do favours and understand the motives and needs of others. They remind people of commitment and champion the cause of their project. They also shape people's expectations. Through frequent communication, they reduce people's concern about project dispel romours, warn people of potential problems and lay the ground work for dealing with setbacks in more effective manner.

Experienced project managers build relationships before they need them. They initiate contact with the key stakeholders at times when there are no outstanding issues or problems and therefore no anxieties and suspicions. On the social occasions they engage in small talk and responsive chitchat. Smart project managers also seek to make deposit in their relationships with potentially important stake holders. They are responsive to others request for aid provide supportive counsel and exchange information. In doing so they are establishing credit in those relationships which will allow them to deal with more serious problems down the road. When one person views another as pleasant, credible and helpful based on past contact, he or she is more likely to be responsive to request for help and less confrontational when problem arise.

c) Managing Upward Relations

Project success is strongly affected by the degree to which a project has the support of the top management. Such support is reflected in

an appropriate budget, responsiveness to unexpected needs, and a clear signal to others in the organization about the importance of cooperation. Visible top management support is not only critical for securing the support of other managers within an organization, but it also is a key factor in the project manager's ability to motivate the project team. Nothing establishes a manager's right to lead more tan his/her ability to defend. To win the loyalty of team members, project managers have to be effective advocates for their projects. They have to be able to get top management to withdraw unreasonable demand, provide additional resources and recognize the accomplishment of team members. Working relationship with top management is a common source of concern. While it may seem difficult for a subordinate to manage a superior, smart project managers devote considerable time and attention to influencing and garnering the support of top management. Project managers have to accept profound differences in perspective and become skilled at the art of persuading superiors.

d) Leading by Example

A highly visible, interactive management style is not only essential to building and sustaining cooperative relationships, it also allows project managers to utilize their most powerful leadership tool – their own behaviour. Often, when faced with uncertainty, people look to others for clues as to how to respond and demonstrate a propensity to imitate the behaviour of superiors. A project manager's behaviour symbolizes how other people should work on the project. Through her behaviour a project manager can influence how other ¥s act and respond to a variety of issues related to the project. To be effective, project managers must "walk the talk". Six aspects of leading by example include setting the priorities, communicating the urgency, help in problem solving, ensuring cooperation, ensuring standards of performance and responding to ethical dilemmas properly.

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Lesson 5.2 - Qualities of Project Manager and Managing Projects

Learning Objectives

- To know the qualities of an effective project manager.
- To learn the ground rules of project team.
- To understand the steps in managing project teams.

Qualities of Project Manager

The above diagram shows the qualities of a successful project manager. What qualities are most important for a project leader to be effective? With the unique opportunity to ask some of the most talented project leaders in the world on their Project Leadership courses, the top 10 qualities of project managers are arrived based on their rank order according to frequency listed.

a) **Inspires a Shared Vision:** An effective project leader is often described as having a vision of where to go and the ability to articulate it. Visionaries thrive on change and being able to draw new boundaries. It was once said that a leader is someone who "lifts us up, gives us a reason for being and gives the vision and spirit to change." Visionary leaders enable people to feel they have a real

stake in the project. They empower people to experience the vision on their own. According to Bennis "They offer people opportunities to create their own vision, to explore what the vision will mean to their jobs and lives, and to envision their future as part of the vision for the organization." (Bennis, 1997).

b) **Good Communicator:** The ability to communicate with people at all levels is almost always named as the second most important skill by project managers and team members. Project leadership calls for clear communication about goals, responsibility, performance, expectations and feedback. There is a great deal of value placed on openness and directness. The project leader is also the team's link to the larger organization. The leader must have the ability to effectively negotiate and use persuasion when necessary to ensure the success of the team and project. Through effective communication, project leaders support individual and team achievements by creating explicit guidelines for accomplishing results and for the career advancement of team members.

c) **Integrity:** One of the most important things a project leader must remember is that his or her actions, and not words, set the modus operandi for the team. Good leadership demands commitment to, and demonstration of, ethical practices. Creating standards for ethical behaviour for oneself and living by these standards, as well as rewarding those who exemplify these practices, are responsibilities of project leaders. Leadership motivated by self-interest does not serve the well being of the team. Leadership based on integrity represents nothing less than a set of values others share, behaviour consistent with values and dedication to honesty with self and team members. In other words the leader "walks the talk" and in the process earns trust.

d) **Enthusiasm:** Plain and simple, we don't like leaders who are negative – they bring us down. We want leaders with enthusiasm, with a bounce in their step, with a can-do attitude. We want to believe that we are part of an invigorating journey – we want to feel alive. We tend to follow people with a can-do attitude, not those who give us 200 reasons why something can't be done. Enthusiastic leaders are committed to their goals and express this commitment through optimism. Leadership emerges as someone expresses such

confident commitment to a project that others want to share his or her optimistic expectations. Enthusiasm is contagious and effective leaders know it.

e) **Empathy:** They are, in fact, mutually exclusive. According to Norman Paul, in sympathy the subject is principally absorbed in his or her own feelings as they are projected into the object and has little concern for the reality and validity of the object's special experience. Empathy, on the other hand, presupposes the existence of the object as a separate individual, entitled to his or her own feelings, ideas and emotional history (Paul, 1970). As one student so eloquently put it, "It's nice when a project leader acknowledges that we all have a life outside of work."

f) **Competence**: Simply put, to enlist in another's cause, we must believe that that person knows what he or she is doing. Leadership competence does not however necessarily refer to the project leader's technical abilities in the core technology of the business. As project management continues to be recognized as a field in and of itself, project leaders will be chosen based on their ability to successfully lead others rather than on technical expertise, as in the past. Having a winning track record is the surest way to be considered competent. Expertise in leadership skills is another dimension in competence. The ability to challenge, inspire, enable, model and encourage must be demonstrated if leaders are to be seen as capable and competent.

g) **Ability to delegate task:** Trust is an essential element in the relationship of a project leader and his or her team. You demonstrate your trust in others through your actions – how much you check and control their work, how much you delegate and how much you allow people to participate. Individuals who are unable to trust other people often fail as leaders and forever remain little more that micro-managers, or end up doing all of the work themselves. As one project management student put it, "A good leader is a little lazy." An interesting perspective!

h) **Cool Under Pressure:** In a perfect world, projects would be delivered on time, under budget and with no major problems or obstacles to overcome. But we don't live in a perfect world – projects have

problems. A leader with a hardy attitude will take these problems in stride. When leaders encounter a stressful event, they consider it interesting, they feel they can influence the outcome and they see it as an opportunity. "Out of the uncertainty and chaos of change, leaders rise up and articulate a new image of the future that pulls the project together." (Bennis 1997) And remember – never let them see you sweat.

i) **Team Building Skills:** A team builder can best be defined as a strong person who provides the substance that holds the team together in common purpose toward the right objective. In order for a team to progress from a group of strangers to a single cohesive unit, the leader must understand the process and dynamics required for this transformation. He or she must also know the appropriate leadership style to use during each stage of team development. The leader must also have an understanding of the different team players styles and how to capitalize on each at the proper time, for the problem at hand.

j) **Problem Solving Skills:** Although an effective leader is said to share problem–solving responsibilities with the team, we expect our project leaders to have excellent problem–solving skills themselves. They have a "fresh, creative response to solve problems and not much concern with how others have performed them. (Kouzes 1987).

The other qualities include the following: a) effective time management; b) optimist; c) systems thinker; and d) proactive.

Managing a Project Team

Managing project teams is the art and science of managing relatively short–term efforts having finite beginning and ending points. The concept of project management involves two equally important components of hardware and software. The hardware of tools and systems make it a science. However, there are other things in managing projects than just applying analytical tools to help monitor, track and control. In managing a project team, a Project Manager needs to possess excellent analytical and organizational skills. A technical proficiency in the specialist area of their project is also a distinct advantage. Remember, though, that projects

achieve their outcomes through people – a variety of people working together in a coordinated way to produce the desired results. How are you encouraging peak performance from your project team? As with any manager getting the best out of their people, you will need to pay attention to your general leadership and management skills. Some of these skill areas that you will need to pay attention to are:

- Clarifying project team member roles
- Setting team and individual goals
- Monitoring and measuring team and individual performance
- Feeding back team and individual performance
- Resolving conflicts between team members constructively
- Delegating responsibilities and tasks
- Motivating using a combination of intrinsic and extrinsic rewards
- Developing the skills of team members
- Coaching team members

Effective teams are so much more productive than groups working on the same task because they are able to leverage off each others' strengths and compensate for each others' weaknesses. Making sure that you have the right mix of team members in your project team is therefore an important consideration. Conducting a team profiling exercise is also an effective method for getting each project team member to appreciate their respective strengths and weaknesses.

Team Ground Rules

If your project team gets stuck in a problem with lots of unproductive conflict, there are a number of things you can try. If you haven't already done so, get your team together to clarify and agree the "ground rules" that govern the team's behavior. Your "ground rules" should cover these five key areas of team operation:

- Team meetings
- Team working
- Team communication
- Team member relationships
- Team decision-making

Discussing the ground rules will uncover hitherto unspoken assumptions. Each team member will come to see more clearly where other team members are coming from and what they need from the team to get their job done. Be sure to post the agreed ground rules in a visible place where the teams meet regularly. The bigger problems for project managers are those associated with the human element: conflict resolution, team building, coaching, mentoring and negotiation. This workshop is intended to provide team leaders with fundamental skills necessary to copy with this element of the art of managing project teams.

Blended Learning – Maximum Benefits with Minimum Time

The goal of blended learning is to provide the most efficient and effective instruction experience by combining delivery modalities. Blended learning offers a range of learning tools and experiences, which in total focuses on the best learning style for all learners. With a combination of online e–learning and classroom training, learners will enjoy an all rounded learning experience.

Learning Outcomes

- Communicate information to team members in accordance with organizational and project requirements.
- Implement training and development for project team to meet project specifications.
- Monitor and evaluate team performance in accordance with performance measures.
- Monitor and manage team dynamic to ensure smooth executing of project.

Steps in Managing the Team

a) **Define the Scope:** The first, and most important, step in any project is defining the scope of the project. What is it you are supposed to accomplish by managing this project? What is the project objective? Equally important is defining what is not included in the scope of your project. If you don't get enough definition from your boss, clarify the scope yourself and send it back upstairs for confirmation.

b) **Determine Available Resources:** What people, equipment, and money will you have available to you to achieve the project objectives? As a project manager, you usually will not have direct control of these resources, but will have to manage them through matrix management. Find out how easy or difficult that will be to do.

c) **Check the Timeline:** When does the project have to be completed? As you develop your project plan you may have some flexibility in how you use time during the project, but deadlines usually are fixed. If you decide to use overtime hours to meet the schedule, you must weigh that against the limitations of your budget.

d) **Assemble Your Project Team:** Get the people on your team together and start a dialogue. They are the technical experts. That's why their functional supervisor assigned them to the project. Your job is to manage the team.

e) **List the Big Steps:** What are the major pieces of the project? If you don't know, start by asking your team. It is a good idea to list the steps in chronological order but don't obsess about it; you can always change the order later.

f) **List the Smaller Steps:** List the smaller steps in each of the larger steps. Again, it usually helps you remember all the steps if you list them in chronological order. How many levels deep you go of more and more detailed steps depends on the size and complexity of your project.

g) **Develop a Preliminary Plan:** Assemble all your steps into a plan. What happens first? What is the next step? Which steps can go on at the same time with different resources? Who is going to do each step? How long will it take? There are many excellent software packages available that can automate a lot of this detail for you. Ask others in similar positions what they use.

h) **Create Your Baseline Plan:** Get feedback on your preliminary plan from your team and from any other stakeholders. Adjust your timelines and work schedules to fit the project into the available time. Make any necessary adjustments to the preliminary plan to produce a baseline plan.

i) **Request Project Adjustment:** There is almost never enough time, money or talent assigned to a project. Your job is to do more with the limited resources than people expect. However, there are often limits placed on a project that are simply unrealistic. You need to make your case and present it to your boss and request these unrealistic limits be changed. Ask for the changes at the beginning of the project. Don't wait until it's in trouble to ask for the changes you need.

j) **Work Your Plan, But Don't Die For It:** Making the plan is important, but the plan can be changed. You have a plan for driving to work every morning. If one intersection is blocked by an accident, you change your plan and go a different way. Do the same with your project plans. Change them as needed, but always keep the scope and resources in mind.

k) **Monitor Your Team's Progress:** You will make little progress at the beginning of the project, but start then to monitor what everyone is doing anyway. That will make it easier to catch issues before they become problems.

l) **Document Everything**: Keep records. Every time you change from your baseline plan, write down what the change was and why it was necessary. Every time a new requirement is added to the project write down where the requirement came from and how the timeline or budget was adjusted because of it. You can't remember everything, so write them down so you'll be able to look them up at the end–of–project review and learn from them.

m) **Keep Everyone Informed**: Keep all the project stakeholders informed of progress all along. Let them know of your success as you complete each milestone, but also inform them of problems as soon as they come up. Also keep you team informed. If changes are being considered, tell the team about them as far ahead as you can. Make sure everyone on the team is aware of what everyone else is doing.

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Lesson 5.3 - Team Building Models, Performance Teams and Team Pitfalls

Learning Objectives

- To understand the stages in Team Development model.
- To understand the situational factors affecting team development.
- To learn how to develop high performance teams.
- To identify area of team pitfalls

Five Stages of Group Development

The following figure shows the five stages team development model.

Stage 1: Forming

In the Forming stage, personal relations are characterized by dependence. Group members rely on safe, patterned behavior and look to the group leader for guidance and direction. Group members have a desire for acceptance by the group and a need to be known that the group is

safe. They set about gathering impressions and data about the similarities and differences among them and forming preferences for future sub grouping. Rules of behavior seem to be to keep things simple and to avoid controversy. Serious topics and feelings are avoided. The major task functions also concern orientation. Members attempt to become oriented to the tasks as well as to one another. Discussion centers around defining the scope of the task, how to approach it, and similar concerns. To grow from this stage to the next, each member must relinquish the comfort of non-threatening topics and risk the possibility of conflict.

Stage 2: Storming

The next stage, called Storming, is characterized by competition and conflict in the personal relations dimension an organization in the task-functions dimension. As the group members attempt to organize for the task, conflict inevitably results in their personal relations. Individuals have to bend and mold their feelings, ideas, attitudes, and beliefs to suit the group organization. Because of "fear of exposure" or "fear of failure," there will be an increased desire for structural clarification and commitment. Although conflicts may or may not surface as group issues, they do exist. Questions will arise about who is going to be responsible for what, what the rules are, what the reward system is, and what criteria for evaluation are. These reflect conflicts over leadership, structure, power, and authority. There may be wide swings in members' behavior based on emerging issues of competition and hostilities. Because of the discomfort generated during this stage, some members may remain completely silent while others attempt to dominate. In order to progress to the next stage, group members must move from a "testing and proving" mentality to a problem-solving mentality. The most important trait in helping groups to move on to the next stage seems to be the ability to listen.

Stage 3: Norming

In the Norming stage, interpersonal relations are characterized by cohesion. Group members are engaged in active acknowledgment of all members' contributions, community building and maintenance, and solving of group issues. Members are willing to change their preconceived ideas or opinions on the basis of facts presented by other members, and they actively ask questions of one another. Leadership is shared, and

cliques dissolve. When members begin to know–and identify with–one another, the level of trust in their personal relations contributes to the development of group cohesion. It is during this stage of development (assuming the group gets this far) that people begin to experience a sense of group belonging and a feeling of relief as a result of resolving interpersonal conflicts. The major task function of stage three is the data flow between group members: They share feelings and ideas, solicit and give feedback to one another, and explore actions related to the task. Creativity is high. If this stage of data flow and cohesion is attained by the group members, their interactions are characterized by openness and sharing of information on both a personal and task level. They feel good about being part of an effective group. The major drawback of the norming stage is that members may begin to fear the inevitable future breakup of the group; they may resist change of any sort.

Stage 4: Performing

The Performing stage is not reached by all groups. If group members are able to evolve to stage four, their capacity, range, and depth of personal relations expand to true interdependence. In this stage, people can work independently, in subgroups, or as a total unit with equal facility. Their roles and authorities dynamically adjust to the changing needs of the group and individuals. Stage four is marked by interdependence in personal relations and problem solving in the realm of task functions. By now, the group should be most productive. Individual members have become self–assuring, and the need for group approval is past. Members are both highly task oriented and highly people oriented. There is unity: group identity is complete, group morale is high, and group loyalty is intense. The task function becomes genuine problem solving, leading toward optimal solutions and optimum group development. There is support for experimentation in solving problems and an emphasis on achievement. The overall goal is productivity through problem solving and work.

Stage 5: Adjourning

The final stage, adjourning involves the termination of task behaviors and disengagement from relationships. A planned conclusion usually includes recognition for participation and achievement and an opportunity for members to say personal goodbyes. Concluding a group

can create some apprehension – in effect, a minor crisis. The termination of the group is a regressive movement from giving up control to giving up inclusion in the group. The most effective interventions in this stage are those that facilitate task termination and the disengagement process.

Situational Factor Affecting Team Development

Experience and research indicate that high-performing project teams are much more likely to develop under the following conditions:

- There are 10 or fewer members per team
- Members volunteer to serve on the project team
- Members serve on the project from beginning to end.
- Members are assigned to the project full-time.
- Members are part of an organizational culture that fosters cooperation and trust all relevant functional areas are represented on the team
- The project involves a compelling objective
- Members are located within conversational distance of each other

In reality, is rare that a project manager is assigned a project that meets all of these conditions. It is important for project managers and team members to recognize the situational constraints; they are operating under and do the best they can. It would be naive to believe that every project theme has the same potential to evolve into a high performing team. Under less than ideal conditions it may be a struggle just to meet project objectives. Ingenuity, discipline and sensitivity to team dynamics are essential to maximize the performance of the project team.

Team Focus

All the team members need to understand the direction you're headed and work toward that end. It is paramount that the team members know and understand the objectives of the project. After all, that is the reason they have been brought together in the first place. Keep in mind that people see and hear things from their own perspective. It is the job of project manager to make certain the team members understand the objectives and their assignments correctly.

Effective Team Characteristics

Effective teams are typically very energetic teams. Their enthusiasm is contagious, and it feeds on itself. They generate a lot of creativity and become good problem solvers. Teams like this are every project manager's dream. Investing yourself in team building as well as relationship building, especially when you don't think you have the time to do so, will bring many benefits.

Factors in Leadership

One of the markers of an effective leader is the ability to size up a situation and make decisions based on what is the best thing to do. A leader who is able to adjust his response to fit the situation is ahead of one who cannot shift between leadership styles. Factors in situational decisions include the motivation and level of competency of the followers. There are four developmental levels of followers who have significant impact on the final outcomes of the situation. The four levels are: the enthusiastic beginner, the disillusioned learner, the reluctant contributor and the peak performer.

a) Enthusiastic Beginner

An enthusiastic beginner has a high level of enthusiasm and commitment and a low level of experience and competence. Leaders who are faced with followers such as this need to be direct and autocratic in their leadership style as the followers are eager and want to please, but often do not know how. The autocratic leadership style provides goals, strategies and deadlines for followers to meet.

b) Disillusioned Learner

Someone who is a disillusioned learner exhibits both low competence and enthusiasm or commitment. Individual or groups of disillusioned followers are difficult to motivate as they believe there is no way to change the situation; that it is hopeless. A leader who has disillusioned followers may be most successful adopting an autocratic leadership style that provides leadership expectations that could override low motivation and competence.

c) Reluctant Contributor

A reluctant contributor is someone who has a high level of competency with low commitment. In this situation, utilizing a participative style of leadership may provide the motivation to participate. The participative leadership style brings everyone's opinion and ideas into the decision-making process. Many competent individuals have low motivation because they feel under-utilized and under-appreciated. The participative style of leadership often makes them feel valued and ready to contribute.

d) Peak Performer

Someone functioning at the peak performance level has high motivation and high competence. Using an autocratic leadership style with this individual is ill-advised and generally only causes resentment and low morale. A laissez faire leadership style is sometimes successful, as this individual has the capability to take the lead and manage the situation herself. The participative leadership style works quite effectively with the peak performer and actually results in a situation being resolved quickly and effectively.

Building High-Performance Project Teams

The project managers play a key role in developing high-performance project teams. They recruit members, conduct meetings, establish team identity, create a common sense of purpose or a shared vision, manage a reward system that encourage teamwork, orchestrate decision making, resolve conflicts that emerge within the team, and rejuvenate the tem when energy diminishes. The project managers take advantage of situational factors that naturally contribute to team development while improvising around those factors that inhibit team development. By this process, they exhibit a highly interactive management style that exemplifies teamwork and manage the interface between the team and the rest of the organization.

a) Recruiting Project Members

The process of selecting and recruiting project members vary across organizations. Two important factors which affect recruitment are

the importance of the project and the management structure being used to complete the project. For high priority projects which are critical to the future of the organizations, the project manager will be given complete freedom to choose whomever he or she deems necessary. For less significant projects, the project manager will have to persuade personnel from other areas within the organization to join the team. When selecting team members, project managers look for individuals with the necessary experience and knowledge/technical skills critical for project completion. At the same time they are less obvious considerations that need to be factored into the recruitment process such as a) problem solving ability, availability, technological expertise, credibility, political connections, ambition, initiative and energy.

b) Conducting Project Meetings

The first project kick-off meeting is critical to the early functioning of the project team. The first team meeting sets the tone for how the team will work together. If it is crisply run, focusing on real issues and concerns in an honest and straightforward manner, members become excited about being part of the project team. There are three objectives project managers try to achieve during the first meeting of the project team:

a) Providing an overview of the project, including the scope and objectives, the general schedule, method, and procedures;

b) Address some of the interpersonal concerns captured in the team development model; and

c) Model how the team is going to work together to complete the project. The project manager must recognize that first impressions are most important and his/her behavior will be carefully monitored and interpreted by team members. This meeting should serve as an exemplary role model for subsequent meetings and reflect the leader' s style.

c) Establishing Ground Rules

The establishment of operational ground rules for how the tea will work together is the important duty of project manager and this can be done as part of an elaborate first meeting or during follow-up meetings.

These ground rules involve not only organizational and procedural issues but also normative issues on how the team will interact with each other. Though specific procedures will vary across organizations and projects, some of the major issues that need to be addressed include:

a) Planning decisions
b) Tracking decisions
c) Managing change decisions; and
d) Relationship decisions

During the course of establishing these operational procedures, the project manager, through word and deed, should begin working with members to establish the norms for team interaction. One of the ways making the norms more tangible is by creating a project team charter that goes beyond the scope statement of the project and states in explicit teams the norms and values of the team. This charter should be a collaborative effort on the part of the team. Project managers can lead by proposing certain tenets, but they need to be open to suggestions from the team. Once there is general agreement to the rules of conduct, each member signs the final document to symbolize commitment to the principles it contains. Very important thing is that this should not become ritual and the charter has to be a legitimate part of the project monitoring system. Just as the team reviews the progress toward project objectives, the team assesses the extent to which members are adhering to the principles in the charter.

d) Managing Subsequent Project Meetings

The project kick-off meeting is one of the several kinds of meetings required to complete a project. Other meetings include status report meetings, problem-solving meetings, audit meetings. Meetings are often considered a disturbance to productivity, but this does not have to be the case. The most common complaint is that meetings last too long. By establishing proper guidelines to conduct various projects related meetings and careful and consistent application of these guidelines can make the meetings a vital part of projects. This will also help in real time communication process.

e) Establishing a Team Identity

One of the challenges project managers often face in building a team is the lack of full-time involvement of team members. Specialists work on different phases of the project and spend the majority of their time and energy elsewhere. They are often members of multiple teams, each competing for their time and commitment. Project managers need to try to make the project team as tangible as possible to the participants by developing a unique team identity to which participants can become emotionally attached. Team identity can be established by

a) Effective use of meeting;
b) Co-location of team members
c) Creation of project team name; and
d) Having team rituals.

f) Creating a Shared Vision

Once the project manager accepts the importance of building a shared vision, the next question is how to get a vision for a particular project. First, project managers do not get visions. They act as catalysts and midwives for the formation of a shared vision of a project team. In many cases, visions are inherent in the scope and objectives of the project. People get naturally excited about being the first ones to bring a new technology to the market or solving a problem that is threatening their organization.

g) Managing Project Reward System

Project managers are responsible for managing the reward system that encourages team performance and extra effort. One advantage they have is that often project work is inherently satisfying, whether it is manifested in an inspiring vision or simple sense of accomplishment. Projects provide participants with a change in scenery, a chance to learn new skills, and an opportunity to break out of their departmental cocoon.

While project managers tend to focus on group rewards, there are times when they need to reward individual performance. Rewards used

to motivate and recognize individual contributions include letters of commendation, public recognition for outstanding work, job assignments and flexibility.

h) Orchestrating the Decision-Making Process

Most decisions on a project do not require a formal meeting to discuss alternatives and determine solutions. Instead decisions are made in real time as part of the daily interaction patterns between project managers, stakeholders, and team members. Group decision making should be used when it will improve the quality of important decisions. This is often the case with complex problems that require the input of a variety of different specialists. Group decision making should also be used when strong commitment to the decision is needed and there is low probability of acceptance if only one person makes the decision. Participation is used to reduce resistance and secure support for the decision.

i) Managing conflict within the Project

Disagreements and conflicts naturally emerge within a project team during the life of the project. Participants will disagree over priorities, allocation of resources, the quality of specific work, solutions to discovered problems, and so forth. Some conflicts support the goals of the group and improve project performance. For example, two members may be locked in a debate over a design trade-off decision involving different features of a product. They argue that their preferred feature is what the primary customer truly wants.

This disagreement may force them to talk to or get more information from the customer, with the result that they realize neither feature is highly valued, but instead the customer wants something else. On the other hand, conflicts can also hinder group performance. Functional conflicts can be encouraged and there should be a clear demarcation between functional and dysfunctional conflict. Members may be upset and dissatisfied with the interchange, but as long as the disagreement furthers the objectives of the project, then the conflict is function. Managing dysfunctional conflict is a much more challenging task than encouraging functional conflict because dysfunction conflict is hard to identify.

j) Rejuvenating the Project Team

Over the course of a long project, a team sometimes drifts off course and loses momentum. The project manager needs to swing into action to realign the team with the project objectives and step on the pedal. There are both formal and informal ways of doing this. Informally, the project manager can institute new rituals to reenergize a team. Another option is to have the project sponsor give a pep talk to the team members. Sometimes, more formal actions need to be taken. The project manager may recognize the need for a teambuilding session devoted to improving the work processes of the team.

Project Team Pitfalls

High performance project teams can produce dramatic results however like any other good thing there is a dark side to project teams that managers need to be aware of. In this section we examine more detail some of the pathologies that the high performing project teams can succumb to and high light what project managers can do to reduce the likelihood of these problems occurring.

a) Groupthink

Janis first identified groupthink as a factor that influenced the misguided 1961 Bay of Pigs invasion of Cuba, his term refers to the tendency of members in highly cohesive groups to lose their critical evaluative capabilities. This malady appears when pressures for conformity are combined with an illusion of invincibility to suspend critical discussion of decisions. As a result decisions are made quickly with little consideration of alternatives; often the practice leads to fiascos that, after the fact, appeared totally improbable. Some of the symptoms of group think include the following:

- *Illusion of Invulnerability:* The team feels invincible. It is marked by a high degree of esprit de corps, and implicit faith in its own wisdom and an inordinate optimism that allows group members to feel–complacent about the quality of the decisions.
- **Whitewash of Critical Thinking**: The group members discuss only a few solutions, ignoring alternatives; they fail to examine the

adverse consequences that could follow their preferred course of action; and they too quickly dismiss any alternatives that on the surface appear to be unsatisfactory.

- *Negative Stereotypes of Outsiders:* Good guy, bad guy stereotypes emerge in which the group considers any outsiders who oppose their decisions as the bad guys, who are perceived as incompetent and malicious and whose points are unworthy of serious consideration.

- *Direct Pressure*: When a team member does speak out or question the direction in which the team is headed, direct pressure is applied to the dissenter. He or she is reminded that speed is important and that the aim is agreement not argument.

b) Bureaucratic Bypass Syndrome

Project teams are often licensed to get things done without having to go through normal protocols of the parent organization. Bypassing bureaucratic channels is appealing and invigorating. However, if bypassing becomes a way of life, it results in the rejection of bureaucratic policies and procedures, which provide the glue for the overall organization. A team that operates outside the organization may alienate other workers who are constrained by the norms and procedures of the organization; eventually, these outside bureaucrats will find ways to put up road blocks and thwart the project team.

c) Entrepreneurs Disease

Project teams can be intoxicating in the same way that start up ventures are. Such intoxication is exciting and contributes greatly to the success of the team. But abuse can occur as the team makes decision based on what is best for the project instead of on what's best for parent organization. The team becomes myopic in its focus and often views the constraints imposed by the parent organization or something to overcome. When this attitude occurs on developmental project the team members, enthralled with their accomplishments sometimes quit the parent organization and start their own business. While starting a new venture may be good for the project team, it does little for the parent organization that sponsored and financed the development work.

d) Team Spirit Becomes Team Infatuation

High-performing project teams can be tremendous source of personal satisfaction. The excitement, chaos, and joy generated by working on a challenging project can be an invigorating experience. Leavitt and Lipman-Blumen even go so far as to say that the team members behave like people in love. They become infatuated with the challenge of the project and the talent around them. This total preoccupation with the project and the project team, while contributing greatly to the remarkable success of the project, can leave in its wake a string of broken professional and personal relationships that contribute to burnout and disorientation upon completion of the project.

e) Going Native

Going native is a phrase first used by the British Foreign Service during colonial times to describe agents who assumed the customs, values and prerogatives of their foreign country assignment, they did so to the point that they were no longing representing the best interest of the British empire but rather those of the natives. This same phenomenon can occur within the project teams working abroad or in those who become closely identified with their customers. In essence, the customer's interest takes precedent organizations interests. This change in view point can lead to excessive scope creep and open defiance of corporate policy and interests.

Conclusion

Dealing with these maladies is problematic because, in most cases, they are a distortion of a good thing, rather than a simple evil. Awareness is the first step for prevention. The next step is to take pre-emptive action to reduce the likelihood of these pitfalls occurring. For example, managers can reduce the isolation of the project team by creating work-related connections outside the project team. These include interactions naturally occur in a matrix environment where members work on multiple projects and maintain ties to their home department. Likewise, the isolation of dedicated project teams can be reduced by the timely involvement of external specialists. In either case, the active involvement of relevant members of the parent organization at project status meetings can help maintain the link between the project and the rest of the organization.

If the team appears to be suffering from group think, then the project manager can encourage functional conflict by playing the devil's advocate to encourage dissent. Finally, formal team-building sessions may reveal dysfunctional norms and refocus the attention of the team on project objectives.

Self Assessment Questions

1) Differentiate between managing versus leading a project.
2) Who are the various project stakeholders? How to manage them?
3) Explain the steps in successfully managing the stakeholders?
4) What is social network building?
5) What is management by wandering around?
6) Discuss the ways to build social network to succeed in projects.
7) Discuss the qualities of an effective project manager.
8) What are the ground rules for project teams?
9) What is blended learning?
10) Explain the steps in managing project teams.
11) Explain the steps in Five Stage Team Development Model.
12) Discuss the factors in leadership in relation to four development levels of followers.
13) Discuss the situational factors affecting team development.
14) How to build high performance project teams? Explain.
15) Discuss the areas of project team pitfalls.

CASE STUDY

The role of the finance team in climate change projects

Asda is Britain's second largest supermarket with 368 stores. It has successfully embedded sustainability in its strategy and has implemented many initiatives to save energy, reduce packaging and remove unnecessary waste from its stores. Asda's finance team plays an intrinsic role in the decision making process including planning, testing and roll out of all of their sustainability programmes. These include: zero waste to landfill; reducing harmful emissions from stores; depots and transport; responsible

store development (e.g. Asda's low carbon flagship store in Bootle, Liverpool); minimising packaging on own-label products; continually improving waste management practices at store level; encouraging customer and associate recycling through 'bring back' facilities and 'green' transport. Below are examples of the finance team's specific contribution to some recent projects at ASDA.

Projects	Finance team's contribution
Bio/bakery recycling projects	Cost benefit analysis
ASDA project management process	Stewardship, progress, responsibility and performance
Reporting	
Evaluation of the potential impact of carbon reduction commitment regulations on Asda	Financial evaluation, interpretation and presentation to
senior executive team	
New initiative store testing	Investment appraisal

Analyse the role of finance team in managing climate change projects.

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