MP-505

Vardhaman Mahaveer Open University, Kota

Project Management

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Project Management

Unit – 1 : Project Management

Structure of Unit

1.0 Objectives

After completing this unit, you would be able to:

- Understand the meaning of project and project management;
- Know the functions of project management;
- Understand the classification of projects
- Know the attributes and responsibility of a good project manager
- Discuss the various aspects of a project

1.1. Introduction

Project is a single shot set of activities having a definite beginning and ending points. For example, construction of a house is a project. The construction of a house consists of many activities like digging of foundation pits, construction of foundations, construction of walls, construction of roof, fixing of doors and windows, fixing of sanitary fittings, writing etc. The construction of a house is accomplished by performing the set of activities. Another aspect of **project** is non-routine nature of activities. Each project is unique in the sense that the activities of a project are unique and non-routine. Thus, we can define a project as an organized program of predetermined group of activities that are non-routine in nature and that must be completed using the available resources within the given limit.

1.2 Meaning

Projects can be of any size and duration. They can be simple, like planning a party, or complex like launching a space shuttle. Generally projects are made up of: a defined beginning, multiple activities which are performed to a plan and a defined end. Therefore, a project may be defined as a means of moving from a problem to a solution via a series of planned activities.

Two essential features are present in every project no matter how simple or complicated they are. In the first place, all projects must be *planned* out in advance if they are to be successfully executed. Secondly, the execution of the project must be *controlled* to ensure that the desired results are achieved.

On most projects it is possible to carry out multiple activities simultaneously. Usually it is possible to perform several activities at the same time, however there will be activities which cannot begin until a preceding activity has been completed. Such relationships are referred to as dependencies or precedence, and when planning a project it is important to establish the order of precedence of dependent activities, and to establish those activities which can be performed in parallel with other activities.

Regardless of the nature or size of your project a successful outcome can only be achieved by using sound project management techniques. The most widely used and popular methods of project management are Gantt Charts, Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT). However, it is important to remember that projects are carried out by people, and the human aspects of project management are critical for the project success.

According to ***Harison,*** a project can be defined as non-routine, non-repetitive, one-off undertaking, normally with discrete time, financial and technical performance goals.

Project Management Institute USA defines project as 'a system involving the co-ordination of a number of separate department entities throughout the organization and which must be completed within prescribed schedules and time constraints.

According to Encyclopedia of Management a project is an organized unit dedicated to the attainment of goal –the successful completion of a development project on time, within a budget, in conformance with pre-determined program specifications.

According to Little and Mirrless a project is any scheme or part of a scheme for investing resources which can be reasonably analyzed and evaluated as an independent specification.

According to Dictionary of Management a project is an investment carried out according to plan in order to achieve a definite objective, within a certain time and which all cease when the objective is achieved.

According to Sinha and Sinha a project is not a mere action or an activity or an attempt towards a particular aim; it is rather an integrated effort, including multifarious actions and activities, towards that aim.

According to the report of the Economic Commission for Asia and Far East (ECAFE) describes that 'Project is a smallest unit of investment activity to be considered in the case of programming. It will, as a rule, be a technically coherent undertaking which has to be carried out technically speaking, independently of other projects.'

According to Food and Agriculture Organization (FAO) a project is an activity sufficiently self contained to permit financial and commercial analysis..in most cases projects represent the expenditure of capital funds by pre-existing entities which want to

prove their operation. It is convenient to divide all projects into two broad classes: (i) Those that are revenue producing and self financing (i.e. commercial types of projects and profit oriented) (ii) Social projects.

According to Project Management Institute, USA, a project is an undertaking with a defined objective by which completion is identified. In practice, most projects depend on finite or limited resources by which objectives are to be accomplished.

According to Turner a project is an endeavor in which human (or machine), material and financial resources are organized in a novel way, to undertake a unique scope of work, of given specification, within constraints of cost and time, so as to deliver beneficial change defined by qualitative and quantitative objectives.

1.3 Project, Program and Plan

From the above definitions of a project, it is observed that the term project is used in a wider sense which encompasses certain other term like Program, Plan Scheme etc. These terms are used as synonyms of a project or convey more or less similar, but it is not correct in all cases. Therefore, it is pertinent to understand the basic difference among these terms as explained, hereunder:

- A '***Project'*** is an activity involving large financial resources while a '**scheme'** is a small project to involve comparatively lesser amount of funds.
- A ***'Program'*** consists of a group of similar, related or allied projects or schemes like health program, educational program, research and development program etc.
- A ***'Plan'*** is comprehensive view of something involving large resources and their allocation for different projects with well-identified objectives. It is a technically pre-determined set of interrelated activities involving most effective use of material, human, technological and financial resources over a given period of time to achieve pre-conceived objectives. For example, Five Year Plans in India since 1951.

1.3.1 Project Characteristics

A project has several characteristics. The main characteristics of a project include the following features:

1. **Objectives or Mission**

   A project has a set of objectives or a mission. Once the objectives are achieved, the project is treated as completed. For example the objective may be constructed of a highway connecting two cities 'X' and 'Y', covering a distance of 100 kilometers. Once the construction of the highway is completed the project comes to an end.

2. Life cycle

A project has a life cycle. The life cycle consists of the following stages:

Conception stage:	Where project ideas are conceived
Design stage:	Where detailed design of project are worked out.
Implementation Stage:	Where the project implemented as per the design
Commissioning Stage:	Where the project is commissioned after implementation. Commissioning a project indicates the end of its life cycle.

3. Definite Time Limit

A project has a definite time limit. It cannot continue forever. Construction of a highway connecting two cities is a project which to be completed within a given time limit. Maintenance of the highway is an on process and it will continue forever, Hence highway maintenance will not come under the purview of project.

4. Uniqueness

Every project is unique and no two projects are same. Setting up a Cement plant and construction of a highway are no doubt two different projects having unique characteristics. Constructing a highway between cities X and Y and constructing another highway between cities A and B are also unique in themselves, In view of the difference existing in the organization, infrastructure, location, technical specification and the people behind the projects.

5. Team work

A project normally consists of diverse areas. There will be personalized in their respective areas. Any project calls for the services of experts from a host disciplines. Co-coordination among the diverse areas calls for teamwork. Hence a project can be implemented only with teamwork.

6. Complexity

A project is a complex set of activities relating to diverse areas. Technology survey, choosing the appropriate technology, procuring the appropriate machinery and equipment, hiring the right kind of people, arranging for financial resources, execution of the project in time by proper scheduling of the different activities etc. contribute to the complexity of the project.

7. Sub-Contracting

The characteristic stems forth in view of the complexity of functions and activities of a project. Some of the activities are entrusted to sub-contractors to reduce the complexity of the project. Sub-contracting will be advantageous if it reduces the complexity of the project so that the project manager can co-ordinate the remaining activities of the project more effectively. In general, the greater the

complexity of the project, the larger will be the extent to which sub-contracting will be resorted to. Sub-contracting is also helpful if the sub-contractors are specialized on their field of activity since this will improve the quality of the project.

8. **Risk and Uncertainty**

   Risk and uncertainty go hand by hand with project. A risk free project cannot be thought of. Even if a project appears to be risk free, it only means the risk element is not apparently visible on the surface and it will be hidden underneath. The risk factor will come to surface when conditions become conducive to it. Some of the risk element can be foreseen and the project can be strengthened to encounter the risk as and when it emerges. Some other risk elements cannot be foreseen. For example assume putting up a cotton yarn spinning mill is the project on hand. If during the project feasibility study it is learnt that there has been a gradual shift among consumers from the usage of cotton yarn to the usage of synthetic yarn, and if it is apprehended that at one stage synthetic yarn will rule over, the machinery can be so chosen that they can be used for both types of yarns. If this is not entirely possible, the choice of machinery can be so done as to avoid major conversion cost while switching over from the manufacturer of cotton yarn to the manufacturer of synthetic yarn in case the need arises. Such eventualities can be foreseen and planned for. On the other hand the sudden entry of a strong competitor who can upset all our forecasts and projection can be anticipated. Sudden fall of Government country which is not anticipated may turn the calculations wrong and make the forecasts meaningless.

9. **Customer Specific Nature**

   A project is always customer specific. This is because the products produces or services offered by the project are necessarily to be customer oriented. It is the customer who decides upon the product to be produced or services to be offered and hence it is the responsibility of every organization to go for projects/services that are suited to customer needs.

10. **Change**

    A project is not rigid in its life span. Changes occur throughout the life span of a project as a natural outcome of many environmental factors. The change may vary from changes which may have very little impact on the project to major changes which have a big impact or even may change the very nature of the project.

    During the course of implementation, the technology would have improved further and equipments with latest technology would have already started arriving. In such a case, if the equipment originally planned had not been yet procured, it would be wise to switch over to the equipment with the latest technology. There could also be latest technological innovations in the

manufacturing process which may deserve a switch over. All such changes are necessitated in order to keep the project update.

11. Response to Environments

Projects take shape in response to environments. Indian Government soon after independence set up major projects in the public sector, in the sectors of iron and steel, coal, power generation, heavy equipments manufacture etc. This was in tune with the then need for the development of infrastructure and heavy industries.

12. Forecasting

Forecasting the demand for any product/service the project is going to produce is an important aspect. Only if the forecast gives positive indications, the project is taken up for further study. Thus, all projects involve forecasts and in view of the importance attached to forecasts, they must be accurate and based in sound fundamentals.

13. Rational Choice

Since a project is a scheme for investing resources, the choice of a project is done after making a study of all the available avenues for investing resources and a rational choice among the available avenues is made.

14. Optimality

A project is always aimed at optimum utilization of resources for the overall development of the organization/economy. Resources are scarce and resources have a cost. Hence, optimum utilization of resources is a must for any project. Many project management concepts have evolved with the aim of achieving optimum utilization of available resources.

15. Control Mechanism

All projects will have pre designed control mechanism. In order to ensure completion of projects within the time schedule, within the estimated cost and at the same time achieving the desired level of quality and reliability.

1.4 Project Management

Project management is an organized venture for managing projects. It involves scientific application of modern tools and techniques in planning, implementing, monitoring, controlling and coordinating various activities or tasks to produce desirable output in agreement with pre-determined objectives within the constraints of time, cost, quantity and quality.

According to Prof. Harold Kerzner "Project management is the process of achieving project objectives through the traditional organizational structure and over the specialties of the individuals concerned. Project management is applicable for any (unique, one time, one of kind) undertaking concerned with specified objectives."

According to Mr. Olsen "Project management is the application of a collection of tools and techniques (such as CPM and matrix organization) to direct the use of diverse resources towards the accomplishment of a unique, complex, one time task, within time, cost and quality, constrains. Each task requires a particular mix of these tools and techniques structured to fit the task environment and life-cycle (from conception to completion) of the task."

According to Project Management Institute of (USA) "Project management is the art of directing and coordinating human and material resources throughout the life of a project by using modern management technique to achieve pre-determined objectives of scope, cost, time, quality to the equal satisfaction of those involved."

1.4.1 Attributes of a Good Project Manager

An effective project manager is the one who should have the following skills/capabilities:

- Planning and organizational skills
- Personal management skills
- Effective communication skills
- Change orientation
- Ability to solve their problem in totality
- High energy level
- Ambition for achievement
- Ability to take suggestion
- Understanding the views of project team members and having a sympathetic attitude towards them
- Ability to develop alternative actions quickly
- Knowledge of project management methods and tools
- Ability to make self-evaluation
- Effective time management
- Capacity to relate current events to the project/project management
- Ability to handle project management software tools/package
- Flair for sense of humor
- Solving issues/problems immediately without postponing them
- Initiative and risk taking ability
- Familiarity with the organization
- Tolerance for difference of opinion, delay, ambiguity
- Knowledge of technology
- Conflict resolving capacity

1.4.2 Responsibilities of a Project Manager

1. To plan thoroughly all aspects of the project, soliciting the active involvement of all functional areas involved, in order to obtain and maintain a realistic plan that satisfies their commitment for performance.

2. To control the organization of manpower needed by the project.
3. To control the basic technical definition of the project, ensuring that "technical" versus "cost" trade-offs determine the specific areas where optimization is necessary.
4. To lead the people and organizations assigned to the project at any given point in time. Strong positive leadership must be exercised in order to keep the many disparate elements moving in the same direction in a co-operative.
5. To monitor performance, costs and efficiency of all elements of the project and the project as a whole, exercising judgment and leadership in determining the causes of problems and facilitating solutions.
6. To complete the project on schedule and within costs, these being the overall standard by which performance of the project manager is evaluated.

1.5 Functions of Project Management

The project management functions developed and divided into three groups. The three groups are;

I. General Project Management Functions

The general project management functions include the following:

1. **Project Integration**

   If there is one most important aspect of project management, it would be integration. One must be able to integrate the many specialty fields provided by the human resource. Integrate the wide variety of equipment and materials, integrate the technologies to produce a product or an end result in conformance to the specifications/ requirements on time, and in the cost frame allowed. With the dynamics of the project environment, it is almost impossible to allocate and schedule every part of the project. The management must be able to use the functional structure to adapt to the things that will always wrong.

2. **Strategic Planning**

   There must be a vision. If it is appropriately conveyed to the project team, it can be an asset in determining controls and integration. On the technical level, strategic planning must involve combining the product concepts and work efforts. A well-defined vision helps define how a project is to be managed. Also, in strategic planning, control requirements and related procedures must be in place before substantial work can be done on the project.

3. **Resource Allocation**

   This is a process which determines the cost of a defined project and provides control over the project team. It is simply the project budget, but is not a simple process. Fortunately, there is the computer with its many software packages. These programs allow identification of critical activities, number of unit resources needed in one day, and activities in which a critical resource is

required. This greatly eases the demand on indentifying critical decision area but the human is the one who makes the ultimate decision.

II. Basic Project Management Functions

1. Scope Management

Scope management is the function of controlling a project in terms of its goals and objectives through the processes of conceptual development. The scope of a project involves either the project work content or its components. It can be fully described by naming all activities performed by identifying the end products and the resources consumed.

2. Quality Management

Quality is the composite of material attributes (including performance features and characteristics) of the product or service which are required to satisfy the need for which the project is launched. This is simply conformance to requirements and specification. The requirement may not only be what is written in the contract, but also the client's real or perception of conformance. Conformance can apply to the project it-self as a measure of how well it was planned and executed relative to such things as environmental and safety expectations of society.

3. Time Management

Time management is the function required to maintain appropriate allocation of time to the overall conduct of the project through the successive stages of its natural life cycle. Time management is divided into four areas: planning, estimating, scheduling and controlling.

4. Cost Management

This includes the processes required to maintain financial control over projects. This requires estimating, organizing, analyzing, controlling, economic evaluation and forecasting to allow for corrective action.

III. Integrative Project Management

1. Risk Management

This is an art and science of identifying, evaluating, and responding to the risk conditions throughout the duration of the project, keeping in the mind the objectives of the project. Risk management needs to be seen as identifying problem areas in advance and not as they happen. This would provide the necessary time to adjust the project in correspondence to objectives and adapting to the situation while the project is progressing. Time and money can be lost here. This is a formal process where a business applies defensive response planning in the wake of mitigation by avoidance, deflection of risk through the contract or by insurance, and contingency planning by providing allowances in the budget for the uncertainties.

2. **Human Resource Management**

   Human Resource Management is the function of directing and coordinating human resources throughout the life of the project. This involves building a project team that would be a workable, cohesive unit. Two types of tasks recognized i.e. administrative and behavioral.

3. **Contract/Procurement Management**

   Contract/Procurement management is the function through which resources including people, plant, equipment and material are acquired for the project in order to produce the end product. Formal negotiations usually result in a written document called a contract. Knowledge is vital to this area of management because of the many differential types of contracts that are required for project completion and success. The fundamental areas of knowledge include initiation and evaluation of contracts, negotiations and administration of contracts. It is also essential to understand the different social, political and financial involvement entangled in contract/procurement management

4. **Communication Management**

   Communication management is the proper organization and control of information transmitted by whatever means to satisfy the needs of the project. It includes the processes of transmitting, filtering, receiving and interpreting or understanding information using appropriate skills according to the application in the project environment. Successful project management must have a viable communication network. Proper communication to the upper management, project team, and to others rely heavily on the ability o breakdown communications that are not clear and convey unfamiliar technical languages.

1.6 Project Classification

Project classification helps in graphically expressing and highlighting the essential features of the project be it quantifiable or non-quantifiable, be it any potential sector be it capital intensive or labor-intensive, whether or will involve small or large scale investment –will materially affect the projects feasibility evaluation is undertaken. As seen already, a project is a proposal for investment to create, expand and/or develop certain facilities in order to increase the production of goods and services in a community during a certain period of time. To carry out these activities capital assets are acquired to replace worn-out machinery for up gradation and restructuring for modernization purpose by new technologies.

Thus, the projects have been classified in various ways by different authorities:

1. **Quantifiable and Non-Quantifiable Projects**

   Little projects have been divided into two broad categories, i.e. quantifiable projects and non-quantifiable projects. Quantifiable projects are those in which a plausible quantitative assessment of benefits can be made. Non-quantifiable projects are those where such an assessment is not possible. Projects concerned with industrial development, power generation, mineral development fall in the

first category while projects involving health, education and defense fall in the second category.

2. Sectoral Projects

The planning commission in India accepted this sect oral bias as the criterion for classification of projects. A project may, under this classification, fall into any one of the following sectors.

a) Agriculture and Allied sector
b) Irrigation and Power sector
c) Industry and Mining Sector
d) Transport and Communication sector
e) Social service sector
f) Miscellaneous

This system of classification has been found useful in resource allocation at macro-level.

3. Techno-Economic Projects

Projects are some time classified on the basis of their techno-economic characteristics. Three main group of classification can be identified here.

a) Factor Intensity-oriented Classification: On the basis of this classification projects may be classified as capital-intensive or labor intensive depending upon whether large scale investment in plant and machinery or human resources in involved.

b) Causation-oriented classification: Here projects are classified as demand based or raw material based projects depending on the non-availability of certain goods or services and consequent demand for such goods or services or the availability of certain raw materials, skills or other inputs as the dominant reason for starting the project.

c) Magnitude oriented classification: in this the size of investment forms the basis of classification. Projects may thus be classified as large-scale, medium scale or small scale projects depending upon the project investment.

Techno economic characteristics based classification is useful in facilitating the process of feasibility using the International Standard Industrial Classification of all economic activities (ISIC) in collection and compilation of economic data. Since this classification covers the entire field of human economic endeavor. It forms a useful basis for classification of projects.

4. Financial Institutions Classification

All Indian and State Financial institutions classify the projects according to there are and experience and the purpose for which the project is being taken up. They are as follows:

(i) New projects

(ii) Expansion projects
(iii) Modernization
(iv) Diversification Projects

The projects listed above are generally profit oriented.

5. Services Projects

The service oriented projects are classified as under:
(i) Welfare projects
(ii) Service projects
(iii) Research and Development projects
(iv) Educational projects

1.7 Success Criteria for the Project

1.7.1 Why do Projects go Wrong?

There can be many reasons why projects go wrong. The most common reasons are as follows:

Problems with Project Goals

- The project sponsor or client has an inadequate idea of what the project is about at the start.
- There may be a failure of communication between the client and the project manager. The may be due to a lack of technical knowledge on the part of the client or an overuse of jargon by the project manager.
- Specifications may be subject to constant change. This may be due to problems with individual clients, decision making processes at the client end, or environmental changes. For example the government may change the basic "rules of the game" before the completion of the project.
- The project goals may be unrealistic and unachievable, and it may be that this is only realised once the project is under way.
- The client may become carried away with the idea of the project and may be unable to see clearly what can be achieved.
- Projects may be highly complex and may have a number of objectives that actually contradict each other.

There are perhaps two stages which can help in ensuring that goals are properly defined and achievable:

a) Ensuring that the client specification is clear and understandable. To do this you must first of all establish the objectives of the project. It would help to ask the following questions:
    - What is it that the organization is setting out to achieve or is being asked to achieve?

- Will the suggested project fulfill these objectives?
- Have all the alternatives been considered and is the chosen option the best one available?
- Have the full effects of the project, both inside and outside the organization, been considered?

b) Preparation of Project overviews (Project brief). The brief should take the objectives set out in the previous exercise and translate them into targets and goals. Any key constraints should also be identified and stated at this stage. This brief should be agreed by the sponsor/client and communicated to the project manager. Any ambiguities or queries should be sorted out as soon as possible.

A good way forward would be through the establishment of **success criteria** for the project. If you want the project to succeed (and who doesn't?), then you have to know when you have succeeded.

1.7.2 Success Criteria

Success criteria can be described as being hard or soft.

A. **Hard criteria** are often the most obvious criteria that are tangible and measurable and can be expressed in quantitative terms. They tend to pose the question "what?", that is "what should be achieved?"

- **Performance specifications**: these may be set out in terms of the ability to deal with certain demands. For example, this could be throughput of traffic, number of patients, volume of transactions processed or the number of enquiries dealt with.
- **Specific quality standards**: this could relate to technical standards and tolerance, or may be the achievement of a favorable report from an outside inspection agency.
- **Meeting deadlines**: this is probably the most obvious one of them all where projects need to be completed within a given time scale. For example, a new system may need to be implemented ready for the start of the financial year, or a new development may have to meet time requirements as laid down in contract specifications.
- **Cost of budget constraints**: an important criterion may be to complete the project within a cost limit or budget which has been determined. Additionally there may be requirements in terms of the ongoing cost of the completed project. For example, a new system may be required to make savings for the organization on a continuing basis.
- **Resource constraints:** there may be other resource constraints such as making use of existing premises or labor force.

As you can see, the above criteria are relatively easy to establish and should also be quite easy to specify in a project brief.

B. **Soft criteria**

Soft criteria are usually less obvious, but not necessarily less important. They are often intangible and qualitative. Consequently they may be difficult to measure. They would tend to ask the question "how?"

- Demonstrative co-operation: this would be about showing that the project team could work together effectively and without a degree of conflict. It could be an important consideration to develop and implement solutions for the organisation which have a wide element of consensus and stem from a co-operative attitude.
- Presenting a positive image: this may also be important but obviously can be difficult or impossible to quantify.
- Achieving a total quality approach: this would be more about the adoption of a philosophy of continuous improvement than the achievement of specific performance targets on quality.
- Gaining total project commitment: this is again about how the project is managed and the attitude of the project team to it.
- Ensuring that ethical standards are maintained: it can be very important to ensure that no corners have been cut that should not have been and that professional standards of ethics have not been breached.
- Showing an appreciation of risk: this would ensure that no unacceptable risks were taken in the pursuit of other project objectives. Again this is about how the project is developed rather than the end product itself.

1.8 Project Constraints

a) Time

Our definition of a project stated that it was an activity which had a defined beginning and ending point. Most projects will be close-ended in terms of there being a requirement for completion by a certain point in time. This point may be the result of an external factor such as new legislation, or may be derived from organizational requirements. It may also be partly determined by other constraints. There is likely to be some relationship between the time taken for a project and its cost. A trade-off between the two constraining factors may then be necessary.

b) Resource Availability

There is likely to be a budget for the project and this will clearly be a major constraint. Cost constraints may be set in a number of ways, for example as an overall cash limit or as a detailed budget broken down over a number of expenditure headings. Labour resources in particular may be a limiting factor on the completion of the project. In the short run it is likely that labour will be fixed in supply. Whilst the overall resource available may in theory be sufficient to complete the project, there may be difficulties arising out of the

way in which the project has been scheduled. That is, there may be a number of activities scheduled to take place at the same time and this may not be possible given the amount of resources available.

c) Quality factors

Whether the project delivers the goods to the right quality. There are techniques which can be used to overcome the problems referred to above. These include:

Budgeting and the corresponding control of the project budget through budgetary control procedures. ***Project planning*** and ***control*** techniques such as Gantt charts and network analysis.

An important point to note at this stage is how the various constraints on project completion are likely to be interlinked with each other. For example, problems with time constraints or resource constraints may be overcome by spending more through working overtime, employing more people or purchasing better machines. Budget problems may have a knock-on effect on the achievement of deadlines.

It is important to remember that while project management techniques are important, they tend to understate the importance of the key resource: people. In a fact changing environment where tasks are often difficult, controversial with uncertain outcomes, "people management" skills are called for.

1.9 Summary

A project is a scheme for investing resources in an enterprise. It can be gigantic scheme like a multipurpose river valley project or a venture small investment. It contains a blue print of a venture. The project provides enough details and analysis of technical, financial, marketing and economic aspects. It also contains plans and programs for implementation. The project management functions developed and divided into three groups. These groups correlate with structure of project management and specify the knowledge required therein. The three groups namely general management, basic project management functions, and integrative project management functions. Projects can be classified into two broad categories viz. quantifiable projects and non quantifiable projects.

1.10 Self Assessment Questions

1. Define project and project management. Describe briefly the features and characteristics of a project.
2. What is a project? How do you classify these projects?
3. Write a detailed note on attributes and responsibilities of a good project manager.
4. Define project management in details. Explain its functions in detail.
5. Explain what project management is? and how it is different from traditional management. Explain the basic functions of project management
6. List the main characteristics of a project.
7. Describe the various aspects of a project.

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Unit - 2 : Project Life Cycle

Structure of the Unit

2.0 Objectives

After completing this unit, you would be able to:

- Understand the meaning of Project Life Cycle.
- Explain different Phases of Project Life Cycle.
- Distinguish one phase from another.
- Prepare various documents / plans for various stages of project life cycle.
- Explain UNIDO's Project Life Cycle Phases.
- Highlight the causes of project failure.

2.1 Introduction

Project management is an important managerial activity for an organization. It is the process of allocating skill, tools, resources and time required to undertake a project successfully. Thus, this is a perfect blend of human and non- human resources pulled together to achieve the pre defined targets. In any organization project management takes place at three different levels- at international or national level, at sector level and at the project level. At the project level individual proposal for project are identified, selected and implemented by giving attention to their financial, economical, technical, social, institutional and other dimensions. These various activities of an individual project are arranged in sequential manner (sometimes overlapping) spread over duration of time, known as 'Project Development Life Cycle'. Every project has a beginning, a middle period during which activities move the project towards completion and an ending (successful or unsuccessful).

2.2 Project Life Cycle

A profit motivated enterprise comprising several interlinked activities could itself be termed as a project. A project can be defined as a non-routine, non- repetitive, one off undertaking, normally with discrete time, financial and technical performance goals. It can be quite simple or very complex. A project could broadly be classified as: New Project, Expansion Project, Modernization Project, Diversification Project or Other Project. Construction of a house/ room, arrangement of a party, establishment of a plant or factory or initial production of a new product are all projects.

Project is a single shot set of activities having a definite beginning and ending points. This group of activities in a project is spread over duration of time, known as its **life span**. These activities are systematically and logically linked with each other in sequential manner. The entire duration which starts with the conception of the project and ends with the closure of the project is called as '**Project Life Cycle**.

In other words it can be said that 'Project Life Cycle' refers to a logical sequence of activities to accomplish the projects goals and objectives. Project life cycle generally defines:

- What technical work to do in each phase?
- Who is involved in each phase?
- What type of resources required in each phase?
- How and when the deliverables generated in each phase, be reviewed, verified and validated?
- How to control and approve each phase?

2.2.1 Phases in Project Life Cycle

The project manager and his team have one shared goal- to carry out the work of the project for the purpose of meeting the project's objectives. A project /idea which look feasible at the first instance might actually not be when details are referred. So, the entrepreneur should make efforts to do the preliminary review - starting should be from making review of the available project ideas, defining and scanning the environment, conducting a feasibility study to decide whether it should undertake the project or not and if accepted then proceeding further for actual implementation and review of the project. Regardless of scope and complexities, any project goes through a series of stages during its life. Taken together, this represent the path a project takes from the beginning to its end and is generally referred as Phases in Project Life Cycle. Sometime these phases may overlap with one another. This entire time frame or life cycle of a project, method of dividing the phases in a project may differ somewhat from industry to industry and from product to product. But in general, most project life cycles as shown in figure 2.1, may be grouped as follows:

a) Conception or Initiation Phase
b) Definition Phase
c) Planning and Growth Phase
d) Implementation or Execution Phase
e) Commissioning, Shut- down or Clean- up Phase

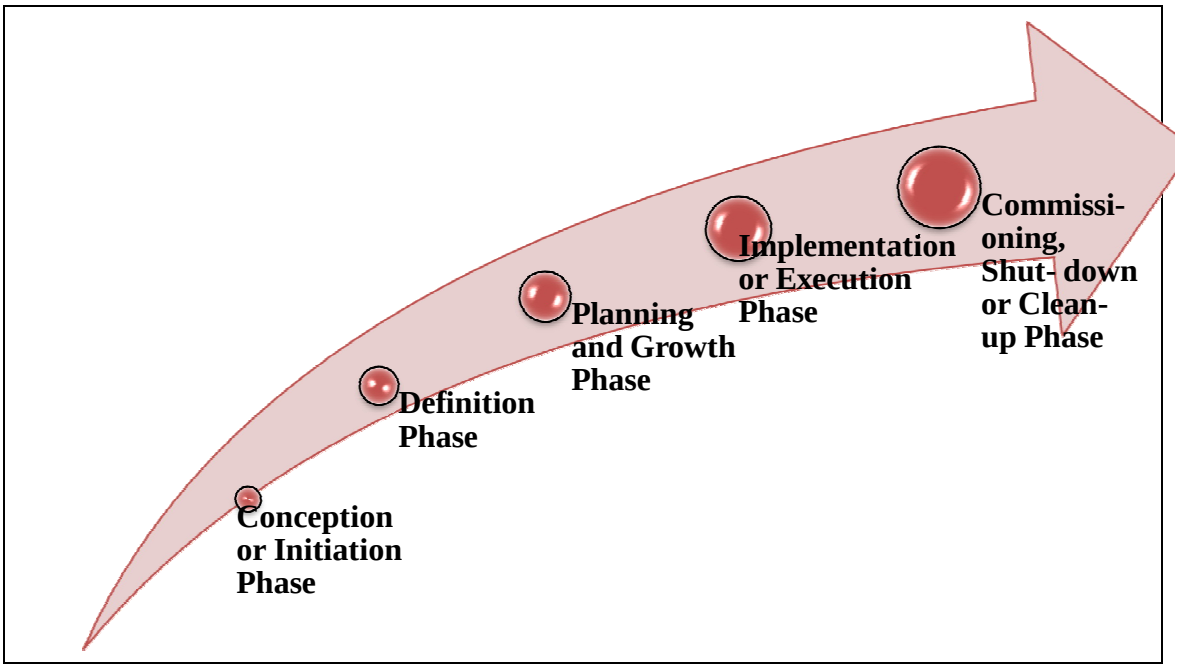

Figure 2.1 Project Life Cycle Phases

In planning these phases, following concepts can be used:

The rolling wave concept- According to this concept, when detailed planning is done for the first phase, summary planning would be done for the remaining stages. When the actual work on first phase commences, detailed planning would be done for the next stage and so on.

The integration concept- According to this concept, planning for all stages must be integrated, even though detailed planning would be done in accordance to the first concept.

Project life cycle phases share the following common characteristics:

i. **Sequential in nature**: The phases in a project life cycle are generally sequential in nature although, for large and complex projects there may be some overlapping between them.

ii. **Cost and staffing**: Costs and staffing are low at the initiation phase, peak during the subsequent phases then, drops rapidly as the project draws to the conclusion.

iii. **Influence of stakeholders**: Stakeholders influence on project characteristics and cost is highest at the start point but gets progressively lower as the project continues.

iv. **Level of uncertainty and risk**: The level of uncertainty and risk of failing is greatest at the initiation and definition phases of a project. The certainty gets progressively better and risk comes down as the project progresses towards next phases.

Project life cycle phases are extremely useful as they provide a framework for budgeting and resource allocation and for scheduling milestones and doing project reviews. Adopting the different phase creates clarity in a project, thereby making it easier to administer. The project manager and the core team can objectively measure achievement of goals and justify their decisions to move ahead, correct or terminate. Deliverables from one phase are usually reviewed (Phase Review) for accuracy and completeness and approved before starting the work for next phase. Let us discuss these phases in detail:

1. Conception or Initiation Phase

At this phase the project idea / business opportunity emerges to the management and it decides on the need of the project either to get over certain problems of under utilization of plant capacity or labour force or due to unfulfilled expectations of customers etc. If management does not have an idea but they want to expand their business, they can use various sources of data generation which includes consumers, employs, intermediaries, research and development laboratories, friends and well wishers etc. These ideas and needs are to be examined in light with the objectives and constraints (entrepreneur's priority and risk taking capability) for a project. In any case, these ideas / needs have to be given shape before they can be considered seriously. A preliminary study is then conducted to confirm and evaluate the need and the preferred approach is defined. An appropriate response to the need is documented in a **Business Case / Plan** with recommended solution options. This business plan precedes a project definition and explains why the project is being initiated.

The initiation phase is the beginning of the project. The goal of this phase is to examine the feasibility of the project. A **Feasibility Study** is conducted to investigate whether each option addresses the project objective and a final recommended solution is determined. Issues of feasibility and justification are addressed. Questions to be answered at this phase can be like:

a. Why this project?
b. Is it viable?
c. Can we do the project?
d. Should we do the project?
e. What is the scope and potential of this project?

The initiation phase essentially involves the project 'start-up'. It is the phase within which the business problem or opportunity is identified, the solution is agreed, and a project team is appointed. The whole working of this phase can be structured as follows:

Prepare Business Case/Plan- It is a written document prepared to describe all the relevant external and internal elements involved in starting a new project. Business plan must describe the current status, expected needs and projected results of the new project. A business plan is outline of the step by step procedure that would be followed to convert a business idea into a successful business venture/project. Since business plan summaries operation of proposed project, lenders and investors demand to see this as a tool for evaluating requests for financing.

Perform Feasibility Study- At any stage during or after the development of a business case, a formal feasibility study may be commissioned. It is an analysis of the viability or justification of an idea through a disciplined and documented process of thinking through the idea from its logical beginning to its logical end. Feasibility may be judged from different perspectives- **financial, economical, technical, market or / and social and ecological.** This study identifies project constraints, alternatives and related assumptions applied to the end product to be developed. A **Detailed Feasibility Report** is required to be drawn up based on the data and results obtained from feasibility study. On the basis of DFR, an entrepreneur or management finally decides whether to invest in a particular project or not, or which alternative project is the best to be selected. But, before reaching on such a decision point, a thorough project or financial appraisal is required with the help of one or more of the certain well established methods.

Appointment of project team and setting up of a project office – Once the recommended solution is approved, a project is initiated to deliver the approved solution. The major deliverables and the participating work groups are identified and the project team and its office begin to take shape. Participants involved in preparing the business need document and developing the project proposal include the sponsor / the entrepreneur, business process owner(s), business analyst(s), project manager and technical experts.

Undoubtedly, a project if well conceived can be later on implemented successfully. It may be possible that the project ideas may undergo certain changes as the project progresses. This is natural because at the initiation phase all the relevant data is not available and the actual real life situation may turn out to be different from what has been assumed initially

2. **Definition Phase**

After the project plan has been approved, the project enters in the definition phase. In order to give a concrete shape to the project idea, a project definition document (project report) is prepared. This describes the strategies involved in starting and running the project. Project report can be an evaluation tool for investors and financial institutions to provide required finance to proposed project. The project report should be-

1. Arranged in a sequence;
2. Cover all the details about the proposed project;
3. Should not be very lengthy;
4. Should be logical and subjective;
5. Should justify needs and market prospects and
6. Should demonstrate promoters of project possess sound experience.
7. The basic contents and consideration in preparing the project definition document are as follows:
    - Resources – Manpower and raw materials
    - Plant location and site
    - Project capacity
    - Plant technology

- Plant layout
- State of art machinery
- Civil engineering works
- Utilities – fuel, power, water etc.
- Financial analysis
- Organisational process
- Project implementation schedule.

Ultimately, a **Project Charter** is prepared which outlines the mission, objectives, scope, deliverables and structure of the project. Well defined objectives and policies serve as the framework for the decisions to be made by the project manager. Throughout the life of the project, project manager has to seek a compromise between the conflicting goals of technical performance, cost standard, and time targets. So, a clear articulation of the priorities of management will enable the project manager to take expeditious actions. A list of requirements (functional and operational), the project must adhere to are developed and presented for the approval of the project decision makers. Once these definitive requirements have been approved, the phase can begin.

It is important that if the definition phase is not thoroughly performed the project may be exposed to great risk. All the parties who are involved in the project must collaborate during the definition phase. So, a 'kick-off' meeting with sponsor, business process owner and project team is arranged to ensure that everyone is familiar with the business need being addressed, the principles guiding the work, the project management method being used and the overall schedule is released. Most of the agreements between the related parties have been established.

The Central Government's Department of Economic Affairs and Industrial Development, Planning Commission as well as State Government's Industrial Development Organizations guides and assists for project related matters. At the end of the definition phase when the project has been cleared for implementation, the project can be considered as born.

3. Planning and Growth Phase

Planning is an ongoing process that is conducted throughout the project life cycle. Initial planning relates with the overall organizational efforts while the subsequent planning relate to specific objectives of the selected project. In the initial stage of project planning, the internal and external factors which influence the project should be determined and given priority weights. In the subsequent planning the concept of the project is verified and developed into a workable plan for implementation. This is the most important phase in project management. The efforts spent in planning can save countless hours of confusion and rework in the subsequent phases. The purpose of this stage is to develop the project plans across the following areas:

1) Integration(Coordination, Planning, Control)
2) Scope

3) Time (Schedule)
4) Cost(Budget) and quality
5) Resources
6) Procurement
7) Risk

At this stage the core project team is formed. This team identifies all of the work to be done. This phase should include a detailed identification and assignment of each task until the end of the project. Although project managers must attend to many matters; they actually direct the project along the following factors, which are known as control factors:

- Duration
- Capital
- Quality
- Organisation
- Information

The governance process is identified, key stakeholders or representative key stakeholders are consulted, advisory committees or task groups are identified and formed and reporting frequency and channels agreed. The project's task and resource requirements are identified, along with the strategy for producing them. This can be referred as scope management. The following plans have been prepared during this phase:

Project Plan/ Schedule: A project plan is created outlining the activities, tasks, dependencies and timeframes. This plan is formalized through defining key elements: what is going to be done, how it will be done, what is required to get it done, who is going to do it and when it will be implemented? A time line is developed and deadlines are assigned to each step of the project plan. This project schedule will become the primary tool for the project manager to access the progress of the project.

Production and Operational Plan: This plan includes strategies related with suitable location, physical layout of plant, availability and cost of raw material, machinery and equipment, cost of manufacturing and operations, production capacity, production planning and scheduling, inventory management, quality management and control and expansion of business.

Resource Plan: It is necessary to allocate the resources required to undertake each of the activities and tasks within the project plan. A detailed resource plan is prepared to identify the type of resources required, total quantity required of each resource type, and quality of each resource (for example quality of human resources like managers, technologists, operators etc.).

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

Financial Plan: Financial plan indicates the financial requirements of the proposed project considering costs related with marketing, operations (labour, equipment, and

materials), human resources and smooth functioning of project. The benefits and costs of the project have been clearly documented in project budget.

Procurement Plan: This plan is made to identify the elements of the project which will be acquired from external suppliers of the project. It also references the process for selection of the preferred supplier and the process for the actual order and delivery of the ordered products.

Communication Plan: This plan identifies the type of information to be distributed, the method of distributing information to stakeholders, the frequency of distribution and responsibilities of each person in the project team for distributing information regularly to stakeholders.

Risk Plan: In risk plan, 'high threat' potential problems are identified along with the action that is to be taken on each high threat problem, either to reduce the probability that the problem will occur or to reduce the impact on the project if it does occur.

Quality and Acceptance Plan: Finally a quality plan is prepared providing quality targets, assurance, and control measures along with an acceptance plan (listing out the criteria to be met to gain customers acceptance).

To execute the above mentioned plans, organizations create a **Project Execution Plan** at this phase and undertake the following actions:

- Preparation of schedules and budgets.
- Preparation of **Work Breakdown Structure.** This specifies the breakdown of the project into tasks and subtasks.
- Project engineering, design, infrastructure and required services for the project.
- Raising funds for the project.
- Obtaining necessary licences and clearances.
- Resource planning.
- Procuring construction equipments and materials for site preparation.
- Procedures for inviting tenders and awarding contracts.
- Work packaging.

4. Implementation or Execution Phase

Project implementation is the key phase of the project life cycle during which the project plan comes to life. This phase involves the execution of each activity and task listed in the project plan. It is important to maintain control and communicate as needed during implementation. As the execution phase progresses, groups across the organization become more deeply involved in planning for the final testing, production and support. But, projects may proceed in different ways depending on the required project outcomes as well as the schedule, staffing and cost constraints. This progress is continuously monitored and appropriate adjustments are made and recorded as variances from the original plan. Establishment of internal control procedure and use of regular progress report are the two important aspects of controlling in progress projects. There is also

need for a high degree of co-ordination and control at this phase. Thus, project management activity during this phase involves:

- Monitoring the environment and anticipating problems (A network chart of the project activities should be prepared for effective monitoring. To ensure effective supervision, Project Information System can be set up);
- Taking action to encounter the issues which affect the project's scope, schedule or budget;
- Reviewing change requests with the project team;
- Recommending whether these will be done within the project or not.
- Keeping people informed about the progress of the project (Project Status Report), ensuring project priorities are clearly understood and communicating which activities are in progress;
- Taking necessary action against the variances between planned and actual work, cost and schedule so as to complete the project within time and budget.
- Delegating authority and responsibility at different levels in the project organization.

(i) Stages in project implementation

The implementation phase is typically the longest phase of the project (in terms of duration). Tasks which are performed at the execution phase include the following:

- ✓ Recruit and train engineers, technicians, supervisors, workers and other staff from time to time to achieve the organisational goal effectively.
- ✓ Prepare specification for all major equipments and machineries. Detailed blue print, design of plants, building, supporting facilities etc., layout of floors shops etc. should be finalized.
- ✓ Invite the contractors to submit bids.
- ✓ Evaluate bids and select contractors.
- ✓ Place orders for the supply of equipments and machineries.
- ✓ Do construction of civil works and equipment foundations.
- ✓ Make arrangements of electrical fittings, instrumentations and piping.
- ✓ Make marketing arrangements with dealers and distributors.
- ✓ Testing and trial run is the final task of this phase.

In any project a project manager will spend most of his time in this step. Information collected from regular team meetings is used to maintain control over the direction of the project. By measuring the performance of the project activities and then comparing the results with the plans, he takes corrective actions as needed. No implementation is worry- free, but with a good provider, a great project team and with logical and practical skills to manage the project, the process of project will be straight forward, predictable and manageable. Throughout this phase, management and other key stakeholders should be kept informed about the status of the project. **Project Status Report** is prepared for this very purpose. This report must emphasize the anticipated end points in terms of cost, schedule and quality of deliverables. Project management processes produce the following deliverables during the implementation stage of the project life cycle:

- Meeting notes
- Status reports (includes risk log)
- Schedules
- Issue resolution log
- Project delay log
- Change request.

(ii) Pre-requisites for successful project implementation

Project execution has a direct correlation to project progress and stakeholder's expectations but, time and cost over runs of the project are the main hurdles in successful implementation of a project. This problem is very common especially in the public sector. Due to such time and cost over runs, projects tend to become uneconomical, resources are not available to support other projects and overall development is adversely affected. To minimize time and cost over runs and thereby to improve the prospects of successful completion of projects, following things can be done:

1. Adequate formulation of the project.
2. Sound project organisation.
3. Timely availability of funds.
4. Better contract management.
5. Use of the principle of responsibility accounting.
6. Proper planning for implementation.
7. Judicious tendering and procurement of required equipments.
8. Advance actions and effective monitoring.

(iii) Causes of project failure:

Although, the causes of failure or mismanagement of any specific project will depend upon case to case basis, the major/common causes of project failure can be summarized as follows:

- Delay in plant location and site selection, land acquisition, receiving clearance, receiving materials/ components/ equipments etc.
- Insufficient funding arrangements.
- Time and cost over runs.
- Lack/ inadequacy of infrastructural facilities.
- Poor selection of suppliers, manufacturers, consultants, contractors, fabricators etc.
- Indecision or delayed decision at different phases of project life cycle.
- Absence of commitment/lack of managerial talent among the project team members.
- Law and order problems.

5. Commissioning, Shut- down or Clean- up Phase

This is the final phase of the project work. The commencement of the project closure phase is determined by the completion of all project objectives and acceptance of the end

product by the management. The project process is completed and documented and the finished product is transferred to the care and control of the owner. The long term objective is to build a project management repository to document best practices and lessons learned during the project. Lessons learned form an integral part of the project closure phase as it helps in the productivity improvement of the project team and helps in identifying the do's and don'ts of the project. This phase involves:

- Assessing whether the project completion criteria have been met.
- Documenting the issues faced in the project and their solution to help other projects to plan for such type of issues in the project initiation phase itself.
- Releasing the final deliverables to the customers.
- Handing over project documents (project personal catalogue, documents, drawings, specifications, operational and maintenance manual etc.) to the management.
- Finalizing project accounts and preparing reconciliation statement.
- Identifying any outstanding item.
- Planning deployment of project staff and workers.
- Terminating supplier contracts, releasing project resources to the business and
- Finally, communicating closure of the project to all stake holders and interested parties.

As project closure is the last phase in the project life cycle, it must be conducted formally so that the business benefits delivered by the project are fully realized by the customer. All contributors should be provided an opportunity to provide feedback on the project as well as any feedback on adjustments that should be made going forward. A project closure report is submitted to the customer/ project sponsor for approval. The project is closed only when all activities identified in the project closure report have been completed. After commissioning, the present project is completed and as such the present project is also termed to be shut down or cleaned up.

(i) Performance Review - The last step of this phase is to conduct lessons learned studies- to examine what went well and what didn't. Success is determined by how well it performed against the defined objectives and conformed to the processes outlined in the planning phase. A number of questions are posed to determine the performance of the project. Some of them are as follows;

- Did it achieve the objectives outlined in the project charter?
- Did it operate within the scope of the project charter?
- Whether it was delivered within the budget outlined in the financial plan?
- Were the risks identified and mitigated?
- Whether it was delivered within the schedule outlined in the project plan?
- What could be done to improve the process next time?

The results, key achievements and lessons learnt are documented within a post implementation review report and presented to the project sponsor for approval. The output from the project closure phase provides as a stepping stone to execute the next projects with much more efficiency and control.

(ii) Post completion audit - An audit of a project after it has been commissioned is done which is referred to as a post audit or a post completion audit. This audit of project:

- Provide a documented log of experience which will be valuable in improving future decision making
- Help in discovering systematic biases in judgement
- Enable the firm to identify the capabilities of the project personnel and
- Induce healthy caution among project sponsors.

2.3 UNIDO's Project Life Cycle Phases

Different guidelines, manuals and authors have called project life cycle phases by different names. United Nations Industrial Development Organization (UNIDO) in its 'Manual for the Preparation of Industrial Feasibility Studies' (Reproduced by IDBI, Bombay, 1987) has divided project life cycle into the following phases and stages:

1. Pre- investment Phase
   1.1. Identification of investment opportunity
   1.2. Preliminary selection Stage
   1.3. Project formulation stage
   1.4. Evaluation and decision stage
2. Investment Phase
   2.1. Negotiation and contracting stage
   2.2. Project design stage
   2.3. Construction stage
   2.4. Start-up stage
3. Operational Phase
   3.1. Short-term views
   3.2. Long- term views

2.4 Summary

Project is a single shot set of activities having a definite beginning and ending points. This group of activities in a project is spread over duration of time, known as its life span. These activities are systematically and logically linked with each other in sequential manner. The entire duration which starts with the conception of the project and ends with the closure of the project is called as 'Project Life Cycle'. These five phases complete the 'cycle'- the journey from identifying the problem to solving the problem. Project life cycle phases are extremely useful as they provide a framework for budgeting and resource allocation and for scheduling milestones and doing project reviews. Adopting the different phase creates clarity in a project, thereby making it easier to administer. Deliverables from one phase are usually reviewed for accuracy and completeness and approved before starting the work for next phase.

2.5 Self Assessment Questions

1. What do you understand by the term 'Project Development Life Cycle'?
2. What are the various Stages of Project Development Cycle? Discuss the various activities undertaken in each of these Stages.
3. Discuss in brief: Project Life Cycle Stages and their significance.
4. Write in brief the basic contents and considerations of a Project Definition Document.
5. Write a short note on the 'UNIDO's Project Cycle Phases'.
6. What actions are required at the Commissioning Phase of a Project?
7. "Project Management is a broad concept which encompasses all the project activities". Illustrate your answer with the help of examples.

2.6 Reference Books

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Unit – 3 : Project Feasibility Study

Structure of the Unit

3.0 Objectives

After completing this unit, you would be able to:

- Understand the meaning of Project Feasibility Study.
- Give reasons in favour and against to do a Feasibility Study.
- Analyse various factors related with Feasibility Study.
- Conduct a Feasibility Analysis of the proposed business idea/project.
- Prepare Feasibility Study report.
- Differentiate business plan from feasibility study.

3.1 Introduction

An organisation can never remain static. For the sake of its survival it has to keep growing continuously. The organisation, therefore, must look for good opportunities for its growth. This growth can be either in the existing lines of business, the purchase of an existing business or in the diversified areas. Generation of idea is not enough; the idea must pass through the scrutiny from financial, market, economical, technical perspectives and so on. A feasibility study allows a project manager to investigate all the possible outcomes (negative and positive) before investing too much sources, time and energy. Thus, determining early that a business idea/ project will not work saves money, time and headache later. What we present here under is a brief outline of the issues impinging upon the various aspects of the feasibility of the proposed project.

3.2 Project Feasibility Study

3.2.1 Meaning

As the name implies, a feasibility study is an analysis of the viability of an idea i.e. whether some idea will work or not. This study focuses on answering the important question ‘should we proceed with the proposed project idea or not’. Feasibility can be defined as an analysis of the ability to complete a project successfully, taking into account financial, technical, and economical and other factors. It is an analysis of

possible alternative solutions to a problem and a recommendation on the best alternative. This is a multivariate concept in which all the facets of the feasibility of the proposed project idea must be examined.

Thus, it can be said that a feasibility study is an analysis of the viability of an idea through a disciplined and documented process of thinking about the idea from its logical beginning to its logical end. It is an extensive research, investigation and evaluation of the potential of the proposed project to support the process of decision making.

3.2.2 Why to do a Feasibility Study?

A feasibility study may be necessary for a variety of projects. It may be for expansion or continued operation of a company or small business as well as for public work initiatives. The aim is to uncover the strength and weaknesses of an existing or proposed venture, opportunities and threats present in the environment, reasons required to carry through and ultimately the prospects for success. It must therefore be conducted with an objective and with unbiased approach to provide information upon which decisions can be based.

Conducting a feasibility study is a good business practice. Normally every successful business venture first thoroughly examines all the issues to assess the probability of success. Following are the reasons in favour of conducting a feasibility study. It-

- Provides all the possible alternatives.
- Provides quality information for decision making.
- Produces new opportunities through the investigative process.
- Give reasons for not proceeding further.
- Helps in securing funds from lending institutions or attracting quality investment.

Project leaders may find themselves under pressure to skip the feasibility analysis and go directly to start or build the project. Following reasons may be given to skip this step:

- We know it is feasible.
- An existing business/ project is running successfully so why to do another feasibility study.
- It will consume lot of time, money and energy.
- The related parties (financing companies, sellers of equipments) have done the analysis.

The reasons given above should not dissuade from conducting a meaningful and accurate feasibility study. The feasibility study is important because it forces to put the ideas on paper and to assess whether or not those ideas are realistic. If properly conducted it may be the best investment the organisation have ever made.

3.2.3 Pre- feasibility Study

One of the first steps required in assessing the feasibility of an idea is to become aware of the forces and factors in the internal and external environment that directly influence the new venture/ project opportunity. A pre-feasibility study may be conducted first to help in sorting out relevant scenarios. It seeks to determine whether the project is prima

facie worthwhile to justify a feasibility study and what aspects of the project are critical to its viability. The Pre- feasibility study helps to 'frame' and 'flesh-out' specific business scenarios .During this process the number of business alternatives under consideration is quickly reduced. It is necessary at the pre- feasibility stage to ensure that the project is viable from the following angles:

- Plant capacity
- Plant location and site
- Work schedule
- Manpower- labour and staff
- Plat technology, equipments and engineering works
- Market demand for end products of the project
- Materials and inputs
- Financial and economic evaluation, investment opportunities
- Legal clearances

A pre-feasibility Report is prepared to elicit the preliminary sanction or first step clearance. The structure/outline of the information and estimates in which the pre-feasibility and feasibility report is prepared is the same. The difference is only in the level of accuracy, precise details and refinement of the data. Supporting documents like graphs, worksheets, diagrams, detailed estimates, explanatory notes may be given with the pre-feasibility report.

3.3 Scope of Feasibility Analysis

Various dimensions of the proposed project are analysed throughout different stages of feasibility study in varying degrees of detail, both separately and in relation to others. Thus, a multi-dimensional feasibility analysis is a vital exercise that is carried out on the following grounds:

1 Industry and Market Analysis

The industry feasibility means analysing the working pattern of the different attributes like size of the industry, location of the industry current trends in the industry etc. It will give a through crux of the industry whether entering into it would be a wise decision or not. A market is the arena for interaction among buyers and sellers. A business plan needs to be based on the market forces that could affect the commercial viability of the project. This is necessary because the viability of a project depends critically on whether or not the estimated sales from the proposed project satisfy the demand for the product or services. The qualitative and quantitative gathered through market analysis serves to identify any untapped market opportunities, refine the target market and develop a market strategy.

Organisation can conduct market analysis both before and after site selection for the project. Market analysis before site selection can help in identify gaps in a given market area that could present future development opportunities. Market analysis after site selection focuses on refining the target market, finalising the project concept and securing finance. Market feasibility study typically involves the following aspects:

- Composition of the market.
- Consumer behaviour (Demographic and psychographic information).
- Competitor's information- nature, their strengths and weaknesses, availability of substitutes, price war activities etc.
- Pattern of consumption growth.
- Supply and demand position.
- Income and price elasticity.
- Distribution channels.
- Administrative, legal and technical constraints related with marketing of the product.
- Projected market share.

2 Technical Feasibility Analysis:

Technical analysis seeks to determine whether the prerequisites for the successful commissioning of the project have been considered and reasonably good choices have been made with respect to location, size, process etc. It refers to the analysis of the technology and operations related aspects in order to justify the proposed project in terms of the following aspects:

a) Plant capacity
b) Plant location and sites
c) Plant structure and civil works
d) Machinery and equipment
e) Production technology
f) Product mix
g) Material inputs and supplies
h) Project charts and layouts
i) Work schedule

The issues related with the above may be classified into those pertaining to inputs, throughputs and outputs. The assessment is focused on gaining an understanding of the present technical resources of the organisation and their applicability to the expected needs of the proposed system. Other types of analyses are dependent and closely inter-twined with technical analysis.

3 Financial Feasibility Analysis:

Finance is the life blood of the business. Without adequate finance even successful market players cannot survive for long. Thus, availability of finance, cost associated with it, revenue generated will be able to stand through the financial cost or not, all these should be ensured in order to work out the financial feasibility of the project. This involves an analysis of the cash flow profile of the project. The financial evaluation of a project includes the following aspects:

A. **Profitability Measurement**-Profitability of the proposed project is measured by making estimates of sales, production cost estimates, Total estimated cost of the project and estimates of the working results. Typically the starting point for the

profitability measurement is the forecast for the sales revenue. In estimating the sales it is reasonable to assume that capacity utilisation would be some what low in the first year and rise gradually to reach the maximum level in the following years. The major components of production cost are- material cost (the cost of raw material, chemicals, components etc.), labour cost (cost of all man power employed in the factory), overhead cost (expenses on repairs and maintenance, rent, taxes, insurance etc.) and utility cost like the cost of water, power and fuel etc.

The profitability projection or estimates of working are prepared along the following lines- (a) cost of production, (b) total administrative expenses, (c) total sales expenses, (d) expected sales, (e) gross profit before interest, (f) total financial expenses, (g) depreciation, (h) operating profit, (i) other income, (j) profit / loss before taxation, (k) provision for taxation, (l) profit after tax .

B. **Financial Appraisal** - Project financing can be a major obstacle in large projects because of the level of capital required. Availability of loan, credit worthiness, loan schedule and equity are the important aspects of financial analysis. While conducting this analysis, the analyst would consider sources of capital, payback periods, residual values, rates of return, breakeven point i. e. (investment worthiness judged in terms of various criteria of merit). Projected Balance sheet, Projected Funds flow statement and Projected Cash Flow Statement can be prepared. The financial viability of a project should provide the following information:

- Total start-up costs required in order to begin operations.
- Full details of the assets to be financed. How liquid those assets are?
- Rate of conversion to cash liquidity, i.e. how easily can the various assets be converted to cash?
- Working capital requirement and planning for its financing.
- Project's funding potential and repayment terms.
- Sensitivity in the repayment capability due to time delay, increase in cost, acute reduction of sales or due to adverse economic conditions.
- Level of risk.

4 Economic Analysis

Economic factors have a major impact on how businesses operate and make decisions. Economic analysis is a methodology for evaluating proposed project's compatibility with the macro-economic environment in the relevant industry and fitting in with the concerned government policies. For example, interest rates affect a firm's cost of capital, returns on capital invested etc. and therefore to what extent a business grows and expands depends on the interest rates. A cost-benefit and a breakeven analysis are important aspects of evaluating the economic feasibility of new industrial projects. The tangible and intangible aspects of a project should be translated into economic terms to facilitate a consistent basis for evaluation. The important economic factors can be enumerated as below:

- Interest rates/ Saving rates/Inflation rates
- Money supply and disposable income
- Business cycles
- Trade balances
- Subsidy/incentive/relief/assistance/exemption/development loan, offered by the government.

5 Energy Management and Ecological Aspects Analysis

In the recent years, environmental concerns have assumed a great deal of significance especially for the projects, which have significant ecological implications like power plants and environment polluting industries like chemicals, leather processing or drug industries. It must be ensured that the proposed project does not affect adversely to the ecological balance and environment remains pollution free. For this purpose, organisation should receive necessary clearance from the State Pollution Control Board and should make the required provisions for treatment of effluents.

Energy management techniques required for the project should be analysed in detail due to high priority and significance being given to the energy conservation and use of alternative source of energy in the recent times. The important factors or laws to be considered are:

- Waste disposal
- Pollution monitoring
- Energy consumption and Carbon footprint
- Recycling
- Using greener (eco-friendly) techniques and processes

6 Other Areas of Analysis

(i) Resource and Schedule Feasibility

This includes the answer of the following questions-how much time is available to build the new system and if it can be completed in a given time period using some methods like payback period. Are the project deadlines reasonable? Whether it interferes with normal business operations? Which type of resources required and its dependencies on other factors?

(ii) Managerial and Organisational Feasibility Analysis

Managerial and organisational structure as contained in the project report should be analysed in the light of functional relationship within the project team and division of work load in the respective areas. Even a great idea with high market potential requires an entrepreneur or team behind it that can effectively and passionately support and grow the ideas some management structure and their styles delay decision making while others facilitate the decision making process. In this analysis, culture and motives of the project owner, personnel policy of the organisation, skills and abilities of the project manager and other managerial personnel etc. are taken care of. Thus, everybody as a team must be coordinated and motivated towards the mission of the proposed venture/ project.

(iii) Legal Feasibility Analysis

Think of the plight of an entrepreneur who worked on the idea of a laundry to cater to hospitals and hotels finds it eminently feasible then learn subsequently that laundry does not figure as an industry within the administrative definition of SSI as applicable on that date. Similarly, an increase in the minimum wage and greater requirement for firms to recycle are the few of the recent examples that have an impact on the costs and demand of the products. Setting up of an industrial unit requires the entrepreneur to obtain a number of clearance and approvals regarding land use, pollution control and safety from government authorities. What is implied from these examples is that every business organisation has to obey and work within the framework of the law, has to be sure also of the administrative and legal issues involved in the project.

(iv) Social and Cultural Feasibility Analysis

Social feasibility addresses the influences the social systems have on the proposed project. These factors are significant in the manner that they function as a basis for deciding the operational policies in regard to product attributes, marketing strategies, promotional policies and campaigns. In labour intensive projects, planned functions must be integrated with the local cultural practices and beliefs. Further an enterprise's own culture can clash with the results of the project. The social structure and the values that a society cherishes have a considerable influence on the functioning of business firms. For example, religious beliefs may influence what an individual is willing to do or not. The **Social Cost Benefit Analysis** is also made while appraising the project in respect of social cost and social benefits of the project.

(v) Operational Feasibility Study

Operational feasibility is a measure of how well a proposed system solves the problems, and takes advantage of the opportunities identified during scope definition and how it satisfies the requirements identified in the requirements analysis phase of system development. The operational feasibility assessment focuses on the degree to which the proposed development projects fits in with the existing business environment and objectives with regard to development schedule, delivery dates, corporate culture and existing business processes. A system may serve its intended purpose most effectively when its technical and operating characteristics are engineered into the design. Design dependent parameters such as maintainability, reliability, usability, supportability, affordability, sustainability and others are required to be considered at the early stages of design if desired operational behaviours are to be realized. Thus, operational feasibility is a critical aspect of system engineering that needs to be an integral part of the early design phases.

(vi) Political Feasibility Study

Political considerations often dictate direction for a proposed project. Political feasibility analysis requires an evaluation of the compatibility of project goals with the prevailing goals of the political system.

3.4 Sources of Information for Feasibility Analysis

Organisation/ consultant tap information and collect data from a wide variety of sources for the purpose of feasibility study. Some of the important sources of information are given below:

- Relevant information may be found through various secondary sources such as government statistical publications, industry reports, trade journals, newspapers, books, magazines etc.
- Through primary research activities such as market surveys.
- Internal sources like company files and documents, data bases, employees, suppliers, trade associations etc.
- Spying and surveillance through ex-employees of competitors etc.
- The internet has also opened up new routes to obtaining information.

While using any of the above sources of information the validity, reliability and time frame of the source should be checked to ensure the authenticity of the source used. The study of above mentioned aspects will help to answer the feasibility of the proposed project.

3.5 Project Feasibility Analysis Process

The go/ no-go decision is one of the most critical in business development. Once decided to pursue a project, there is usually no turning back. The feasibility study will be a major information source in making this decision. It is a multi-step exercise. As the analysis progresses, the developer will gradually acquire more information that will help in determining whether or not to proceed further. Although every feasibility study is different, here are some of the main parts necessary when officials, business managers or consultants want to do a feasibility study.

Step 1- Plan a study

Business leaders or others responsible for a feasibility study will need to plan out various aspects of the study, from identifying goals to considering alternatives for implementation. A preliminary study is conducted to confirm and evaluate the need of the proposed project. A proposal of how the need may be satisfied is then made. Pertinent questions that should be asked include-
Is the need significant enough to justify the proposed project?
What are the alternate means of satisfying the need?
Would the need exist by the time the project is completed?

Step 2- Hire staff as needed

Examination of the feasibility may require special skills of which organisation may fall short of. Similarly some feasibility studies rely on skilled engineers to collect and interpret some of the data that will build study credible. Organisation can look for outside firms willing to consult for a specific study or project and make sure the individuals selected have the proper credentials. It might be tempting to choose the lowest cost consultant or a personal acquaintance of one of the organizers, but always

remember that quality work is the most important factor when choosing a consultant. Besides this, he must provide an independent assessment of the business opportunity.

Step 3-Monitor or identify factors

The analyst needs to identify all the relevant factors, both internal and external components (financial, physical issues etc.) that might affect the venture/ project. For technology oriented projects, artist's conception and scaled-down models may be used for illustrating the general characteristics of the project. Simulation can be carried out to predict the outcome before actual commencement of the project.

Step 4- Start the study

When all of the numbers points of the study have been worked up on paper, the involved individuals must go out and do what has been planned. The feasibility study should have a time frame for all the activities needed to fully implement it. The main goal of feasibility study is not to solve the problem but to achieve the scope. Collecting relevant information from the selected areas and to identify the variables in such areas are the basics of analysis. While evaluating various alternatives, the inter-linkages among key facets of the project like product or service, demand, plant capacity, location, investment outlay, financial resources, selling price and profitability must be borne in mind. Environmental, economic, social, cultural and political impacts may be some of the factors that will determine how a project will be perceived by the public. Different types of methods, tools and techniques like SWOT (Strengths, weaknesses, opportunities and threats) Analysis, SAP (Strategic Advantages Profile) Analysis, ETOP (Environment Threat and Opportunity Profile) Analysis, Business Evaluation scoring Technique (BEST), Porter's Five Forces Model, Sensitivity Analysis can be used for analysing these factors.

Step 5- Feasibility Report

The study should end with the overall outcome of the project analysis. Those involved should be able to collect the final results of their activities and compile them into a single report. This is called as project feasibility report. The conclusions of the feasibility analysis should outline in depth the various scenarios examined and the implications, strengths and weaknesses of each. This may indicate an endorsement or disapproval of the project. Recommendations on what is to be done should be included in this section of the feasibility report. A feasible project is one which will generate adequate profit and cash flows, with stand the risk it will encounter, remains viable in the long run, meets all the legalities and fulfils the goals of the founders. When writing a feasibility report, the following should be taken into consideration:

- A brief description of the business to assess more possible factors which could affect the study
- The part of the business being examined
- Details of all the relevant factors
- The evaluation criteria
- An endorsement or disapproval of the project

- The possible solution to the problem
- Findings and recommendations.

Step 6-Distribute the feasibility study report

The results of a feasibility analysis can provide with a much better understanding of the capabilities of the new venture or project but it must be kept in mind that it is not the purpose of the feasibility study or the role of the consultant to decide whether or not to proceed with a business idea. It is the role of the project leaders to make this decision, using information from the feasibility study and inputs received from the consultant. If the results of the feasibility study indicate that the proposed venture is viable then the management can begin to develop a business plan.

3.6 Feasibility Study Versus Business Plan

A feasibility study is not a business plan. The separate roles of the feasibility study and the business plan are frequently misunderstood. The feasibility study provides an investigating function. It addresses the question of "Is this a viable project?" It outlines and analyzes several alternatives or methods of achieving business success. The feasibility study helps to narrow the scope of the project to identify the best business scenario(s). This becomes the basis for the business plan. Thus, a business plan is prepared only after the business venture / project has been deemed to be feasible. If the venture is deemed not to be feasible, efforts may be made to correct its deficiencies, other alternatives may be explored, or the idea is dropped. The business plan provides a planning function. It outlines the actions needed to take the proposal from idea to reality. As such, a business plan is a blue print of entrepreneurial intentions. It is a written document that serves as a road map in the entrepreneur's journey from start-up to project implementation. It describes all the relevant elements involved in starting a new project. It is often an integration of functional plans such as finance, marketing, manufacturing and human resources.

3.7 Summary

Feasibility study is an important part before converting business idea into reality. Normally it has been estimated that only one idea in fifty is commercially viable. The research and investigation work done for feasibility study will uncover all the factors and this will support the detailed planning. The feasibility of a project can be ascertained in terms of financial, technical economical factors etc. It knows beforehand whether there exists a sizeable market for the proposed product/ services, what would be the investment requirements, where to get the funding from, whether and wherefrom the required technical know-how to convert the idea into a tangible product may be available and so on. As such, a well-designed feasibility study should provide details of operations and management, financial treatment, marketing research and policies, legal aspects, description of the product and service etc. The document prepared to show the ramification of the project is called as project feasibility report, which helps in identifying the risk and can be used in securing funds from lending institutions or attracting quality investment.

3.8 Self Assessment Questions

1. What is pre- feasibility analysis?
2. Describe the linkage between project planning and project feasibility.
3. What do you mean by market feasibility of a project?
4. What are the important factors to be considered in market analysis? Explain the relevance of conducting a market survey and how the same should be done.
5. What is project feasibility? Explain its various dimensions with the help of appropriate illustrations.
6. Explain the key considerations in technical analysis?
7. Differentiate between business plan and feasibility analysis.
8. Discuss the process of technical feasibility analysis, selecting the project of your choice.

3.9 Reference Books

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Unit - 4 Project Planning and Scheduling

Structure of Unit

4.0 Objectives

After completing this unit, you would be able to:

- Understand the importance of project planning.
- To know how does project planning reveal future opportunities and risk.
- Understand how to evaluate project for its feasibility in the planning stage.
- Understand the scheduling process of project.
- To know how duration and activity relationship is being carried out.
- To know how networking is assisting in finalizing the scheduling with critical path analysis and site execution for project.
- Describe how network cost models provide the direction of cost reduction in the project management.

4.1 Introduction

Project is a temporary endeavor undertaken to create a unique Product, Service or Result. Temporary Endeavour means every Project has a finite duration (a definite beginning and a definite end). Projects are not ongoing efforts like production of a product from a plant that is comes under operation management. Hence execution of a fertilizer plant is a project stage and production of fertilizer from that plant is an operation stage. Uniqueness means the location, time period of execution, size, technology and the cost out of which any or more than one factor not is similar of the two projects. E.g. Fertilizer plant at Kota city and the fertilizer plant at Babrala would not be same in the above factors during its project stage. Every project includes its activities to be sequenced for execution and final duration of project is to be taken out. The first part activities sequencing and duration of activities are known as Project Planning. The duration of planned project after activities sequencing and relationship between activities would provide the end date of planned project that is known as Scheduling. This will provide a guide for each team member for their activities to be carried out with an indication of start date, finish date and duration. Hence planning and scheduling are an important aspect to accomplish the project within time, cost and with

minimum resources. However during execution of a project it is not necessary that all activities would follow the path of planned duration and dates. The deviations in the execution time and resources of a project become data for analysis for a project schedule and cost variance and reference for similar kind of projects to be executed in the future.

4.2 Project Planning

Project planning is a rational determination of how to initiate, sustain, and terminate a project. After the initiation stage, the project is planned to an appropriate level of detail .The main purpose is to plan time, cost and resources adequately to estimate the work needed and to effectively manage risk during project execution. As with the initiation process group, a failure to adequately plan greatly reduces the project's chances of successfully accomplishing its goals.

Project Planning generally consists of:

- determining how to plan (e.g. by level of detail or rolling wave);
- developing the scope statement;
- selecting the planning team;
- identifying deliverables and creating the work breakdown structure;
- identifying the activities needed to complete those deliverables and networking the activities in their logical sequence;
- estimating the resource requirements for the activities;
- estimating time and cost for activities;
- developing the schedule;
- developing the budget;
- risk planning;
- gaining formal approval to begin work.

Additional processes, such as planning for communications and for scope management, identifying roles and responsibilities, determining what to purchase for the project and holding a kick-off meeting are also generally advisable. For new product development projects, conceptual design of the operation of the final product may be performed concurrent with the project planning activities, and may help to inform the planning team when identifying deliverables and planning activities.

4.2.1 Why Project Planning?

Consider a project E.g. “Building Construction of double story with size 25’ x 50’ Keeping the title as a single activity with rough estimate of duration for execution into six to eight months and no detailing for small work package (as activities) and its sequencing is being done.

In the above situation, the project execution will face the following problems:

a) Since in the beginning construction manager takes into consideration that project has variation of two months duration.
b) It is very difficult to monitor the execution for single task since the duration is too high.

c) "No road map of sequence of small units of work packages (activities), since it is to be considered as single activity.
d) Resource mobilization on each work package becomes crucial since, when the activity starts at site the requirement of resources will be initiated at that time only.
e) A very poor communication will be there between various agencies to coordinate activities since everybody will work in their own priority.

Example: Electrical Conduit place on vertical walls to be left without plaster (till it has been laid down) but mason has completed it, since activity sequencing was not because lack of planning and scheduling and hence not coordinated. Hence, Project Plan drawn up at the start of the project should be used as the driver for the project.

4.2.2 How to Develop Project Plans?

Project planning generally consists of the following steps:

1) <u>Work Break down structure</u>

Work break down structure of a project is a process of breaking down the projects into levels of similar or identical groups up to activity level, so that duration of an activity can be monitored and controlled during execution. Below is break down structure for <u>"Building Construction of double story with size 25' x 50' "</u>

At level -1 : The project summary title will come.

At Level-2 : Break down of project w.r.t. sub-group of steam wise/ similar activity wise. This is still the activity level, which can be controlled as duration day wise (as standard practice in building construction duration for activities are taken as days). Hence this needs to break down for level -3

At Level-3 : Further break down of sub-group is being carried out up to level -3. Here "Masonry" work is further broken down to next level i.e. level 3.

At Level-4 : Further sub-group is broken down up to level-4 i.e. the activity level. This is to be monitored w.r.to planned duration, start & finish time and resources respectively.

2) **<u>A schedule for the project</u>**

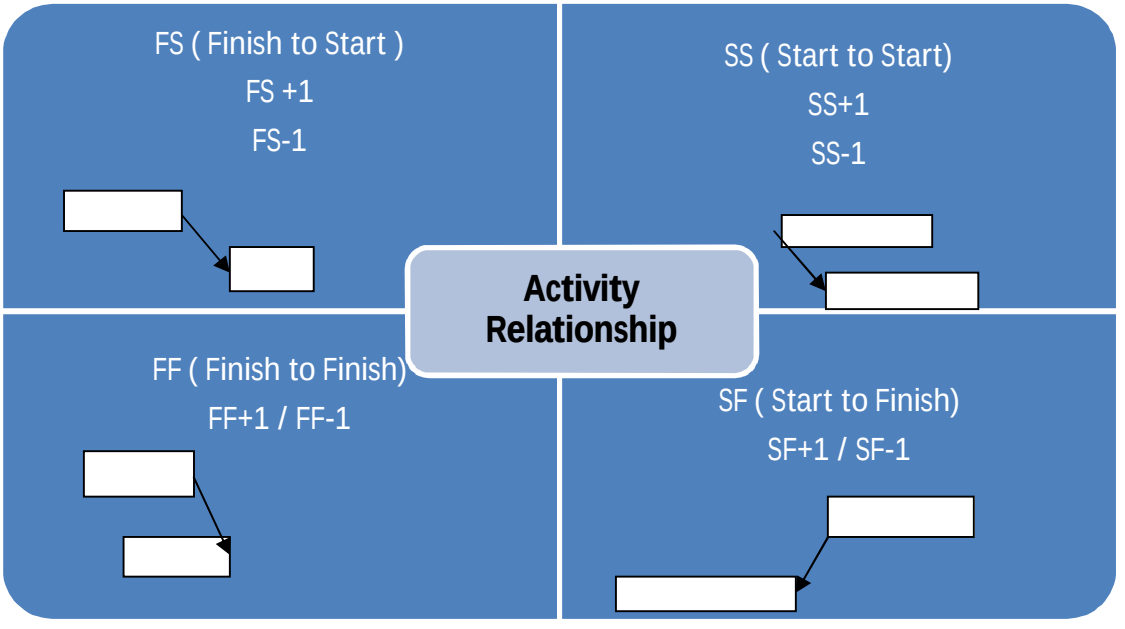
Schedule for a project is being done in the following steps:

a) Project information is created in which project start date is finalized.
b) On the activity the duration is considered based on standard practice and experience. Example : We consider 5 days for excavation on above foundation activity.
c) Activity relationship is built-up.

Following are the four types of activity relationship:

- Finish to start relationship of activity: Example : Laying forms is immediate successor of excavation.
- Start to start relationship of activity: Example : Pillar form laying with another pillar
- Finish to finish relationship of activity: Example : Doors of building would finish electrical fittings
- Start to finish relationship of activity: Start time of activity relates to finish time of its immediate successor activity. This relationship is mostly not used, since it is reverse relationship. Example : Trial run of pump and handing over the pump to stakeholder. Suitable relationship is made between activities and this will give a final finish date of last activity.

Below is the chart indicating activity relationship as described above.



3) <u>Resources required for the activities and whole project</u>

In the project resources are being used for its execution. These resources once assigned to activity will indicate the budget cost. Resources are classified in the following types:

a) Manpower Resources: From the project manager to all contractors assigned to the project are being treated as manpower resources. Example : Construction manager, skilled mason, Carpenter, Labors etc.

b) Material Resource: The items used as consumables in the project are known as materials resources Example : in the Building construction project – cement, steel bricks are major material which are used.

c) Equipment Used: The support tools and equipment used in the project execution fall in this category. Example : Mixer, Scaffolding, plywood forms etc.

4) Budgeted cost of each activity, sub group and whole project

Once the resources are assigned to the activity. It will calculate the budgeted value based on the rate decided for the resources. E.g. : Sheet indicates the building construction foundation breakdown structure. It also indicates the duration as well as resources used. Budgeted cost of activity excavation - duration 5 days. Civil Engineer will be available site to supervise the job. Max 50%. Current rate per day basis for civil engineer is –2000/- per day. Labour: 400 per day. Hence budgeted cost for excavation – 5 x 2000 x .50 + 5 x 400 = 7000/-. This way budgeted cost on each activity is calculated.

4.2.3 Constraints in Project Planning

Constraints are the restrictions which are considered during the project planning. These are imposed on the activity in the form of scheduled date of completion of activity. These constraints are imposed on activity during planning of a project. Below is the example shown of constraint on an activity? The slide is taken from the M.S project software 2010 version along with dialog box of task information. In the Task information dialog box the task name is dewatering and constraint type is "As soon as possible" and it is a default constraint. The meaning of this constraint is schedule the task to begin as early as possible.

Other constraints are:

As late as possible (ALAP): It means schedule the task as late as possible without delaying subsequent task. Example : Payment of the contractors in the industry projects normally final bills are delayed till all punch points are not rectified.

Finish no earlier than (FNET): It means schedule the task to finish on or after the specified date. Use to ensure that a task does not finish before a certain date. Example : boundary wall of a building construction project could be delayed since independent activity.

Finish no later than (FNLT): It means schedule the task on or before the specified date. Use to ensure the task does not finish after a certain date. Example : casting of foundation prior to receive the machine for installation i.e. delays in the delivery would allow the delay in foundation casting.

Must finish on (MFO): Schedules the task to finish on a specified date. Other scheduling parameters such as task dependencies lead or lag time, resource leveling and delay become secondary. Example : Erection of heavy equipment by heavy duty crane (hired) having very high charges, hence this activity to be finished prior or scheduled date Must start on: Schedules task to start on a specific date. Other scheduling parameters such as task dependencies lead or lag time, resource leveling and delay become secondary. Example : Bhomi pujan activity to be done on specific date for building construction project.

Deadline: Task can include a dead line date allows as indicator to be displayed in the indicator column. Example : During shut down of plant the last activity or the longest duration activity is to be controlled and given the dead line so that the total shut down is not delayed.

4.2.4 Linear Responsibility Matrix

There are various agencies involved in a project. These agencies are having very close boundary limits of the activities to be carried out in a project. To ascertain the specific and combined responsibility in a project a matrix in linear form is developed. In which on the horizontal axis the responsibility with functional position or agency is indicated. On the vertical axis the scope of work of project is indicated in the form of WBS group or subgroup or a special task. The assigned responsibility is indicated in the related matrix box with a symbol which indicates the nature of work assigned for the activity or WBS group. This will assists during execution the functional responsibility of the group or agency. This is called linear responsibility Matrix. This is a simultaneous process during project planning even prior to the development of activity planning and scheduling.

4.3 Scheduling

The process of converting a general or outline plan for a project into a time-based graphic presentation using information on available resources and time constraints is called Scheduling. Scheduling is a management tool which can be used to satisfy a number of objectives. Scheduling enables you to integrate the activities of the various project participants. It show interface responsibilities particularly with respect to timing. It helps to secure, record and communicate commitment to tasks by the various contributors to the project effort.

Scheduling also enables you to identify the key activity sequence (critical path) determining the length of the project and display departmental work loading and hence facilitate departmental planning. It provides the basis for more detailed scheduling. Scheduling enables analysis and forecasting which show priorities for procuring equipment, material, labor and services. It analyze complex work areas with many interrelated activities through network analysis. It also facilitate long range planning and future resource allocation.

It measures progress, and performance. We can use scheduling for reporting to provide a visible summary of important or major activities. It reports planned completion dates, deviations from plan, and provide an early warning system for delays. It monitor cash flow for estimating on future projects.

4.3.1 Three Basic Steps to a Project Schedule

Define the work

As defined above in the planning, it is the process of splitting the project in the activity level. Estimation of time duration of the activity. Estimation for time duration is done in the following steps :

Step-1 **Efforts:** how much work wills the activity need to be completed

Step-2 Resources: how many resources will be working on the activity?

Duration of 5 days == 40 hours (8 hours a day) = 1 calendar week (sat and sun rest time). 40 hours are the total effort time by the resources. If the activity has fixed duration then the more than one resource will not change the duration. Example : An activity duration is set with effort is 5 days == 40 hours (8 hours a day) = 1 calendar week (sat and sun rest time). 40 hours will be by each resources is required for the activity to complete.

Similarly if the activity is with fixed units of effort then the duration will govern by no of resources. Example : In the above activity effort is set to == 40 hours (8 hours a day by each resource) 40 hours will be total effort including all resources. First resource effort – 20 hrs & second resource effort -20 hrs include 40 hrs. Hence the duration will be 2.5 days.

2) Schedule activity

Organizing the activity concurrently with developing dependencies between activities. Minimize task dependencies to avoid delays caused by one task waiting for another to complete. It depends on project manager's skills and experience. It will provide the start and finish date of the project.

3**) Allocate Resources**

Project manager's best of their skills and experience calculate the resources required on the activity. It is calculated based on total effort required and duration to be kept on the activity. This allocation of resources will provide the budgeted cost of individual activity, sub group and total project.

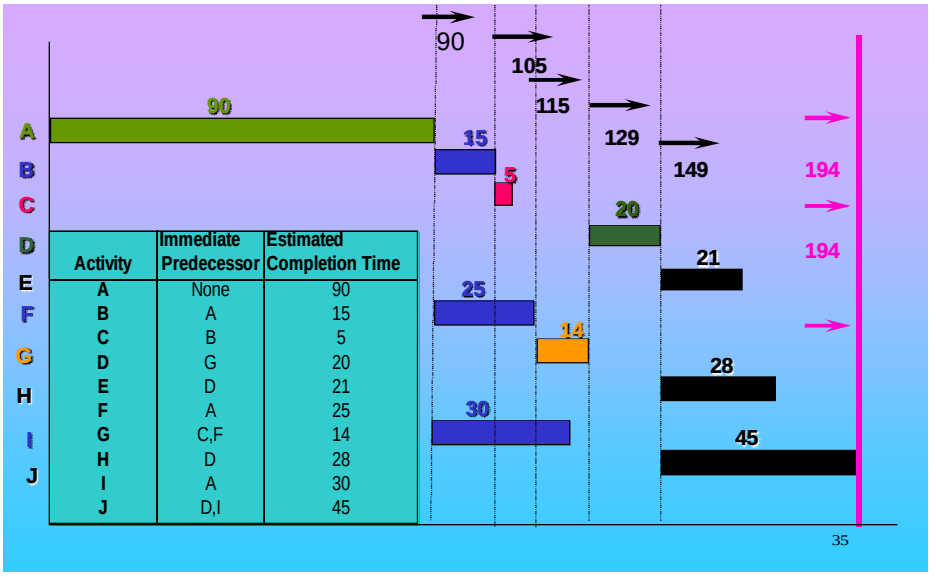
4.3.2 Types of Schedules

There are many ways of presenting similar information, each with different objectives as discussed below:

a) Gantt or Simple Chart

Gantt charts are used as a tool to monitor and control the project progress. A Gantt Chart is a graphical presentation that displays activities as follows:

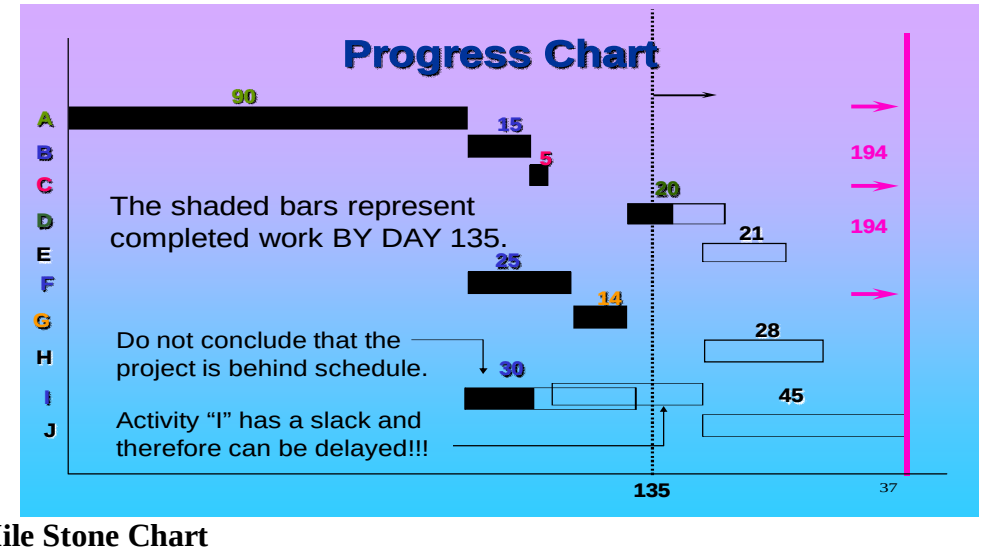
Time is measured on the horizontal axis. A horizontal bar is drawn proportionately to an activity's expected completion time. Each activity is listed on the vertical axis. Gantt chart can be used as a visual aid for tracking the progress of project activities. Appropriate percentage of a bar is shaded to document the completed work. The manager can easily see if the project is progressing on schedule (with respect to the earliest possible completion times).



Activity	Immediate Predecessor	Estimated Completion Time
A	None	90
B	A	15
C	B	5
D	G	20
E	D	21
F	A	25
G	C,F	14
H	D	28
I	A	30
J	D,I	45

b) Progress Bar Chart

Graphical representation shows progress relative to plan. Appropriate percentage of a bar is shaded in document for the completed work. The manager can easily see if the project is progressing on Schedule (with respect to the earliest possible completion times).



c) Mile Stone Chart

Graphical representation shows milestone dates. It identifies key points in the project's life span The bars are not necessarily visible.

4.3.3 Characteristics of a Good Schedule

A good schedule will indicate logical sequence of the activities, simle to work for necessary Changes. It should indicate the progress at a glance and based on site

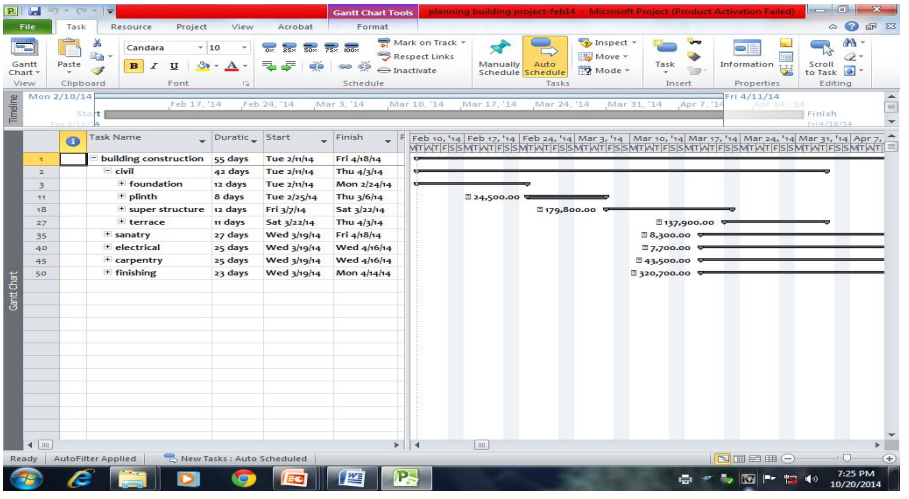
progress it should be flexible to update and indicate the actual progress against the baseline schedule It should indicate the time duration as well as planned start and finish time as well as actual start and finish time of an Activity. Also anticipate the problem of delay in the activity schedule or resource problem.

4.3.4 Master Schedule

Master Schedule means the highest summary level schedule for a project showing the overall phasing and all major interfaces, key milestones and significant work elements. It is also known as an Executive Summary Level Schedule. Usually prepared manually as an outline of intent very early in the project's life span. It is developed as early as possible in the project life span. It is maintained by the project manager. It is coordinated with all discipline engineer's and then developed by relationship and duration between all activities and it will indicate subgroup schedule and finally Ist level schedule. It will show all major activities at a summary level. It include key milestones or events relating to each major activity at critical points in time. Provides a yardstick for the overall project status against which overall progress is measured. The Baseline Master Schedule should not be changed unless formal and agreed re-scheduling takes place for the entire project or a major part of it.

Below is the Example of Mater Scheduling in the M.S. Project 2010 in which the

Level I summary task is the Building construction. Under which IInd level summary task are: Civil, sanitary, electrical, carpentory, and finishing.IIIrd level sub groups under civil are foundation, plinth, super structure, and terrace.



4.3.5 Preparing a Schedule

There are ten general steps in preparing a reliable schedule. Before you start preparing a serious detailed schedule, you must first have Work Breakdown Structure (WBS). In fact, your detailed schedule should only come after several schedule iterations earlier in the project life span.

Step 1

- Establish and agree the scheduling assumptions, especially a clear set of scheduling objectives. For example, product quality grade, time and cost limitations that will affect activities.
- Overall strategy for the project
- Methodology or technology to be used.
- Sources of resources and their competence, or training needs.
- Working hours, holidays and other interruptions.

Step 2

- Identify each logical work area as reflected in the WBS and the activities associated.
- Make sure that all the necessary major activities and tasks have been included to create the required intermediate and final deliverables.
- If you have too many activities consider using "hammocks" to group discrete tasks as one activity.

Step 3

- Establish the project's natural or "inherent" logic.
- Some projects have very clear logic while others provide more options depending on resources or the nature of the project or other circumstances.
- Work the activities from the beginning to the end.
- Use the work breakdown structure as a "To do" list.
- Which of these items must be done first?
- Assemble a simple logic diagram arranged from left to right

Step 4

- Estimate the duration of each activity or task.
- Pay particular attention to this step since the whole schedule will depend upon it.
- Use all available sources of information.
- Some tasks will still be difficult to estimate, seek expert help, use ranges.
- Document areas of high uncertainty (risk).
- Always aim for the "most likely" duration – don't build in contingency at every step, or the project will not fly.

  Always be realistic – you can refine on the second pass and make appropriate contingency allowances later.

Step 5

- Calculate the Forward Pass by adding the durations along each path in your network to establish the earliest start (ES) and finish (EF) dates for each activity.
- Calculate the Backward Pass by repeat this operation but working backwards from the last date established in the Forward Pass or from a specified Required Completion date to establish the latest start (LS) and finish (LF) dates for each activity.
- If you examine the values of (ES-LS) and (EF-LF) you will note that
  - The string of activities where these values are zero is the longest path through the network.
  - This is known as the Critical Path.
  - Where the values are positive indicates that there is Float for those activities
- A negative ES-LS value implies that you must start an activity before you are logically able to do so, that is, you don't have enough time to do all of the work as planned
- This usually only happens when you are given a mandated finish date which is inadequate or too tight.
  If you have negative values the schedule doesn't work, and you need to go to Step 7

Step 6

- To meet a predetermined end date
  - Check whether all activities are really necessary
  - Move activities off the critical path or eliminate them altogether
  - Accelerate critical activities
  - Using overtime or more resources
  - Work some activities in parallel (concurrently) or increase the amount of overlap

Step 7

- Make sure the resulting schedule chart makes sense and looks good
- A well-presented bar chart will show the grouped activities in a progressive cascade making it clear and easy to read
- Use the calendar dates and create an ideal master schedule of milestone dates identifying the completion of major or key activities
- Finally, when everyone is satisfied, follow up with these last two steps

- Chart or print the results and distribute for final team review and acceptance before issuing it to management
- Abstract or summarize schedule data for different levels of management

4.4 Project Networking

A network is a graphical display of the logical order of activities that defines the sequence of work in a project where activities are represented by boxes. Networks are usually drawn from left to right with lines drawn between the boxes to show the precedence relationships between them. Arrow heads are sometimes placed on the lines to indicate the direction of the flow through time.

Network Advantages

- Precedence diagram format is the most common.
- Shows logical inter-relationships between activities, that is, their interdependence.
- Enables easy calculation of critical path either manually or with software.
- Critical Path activities have zero float and constitutes the longest path in the project shows how much float other activities have.
- The critical path determines length of project according to the project logic and the critical activities for that particular scenario.
- Easy to assign leads and lags between activities to solve a deadline problem.
- Easy to apply resources and determine resource or time trade-offs.

4.4.1 Network Basics

The purpose of network is to identify all the events / activities that are essential for completion of a Project and to bring out their interrelationship to satisfy the technological / logical sequencing requirements. By incorporating the time required for completing each of the activities in the network, the project duration as well as the criticality of the activity can be found out. At this stage it is also possible to compute the probability of completing the Project or part of the project in a given specified time. Based on the network calculation and assessment of resources required for each of the activities, the plan is translated into a time schedule. If it is possible to expedite the activities by incurring additional cost, the economics of doing so are also examined before finalizing the schedule.

Terminology

- **Activity** – An item of work that consumes time and resources to produce some result.
- **Critical Path** – The series of activities all of which must finish on time for the whole project to finish on time. Sometimes described as the longest path through a

network, hence the shortest project time. A critical path has zero float. A critical path assumes that the network logic is sound.

- **Event or Milestone** – A point in time when certain conditions have been fulfilled, such as the start or completion of one or more activities. Unlike an activity, does not consume time or resources.
- **Float or Slack Time** – The additional time available to complete a non-critical activity without delaying its successor or project finish time.
- **Leads and Lags** – An imposed modification of the logical relationship between activities to Accelerate or delay the apparent natural order.
- **Scheduling Network** – Graphical representation of activities or nodes and the dependencies between them.
- **Time Estimate** – The prediction of the most likely duration of an activity.
- **Earliest Start** (**ES**) = The earliest finish of the immediately preceding activity.
- **Earliest Finish** (**EF**) = It is the **ES plus** the **activity time.**
- **Latest Start** (**LS**) **and Latest Finish** (**LF**) = The latest an activity can start (LS) or finish (LF) without delaying the project completion.
- **Predecessor Activity** – Activity that complete before the next activity starts. It can be immediate predecessor also if the activity just before the activity.
- **Successor activity**—activity that starts after the activity completion.

4.4.2 Network Planning Techniques

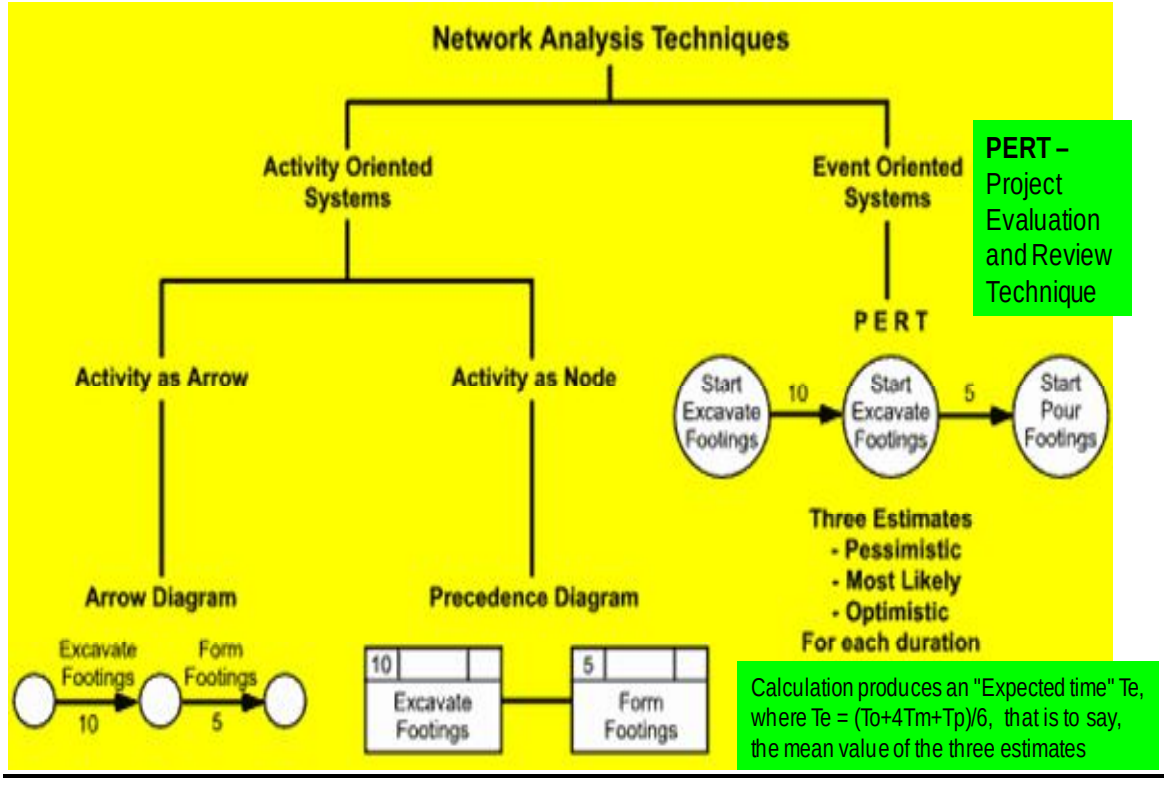
1. Activity-Oriented Systems

CPM originated in Du Pont de Nemours Company almost at the same time in 1958. CPM is a Network analysis method and differs from PERT only in the approach to the network analysis. In this system activities are displayed as connectors and event on the node. Graphically display the precedence relationships & sequence of activities. Estimate the project's duration. Identify critical activities that cannot be delayed without delaying the project Estimate the amount of slack associated with non-critical activities. This technique is suitable for the industry projects to be executed and shut down projects in industry. This is because it is having more reliable and deterministic time duration for each activity which is based on previous experience and skill set of project planner.

2. Event Oriented System

Developed by US Department of Navy for their "Polaris missile" program in 1958. It is a form of network analysis technique. PERT (Program evaluation & Review Technique) is a technique that treats activity completion. Times as random variables. Completion time estimates can be estimated using the Three Time Estimate approach. In this approach, three time estimates are required for each activity. It is developed to manage the Polaris missile project. Many tasks pushed the boundaries of science & engineering (tasks' duration = probabilistic.

Below is the Chart indicating Network Analysis Techniques with basic details



4.4.3 Steps involved in drawing a Network

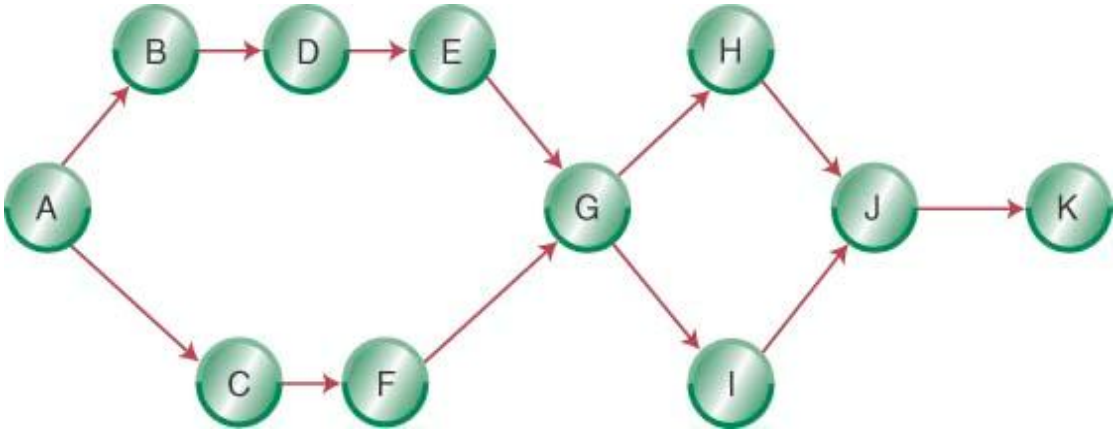
Step 1-Define the Project: Bringing a new product on line to be manufactured in their current facility in some existing space. The owners have identified 11 activities and their precedence relationships. Develop an AON (activity on Node) for the project.

Activity	Description	Immediate Predecessor	Duration (weeks)
A	Develop product specifications	None	4
B	Design manufacturing process	A	6
C	Source & purchase materials	A	3
D	Source & purchase tooling & equipment	B	6
E	Receive & install tooling & equipment	D	14
F	Receive materials	C	5
G	Pilot production run	E & F	2
H	Evaluate product design	G	2
I	Evaluate process performance	G	3
J	Write documentation report	H & I	4
K	Transition to manufacturing	J	2

Step 2- Developing the Network diagram

Activity A is the first activity shown in the node. Activity A precede the activities B and C so indicated by arrow and activities are shown in node. Similarly all other activities are drawn.

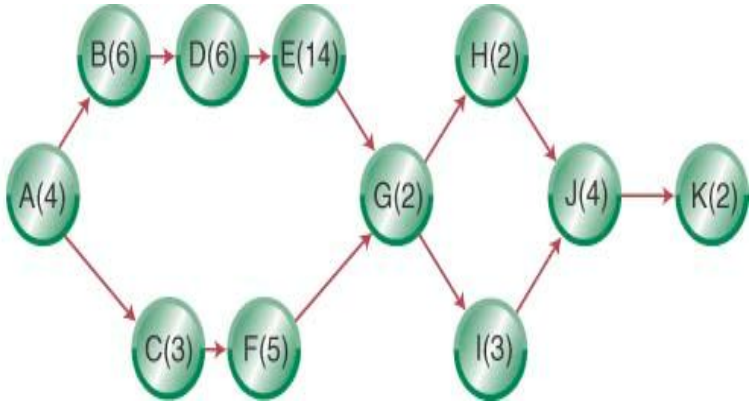
Below is the complete network diagram of above example.



Step 3 (a)- Add Deterministic Time Estimates in the Connected Paths

Time is indicated in the individual activity.

Connected paths
1. A, B, D, E, G, H, J, K
2. A, B, D, E, G, I, J, K
3. A, C, F, G, H, J, K
4. A, C, F, G, I, J, K



Step 3 (a) (Continued): Calculate the Path Completion Times

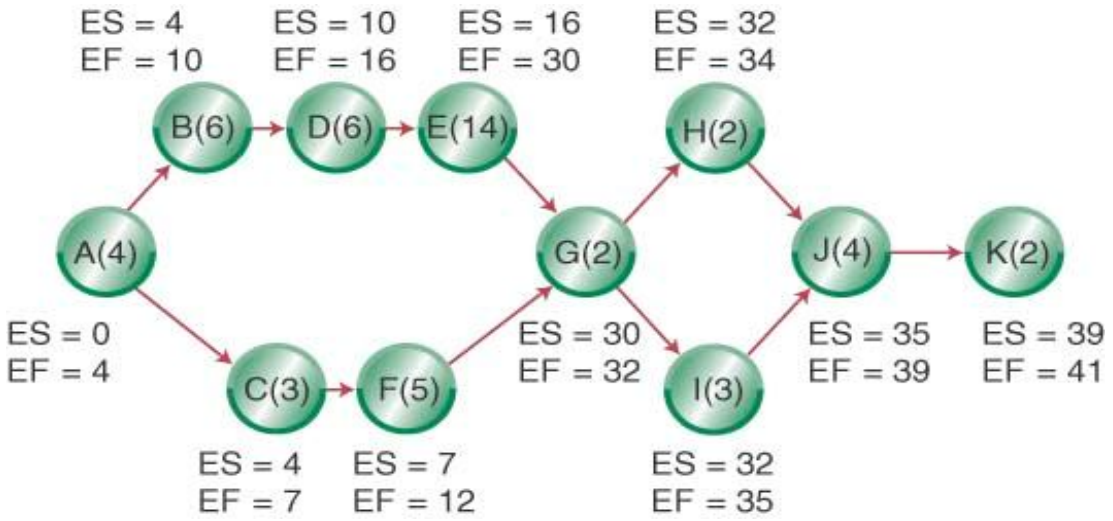
Below is the table of the paths and duration

Paths	Path duration
ABDEGHJK	40
ABDEGIJK	41
ACFGHJK	22
ACFGIJK	23

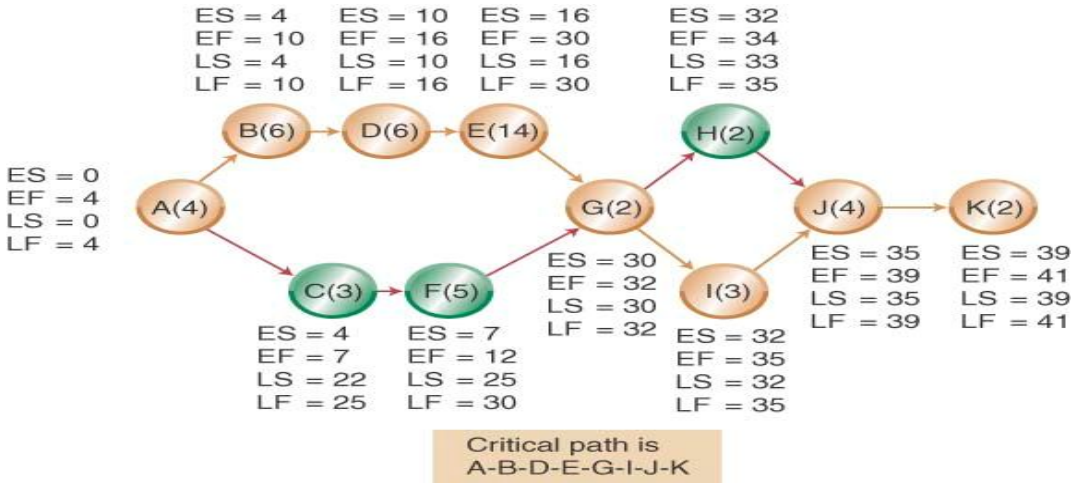
- The longest path (ABDEGIJK) limits the project's duration (project cannot finish in less time than its longest path). This is the path ABDEGIJK and is the project's critical path. Earliest start and earliest finish time on the activity in the Network.

- Earliest time , **Te** , which is a calendar time when a event can occur when all the predecessor events completed at the earliest possible times
- Latest time ,**TL ,** which is the latest time the event can occur without delaying the subsequent events and completion of project.

- Difference between the latest time and the earliest time of an event is the slack time for that event



Latest Start & Latest Finish duration on the activity in the Network



Calculating Slack (Late finish – early finish)- for above network

Activity	Late Finish	Early Finish	Slack (weeks)
A	4	4	0
B	10	10	0
C	25	7	18
D	16	16	0
E	30	30	0
F	30	12	18
G	32	32	0
H	35	34	1
I	35	35	0
J	39	39	0
K	41	41	0

Calculation of Expected Time Estimates

Below is the given table in which activity No, description, optimistic time, most likely time and pessimistic time is given.

Optimistic time: Would likely occur 1 time in 20

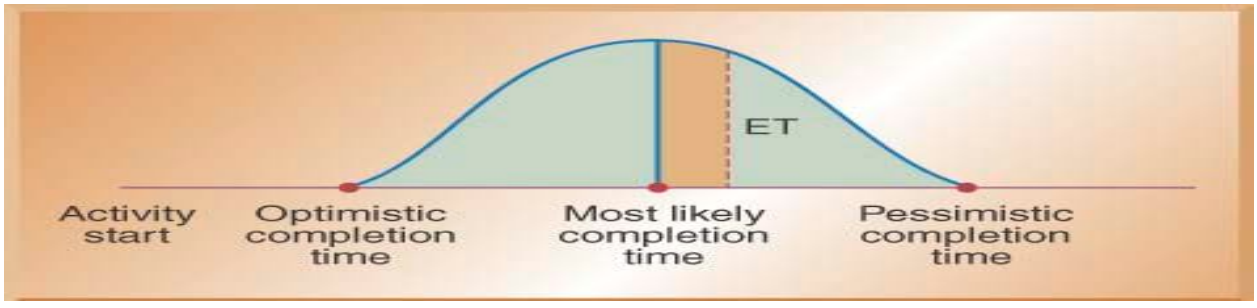
Most likely time: Modal value of the distribution

Pessimistic time: Would be exceeded only one time in 20

Activity	Description	Optimistic time	Most likely time	Pessimistic time
A	Develop product specifications	2	4	6
B	Design manufacturing process	3	7	10
C	Source & purchase materials	2	3	5
D	Source & purchase tooling & equipment	4	7	9
E	Receive & install tooling & equipment	12	16	20
F	Receive materials	2	5	8
G	Pilot production run	2	2	2
H	Evaluate product design	2	3	4
I	Evaluate process performance	2	3	5
J	Write documentation report	2	4	6
K	Transition to manufacturing	2	2	2

Using Beta Probability Distribution to Calculate Expected Time Durations

A typical beta distribution is shown below, note that it has definite end points. The expected time for finishing each activity is a weighted average

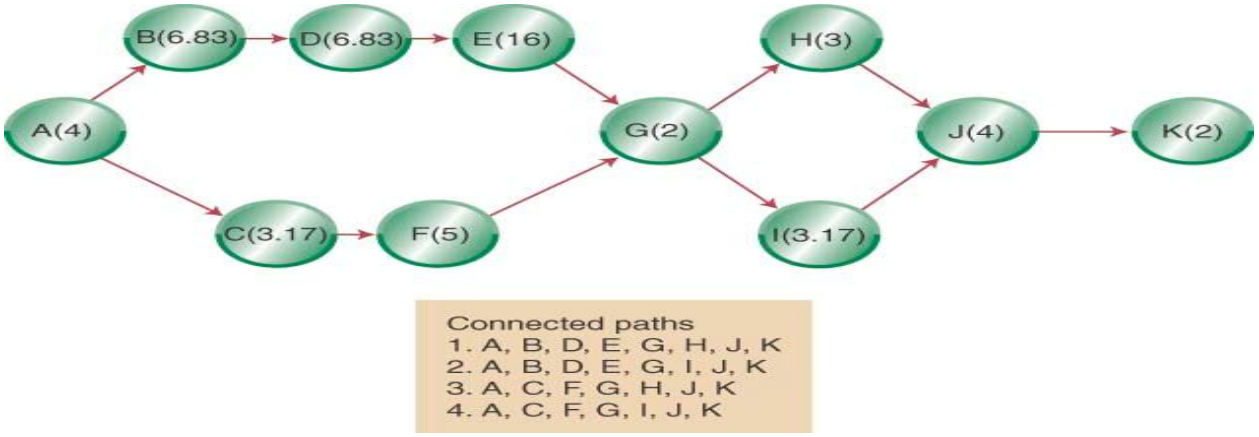


$$\text{Exp. time} = \frac{\text{optimistic} + 4(\text{most likely}) + \text{pessimisti c}}{6}$$

Calculating Expected Task Times based on the above formula.

Activity	Optimistic time	Most likely time	Pessimistic time	Expected time
A	2	4	6	4
B	3	7	10	6.83
C	2	3	5	3.17
D	4	7	9	6.83
E	12	16	20	16
F	2	5	8	5
G	2	2	2	2
H	2	3	4	3
I	2	3	5	3.17
J	2	4	6	4
K	2	2	2	2

Network Diagram with Expected Activity Times

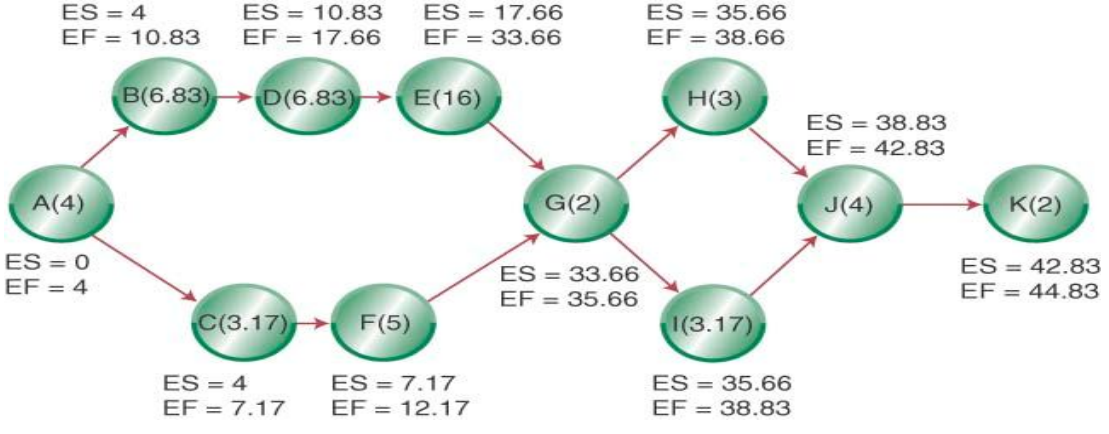


Estimated Path Durations through the Network

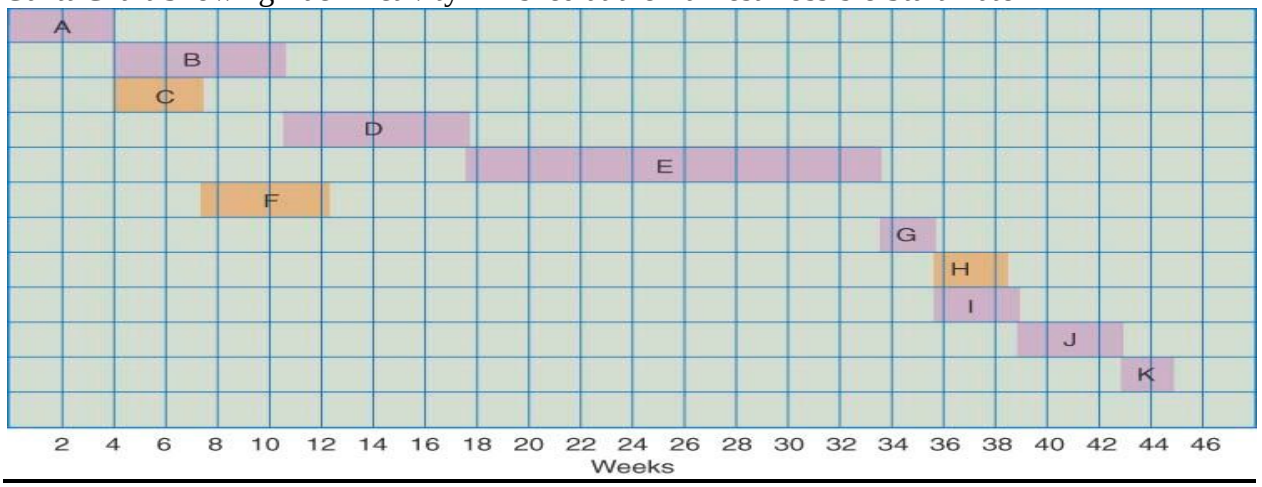
Activities on paths	Expected duration
ABDEGHJK	44.66
ABDEGIJK	44.83
ACFGHJK	23.17
ACFGIJK	23.34

ABDEGIJK is the expected critical path & the project has an expected duration of 44.83 weeks.

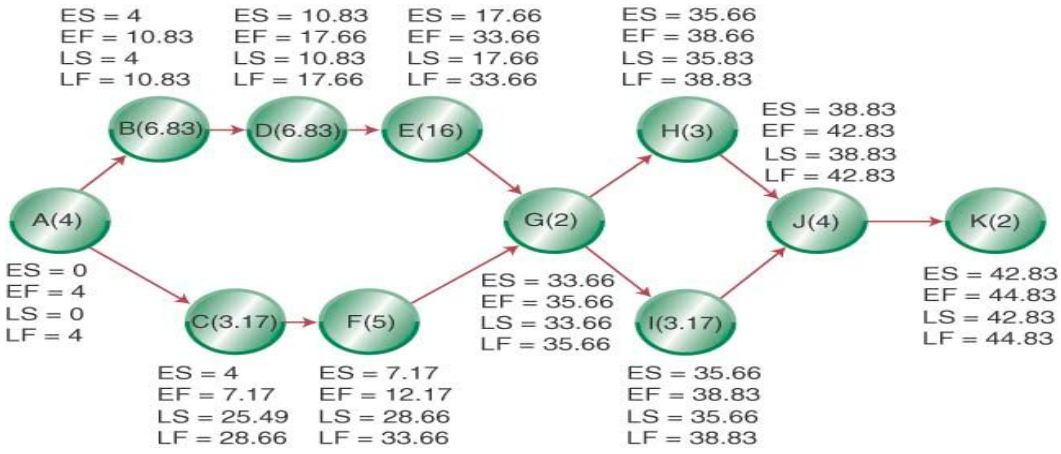
Adding ES and EF to Network



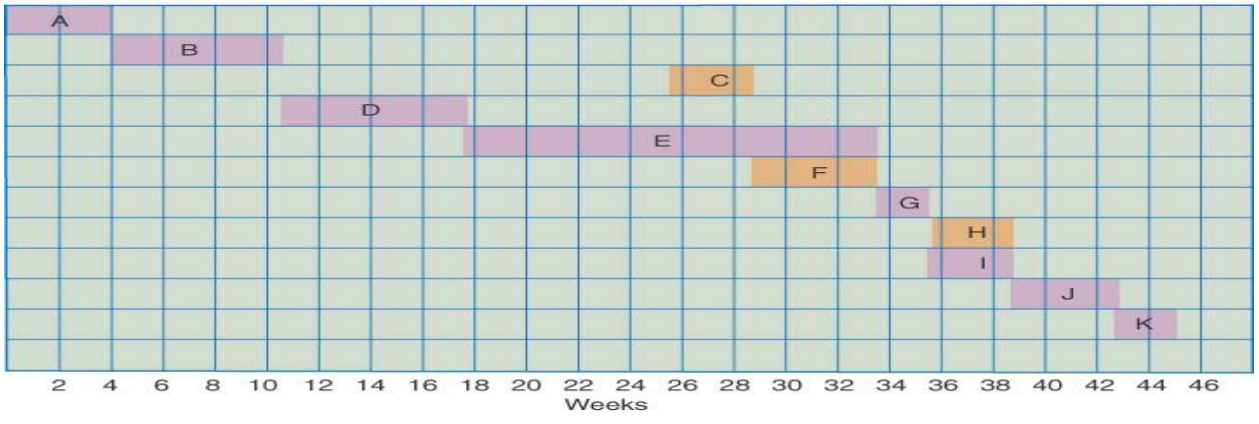
Gantt Chart Showing Each Activity Finished at the Earliest Possible Start Date



Adding LS and LF to Network



Gantt Chart showing the Latest Possible Start Time if the Project is to be completed in 44.83 Weeks.



Estimating the Probability of Completion Dates

Using probabilistic time estimates offers the advantage of predicting the probability of project completion dates. We have already calculated the expected time for each activity by making three time estimates. Now we need to calculate the variance for each activity. The variance of the beta probability distribution is:

$$\sigma^2 = \left(\frac{p-o}{6}\right)^2$$

Where p=pessimistic activity time estimate

o=optimistic activity time estimate

Project Activity Variance

Activity	Optimistic	Most Likely	Pessimistic	Variance
A	2	4	6	0.44
B	3	7	10	1.36
C	2	3	5	0.25
D	4	7	9	0.69
E	12	16	20	1.78
F	2	5	8	1.00
G	2	2	2	0.00
H	2	3	4	0.11
I	2	3	5	0.25
J	2	4	6	0.44
K	2	2	2	0.00

Variances of Each Path through the Network

Path Number	Activities on Path	Path Variance (weeks)
1	A,B,D,E,G,H,J,k	4.82
2	A,B,D,E,G,I,J,K	4.96
3	A,C,F,G,H,J,K	2.24
4	A,C,F,G,I,J,K	2.38

4.4.4 Crashing

Reducing the project completion is basically reducing the project cost. Some time there are requirements due to which project duration is to be reduced these are:

- Different deadlines
- Penalty clauses
- Need to put resources on a new project
- Promised completion dates

Reduced project completion time is known as the project "crashing". Crashing a project needs to balance shorten a project duration, and cost to shorten the project duration, and Crashing a project requires to understand crash time of each activity and crash cost of each activity.

Crash cost/duration = (crash cost-normal cost)/(normal time – crash time)

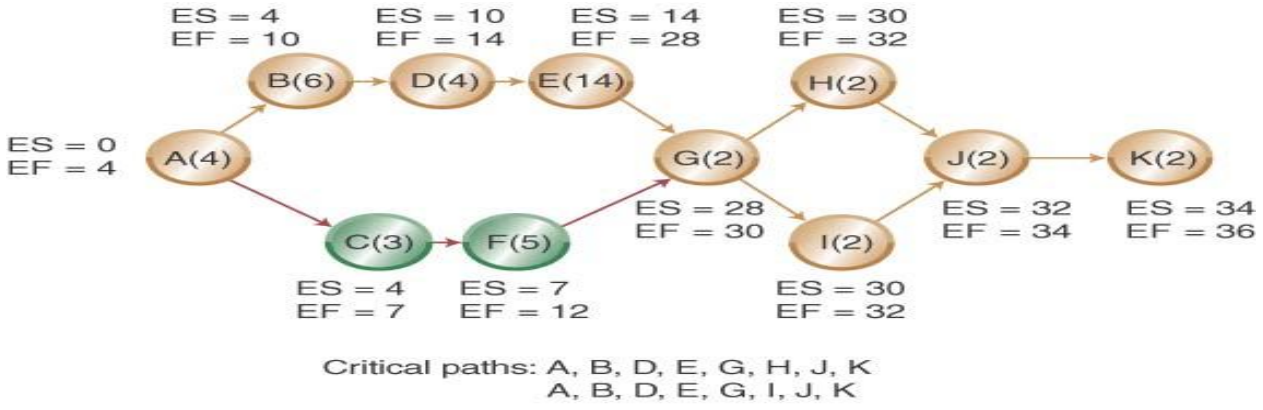
Reducing the Time of a Project (crashing)

Activity	Normal Time (wk)	Normal Cost ($)	Crash Time	Crash Cost ($)	Max. weeks of reduction	Reduce cost per week
A	4	8,000	3	11,000	1	3,000
B	6	30,000	5	35,000	1	5,000
C	3	6,000	3	6,000	0	0
D	6	24,000	4	28,000	2	2,000
E	14	60,000	12	72,000	2	6,000
F	5	5,000	4	6,500	1	1500
G	2	6,000	2	6,000	0	0
H	2	4,000	2	4,000	0	0
I	3	4,000	2	5,000	1	1,000
J	4	4,000	2	6,400	2	1,200
K	2	5,000	2	5,000	0	0

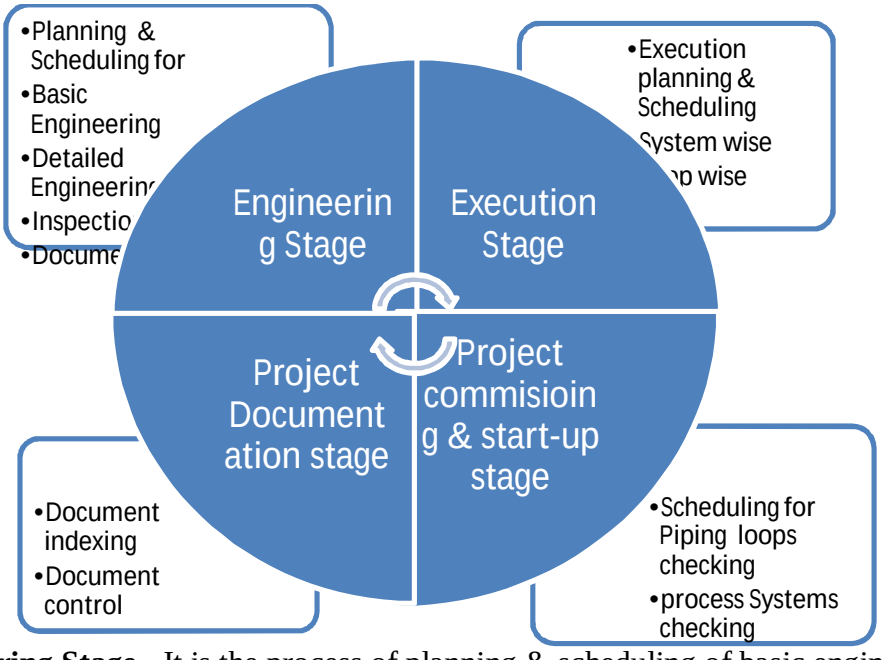
Crashing Example: Suppose the project manager wants to reduce the new product project from 41 to 36 weeks. Crashing Costs are considered to be linear.

- Look to crash activities on the critical path
- Crash the least expensive activities on the critical path first (based on cost per week)
    - Crash activity I from 3 weeks to 2 weeks $1000
    - Crash activity J from 4 weeks to 2 weeks $2400
    - Crash activity D from 6 weeks to 4 weeks $4000
    - Recommend Crash Cost $7400
- Question: Will crashing 5 weeks return more in benefits than it costs?

Crashed Network Diagram



4. 5. Case Study : Fertilizer Plant



1. Engineering Stage - It is the process of planning & scheduling of basic engineering finalization award of detailed engineering and scheduling of drawings system equipment

and piping loops. Also planning for quality assurance and documentation.
Responsibility matrix is also prepared for assigning the responsibility and scope of work.

2. Execution Stage - Keeping in view of mind the long lead items procurement at the beginning a sequence is prepared. A rigorous follow-up meetings are held on weekly basis with all agencies to decide for problems and solutions.

3. Commissioning Stage - Detailed loop wise S\schedule and site network diagrams as chart is kept at site along with necessary file wise drawings /documents. Joint visual inspection is carried out by team of process , mechanical and inspection engineers for clearance and testing. Once the system or loop is ready for visual inspection It is followed by start-up preparation by process group assisted by mechanical and instrumentation group with electrical as well.

4. Project Documentation Stage - Detailed "**Quality Plan and Control**" is illustrated and agreed upon during the finalization of project by the technology licensers, engineering consultants and project management teams. It covers

- Indexing systems of documentation
- Documentation scheduled delivery methods
- Documentation distribution
- Documentation keeping system
- Documentation control
- As built updating process of Documentation

4.6 Summary

In conclusion we find that in order to achieve Projects are involved with a huge amount of financial and manpower resources. Time for completion of any project is very important aspect as project life cycle and to get revenue generation of project as initially targeted. Hence a detailed and systematic planning, scheduling and networking is very essential tools for project guidelines, project problems to reflect and mitigate in time. Planning & scheduling as important key , one has to integrate the concepts of Project management at the project initial stage and throughout its different phases.

1.7 Self Assessment Questions

1. Explain project planning and break down structure with examples?
2. Explain the key elements of a project planning?
3. Prepare a chart of responsibility matrix with example?
4. Explain the project scheduling steps to develop a project schedule?
5. Explain the details of stages of project planning and scheduling for fertilizer industry?

4.8 Reference Books

- Project Management- By Vasant Desai- Himalaya Publishing
- Project Management (Step by Step) – Larry Richman –PHI
- Project Management – Clifford F Gray , Erik W Larson- Mc Grawhill
- Project management (core text book) – Samual J. Mantel, Scott M. shafer
- Project Management- By Dennis Lock- Gover House,British Library publication.

Unit - 5 Project Budgeting

Structure of the Unit

5.0 Objectives

After completing this unit, you would be able to:

- Understand the Meaning and Concept of Project Budgeting/ Capital Budgeting.
- Explain different Techniques of Project Budgeting.
- Distinguish one Technique from another.
- Analyze Risk and Uncertainty in Capital Budgeting.
- Select the Proposal under Capital Rationing.
- Highlight Non-Financial Aspects related with Project Appraisal.

5.1 Introduction

Once a project's proposal is identified, a detailed analysis of the marketing, technical, economical, social and ecological aspects (Feasibility Study) is done. On the basis of this Feasibility Study, management finally decides whether to invest in a particular project or not, or which alternative project is the best to be selected. But, before reaching on such a decision, a thorough financial appraisal is required to address the question – Is the project worthwhile in financial terms?

Project budgeting is the discipline of calculating the viability of the project in financial terms. It is an important tool in decision making and lays the foundation for delivery and evaluation. Project budgeting is the process that most companies use for authorizing capital spending on long term projects and on other projects requiring significant investment of capital. These methods are also known as capital expenditure planning methods, long term investment decision methods and more popularly known as capital budgeting methods. By applying budgeting techniques, a company examines the financial flows generated by the project itself and the direct costs of the project measured at market prices to find out the financial viability of projects under consideration. This process culminates in clear recommendations which inform approval or rejection of the project.

5.2 Project Budgeting

A **capital project** represents a scheme for investing resources that can be analyzed and appraised reasonably and independently. It typically involves a current outlay of funds in the expectation of a stream of benefits extending far into the future. The term **Capital Budgeting** is used to allocate the investible funds to these capital projects. In other words, the system of capital budgeting is employed to evaluate expenditure decisions which involve current outlay but are likely to produce benefits over a period of time longer than one year. Some of the important definitions of capital budgeting is as follows:

"Capital budgeting is long-term planning for making and financing proposed capital outlay". **Charles T. Horngren**

"Capital budgeting is a current outlay or a series of outlays of cash resources in return for an anticipated flow of future benefits". **G. D. Quirin**

"Capital budgeting refers to the total process of generating, evaluating, selecting and following up on capital expenditure alternatives". **L. J. Gitman**

From the above definitions we can conclude that **capital budgeting is the process of analyzing alternative proposals to a particular long term project with the aim to select those projects that are expected to make maximum contribution to the wealth of shareholders in the long run.** As the funds remain invested over a long period of time, the decisions are very crucial for the very existence of the firm. Basically the firm may be confronted with three types of capital budgeting decisions: -

- **Accept- Reject decision:** if the project is accepted, the firm invests in it. If the proposal is rejected, the does not invest. Independent projects come into this decision criterion.
- **Mutually Exclusive Decision:** Projects, which compete with other project in such a way that the acceptance of one will exclude the acceptance of the other project. Mutually exclusive decisions acquire importance when more than one proposal is acceptable under the accept-reject decision. Then some technique has to be used to determine the 'best' one. The acceptance of this best automatically eliminates the other alternatives.
- **Capital Rationing Decision :** From the above discussion we may deduce the following features of capital budgeting:

    - Requires large amount of funds;
    - Current funds are exchanged for future benefits;
    - Future benefits will occur to the firm over a series of years;
    - Have long-term effects on the future profitability and cost structure of the firm;
    - Contains a relatively high degree of risk;

- Most difficult decisions because assessment depends on the uncertainty of future events and activities of the firm;
- Decisions are irreversible; the amount invested cannot be realized back.

5.3 Methods of Capital Budgeting

Capital expenditure decision involves a long-term commitment in the sense that current investment yields benefit in future. A systematic appraisal of the capital investment proposal is essential to know whether they are feasible and profitable or not. To judge the profitability of any investment proposal, financial manager must consider: - (a) the net amount of investment, (b) the operating cash inflows, and (c) the economic life of the project. An investment proposal should be analyzed with regard to these three elements.

A wide range of appraisal criteria have been suggested to judge the worthwhileness of a project. However, the method of appraisal should have following requisites:

i. It should be able to clearly distinguish between an acceptable and non-acceptable project.
ii. It should provide a basis for ranking of projects in accordance with desirability.
iii. It should recognize that early benefits are preferable to later benefits.
iv. It should help in choosing the right one among alternative projects if any.

These methods can be grouped into two categories as follows-

5.3.1 Traditional Methods

Traditional methods of project appraisal are also known as 'unadjusted time methods', because these methods basically ignore the time value of money. The important methods are payback period method and accounting rate of return method.

1. Pay Back Period Method

The payback period is defined as the number of years required to recover the investment in a project. It recognizes that recovery of the original investment in the shortest period is an important element while appraising capital expenditure decisions. The total project life and the total quantum of gains are not considered under this method. This method is actually a measure of a project's liquidity and capital recovery rate rather than its profitability. The payback period can be calculated in two different situations as follows-

- **Even cash flows**: When cash flows generated by a project per year are equal or constant, the payback period is computed by dividing the total investment by the yearly cash inflows. Thus, as a formula:

Payback Period=Initial Investment or Cash Outflow ÷Net Annual Cash Inflows

- **Uneven Cash flows:** where there is unequal cash inflow, the payback period may be calculated by adding up the cash inflows until the total is equal to the total investment. In case the investment is recovered in between a year, it can be presumed that during the year there will be even flow of cash and the payback period can be calculated on a proportionate basis. In the formula form:

Payback Period = E+B÷C

Here;
E= No. of years immediately preceding the year of final recovery.
B= Balance amount to be recovered in that year (year of final recovery).
C= Cash inflows during the year of final recovery.

Decision criterion: A project will be accepted, if the payback period calculated is less than its economic life or the maximum period set by the management. In case of alternative projects, different projects may be ranked in order of payback period- the shorter the period the higher the ranking. The project with the shortest payback period will be selected in case of two mutually exclusive projects.

Merits:

1. It is simple to operate and easy to understand.
2. It lays a great emphasis on liquidity.
3. Risk is also considered in payback period method. On account of fast technological changes, there may be a risk of obsolescence in a long period.
4. If cost of external financing is high, early release of funds will generate resources internally to support future ventures.

Demerits:

1. No importance is given to income received in later years. It ignores the magnitude and timing of cash inflows.
2. It ignores the time value of money.
3. No differentiation is made between projects requiring different cash investments.
4. There is no rational basis for setting the maximum acceptable pay back period.
5. It does not consider the cost of capital which is a base for sound investment decisions.

As pointed out by Merritt and Sykes, "Pay back causes assessors to concentrate on unimportant and often irrelevant characteristics of an investment project to the detriment of its significant characteristics. It has harshly, but not unfairly, been described as the 'fish bait' test, since effectively it concentrates on the recovery of the bait (the capital outlay) paying no attention to the size of the fish (the ultimate profitability), if any." So, pay back is more commonly used as a constraint rather than as a method for deciding among or ranking projects.

Improvements in payback period method: in order to remove demerits of payback period method, various improvements have been laid down which are as follows:

A. Post Pay back Profitability: this method recognizes the total cash flow remains after recovering the cost of investment i.e. profitability of the project. If other things remains the same, that project is to be preferred which has highest post back profits. Thus, it recognizes the entire life of the project and the quantum of profits also.
Post pay back Profitability = Total cash inflows – Initial investment

Or

= Annual cash inflows (Expected life of the project – Payback period)

B. Discounted payback period: when payback period is calculated by taking into account the discounting or interest factor, it is known as discounted payback period. This method actually recognizes the time value of money. Under this method, present value of cash flows is calculated. The procedure for finding out the discounted payback period is the same as discussed earlier except present values of cash inflows at certain discount or interest factor are used.

C. Pay back Reciprocals: limitations of time factor and rate of return can be eliminated through pay back reciprocals. It is calculated by the following formula:

$$\text{Pay back Reciprocals} = \frac{1}{\text{Pay Back Period}}$$

2 Average or Accounting Rate of Return Method

The yearly after tax income as a percentage of investment is known as accounting rate of return. It is based on accounting concept of return on investment. Under this method, average annual profit (after tax) is expressed as percentage of investment to measure the profitability of the investment proposal. It is also known as unadjusted rate of return, since it does not take into account the time value of money. There is no unanimity regarding the definition of the rate of return. There are a number of alternative methods for calculating the ARR. These are:

a. $$\text{ARR} = \frac{\text{Average annual profit after tax and depreciation}}{\text{Initial investment}} \times 100$$

b. $$\text{ARR} = \frac{\text{Average annual profit after tax and depreciation}}{\text{Average investment}} \times 100$$

$$\text{Annual depreciation} = \frac{\text{Initial investment} - \text{Scrap value}}{\text{Life of the project}}$$

$$\text{Average investment} = \frac{\text{Initial investment} + \text{Scrap value}}{2}$$

$$\text{Average investment} = \frac{\text{Initial investment} + \text{Scrap value} + \text{Additional working capital}}{2}$$

Decision criterion: A minimum rate of return is pre-determined and the projects yielding lower returns are rejected. This pre decided rate is known as cut off rate. In case of various alternative projects, their ranking is done as per the ARR of each project. The project with the highest ARR will have the top priority while the project with the lowest ARR will be assigned lowest priority. Obviously, projects having higher ARR would be preferred to projects which have lower ARR.

Merits:

1. It is simple to understand and easy to compute and hence it is widely used.
2. Savings over the entire economic life of the asset are considered.

3. This method considers the profitability of the investment (earnings) not cash inflows.
4. Right decision regarding investment proposals is taken by comparing ARR with cost of capital.

Demerits:

1. This method does not consider the time value of money.
2. The ARR is based on the accounting profits rather than the cash flows.
3. It does not take into account life period of the various investments.
4. Determination of minimum acceptance rate is very difficult.

5.3.2 Discounted Cash Flow Methods:

In order to overcome the limitations of Payback Period and ARR, discounted cash flow methods are recognized. These methods recognize the time value of money and provide a more objective basis. This is based on the theory that one rupee obtained after one year or any other period is less valuable than the one rupee received today. So in any investment or project the time adjustment should be made for future earnings. Consideration of time value of money is important when evaluating projects with different costs, different cash flows and different service lives. The various discounted cash flow methods are as follows:

1. Net Present Value Method:

Net present value may be defined as the summation of the present value of the cash inflows minus present value of cash outflows.NPV compares the value of money today to the value of that same money in future, taking inflation and returns into account. This method uses the discounted cash flows of a project to determine whether the rate of return on that project is equal to, higher than or lower than the desired rate of return. The various steps involved in this method are:

- Determine cash outflows and cash inflows for different periods.
- Determine the cut off rate.
- Calculate the Present Value
- Present value = $\frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \ldots\ldots\ldots \frac{C_n}{(1+r)^n}$

Here;

C_1, C_2, C_n = Cash flows for n years;

r = discount factor or interest rate (minimum rate of return a firm wants to earn on the amount invested);

n = Number of years.

Note: Present value of any amount receivable in future after a definite period can be calculated with the help of present value tables.

- Compute the Net Present Value:

Net Present Value = Present Value of Cash Inflows – Initial Investment or Present Value of Cash Outflows

Decision criterion: The decision rule for a project under NPV is to accept the project if the NPV is positive and reject if it is negative or:

a. Net Present Value > Zero = Accept
b. Net Present Value < Zero = Reject

In case of ranking mutually exclusive projects the project proposal with highest positive NPV is given the top priority. It may be noted that this method gives valid results only if money can be immediately reinvested at the chosen rate of interest.

Merits:

1. It recognizes the time value of money.
2. It considers all cash flows over the entire life span of the project.
3. This method is particularly useful for the selection of mutually exclusive projects.
4. This method provides a clear acceptance criterion; the interpretation is easy
5. The objective of maximizing the welfare of the owners is met.

Demerits:

1. It is difficult to calculate and understand.
2. It fails to give satisfactory answer when projects under consideration involve different amounts of investment and with different economic life periods.
3. Deciding the appropriate discount rate is a difficult task. If this rate is not correctly taken then whole task may give wrong results.

A. Profitability Index or Benefit Cost Ratio:

Net present value method cannot be used for those project proposals whose amount of investment differs. To overcome this problem, the profitability index is calculated. Profitability index is the relationship between present value of cash inflows and present value of cash outflows. This ratio is an indicator of the profitability of the project and hence it is known as profitability index. It can be calculated by using the following formula:

$$\text{Profitability Index} = \frac{\text{Present Value of Cash Inflows}}{\text{Present Value of Cash Outflows}}$$

Decision Criterion: Under this method, an investment proposal may be accepted when the profitability index exceeds one and rejected of the PI is less than one. In case of ranking of mutually exclusive projects, the project proposal with highest positive profitability index will be given top priority.

Net Present Value vs. Profitability Index

Profitability index is similar to Net Present Value approach. Both NPV and PI will give the same decision as regards the accept reject decision (for same initial investment proposals). The only difference is that NPV is an absolute measure of a project's acceptability (discriminate between the projects having large outlays and projects having

small outlays) whereas; profitability index is a relative measure. So, a decision may differ in case of evaluation of mutually exclusive proposals.

For example if the present value of cash inflows Project A Rs. 30000, Project A Rs. 15000. Initial investment in Project A Rs. 15000, in Project B Rs. 6000, according to net present value method project A will be selected because its NPV is more than the NPV of project B. But, as per PI method project B will be preferred as its profitability index 2.5 is higher than that of project A 2.

Similarly if the present value of cash inflows of project A and project b are 120000 and 100000 respectively. Initial investment in project A and project B are 100000 and 80000 respectively. According to NPV method both the projects are alike whereas profitability index of project B is more than that of project A.

B. Internal Rate of Return Method

This term was first coined by Joel Dean. The rate at which the total of discounted cash inflows equates with the total of discounted cash outflows is known as internal rate of return. IRR is probably the most sophisticated project budgeting technique. This is the rate at which NPV of investment is zero. Thus it depends on cash inflows and outflows of the project or it can be said that this rate is not decided by the management (pre-determined rate). This rate is also known as time adjusted rate or yield rate or marginal rate of return or break even rate and so on. The assumption under this method is that future cash inflows will be reinvested at a rate equal to IRR.

In the form of a formula, it may be expressed as follows:

$$\frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \ldots\ldots\ldots \frac{C_n}{(1+r)^n} - I = 0$$

The procedure used to find out the internal rate of return can be as under:

(a) When cash inflows are uniform: in case the project proposal has a stream of equal cash inflows the following procedure is to be adopted:

- Calculate the present value factor by dividing the initial investment with annual cash inflows.
  Present Value Factor = Initial Investment ÷ Cash Inflows per Year
- This present value factor is located in the annuity Table on the line representing the number of years corresponding to the economic life of the project. The relevant discount rate is Internal Rate of Return.
- Usually, the same PV Factor is not available in the table. It may lie in between two rates, which can be interpolated by using the following formula:

$$IRR = LDR + \frac{P1 - Q}{P1 - P2} \times (HDR - LDR)$$

Here: IRR = Internal Rate of Return

LDR= Lower Discount Rate

HDR = Higher Discount Rate

P1 = Present value at lower rate of interest

P2 = Present value at higher rate of interest

Q =Net cash outlay

(b) When cash inflows are not uniform: The rate can be determined by adopting 'trial and error approach'. The following procedure is involved in this approach:

- Find out the average of the cash inflows of different years.
- Calculate the present value factor by dividing the cash outlay with average of cash inflows.
- Find out the first trial rate as mentioned above (as mentioned for even cash flows).
- If the present value of cash inflows is higher than the initial investment, a higher rate should be tried and vice versa. Thus, calculate the second trial rate.
- The actual Internal Rate of Return can be ascertained with the help of interpolation by applying the formula as given earlier (in case of even cash inflows).

Decision criterion: under this method a project is accepted if it's IRR is greater than or equal to the pre-decided cut off rate (normally cost of capital), otherwise rejected. In case of selection from various alternative proposals, projects may be ranked according to their IRR – the project with the highest internal rate is ranked first and so on (descending order). The proposal with the highest IRR will be given top priority.

Merits:

1. It recognizes the time value of money.
2. It provides more precise information regarding profitability. T itself provides a rate of return which is indicative of the profitability of the proposal.
3. It takes into account the total cash inflows and outflows.
4. It considers the expected benefits over the entire economic life of the project.
5. It is consistent with the overall objective of maximizing shareholder's wealth.

Demerits:

1. It involves complicated calculations.
2. In case of too uneven cash inflows there may be more than one internal rate of return.
3. It is based on wrong assumption. A firm may have different re-investment opportunities, so it is not necessary to re-invest at IRR.
4. It does not provide significant answers under all situations.

Internal Rate of Return vs. Net Present Value:

Both recognize time value of money, generally give the same result as to the acceptance of the project and consider the returns over entire economic life of the project but they differ on the following grounds:

a. Minimum required rate is a known factor before calculating net present value. On the other hand, in case of IRR method this rate is to be determined by trial and error.

b. If size, time and life of the project proposals are not equal, conclusions under both the methods may differ.

c. Assumption of re-investment rate of cash inflows also differ. Under NPV Method it is cost of capital while in IRR method it is Internal Rate of Return.

d. Net present value is expressed in monetary terms, while internal rate is expressed in terms of percentage.

5.4 Capital Rationing

In a situation where the firm has unlimited funds, capital budgeting becomes a very simple process in that all independent investment proposals yielding returns greater than cut-off rate are accepted. However, this situation is not prevailing for most of the firms. They have financial constraints or we can say have, limited / fixed capital budgets. **Capital rationing** refers to a situation where a company can not undertake all the profitable projects because of shortage of capital (financial constraints). The company must then select such a combination of investment proposals that fits the budgets and maximizes the return. The projects are ranked according to their relative profitability. A cut off point/rate is then fixed. Proposals above the cutoff point/ ate should be chosen and those below the cutoff point/ rate should be delayed or rejected. The procedure to select the package of projects will relate to whether the project is divisible or indivisible, the objective being the maximization of total NPV by exhausting the capital budget as far as possible. It may be noted that only acceptable projects should be ranked.

5.5 Non-Financial Aspects

The above mentioned methods help the entrepreneur or management in deciding as to 'go' or 'not-go' for the project investment but these consider only the financial aspects. In addition to financial considerations or say financial costs and benefits directly accruing to the project authority from project, the non-financial considerations relevant to a project may be broadly classified into economic or social and environmental costs and benefits accruing to the economy or society at large. As every project has a bearing on the society, the impact on the society in terms of costs it has to endure and the benefits it derives should also be assessed. **Social Cost Benefit Analysis** provides a scientific and quantitative base for the appraisal of projects with a view to determine whether the total social benefits of a project justify the total social cost. It seeks to assess the utility of a project to the society as a whole. This consideration enhances profitability, productivity and efficiency along with better goodwill, name and fame for the management. Sometimes projects are selected due to urgency/ sudden need, competitor's strategy, due to legal requirements or to build-up a corporate image.

5.6 Risk Analysis in Capital Budgeting

The assumption underlying capital budgeting analysis done so far has been that the decisions would not change the risk complexion of the project. This means that risk will remain constant (certainty of cash flow occurrence). However, it may not be always the

case. So, the analysis of risk and uncertainty is an important element in the project budgeting decisions. The term Risk refers to the variability of the actual returns from the expected returns in term of cash flows. Under risky situations, the probabilities of happening specific events are known. Uncertainty postulates that the decision maker may or may not aware of all the possible states that affect the decision and may or may not be able to place a probability on the occurrence of each. If these factors are not taken into account, there is always a danger of getting misleading results. This is so because risk and returns are directly related. Higher the return, higher will be the risk. Thus, efforts should be made to optimize the risk and return factor.

Sensitivity Analysis and Standard Deviation are the absolute measures of risk whereas the Coefficient of Variation is a relative measure. Besides these, the following are the main models or techniques of decision making under the conditions of risk and uncertainty:

1. Probability and expected value assignment model
2. Risk adjusted discount rate
3. Certainty Equivalent Approach
4. Simulation
5. Decision Tree Analysis
6. Optimistic- Pessimistic Estimates
7. Heuristic Decision Criterion

5.7 Illustrations

Illustration1. Padma Limited is considering the purchase of a machine. Two machines are available in the market X and Y, each costing Rs. 3,00,000. Earnings after tax but before depreciation are expected to be as follows:-

Cash Inflows /Years	1	2	3	4	5
Machine X (Rs.)	37,500	1,12,500	1,50,000	1,12,500	75,000
Machine Y (Rs.)	75,000	1,12,500	1,50,000	75,000	37,500

Evaluate the two alternatives according to (I) Pay back Method (II) Post Pay back Method.

Solution: - **Calculation of Payback Period**

Years	Machine X (Rs. 3,00,000)		Machine Y (Rs. 3,00,000)	
	Net Cash Inflows	Cumulative Cash Inflows	Net Cash Inflows	Cumulative Cash Inflows
1	37,500	37,500	75,000	75,000
2	1,12,500	1,50,000	1,12,500	1,87,500
3	1,50,000	3,00,000	1,50,000	3,37,500
4	1,12,500	4,12,500	75,000	4,12,500
5	75,000	4,87,500	37,500	4,50,000

(I) **Payback Period**:-

Machine X = 2+ 3, 00,000 – 1,50,000/ 1,50,000
= 2+ 1 = 3 years
Machine Y = 2+ 3,00,000 – 1,87,500/ 1,50,000
= 2+ .75 = 2.75 years

Decision : Underpay back period method, Machine Y will be selected.

(II) **Post Pay back Profitability** = Total Cash Inflows- Initial Investment

Machine X = 4,87,500 – 3,00,000
= Rs. 1,87,500
Machine Y = 4,50,000 – 3,00,000
= Rs. 1,50,000

Decision: Post pay back profitability of Machine X is more than Machine Y. Therefore Machine X will be selected.

Illustration2. Calculate the Average Rate of Return for Project P and R from the following:

	Project P	Project R
Initial Investment	Rs. 80,000	Rs. 1,20,000
Expected Life	4 Years	5 Years
Salvage Value	Rs. 8,000	Rs. 16,000

Projected Net Income (After interest, depreciation and tax):

Years	1	2	3	4	5
Project P (Rs.)	8,000	6,000	6,000	4,000	-
Project R (Rs.)	12,000	12,000	8,000	4,000	4,000

If the required rate of return is 12%. Which project should be undertaken?

Solution:-

$$\text{ARR} = \frac{\text{Average annual income after tax and depreciation}}{\text{½ (Initial investment + scrap value)}} \times 100$$

$$\text{Project P} = \frac{6{,}000}{\text{½ (80,000 + 8,000)}} \times 100$$

= 13.64 %

$$\text{Project R} = \frac{8{,}000}{\text{½ (1, 20,000 + 16,000)}} \times 100$$

$$= \frac{8{,}000}{68{,}000} \times 100$$

= 11.76 %

Decision: If the required rate of return is 12%, selection of Project P will be profitable.

Illustration3. Data in respect of two machines namely J and K are detailed below. Depreciation has been charged on straight- line basis and estimated life of both machines is five years.

Items	Machines J (Rs.)	Machine K (Rs.)
Cost	56,125	56,125
Net Income after depreciation and taxes:		
1st Year	3,375	11,375
2nd Year	5,375	9,375
3rd Year	7,375	7,375
4th Year	9,375	5,375
5th Year	11,375	3,375
Total	36,875	36,875

Find Out:-

(a) Average rate of return on 'J' and 'K' machines.

(b) Which machine is better from the point of view of payback period and why?

(c) Calculate average rate of return when salvage value of machine 'J' turns out to be Rs. 3,000 and when 'K' machine has zero salvage value. Which machine is better?

Solution:-

$$\textbf{(a) ARR} = \frac{\text{Average net income after tax and depreciation}}{\text{Average Investment}}$$

Average Income

$$\text{Machine J} = \frac{36,875}{5}$$

$$= \text{Rs. } 7,375$$

$$\text{Machine K} = \frac{36,875}{5}$$

$$= \text{Rs. } 7,375$$

$$\textbf{Average Investment} = \frac{56,125}{2}$$

$$= \text{Rs. } 28,062.50$$

Average Rate of Return

(i) Machine J $= \frac{7,375}{28,062.50} \times 100$

$= 26.28\%$

(ii) Machine K $= \frac{7,375}{28,062.50} \times 100$

$= 26.28\%$

(b) Payback Period:

Depreciation

(i) Machine J $= \frac{56,125}{5}$

$=$ Rs. 11,245

(ii) Machine K $= \frac{56,125}{5}$

$=$ Rs. 11,245

Years	Cash Inflows Project J (Net Profit + Dep.)	Cumulative Cash Inflows Rs.	Cash Inflows Project K (Net Profit + Dep.)	Cumulative Cash Inflows Rs.
1st Year	14,620	14,620	22,620	22,620
2nd Year	16,620	31,240	20,620	43,240
3rd Year	18,620	49,860	18,620	61,860
4th Year	20,620	70,480	16,620	78,480
5th Year	22,620	93,100	14,620	93,100

Payback Period:

Machine J $= 3 + \frac{6,265}{20,620}$ Months

Machine K $= 2 + \frac{12,885}{18,620}$ Months

Since payback period of Machine K is shorter, Machine K is better.

(c) Average Rate of Return when salvage values are given:

$$\text{Average Investment} = \frac{56{,}125 + 3{,}000}{2}$$

$$= \frac{59{,}125}{2}$$

$$= \text{Rs. } 29{,}562.50$$

ARR:

$$\text{Machine J} = \frac{7{,}375}{29{,}862.50} \times 100$$

$$= 24.95\%$$

ARR for machine K will remain unchanged i.e. 26.28%
Since ARR of Machine K is higher, So Machine K is better.

Illustration4. From the following details relating to two machines P and R, suggest which machine should be accepted:

	Machine P	Machine R
	Rs.	Rs.
Cost	56,125	56,125
Estimated Life	5 Years	5 Years
Estimated Salvage Value	3,000	3,000
Annual Income after Tax and Depreciation		
	Rs.	Rs.
1st Year	3,375	11,375
2nd Year	5,375	9,375
3rd Year	7,375	7,375
4th Year	9,375	5,375
5th Year	11,375	3,375

Overhauling charges at the end of 3rd year: Rs. 25,000

Depreciation has been charged at straight line method. Discounting rate is 10%. P.V.F. at 10% for five years are: 0.909, 0.826, 0.751, 0.683, 0.621.

Solution: **Present Value of Cash Outflows**

	Machine P	Machine R
	Rs.	Rs.
Initial Investment	56,125	56,125
Overhauling charges		
25,000 * 0.751	18,775	-----
Total	74,900	56,125

(I) Present Value of Cash Inflows (Machine P)

Years	Income after Tax and Dep.	Dep.	CFAT (2+3)	P.V.F. at 10%	Present Value
	Rs.	Rs.	Rs.	Rs.	Rs.
1st Year	3,375	10,625	14,000	0.909	12,726
2nd Year	5,375	10,625	16,000	0.826	13,216
3rd Year	7,375	10,625	18,000	0.751	13,518
4th Year	9,375	10,625	20,000	0.683	13,660
5th Year	11,375	10,625	22,000	0.621	13,662
					66,782
			Value of Scrap 3,000 × 0.621		1,863
			Total		68,645

(II) Present Value of Cash Inflows (Machine R)

Years	Income after Tax and Dep.	Dep.	CFAT (2+3)	P.V.F. at 10%	Present value
	Rs.	Rs.	Rs.	Rs.	Rs.
1st Year	11,375	10,625	22,000	0.909	19,998
2nd Year	9,375	10,625	20,000	0.826	16,520
3rd Year	7,375	10,625	18,000	0.751	13,518
4th Year	5,375	10,625	16,000	0.683	10,928
5th Year	3,375	10,625	14,000	0.621	8,694
					69,658
			Value of Scrap 3,000 × 0.621		1,863
			Total		71,521

So for:

Machine P 68,645 < 74,900

Machine R 71,521 > 56,125

Decision: Present value of cash inflows for machine P is less than its cash outflows. Whereas Present Value of cash inflows for machine R is more than its cash outflows. Hence Machine R should be accepted.

Illustration 5. From the following information calculate the Net Present Value of the two projects and suggest which of the two projects should be accepted assuming a discount rate of 10%.

	Project R	Project S
Initial Investment	Rs. 60,000	Rs. 80,000
Estimate life	5 Years	5 Years
Scrape value	Rs. 4,000	Rs. 6,000

The Profits after tax but before depreciation are as follow:-

Years	1	2	3	4	5
Project R (Rs.)	14,000	24,000	24,000	10,000	8,000
Project S (Rs.)	44,000	24,000	14,000	10,000	8,000

Solution:-

Calculation of Net Present Value

Years	Cash Inflows (Rs.)		P.V. Factors at 10%	Present Value (Rs.)	
	Project R	Project S		Project R	Project S
1	14,000	44,000	0.909	12,726	39,996
2	24,000	24,000	0.826	19,824	19,824
3	24,000	14,000	0.751	18,024	10,514
4	10,000	10,000	0.683	6,830	6,830
5	8,000	8,000	0.621	4,968	4,968
5 (Scrap)	4,000	6,000	0.621	2,484	3,724
Total Present Value				64,856	85,856

Net Present Value = Present Value of Cash Inflows – Cost of Investment
Project R = 64,856 – 60,000
= Rs. 4,856
Project S = 85,856 – 80,000
= Rs. 5,856

Decision: Project S will be chosen because its Net Present Value is more.

Illustration 6. The Initial cash outlay of a Project is Rs. 1,50,000 and it generates cash inflows of Rs. 60,000, Rs. 45,000, Rs. 75,000 and Rs. 30,000 in first four years. Using Present Value Index method, appraise profitability of proposed investment assuming 10% rate of discount.
The present value of Rs. 1 at 10% discount factor for four years is 0.909, 0.826, 0.751, and 0.683.

Solution:

Calculation of Present value and profitability Index

Years	Cash Inflows	P.V Factors at 10%	Present value Rs.
1	60,000	0.909	54,540
2	45,000	0.826	37,170
3	75,000	0.751	56,325
4	30,000	0.683	20,490
	Total		1,68,525

Net Present Value = Total Present Value – Cost of Investment
= 1,68,525 - 1,50,000
= Rs. 18,175

$$\text{Profitability Index} = \frac{\text{Present Value of Cash Inflows}}{\text{Initial Outflow}}$$

$$= \frac{1,68,525}{1,50,000}$$

= 1.1235

Decision: As the profitability Index is more than 1, the proposal can be accepted.

Illustration 7. The cost of capital of a firm is 10%. It is considering two mutually exclusive Projects A and B. The details of which are:

	Project A Rs.	Project B Rs.
Investment	70,000	70,000
Cash Flow in Year 1	10,000	50,000
Cash Flow in Year 2	20,000	40,000
Cash Flow in Year 3	30,000	20,000
Cash Flow in Year 4	45,000	10,000
Cash Flow in Year 5	60,000	10,000
Total cash flow	1,65,000	1,30,000

Compute the Net Present Value at 10% and profitability index for the two projects.

DISCOUNT FACTORS

Years	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**
1	.909	.870	.833	.800	.769	.741	.714
2	.826	.756	.694	.640	.592	.549	.510
3	.751	.658	.579	.512	.455	.406	.364
4	.683	.572	.482	.410	.350	.301	.260
5	.621	.497	.402	.328	.269	.223	.186

Minimum rate of return laid down by the management is 30% per annum. Is the investment desirable? Discuss it according to Internal Rate of Return.

Solution:

(I) Net Present Value

Years	Cash Flows		P.V. Factors at 10%	Discounted Cash Flows	
	Project A	**Project B**		**Project A**	**Project B**
	Rs.	Rs.	Rs.	Rs.	Rs.
1	10,000	50,000	.909	9,090	45,450
2	20,000	40,000	.826	16,520	33,040
3	30,000	20,000	.751	22,530	15,020
4	45,000	10,000	.683	30,735	6,830
5	60,000	10,000	.621	37,260	6,210
Net present Value = (P.V. of Inflows –Initial investment)				46,135	36,550

(II) Profitability Indices:

$$\text{Project A} = \frac{\text{Discounted Cash Inflows}}{\text{Discounted Cash Outflows}}$$

$$= \frac{1,16,135}{70,000}$$

$$= 1.659$$

$$\text{Project B} = \frac{\text{Discounted Cash Inflows}}{\text{Discounted Cash Outflows}}$$

$$= \frac{1,06,550}{70,000}$$

$$= 1.522$$

(III) Internal Rates of Return:

Project A

Years	Cash Flows Rs.	P.V. Factor at 25%	Discounted Cash Flows Rs.	P.V. Factor at 30%	Discounted Cash Flows Rs.
1	10,000	.800	8,000	.769	7,690
2	20,000	.640	12,800	.592	11,840
3	30,000	.512	15,360	.455	13,650
4	45,000	.410	18,450	.350	15,750
5	60,000	.328	19,680	.269	16,140
		Net Cash Flows	+4,290		-4,930

$$\text{IRR} = 25\% + \frac{4,290}{9,220} \times 5$$

$$= 25 + 2.326$$

$$= 27.326\%$$

Project B

Years	Cash Flows Rs.	P.V. Factor at 35%	Discounted Cash Flows Rs.	P.V. Factor at 40%	Discounted Cash Flows Rs.
1	50,000	.741	37,050	.714	35,600
2	40,000	.549	21,960	.510	20,400
3	20,000	.406	8,120	.364	7,280
4	10,000	.301	3,010	.260	2,600
5	10,000	.221	2,230	.186	1,860
	Net Cash Flows		+2,370		-2,260

$$\text{IRR} = 35\% + \frac{2,370}{4,640} \times 5$$

$$= 35 + 2.56$$

$$= 37.56\%$$

Decision: Internal Rate of Return of Project B is higher than the desired rate i.e. 30%. So investment in profit B is desirable.

Illustration 8. Rishabh Ltd. is considering two mutually exclusive projects. The following are the information for the same:-

Initial Investment	=	Rs. 40,000
Life Time	=	5 Years.
Required Rate of Return	=	10%
Tax Rate	=	50%

Net cash inflows after tax and depreciation are:-

Years	1	2	3	4	5
Project X	12,000	12,000	12,000	12,000	12,000
Project Y	14,000	12,000	8,000	14,000	14,000

You are required to calculate:-

(i) The Net Present Value and Profitability Index for each Project.

(ii) The Internal Rate of Return for each Project.

Which Project should be accepted and why?

DISCOUNT FACTOR

Years	**10%**	**15%**	**16%**	**18%**
1	.909	.870	.862	.847
2	.826	.756	.743	.718
3	.751	.658	.641	.609
4	.683	.572	.552	.516
5	.621	.497	.476	.431
Total	3.490	3.353	3.274	3.121

Solution:-

Calculation of Net Present Value

Years	**Cash Inflows**		**P.V. Factors at 10%**	**Present Value**	
	Project X Rs.	Project Y Rs.		Project X Rs.	Project Y Rs.
1	12,000	14,000	.909	10,908	12,726
2	12,000	12,000	.826	9,912	9,912
3	12,000	8,000	.751	9,012	6,008
4	12,000	14,000	.683	8,196	9,562
5	12,000	14,000	.621	7,452	8,694
	Net Present Value			45,480	46,902

1. (a) Net Present Value = Total Present Value - Initial Investment

Project X = 45,480 – 40,000

= Rs. 5,480

Project Y = 46,902 – 40,000

= Rs. 6,902

1. (b) Profitability Index = $\frac{\text{Present Value of Cash Inflows}}{\text{Present Value of Cash Outflows}}$

Project X = $\frac{45,480}{\quad\quad}$

$$= \frac{40,000}{1.137}$$

$$\text{Project Y} = \frac{46,902}{40,000}$$

$$= 1.173$$

2. Internal Rate of Return

Project X: As the Cash Inflows for each year are even, P.V. Factors for this project will be as follows:

$$\textbf{PVFactors} = \frac{\text{Initial Investment}}{\text{Average Cash Inflows}}$$

$$= \frac{40,000}{12,000}$$

$$= 3.33$$

In the cumulative PV Table, the rate of return at this PV Factor is 15%, but it is (3.35) more than 3.33. So the actual IRR must lie in the between 15% and 16%

Present Value at 15% = 12,000 X 3.352

= Rs. 40,224

Present Value at 16% = 12,000 X 3.274

= Rs. 39,288

$$\textbf{IRR} = \text{LDR} + \frac{P_1 - Q}{P_1 - P_2} \times (\text{HDR-LDR})$$

IRR = Internal Rate of Return

LDR = Lower Discount Rate

HDR = Higher Discount Rate

P_1 = Present Value at Lower Rate

P_2 = Present Value at Higher Rate

Q = Net Cash Outlay

$$\text{IRR} = 15 + \frac{40,224 - 40,000}{40,224 - 39,288} \text{ X } (16 - 15)$$

$$= 15 + \frac{224}{936} \text{ X } (16 - 15)$$

$$= 15 + .24$$

$$= 15.24\%$$

Project Y: Cash Inflows are uneven, so trial and error method will be used. The PV Factor will be as follows:

$$\textbf{PV Factor} = \frac{\text{Initial Investment}}{\text{Average Annual Cash Inflows}}$$

$$\frac{40,000}{}$$

$$= \frac{}{62,000/\ 5}$$

$$= \frac{40,000}{12,400}$$

$$= 3.23$$

In the 5th year row of cumulative PV Table the approximate rate at this factor is 18%.

Years	Cash Inflows Rs.	Trial Rate 18%		Trial Rate 16%	
		PV Factor at 18%	Present Value Rs.	PV Factor at 16%	Present Value Rs.
1	14,000	.847	11,858	.862	12,068
2	12,000	.718	8,616	.743	8,916
3	8,000	.609	4,872	.641	5,128
4	14,000	.516	7,224	.552	7,728
5	14,000	.431	6,034	.476	6,664
	Total Present Value		38,604		40,504

As the Present Value of total cash inflows 38,604 is less than the cost of the project, next lower rate 16% is chosen. The actual IRR lies in between 16% and 18% which will be calculated as follow:

$$\text{IRR} = \text{LDR} + \frac{P_1 - Q}{P_1 - P_2} \times (\text{HDR-LDR})$$

$$= 16 + \frac{40,504 - 40,000}{40,504 - 38,604} \times (18 - 16)$$

$$= 16 + \frac{504}{1900} \times 2$$

$$= 16 + .53$$

$$= 16.53\ \%$$

Decision:-

According to Net Present Value Method, Profitability Index Method and Internal Rate of Return Method Project Y should be accepted because its NPV Rs. 6,902 is higher than the NPV of project X which is Rs. 5,480. Similarly Profitability Index of project Y is 1.173 where as Profitability Index of Project X is 1.137. Internal Rate of Return of Project X is 15.24 where as IRR of Project Y 16.53 which is higher than Project X. So selection of project Y would be profitable.

5.8 Summary

Project budgeting is the discipline of calculating the viability of the project in financial terms. The capital budgeting is mainly a decision-making process for investment in projects that have long- term implications, affect the future growth and profitability of the firm and basic composition and asset-mix of the firm. Capital budgeting decisions are of paramount importance in financial decision making. These decisions affect the profitability of a firm for a long period, and therefore, importance of these decisions is obvious. The system of capital budgeting is employed to evaluate expenditure decisions which involves a current outlay or series of outlay of cash resources in return for an anticipated flow of future benefits. The project budgeting/ capital budgeting methods are (a) Traditional and (B) Discounted/Time Adjusted. The first category includes Payback Period Method and Accounting Rate of Return. The discounted cash flow methods i.e. Net Present Value, Profitability Index and Internal Rate of Return satisfy all the attributes of a good measure of appraisal as they consider the total benefits as well as the timing of the benefits. The procedure to select the package of projects will relate to whether the projects is divisible or indivisible, the objective being the maximization of total wealth of the shareholders by exhausting capital budgets as far as possible. Capital rationing refers to a situation where a company can not undertake all the profitable projects because of shortage of capital (financial constraints). Analysis of risk and uncertainty is also an important element in the project budgeting decisions. In addition to financial considerations or say financial costs and benefits directly accruing to the project authority from project, the non-financial considerations relevant to a project may be broadly classified into economic or social and environmental costs and benefits accruing to the economy or society at large. Social Cost Benefit analysis seeks to assess the utility of a project to the society as a whole.

5.10 Self Assessment Questions

1. Define Capital Budgeting. Discuss the importance of Capital budgeting.
2. Pay- back Period Method of project evaluation is a test of liquidity and not profitability' Explain.
3. Discuss the salient features of 'Present Value Method' of project evaluation and examine its rationality.
4. Critically examine the various methods of evaluation of project proposals. Discuss their advantages and disadvantages.
5. 'Internal Rate of Return is a superior technique than the Net Present Value Method.' Do you agree with this statement? Give brief critical view in support of your answer.
6. What are the various discounting and non-discounting investment project appraisal criteria? Discuss the rationale, pros and cons of IRR criterion.
7. A project requires an investment of Rs. 400000. It yields an annual cash flow of Rs. 80000 for 10 years. Find out the pay-back period of the project.

5.11 Reference Books

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Unit – 6 : Project Quality Management

Structure of Unit

6.0 Objectives

After completing this unit, you would be able to:

- Understand the importance of project quality management.
- Know how to define project quality management.
- Understand how to design tools & techniques for project quality.
- Able to understand the phases of project quality management.
- Able to analyze the rework due to non- compliance of project quality.
- Describe how leadership, cost, organizational influences, standards, and maturity models relate to improving quality.
- List the outputs of the quality control process.

6.1 Introduction

Project quality management includes the process required to ensure that the project satisfies the needs for which it is undertaken. It includes all necessary inspections and quality checks which are required to carry-out in a project. These are based on quality assurance plan, which are developed by engineering consultants and /or by construction company inspection department. Project basic design stage is a stage for basic features to be finalized with size and specifications. These specifications are being checked and verified for the project requirement. Project engineering stage is the stage for failure analysis against capacity and load.

The term quality management has a specific meaning within many business sectors. This specific definition, which does not aim to assure 'good quality' by the more general definition, but rather to ensure that an organization or product is consistent, can be considered to have four main components: quality planning, quality control, quality assurance and quality improvement. Quality management is focused not only on product/service quality, but also the means to achieve it. Quality management therefore

uses quality assurance and control of processes as well as products to achieve more consistent quality. Project Quality Management, includes all the activities of the overall management function that determine the quality policy, objectives, responsibilities and implements them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system. These processes interact with each other as well as with the processes of other knowledge areas Each process involves an effort of one or more individual or group of individuals based on the need of the project. Each process occurs at least once in every project phase during the project life cycle.

The International Standard for Quality management (ISO 9001:2008) adopts a number of management principles that can be used by top management to guide their organizations towards improved performance. The principles include:

a) **Customer focus**
   An organization attains customer focus when all people in the organization know both the internal and external customers and also what customer requirements must be met to ensure that both the internal and external customers are satisfied.

b) Leadership
   Leaders of an organization establish unity of purpose and direction of it. They should go for creation and maintenance of such an internal environment, in which people can become fully involved in achieving the organization's quality objective

c) Involvement of people
   People at all levels of an organization are the essence of it. Their complete involvement enables their abilities to be used for the benefit of the organization

d) Continual improvement
   One of the permanent quality objectives of an organization should be the continual improvement of its overall performance. **E.g.** Quality management of yarn produced by a textile industry, in which yarn quality for its denier is checked and necessary changes if required in the production process is changed for better quality.

6.2 Project Quality Management Phases

Phases of project quality management are Quality Planning, Quality assurance and Quality Control. Each of them is associated with Input, Tools and Techniques and Output. Input means the details required for quality planning, quality assurance and quality control. Similarly tools and techniques used during each phase and finally the results as output. The Phases of Project Quality Management are described as below:

6.2.1 What is Quality Planning?

Quality Planning is identifying which quality standards are relevant to the project and determining how to satisfy them. It implies the ability to anticipate situations and prepare actions to bring about the desired outcome. It is important to prevent defects by:

- Selecting proper materials.
- Training and indoctrinating people in quality.

- Planning a process that ensures the appropriate outcome.

According to ISO 9000:2000 the definition of Quality Planning is "art of quality management focused on setting quality objectives and specifying necessary operational processes and related resources to fulfill quality objectives." A Quality Plan is a document specifying which procedures and associated resources shall be applied by when and by whom to a specific project, product, process, or contract. Project Quality Plan can be defined as a set of activities planned at the beginning of the project that helps achieve Quality in the Project being executed. The Purpose of the Project Quality Plan is to define these activities / tasks that intends to deliver products while focusing on achieving customer's quality expectations. These activities / tasks are defined on the basis of the quality standards set by the organization delivering the product.

Project Quality Plan identifies which Quality Standards are relevant to the project and determines how they can be satisfied. It includes the implementation of Quality Events (peer reviews, checklist execution) by using various templates, standards, checklists available within the organization. Project Quality Plan should be written with the objective to provide project management with easy access to quality requirements and should have ready availability of the Procedures and standards. Project Quality Plan is a team process that depends as much on communicating information as it does on planning. Based on this awareness, project managers can prepare plans and actions to counter any weaknesses or deficiencies in the project execution, thus Ensuring that all quality standards are met effectively.

The following list provides the various elements that should be included in a detailed Project Quality Plan:

Management Responsibility: Describes the quality responsibilities of all stakeholders. Documented

Quality Management System: This refers to the existing Quality Procedures that have been standardized and used within the organization.

Design Control: This specifies the procedures for Design Review, Sign-Off, Design Changes and Design Waivers of requirements.

Document Control: This defines the process to control Project Documents at each **Project Phase.**

Purchasing: This defines Quality Control and Quality Requirements for sub-contracting any part / whole part of the project.

Inspection Testing: This details the plans for Acceptance Testing and Integration Testing.

Non- Conformance: This defines the procedures to handle any type of nonconformance work. The procedures include defining responsibilities, defining conditions and availability of required documentation in such cases.

Corrective Actions: This describes the procedures for taking Corrective Actions for the problems encountered during project execution.

Quality Records: This describes the procedures for maintaining the Quality Records (variance reports, executed checklists etc) during project execution as well as after the project completion.

Quality Audits: An internal audit should be planned and implemented during each phase of the project.

Training: This should specify any training requirements for the project team.

Example: NDT Testing quality plan for piping work of a fertilizer plant is developed for different service such as water service lines welding joints are planned for 5-10% joints to be tested, while ammonia and other chemicals service lines welding joints are planned for 100% joints to be tested.

6.2.2 What is Quality Assurance?

Quality assurance is evaluating the overall project performance on a regular basis to provide a confidence that the project will satisfy the relevant quality standards. Activities of project quality assurance department includes quality mapping, quality improvement, quality audit and reliability. It also includes activities such as quality advice & expertise; training of personnel's in project quality, provisions of appraisal methods for supplier, processes and finished products / services analysis of project execution complaints, project warrantee claims and service liability cases. A quality audit is a structured review of specific quality management activities that help identify lessons learned that could improve performance on current or future projects. Example : NDT Testing quality plan for piping work of a fertilizer plant which is developed for different service is to be strictly followed. Also during review / verification of NDT Testing films .it should be verified with a competent and skilled persons for correct decisions. Like if there is a small repair in the welding joint then it should be marked adequately and repaired properly by qualified welder. (Welders are qualified as per QAP –Quality Assurance Plan- procedures).

6.2.3 What is Quality Control?

Quality Control is the monitoring of specific project results to determine if they comply with the relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance. Project Quality control dept. is mainly work on the output review.

Example: NDT Testing quality plan for piping work of a fertilizer plant is executed for different service. (Like utility –Nitrogen, air, water, ammonia and urea). Project Quality Control process would review percentage defects and provide necessary corrective measures for improvement in the piping welding process or else training for the welders as per analysis. A revision in the Project Quality plan is developed to reduce the percentage detects and better quality in the process.

The main outputs of quality control are: Acceptance of decisions, (b) Rework and (c) Process adjustments. To carry out quality control process tools and techniques are used. Following are the tools and techniques:

- **Pareto Analysis :** The Pareto principle (also known as the 80–20 rule, the law of the vital few, and the principle of factor sparsely) states that, for many events, roughly 80% of the effects come from 20% of the causes
- **Sis Sigma :** Six Sigma is a process improvement methodology that focuses on eliminating the defects in a product or service. The goal of Six Sigma is to have a product or service operate at near-perfection (99.9996 percent) at each occurrence. The five principles of Six Sigma are define, measure, analyze, improve and control.
- **Control Charts :** Control charts, also known as Shewhart charts (after Walter A. Shewhart) or process-behavior charts, in statistical process control are tools used to determine if a manufacturing or business process is in a state of statistical control. A control chart consists of:
    - Points representing a statistic (e.g., a mean, range, proportion) of measurements of a quality characteristic in samples taken from the process at different times [the data]
    - A centre line is drawn at the value of the mean of the statistic
    - The standard error (e.g., standard deviation) of the statistic is also calculated using all the samples with respect to Upper and lower control limits (sometimes called "natural process limits") indicate the threshold at which the process output is considered statistically 'unlikely' and drawn typically at three standard errors from the centre line:
- **Non Destructive Testing : Nondestructive testing** or **Non-Destructive Testing** (**NDT**) is a wide group of analysis techniques used in science and industry to evaluate the properties of a material, component or system without causing damage. Common NDT methods include Ultrasonic, magnetic-particle, liquid penetrant, radiographic, remote visual inspection (RVI) etc.

6.3 Quality Planning

Quality Planning is the first phase of the Project Quality Management. It is a very crucial stage of the project in which quality standards are finalized based on the requirement. Example: For water treatment plant project the necessary quality checks and their standards are different from the Petroleum plant project quality checks and standards, definitely quality standards and checks in the petroleum plant will be very strict and no of inspection stages carried out would be more with high standards. It is also a key facilitating process during the Project planning stage and it is simultaneously being worked.

6.3.1 Process Flow Chart- Project Quality Planning

Below is the process flow chart for project quality planning which starts from inputs, followed by use of tools and techniques and this will provide the results as output.

A. Quality Planning Inputs

a) Quality Policy

It is a guide for everyone in the organization as to how they should provide project outputs and services to the stakeholder / customer. The overall intentions and direction of an organization with regard to quality, as formally expressed by the top management of the organization. The management team is responsible for dissipating the quality policy to all project stakeholders through appropriate information channels.

Quality Policy of Reliance Industries Limited - "We at RIL are committed to total customer satisfaction in terms of quality and services for the entire range of our products. Our continued commitment to excellence and innovative efforts helps us to stay ahead as market leader." **By Mukesh D. Ambani.** It means all project team members during project execution stay with total customer satisfaction: internal and external, as well as during production of a product and services provided to end users in the market.

b) Scope Statement : The scope statement is a key input to quality planning because it documents major project deliverables as well as project objectives which serve to define important stakeholder requirements. The meaning of above is to prepare a complete manual and documents for the quality standards as well as quality requirements for inspection and other quality checks for verification.

Involves following stages for defining the scope statement for quality checks and inspection in the quality planning documents with reference to :

Stage -1 Inspection: Checking of primer thickness 10 to 20 % of all pipes.

Stage -2 Inspection: Wrapping and Coating material inspection with specification and brand.

Stage -3 Inspection: Digging depth adequacy and bottom sand leveling and supporting

Stage-4 Inspection: Adhesion test: Adhesion test shall be made to determine the proper bond between the wrapping and coating on the primed pipe.

Stage -5 Inspection: Hydro test and flushing of pipeline and final boxed up for use.

Stage -6 Inspection: Filling of sand and compacting of sand.

All formats for documentation and level of signatory is being decided. These stage wise inspection are as per standard practice, however any addition or deletion in these stage inspection are based on the management discretion.

c) **Standards and Regulations**

The project management quality team or consultant provides the complete details and procedure of inspection and tests to be carried out during execution based on the scope defined for each system. This also covers details of the test equipment used and the range of inspection and test criteria / standards values or attributes. Example : Quality planning scope statement for underground fire water piping work.

Stage -1 Inspection: Checking of primer thickness 10 to 20 % of all pipes.

All the C.S. (Carbon steel) pipes adequately sandblasted and primer of zinc phosphate based to be done with a coating thickness from 150 to 200 micron. It is to be inspected randomly 10 to 20 % of pipes length (on each pipe) by competent quality engineer and reports are to be documented in the standards format as prescribed by the project quality department.

Stage -2 Inspection: Wrapping and Coating material inspection with specification and brand. This is the material after primer to be wrapped and coated. Specification of wrapping and coating (Bitumen) to be prepared based on guidelines by quality dept. or by engineering consultant. It should be used with a standard format and to be signed by competent quality engineer from owner's side.

Stage -3 Inspection: Digging depth adequacy and bottom sand leveling and supporting. The depth to be indicated in the document or the drawing normally one meter below as top of the pipe to be kept (as standard) and leveling means the entire length of dig area should be leveled and sand bags are provided as support to the pipe/ sometime saddle support of pipe materials / wood materials are also used along with sand bags. This is also to be recorded in the standard format (may be same for stage 1 to 3).

Stage-4 Inspection: Adhesion test: Adhesion test shall be made to determine the proper bond between the wrapping and coating on the primed pipe. This is to be carried out with equipment named as holiday tester which will give a spark at the loose bonding while it is moved on the wrapped pipe. Repair procedure at the loose wrapping and coating is to be marked. To be tested after repair by agency / assigned contractor.

Stage -5 Inspection: Hydro test and flushing of pipeline and final boxed up for use. Entire length of pipeline is to be tested normally 1.5 to 2 times of the designed pressure of service. Then water flushing to be done to clean the line from mud or sand and then it is boxed up with valves and instruments. Format to be developed for the same for document record.

Stage -6 Inspection: Filling of sand and compacting of sand. After the line boxed up the sand filling and compacting to be done by contractor and to be checked by quality engineer / site supervisor. The format for the same is indicated in the hydro test report.

d) Other Process Outputs

In addition to the scope statement and product description, processes in other knowledge areas may produce outputs that should be considered as part of the quality planning Example: procurement planning outputs may identify contractor quality requirements that should be reflected in the overall Quality Management Plan. Also the documents other then site are to be finalized for documentation and requirement of documents requirement from manufacturer and suppliers to be prepared. Example**:** Pump suppliers for fertilizer plant should also supply the documents for : Erection and commissioning procedure of pump. Maintenance manual of pump along with recommendation of maintenance parts for -2 years of operation and sectional drawings with materials details

of components. Any necessary guideline for alarming limits of pump when it is in operation.

B. Quality Planning Tools and Techniques

a) **Benefit / Cost Analysis**

It is project quality management team from owners side or engineering consultant ,that they should consider quality checks and inspection for entire project in such a way that the cost associated for the inspection should not be high and time consuming but at the same time critical inspections should not be left during planning irrespective of time of inspection or cost. The benefits from the quality planning is to be studied in such a way if any repair does not attended in the underground fire water line (found during inspection) would leak in leakage after some time and the cost associated for attending it at later stage would be very expensive and time consuming. Hence Quality planning process must consider benefit/cost tradeoffs and analyze for primary benefits like less work, higher productivity, lower costs, and increased stakeholder satisfaction. The Cost associated with project quality management during planning to be assessed for activity and system criticality wise.

b)Benchmarking

Benchmarking involves comparing actual or planned project practices to those of other projects to generate ideas to: generate ideas for improvement, and provide a standard for measurement of performance.

c) Flow Charting

A flowchart is a formalized graphic representation of a logic sequence, work or manufacturing process, organization chart, or similar formalized structure. The purpose of a flow chart is to provide people with a common language or reference point when dealing with a project or process.The flowcharting techniques in quality management generally include

- System or process flow charts
- Cause & Effect Diagrams
- System or process flow charts

  How to Use the Tool Most flow charts are made up of three main types of symbol:

  - Elongated circles, which signify the start or end of a process.
  - Rectangles, which show instructions or actions
  - Diamonds, which show decisions that must be made Within each symbol,

d) **Cause and Effect Diagram**

The cause-and-effect diagram, also called “fishbone” or the “Ishikawa diagram” (named after its inventor), permits identification and organization of a list of factors thought to cause a problem or affect variation in a desired outcome. The cause-and-effect diagram

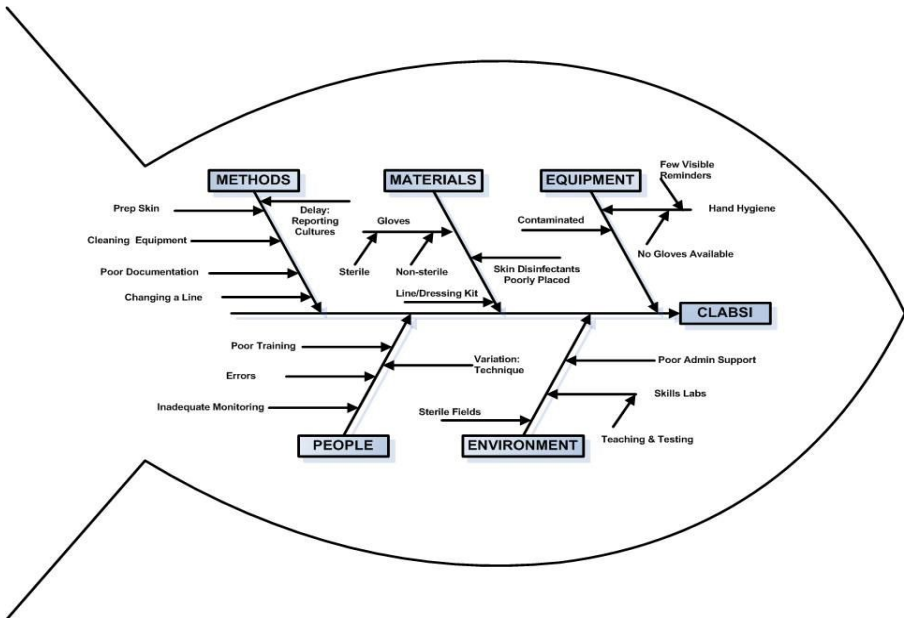
is essentially a pictorial display of a list. Each diagram has a large arrow pointing to the name of the problem or issue. The branches off the large arrow represent main categories of potential causes. Smaller branches, representing sub-categories (can be a list of items) are then drawn off of each major branch.

The Fishbone Diagram can also be used as a Root Cause Analysis Tool. A combination of the Affinity Diagram and the Cause and Effect allows the generation of ideas, in a brainstorming fashion, then the clustering of the ideas around the "Bones." These main categories ("Bones") may be customized to fit the process under study, however, typical categories of major causes used with the cause-and-effect diagram are:

The following large arrow can be considered : Equipment, Methods, Materials, People, Environment/Measurements/Procedures, People, Provisions (Supplies), Procedures, Place, Patrons (Patients).

The branch arrow of each category can be considered based on site conditions

Each branch is checked for the cause and finally it can be traced which is the most feasible cause of problem and it is rectified and improvement is recorded for next project fire water piping erection.



C. Quality Planning Outputs

a) Quality Management Plan

The quality management plan should describe how a project management team will implement its quality policy and quality standards. Also the plan should define the organizational structure, roles and responsibilities & resources needed for implementation of quality management. The Quality Plan should address Quality Control of the project, Quality Assurance & Quality Improvement of the project.

b) Operational definitions

These are terms and definitions related to quality and inspection to be executed at site and document terms.

Class of Inspection: It is basically, while defining quality inspection there are class of inspection is decided .these class of inspection normally categories in three major class in which sub groups are defined. This inspection class is based on type of materials and service of fluid.

Qualifications of inspectors /Engineers

This is defined such as for NDT (Non Destructive Testing) level- II certification from ASNT (American society for non destructive testing) to be passed and past experience level will be defined under management policy.

c) Checklists

A checklist is a structured tool used to verify that a set of required steps or requirements have been performed. Many organizations have standard checklists to ensure consistency of frequently performed activities.

Summary Check List for Fertilizer urea plant piping-Quality Execution Plan

Project Start Date: Quality check list date

Project End Date:

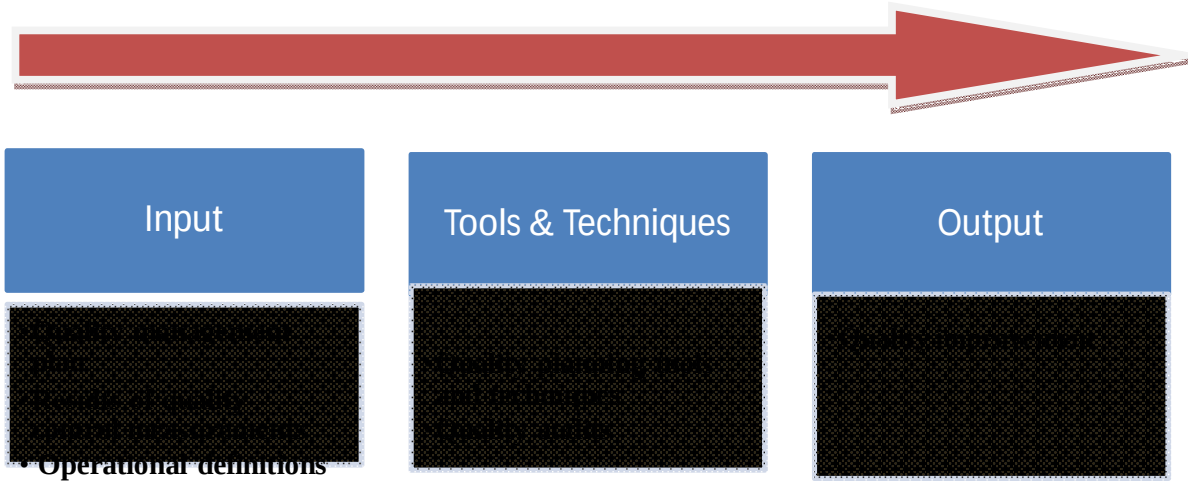
No.	Item/Comments	YES	NO	Planned Completion Date	Planned Effort (hours)	Actual Completion Date	Actual Effort (hours)
1	Piping inspection scope finalized						
2	Piping inspection schedule finalized						
3	Major Deliverables defined (Deliverables Plan)						
4	Work Breakdown Structure completed						
5	Resources are finalized –piping inspection						
6	Major Milestones defined						
7	Master Integrated Schedule completed						
8	Product and Services Requirements defined						
9	Organization Plan completed						
10	Performance, Evaluation and Test Plan completed						
11	Change Control Plan completed						
12	Problem Tracking Plan completed						

13	Documentation Plan completed						
14	Communication Plan completed						
15	Legal and Regulatory Requirements Plan completed						
16	Risk Management Plan completed						
17	Reliability, Availability, Usability Plan completed						
18	Preliminary Support Plan completed						

6.4 Project Quality Assurance

Quality assurance encompasses all the planned and systematic activity implemented in a quality system to provide confidence that the project will satisfy the relevant quality standards. Quality assurance is provided by a Quality Assurance dept. Quality assurance can be INERNAL (from the project management team to the performing organization). Quality assurance can be EXTERNAL (provided to the customer and other parties actively involved in the work of the project.

Quality Assurance Flow Chart



Quality Assurance Input

Quality management plan as previously described. Results of quality control measurements which are records of quality control testing and measurement in a format of comparison or analysis. Operational definitions as previously described in the output of the Quality Planning.

Tools & Techniques for Quality Assurance

Quality Planning tools and techniques, which can be used for quality assurance as well Quality Audits which are a structured review of other quality management activities.

They may be timely carried out randomly. They may be carried out by properly trained Internal-auditors or by third parties such as quality systems registration agencies.

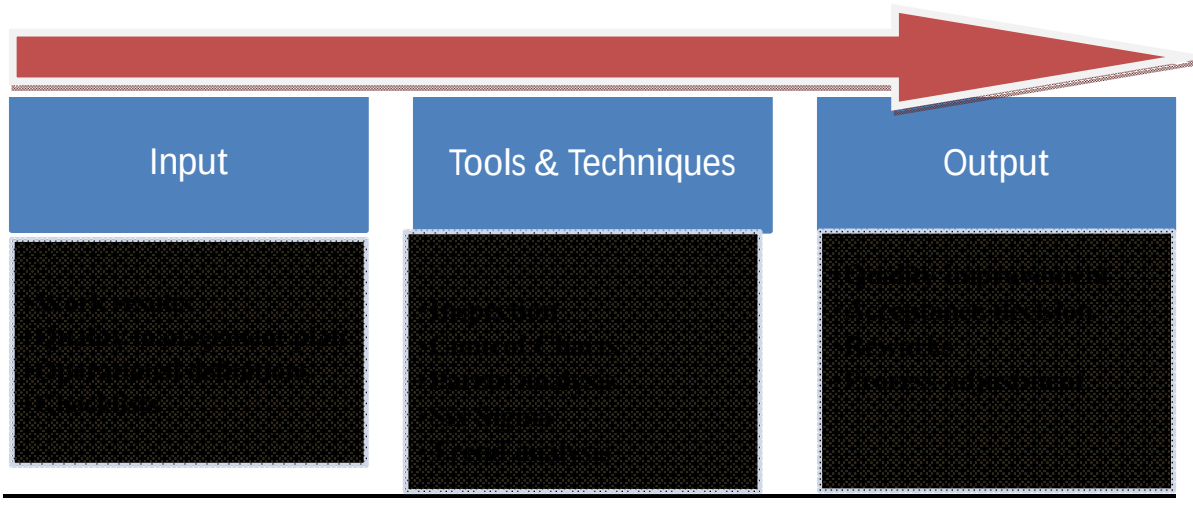
6.5 Project Quality Control

Quality control involves monitoring specific project results to determine if they comply with relevant standards and identifying ways to eliminate causes of unsatisfactory results. Project results mentioned include both PRODUCT results such as deliverables and MANAGEMENT results such as cost and schedule performance. Quality control is often performed by a quality control department. The project management team should have a working knowledge of statistical quality control especially sampling and probability to help evaluate and control outputs.

The project management should be aware of the following among other subjects:

- ***prevention*** (keeping errors out of the process)
- ***Inspection*** (keeping errors out of the customers hand
- ***Attribute sampling*** (for conformity of results)
- ***Variable sampling*** (where the results are rated on a continuous scale that measures the degree of conformity or non conformity
- ***Special cause*** (unusual events)
- ***Random causes*** (normal process variations)
- ***Tolerances*** (where results should fall within a defined tolerance range
- ***Control limits*** (the process is in control if it falls within these defined limits)

6.5.1 Quality Control Flow Chart



Inputs -Quality control

a) Work results: including both product results and process results

b) The quality management plan

c) Operational definitions

d) Checklists

Tools & Techniques for Quality Control

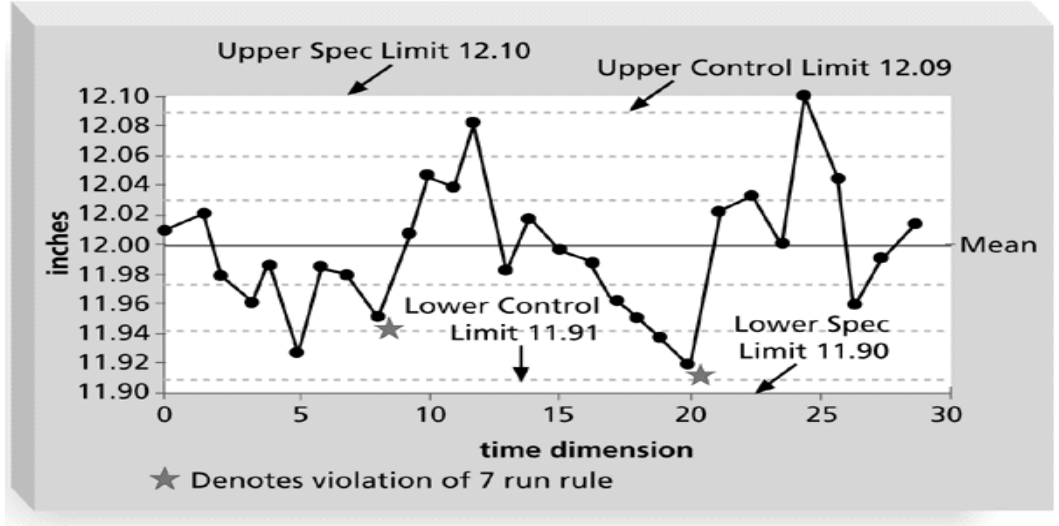
a) Inspection

Inspection includes activities such as measuring, examining and testing undertaken to determine whether results conform to requirements. Inspection can be carried out on the level of a single activity or a final product. Inspection can be called reviews, product reviews, audits, and walk-troughs.

b) Control Charts

These charts are graphical representations that display the result of a process over time and are used to determine if the process is "in control". Control charts are most often used to monitor repetitive activity in production but can also be used to monitor cost and schedule variances. The main use of control charts is to prevent defects, rather than to detect or reject them. Quality control charts allow you to determine whether a process is in control or out of control. When a process is in control, any variations in the results of the process are created by random events; processes that are in control do not need to be adjusted. When a process is out of control, variations in the results of the process are caused by non-random events; you need to identify the causes of those non-random events and adjust the process to correct or eliminate them.

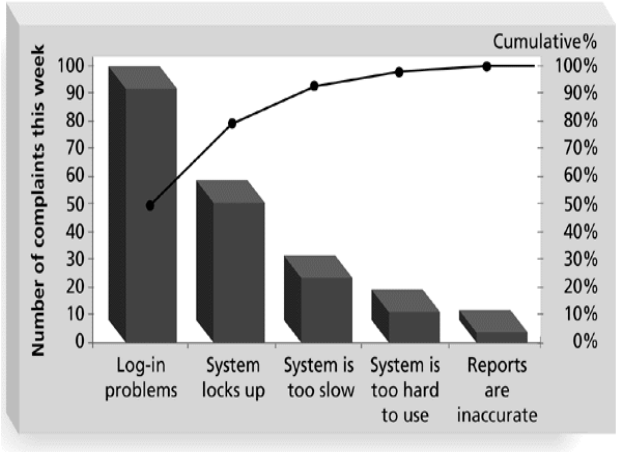
Sample Quality Control Chart



b) Pareto Analysis

Involves identifying the vital few contributors that account for the most quality problems in a system. Also called the 80-20 rule, meaning that 80 percent of problems are often due to 20 percent of the causes. **Pareto diagrams** are histograms, or column charts representing a frequency distribution, that help identify and prioritize problem areas.

Sample Pareto Diagram



c) Six Sigma

is "a comprehensive and flexible system for achieving, sustaining, and maximizing business success. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes." It requires an organization-wide commitment. Training follows the "Belt" system. Six Sigma organizations have the ability and willingness to adopt contrary objectives, such as reducing errors and getting things done faster. It is an operating philosophy that is customer focused and strives to drive out waste, raise levels of quality, and improve financial performance at *breakthrough* levels.

Basic Information on Six Sigma

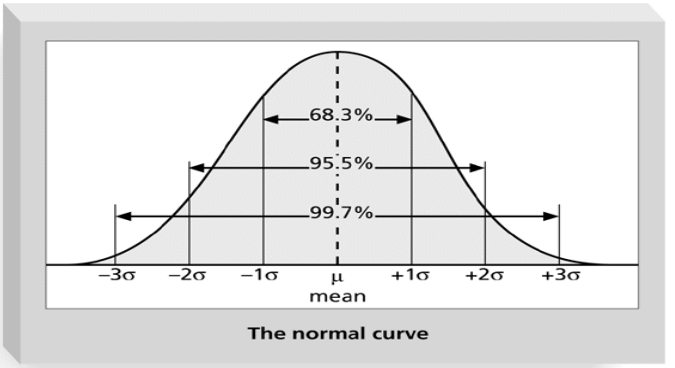
The target for perfection is the achievement of no more than 3.4 defects per million opportunities. The principles can apply to a wide variety of processes. Six Sigma projects normally follow a five-phase improvement process called DMAIC. DMAIC is a systematic, closed-loop process for continued improvement that is scientific and fact based. DMAIC stands for: **D**efine: Define the problem/opportunity, process, and customer requirements. **M**easure: Define measures, then collect, compile, and display data. **A**nalyze: Scrutinize process details to find improvement opportunities. **I**mprove: Generate solutions and ideas for improving the problem. **C**ontrol: Track and verify the stability of the improvements and the predictability of the solution.

Six Sigma and Statistics

The term *sigma* means standard deviation. Standard deviation measures how much variation exists in a distribution of data. Standard deviation is a key factor in determining the acceptable number of defective units found in a population. Six Sigma

projects strive for no more than 3.4 defects per million opportunities, yet this number is confusing to many statisticians.

Normal Distribution and Standard Deviation



The normal curve

Sigma and Defective Units

SIGMA	YIELD	DEFECTS PER MILLION OPPORTUNITIES (DPMO)
1	31.0%	690,000
2	69.2%	308,000
3	93.3%	66,800
4	99.4%	6,210
5	99.97%	230
6	99.99966%	3.4

Six Sigma and Project Management

The training for Six Sigma includes many project management concepts, tools, and techniques. For example, Six Sigma projects often use business cases, project charters, schedules, budgets, and so on. Six Sigma projects are done in teams; the project manager is often called the team leader, and the sponsor is called the champion.

Trend Analysis

The trend analysis involves the use of mathematical techniques to forecast future outcomes based on historical results it is often used to monitor. Technical performance – how many defects have been identified and how many remain uncorrected. Cost and schedule performance – how many activities in a certain period were completed with significant variances.

Outputs for Quality Control

Completed Checklists, which become a part of a project record when they are used. Process Adjustments, which involves immediate corrective or preventive action as a result of quality control measurements. In some cases the adjustment may need to be handled according to procedures for overall change control.

a) **Quality Improvement:** It is the learning from the tools and techniques for improvement in the process of quality management.

b) **Acceptance Decision :** It is the criteria for the range of acceptance for the inspection results.
c) **Rework:** Based on the results from the tools and techniques and inspection at site ,necessary rework to be done to maintain the six sigma range of quality.
d) **Process adjustment:** It is necessary change in the class of inspection based on the results.

6.6 Cost of Quality

The cost of quality is the cost of conformance plus the cost of nonconformance. Conformance means delivering products that meet requirements and fitness for use.Cost of nonconformance means taking responsibility for failures or not meeting quality expectations.

Elements of Cost of Quality

- **Prevention cost**: Cost of planning and executing a project so it is error-free or within an acceptable error range.
- **Appraisal cost**: Cost of evaluating processes and their outputs to ensure quality.
- **Internal failure cost**: Cost incurred to correct an identified defect before the customer receives the product.
- **External failure cost**: Cost that relates to all errors not detected and corrected before delivery to the customer.
- **Measurement and test equipment costs**: Capital cost of equipment used to perform prevention and appraisal activities.

6.7 Summary

In conclusion we find that in order to achieve Project Quality Management, one has to integrate the concepts of Project management with the processes of quality management at the project scale and throughout its different phases. For effective Project Quality Management it is essential that the project management team be aware of the concepts of quality management to be able to make use of the described processes and implement them to achieve the required end product.

6.8 Self Assessment Questions

1 Explain project quality management and its importance?
2 Prepare a chart for elements of Project Quality Management?
3 Explain the Quality Control in detail?
4 what is cost of quality? Explain its elements?
5 Prepare a chart for Project quality management for fertilizer industry?

6.9 Reference Books

- Project Management- By Vasant Desai- Himalaya Publishing
- Project Management- By Dennis Lock- Gover House,British Library publication-
- Project Planning & Management-PPM CADD Centre .
- http://www.sasqag.org/pastmeetings/QualityPlans.pdf

Unit – 7 : Project Performance Management

Structure of Unit

7.0 Objectives

After completing this unit, you would be able to:

- Understand the concept of project performance measurement ;
- Learn the performance measurement process and techniques;
- Understand Earn Value Analysis;
- Understand managing project scope creep;
- Learn about forecasting project's final cost;
- Learn Project Performance Measurement Report.
- Learn about calculating schedule performance index and cost performance Index
- Understanding and importance of work break down structure in EVA.

7.1 Introduction

Assessing the magnitude of deviation from the original project plan is called project performance measurement. Project performance measurement includes measuring performance against key project performance criteria like project scope, schedule, quality, cost and risk criteria. Performance measurement process includes Identify any deviations from the plan, assess the impact of deviations on the project and overall programme, and report results to key stakeholders. Recommend, implement and monitor remedial action, when required, in line with the programme and project governance framework.

7.2 Project Performance Management Process

Project performance measurement process involves collection of status data (determining what data to collect, how, when and who will collect the data); analysis of date (techniques used for performance measurement) and reporting of current progress of project.

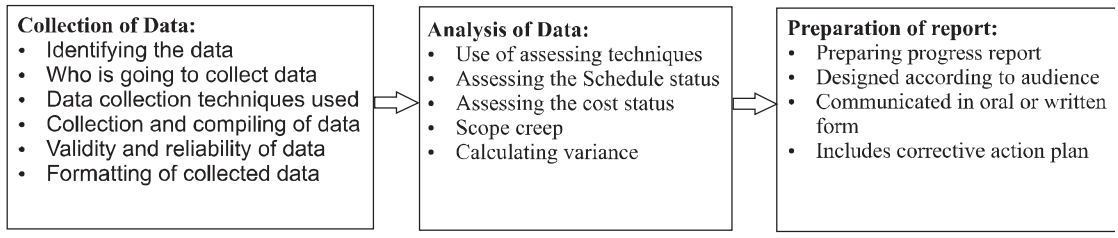


Fig. 7.1 Project Performance Management Process

7.2.1 Collection of Data

Status data offer several advantages. The data can determine project performance especially how well the goals of the project are being met. Data collected are determined by which metrics will be used for project control. Typical key data collected are activity duration times, resource usages and rate, and actual cost, which are compared against planned times, resources and budgets. The collected data must address these questions:

- What is the current status of the project in terms of schedule and cost?
- How much will it cost to complete the project?
- When will the project be completed?
- Are there potential problems that need to be addressed now?
- What, who, and where are the causes for cost or schedule overruns?
- What did we get for the money spent?
- If there is a cost overrun midway in the project, can we forecast the overrun at completion?

7.2.2 Data Collection Techniques

A) **Pulse Meetings**: Pulse meetings are short team status meetings where the project management team is able to gather project performance information about the activities that are underway. These meetings should occur frequently and can either be face-to-face or virtual. Normally they are only a few minutes in duration. The frequency of the Pulse meeting is determined based upon the status of the project. When in an Extreme mode, the Pulse meeting may be happening several times a day. Projects that are running smoothly may only need to have a Pulse meeting once a week.

B) **Forms**: Forms are useful in collecting and communicating project performance information. Forms also provide audit trails to help learn from past experience,

compile statistics, and conduct post-implementation reviews. Forms can be distributed electronically or in hard copy.

C) **Surrogate Data**: Data can be collected electronically with the help of Project Management Information System (PMIS). These data includes cash flows, machine hours, labor hours or material in place.

Data can be collected by project team, contractor, independent cost engineers or project manager. Expertise knowledge is required to collect data. Improper data may lead to inappropriate assessment of project performance.

Validity and Reliability: While collecting data, two concepts are important one is reliability of data and another is validity of data. Reliability implies consistent result; does date result reliable result? Validity of data means predictability of collected data; whether that data is going to predict desired performance measurement?

7.2.3 Analysis of Data

With reliable and valid data, project manager can assess overall project performance. Assessment involves determining how well the project has and will achieve its goals. Performance management mainly focuses on three areas: schedule, cost, and quality. Assessment can be done via two principal reviews, looking back (history) and looking forward (the future). Looking a past performance is called tracking; projecting into the future using past performance is called monitoring. Both are important for determining where the project has been and where it will be if the current level of performance continues.

A key concept behind assessing status is variance, the difference between what is planned and what actually occurred up to a specific point. The formula is quite simple: Variance=planned-actual

If the difference between the two is zero or a positive number, then the project is proceeding as expected, whether from a cost, schedule, or quality perspective. If the difference between the planned and actual is a negative number, then the project is not progressing as anticipated.

Tools and Techniques Used for Project Performance Measurement:

- Through meetings with clients, parties involved in project (Contractor, supplier, etc.)
- For schedule – Update CPA, PERT Charts, Update Gantt Charts
- Milestones
- Using Earned Value Analysis
- Calculate Critical Ratios
- Reports

7.3 Earn Value Analysis

Traditional financial planning and tracking tools (Cost-budget systems) do not fit the project context. For instance, the traditional financial planning tools are tied to annual budgeting cycles not project schedules. Projects activities are planned with start and stop dates and resources are assigned and removed from the project plan throughout the project life-cycle. Therefore some of the major assumptions on which financial planning tools are based are invalid in the project planning environment.

Further, traditional financial accounting systems make some assumptions when tracking costs that are not valid in the project control environment. For instance, the tracking cycle used in financial systems is based upon calendar events such as end of month, end of quarter, or end of year because these are major reporting points to taxing authorities and investors. However, the significant project reporting points are the project milestones; which seldom precisely align with financial calendar dates. An additional assumption in the financial systems is that the business is on-schedule - again because of the financial planning calendar it is impossible for the business to get behind schedule. There is no such thing as stretching December out to have 37 or 38 days. The financial control system assumes the project is always on schedule, so any over-spending or under-spending during a time period is a true over-run or under-run on the project. However, a project is seldom precisely on schedule, and over-spending in one month may be the result of activities being delayed or accelerated and do not necessarily indicate the final project spending will be over-run.

The Earned Value Analysis (EVA) technique takes into consideration the project context for the planned and actual expenditures and integrates the project scope, schedule, and resource characteristics into a comprehensive set of measurements. The earned value system starts with the time-phased costs that provide the project budget baseline, which is called the planned budget value of the work scheduled (PV). Given this time-phased baseline, comparisons are made with actual and planned schedule and cost using earned value. The earned value approach provides the missing links not found in conventional cost-budget systems. At any point in time, a status report can be developed for the project.

Table 7.1: Acronym used in EVA

Acronym	Meaning
EV	Earn value for a task is simply the percent complete times its original budget. In other words, EV is the percent of the original budget that has been earned by actual work completed. (The older acronym for EV was BCWP – budgeted cost of the work performed)

PV	The planned time phased base line of the value of the work schedule. An approved cost estimate of the resources scheduled in time phased cumulative base line. (BCWS: Budgeted cost of work scheduled)
AC	Actual cost of the work completed. Sum of the costs incurred in accomplishing work (ACWP: Actual cost of the work performed)
CV	Cost variance is the difference between the earned value and the actual cost for the work completed to date where *CV = EV-AC*
SV	Schedule variance is the difference between the earn value and the baseline to date where SV=EV-PV
BAC	Budgeted cost at completion. The total budgeted cost of the base line or project costs accounts.
EAC	Estimated cost at completion
ETC	Estimated cost to complete remaining work.
VAC	Cost variance at Completion. VAC indicated expected actual over-or under run cost at completion.

7.3.1 Process of Earn Value Analysis

The earn value analysis is integration of cost and schedule tracking. EVA composed of following steps:

1. Define the work using WBS. First step includes:
    a. Project Scope
    b. Work Package
    c. Deliverables
    d. Organization units
    e. Resources
    f. Budgets for each work package
2. Develop work and resource schedule
    a. Schedule resource to activities
    b. Time-phase work package into a network

3. Develop a time- phase budget using work packages included in an activity. The cumulative value of these budgets will become the base line and will be called the planned budgeted cost of the work scheduled (PV). The sum should equal the budgeted amounts for all the work packages in the cost accounts.

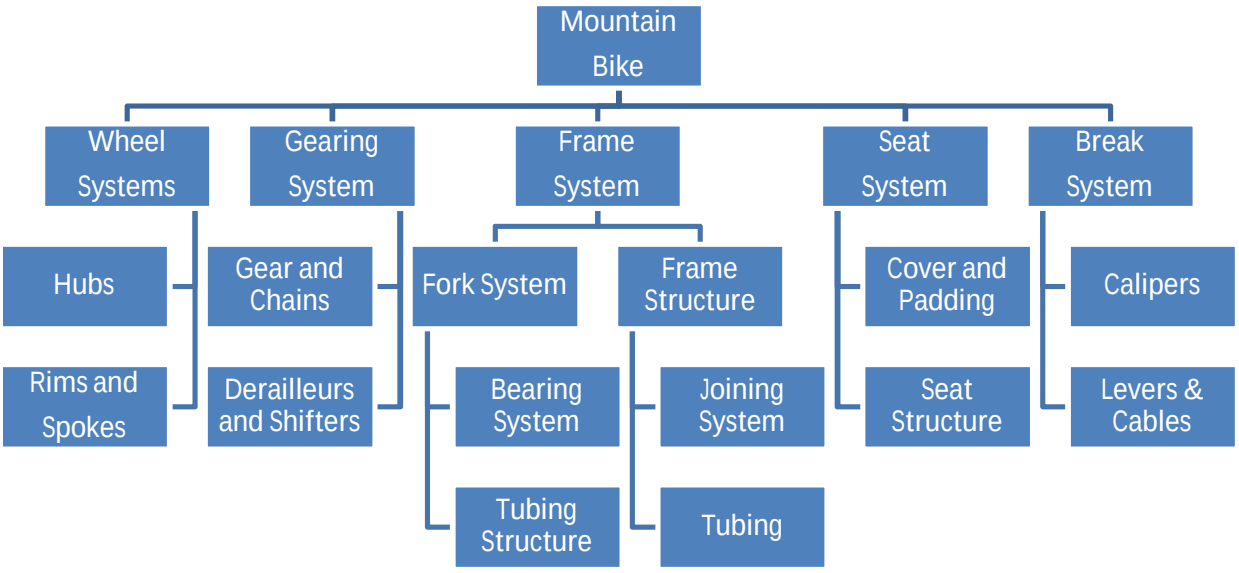


Figure 7.2: Work Break Down Structure

4. At the work package level, collect the actual cost of the work performed. The cost will be called the actual cost of the work completed (AC). Collect percent complete and multiply this time the original budgeted amount for the value of the work actually completed. These values will be called the earned value (EV).
5. Compute the scheduled variance (SV=EV-PV) and cost variance (CV= EV-AC). Prepare the hierarchical status report for each level of management – from work package manager to customer or project manager. The report should also include project roll-ups by organization units and deliverables. In addition, actual time performance should be checked against the project network schedule.

7.3.2 Work Break down Structure

Work break down (WBS) is the process of subdividing the project deliverables and project work into smaller and more manageable components. WBS is defined 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. It organizes and defines total scope of project." The WBS is a map of the project. WBS is an outline of the project with different levels of detail. The WBS begins with the project as the final deliverable. Major project deliverables/systems are identified first; the sub-deliverables necessary to accomplish the larger deliverables are defined. The process is repeated until the sub-deliverable detail is small enough to be manageable and where one person can be responsible. This sub-deliverable is further divided into work packages. Because the lowest sub-deliverables usually include several work packages, the work packages are grouped by type of work.

7.3.3 Percent Complete Rule

The best method for assigning costs to the baseline under this rule is to establish frequent check points over the duration of work package and assign completion percentage monetary terms.

7.3.4 Cost included in Baseline

The baseline is the sum of the cost accounts and each cost account is the sum of work packages in the cost accounts. It includes:

- Labor
- Equipment
- Materials

These are the direct cost which a project manager can control. Overhead cost and profit are typically added later by accounting process. Most work packages should be discrete, of short time span and have measurable outputs. If the material or equipment are a significant portion of the cost of work packages, they can be budgeted in separate work packages and cost accounts.

7.3.5 Variance Analysis:

Variance analysis includes two key calculations-

A) Comparing earned value with the expected schedule value
B) Comparing earned value with the actual costs

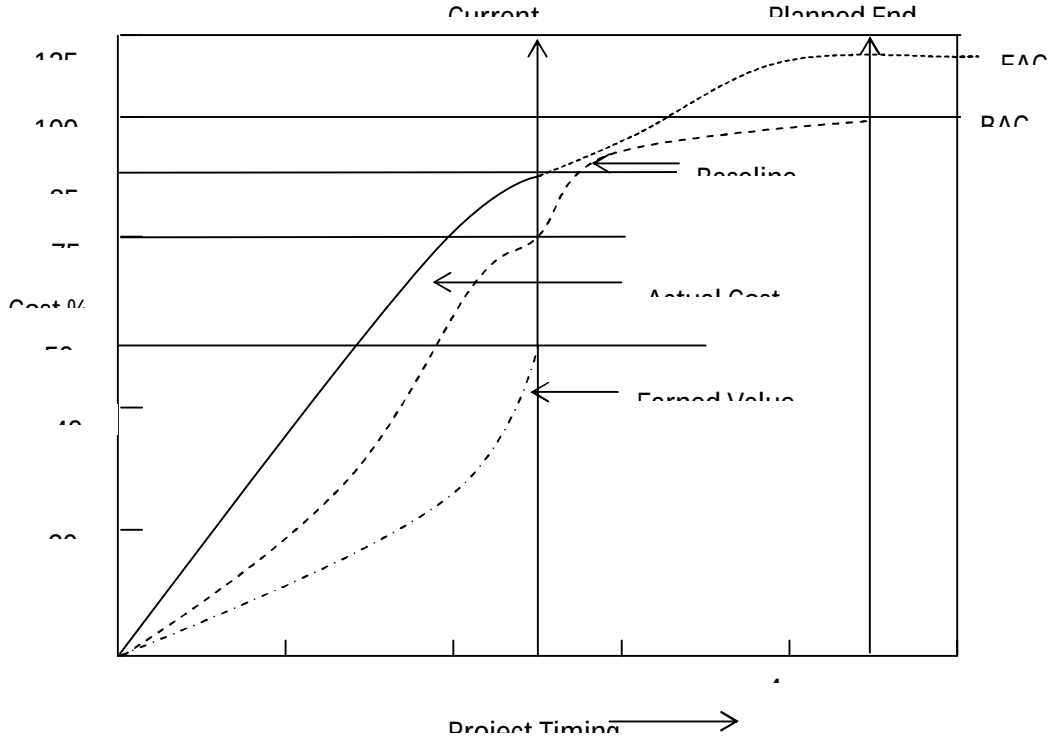
For the assessment of project status earn value cost/schedule analysis requires three data elements:

i) Planned cost of the work scheduled (PV)
ii) Budgeted cost of the work completed (EV)
iii) Actual cost of the work completed (AC)

From the above data cost variance (CV) and schedule variance (SV) are calculated for each reporting period. A positive variance indicates a desirable condition, while a negative variance suggests problems or changes that have taken place.

Cost variance: If the work completed costs more or less than was planned at any point over the life of project. Cost variance should be reviewed carefully to identify the cause of variance (i.e. labor or material or both).

Schedule variance: An overall assessment of all work packages in the project schedule to date. Schedule variance measures progress in monetary terms rather than time units. Schedule variance is useful in asses sing the direction all the project is taking.



Project Timing

Figure 7.3: Cost-Schedule Chart

Figure 10.3 shows a sample cost/schedule chart with variances identified for a project at the current date. The "Current Status" mark shows the reporting date (time period 25) of where the project has been and where it is going. The top most line represents the actual cost incurred, the dotted part shows the extending the actual cost. The middle line represents the baseline (planned schedule).

One the vertical axis percentage of total project budget is shown or percentage of scheduled task. Like on period 25, 75% project task completion was scheduled but only 50% task was completed (represented by earned value line).

Table 7.1: Key issues in Variance Analysis

Five Questions Must Be Addressed During Variance Analysis
What is the problem causing the variance?
What is the impact on time, cost, and performance?
What is the impact on other efforts, if any?
What corrective action is planned or under way?
What are the expected results of the corrective action?

7.4 Forecasting Using Earn Value

The variance calculations for SV and CV give us specific values of under-run/over-run. We can also calculate indices that give us trends and that can assist in the estimating of final project cost. The two indices generated in the Earned Value technique are the Schedule Performance Index (SPI) and the Cost Performance Index (CPI).

Interpretation of Indexes		
Index	Cost (CPI)	Schedule (SPI)
>1.00*	Under cost	Ahead of schedule
=1.00	On cost	On schedule
<1.00	Over cost	Behind Schedule
* 1.00=100%		

Table 7.3 Interpretation of CPI and SPI

The first index measures cost efficiency of the work accomplished to date:
Cost performance index (CPI) = EV/AC
The second index is a measure of scheduling efficiency to date:
Schedule performance index (SPI) = EV/PV
An index of 1.00 (100%) denotes project progress is as planned. An index greater than 1.00 shows progress is better than expected. An index less than 1.00 indicates project is behind the planned (cost/schedule).

Table 10.4: Sample Status report for any ending period

Sample Project Status Report: Ending Period n						
Cost Variance CV=EV-AC Schedule Variance SV= EV-PV						
Task	**% Complete**	**EV**	**AC**	**PV**	**CV**	**SV**
A	Finished	20	30	20	-10	0
B	Finished	15	20	15	-5	0
C	90%	90	120	100	-30	-10
D	Finished	35	60	35	-25	0

E	0%	0	0	30	0	-30
F	0%	0	0	0	0	0
Cumulative Totals		160	230	200	-70	-40

7.4.1 Project Percent Complete Indexes

Two project percent complete indexes are calculated by two different methods, based on different assumptions. The first index assumes the original budget of work complete is the most reliable information to measure project percent complete.

Percent complete index PCIB=EV/BAC

This method does not include actual cost incurred. This method assumes that project manager has confidence in original budget estimated.

The other method assumes the actual cost to date and expected cost at completion are the most reliable to calculate project percent complete index.

Project complete index PCIC=AC/EAC

This method includes actual and revised estimates, more complete information.

7.5 Forecasting Final Project Cost

There are basically two methods used to revise estimates of future project cost. The first method allows change original baseline durations and costs because new information tells them the original estimates are not accurate. This method is useful for small projects.

EAC=AC+ETC
Where:
EAC= revised estimated cost at completion
AC= cumulative actual cost of work completed to date
ETC= revised estimated cost to complete remaining work
A second method is used for large projects where the original estimation is less reliable. This method uses actual cost to date and cost performance index. Now:
EAC= ETC+AC

ETC=$\frac{Work\ Remaining}{CPI} = \frac{BAC-EV}{EV/AC}$

Where: EAC= estimated total cost at completion
ETC= estimated cost to complete remaining work
AC= cumulative actual cost of work complete to date
CPI=cumulative cost index to date
BAC= total budget of the baseline
EV= cumulative budgeted cost of work completed to date

Table 7.5 : Over view of Earn Value Analysis

Requisites of Earned Value Analysis
Proper Work Break Down Structure Design
Baseline Budget Control Accounts
Baseline Schedule
Work measurement by Control Account (work-hours, cost in $ etc.)
Good Project Management Practices.
Pros
Normalizes and quantifies 'cost variance' and 'schedule variance'; allows meaningful comparisons of the two to determine optimal tradeoffs
Provides indication of productivity if actual costs available
Gives indication of "value created" to stakeholders
Cons
Needs accurate estimation of project tasks (Work Breakdown Structure)
Productivity calculations only available if accounting/payroll logs charged hours on a per-project basis.

7.6 Project Scope Creep

Project scope is definition of the end result or mission of a project. Project scope incudes:

- Objectives
- Deliverables
- Milestones
- Specifications
- Limits
- Exclusions
- Key stake holders
- Issues and Risk involved

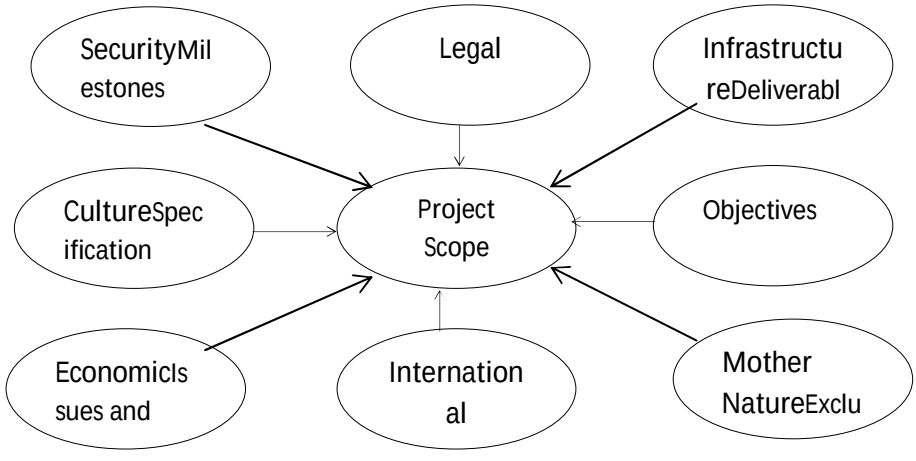


Figure 7.4: Elements of Project Scope

Project Scope Creep is also known as focus creep, and requirement creep. Project scope creep in project management refers to uncontrolled changes or added objectives in a project's scope. Scope creep refers the tendency for the scope of a project to expand once it has started. Some of the sources of project scope creep are as follows:

- Unclear understanding of the project scope.
- Adding features because they are considered useful, interesting and/or low cost.
- Adding unplanned necessary features (missed scope).
- Idle hands adding a feature to fill in time.
- New technology
- Poor design assumptions
- Poor communication between customer and project suppliers.

Scope creep affects the organization, project team and project suppliers. Negative effects of scope creep may be:

- Effect on organization cash flow
- Effect on other projects due to additional resources required for current project
- Negative effect on team motivation and cohesiveness
- Loss of focus or less focus on main objective of project
- Lower productivity and disturbed project rhythm

7.6.1 Controlling Project Scope Creep

Guide lines to avoid and control project scope creep are as follows:

- Well defined project scope
- Documentation of project scope
- Change management process (approval process before any change in scope)
- Update baseline for approved changes in scope
- Create a clear project schedule
- Good communication between project team and other stakeholders of project

7.6.2 Project Performance Report

This is one of the important tasks of project manager to prepare status report. Status report must be customized in such a way that each participant receives tailored information according to their specific needs. Project report must include out-of-tolerance situations, any scope change and facilitate corrective action.

A common format of performance status report is as follows:

- Executive summary and headlines of current status
- Progress since last reported
- Current status
- Cost variance
- Schedule variance
- Scope creep

- Cumulative trends
- Problems in project
- Corrective action plan to control project

7.7 Summary

Project performance measurements accomplishments against planned and deliverables. Performance management also helps in increasing communication with customer.The WBS is used as the basic building block for the planning of the project. It is a product-oriented division of project tasks that ensures the entire Scope of Work is captured and allows for the integration of technical, schedule, and cost information. It breaks down all the work scope into appropriate elements for planning, budgeting, scheduling, cost accounting, work authorization, progress measuring, and management control. Earned value system allows integrating cost and schedule. This allows project manager to estimate exact time schedule and budget for project. Earned Value Analysis (EVA) is an industry standard method of measuring a project's progress at any given point in time, forecasting its completion date and final cost, and analyzing variances in the schedule and budget as the project proceeds. Schedule Variance (SV=EV-PV) is comparison of amount of work performed during a given period of time to what was scheduled to be performed. A negative variance means the project is behind schedule. Cost Variance (CV= EV-AC) is comparison of the budgeted cost of work performed with actual cost. A negative variance means the project is over budget. Project manager is also responsible for controlling of project scope creep. Gradual changes in scope may lead to major cost and schedule variance. After monitoring and tracking the project, all the stake holders are informed about current status of project. Proactive corrective action is taken, if required.

7.8 Self-Assessment Questions

1. What do you mean by “Earn Value Concept”. Explain in detail.
2. What are the different aspects to be covered in Project Performance?
3. Explain Scope Creep.
4. What is cost variance and schedule variance?
5. Define Milestones.
6. Describe work breakdown structure.
7. When collecting data, did you identify threats of reliability and validity? How will you deal with these threats?

7.9 Reference Books

- Harvay Maylor; **Project Management** ; fourth edition, Prentice Hall, Pearson, New Delhi.
- Gray,Larson, Desai; **Project Management: The Managerial Process**; 4 edition, McGraw Hill Education (India), New Delhi
- Meredith, Samuel, Mantel; **Project Management: A Managerial Approach**; Wiley Student edition, Wiley and Sons(Asia), Singapore.
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Unit - 8 Project Control Process

Structure of Unit

8.0 Objectives

After completing this unit, you would be able to:

- Understand the Project Control Process
- Performance management and controlling technique;
- Learn about Gantt chart and control chart;
- Know about Critical path and PERT;
- Learn about critical ratios;
- Understand the crashing.

8.1 Introduction

Project control is the process of controlling actual performance against plan to identify deviations, evaluate possible alternative courses of actions and take corrective decisions. 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. Project management control is not equated to authority control of project team and activities. Project controlling is like steering a ship towards harbor safely; making necessary changes on the way. Project manager is captain of that ship.

8.2 The Project Control Process

Controlling procedure need to address such questions:

- Are we on planned track?
- Are we on expected budget?
- Are we on planned schedule?
- Are we delivering what we said we would?

- Are we meeting quality and performance standards?
- Are we meeting stakeholder expectations?
- What have we accomplished?
- Will the project objectives be met?
- What deviations/variances exist?
- What corrective actions are we taking?

Table 8.1: Requirement of Project Control

Requirement of Project Control	
Performance Control	Unexpected technical problem arise
	Insufficient resources
	Quality or reliability problems
	Client require changes in specified system
	Inter-functional problems arises
	Technological breakthroughs affect the projects
Cost	Technical difficulties require more resources
	The scope of work increases
	Initial bid or estimate was too low
	Reporting was poor or untimely
	Budgeting was poor
	Corrective control actions were not taken timely
	Input price changes occurred
Time	Technical difficulties took longer than planned
	Initial time estimates were optimistic
	Task sequencing was incorrect
	Required inputs of raw material, personnel and equipment were unavailable when needed
	Necessary preceding task were incomplete
	Government regulation changes during the project

The project control includes project status reporting, schedule control, cost control, quality control and risk control. Controlling process consists of following steps:

8.2.1 Establish A Baseline of Measurement:

The baseline of measurement is actually represented by your project plan. This includes your control schedule, project budget, and any design or performance specifications related to project deliverables. The estimates embodied in these documents create the basis from which variance is measured. The success of project measurement and control depends on how accurate estimated baseline is? What if an estimate is wrong? What if an element of your baseline is a poor representation of what's actually achievable? In case of variance it is difficult to know who is responsible for variance, estimator or task performer. The baseline is derived from the cost and duration information found in work breakdown structure and scheduling decisions.

Measuring Progress and Performance:

Time and Budget are two quantitative measures. Many methods are available to measure these two. Qualitative measures (i.e. technical specification, production function, reliability etc.) are difficult to measure. Tracking time performance is easier than monitoring budgets. Some of valuable and essential control techniques are:

- Gantt Chart
- Control Chart
- Critical Path Method (CPM)
- Program Evaluation and Review Technique (PERT)
- Critical Ratios

Analyzing the Performance:

Almost all the projects need to be guided right throughout in order to receive the required and expected output at the end of the project. Project status report must be generated on every week or every month. Comparisons of actual and expected (planned) must be done for proactive correction.

8.2.2 Instituting Corrective Action Where Required

If project is significantly deviated from scheduled plan then corrective action must be instituted. Some time we need to change scope of project also in that case we need to rebuild baseline plan. It is better to take early corrective action to avoid extended time and budget.

Table 8.2: A Real life Project Progress

2 X 600 MW Rajiv Gandhi Thermal Power Project, Hissar (A Project by Reliance Infrastructure)
This is the second project awarded by Haryana Power Generation Company Limited (HPGCL) which started on January, 29, 2007. Against the aggressive schedule of 35 months for Unit-I and 38 months Unit-II, the project is progressing as per the planned schedule. The project has achieved 67.88% progress as on date. In achieving this progress, the significant highlights and milestones reached are: • Boiler Hydro Test for Unit No 1 has been completed successfully in 25th month from issue of Letter of Intent and in 23rd month from zero date of award of main plant contract. This was achieved in a record time in the Indian power sector.

- Dematerialized and pre – treatment plant commissioned in January 2009; Water filling completed in raw water reservoir No.1.
- Chimney Shell (275 m) casting completed to full height
- Cooling Tower No 1 with 173 m height, tallest in the country, has reached to its full height. Cooling Tower no 2 has been constructed up to 160 m height.
- Switchyard works are in full swing with 98% progress in engineering and procurement and 90% progress achieved in construction.

(Source: Reliance Infrastructure website, http://www.rinfra.com/)

8.3 Gantt Chart

A Gantt chart, commonly used in project management, is one of the most popular and useful ways of showing activities (tasks or events) displayed against time. Typically, tasks are shown on the vertical axis, and the project time span is represented on the horizontal axis. Each task has a corresponding bar that shows the time span required for that task. The bar can be filled in to show the percentage of the task that has been completed. Gantt charts also indicate dependencies, those tasks that are dependent upon other tasks. Gantt Chart represents:

- What the various task/ activities are?
- When each activity begins and ends?
- How long each activity is scheduled to last?
- Where activities overlap with other activities, and by how much overlap?
- The start and end date of the whole project?

Henry Laurence Gantt, an American mechanical engineer, is recognized for developing the Gantt Chart (Around 1910).

Table 8.3 Steps involved in making Gantt chart

Steps Involved in Making of Gantt Chart	
1	Understand the work breakdown structure
2	Gather necessary information about all steps or processes included in a project
3	Building Timeline: • How long each project step/process will take • Plot lengths for individual bars (individual process) • Situate these within the Gantt chart to arrive at a deadline for each element
4	Layout all of the bars on the graph
5	Evaluate dependency or relationship between phases/processes • Looking at the Gantt chart can also make it clear which parts of a project are dependent on others.

Figure 8.1 presents a Baseline Gantt chart for six activities. On the vertical axis six activities are shown and on horizontal axis time slots are shown. For example actual start for activity A is 0 time slot (first activity) and schedule end of activity A is time slot 2.

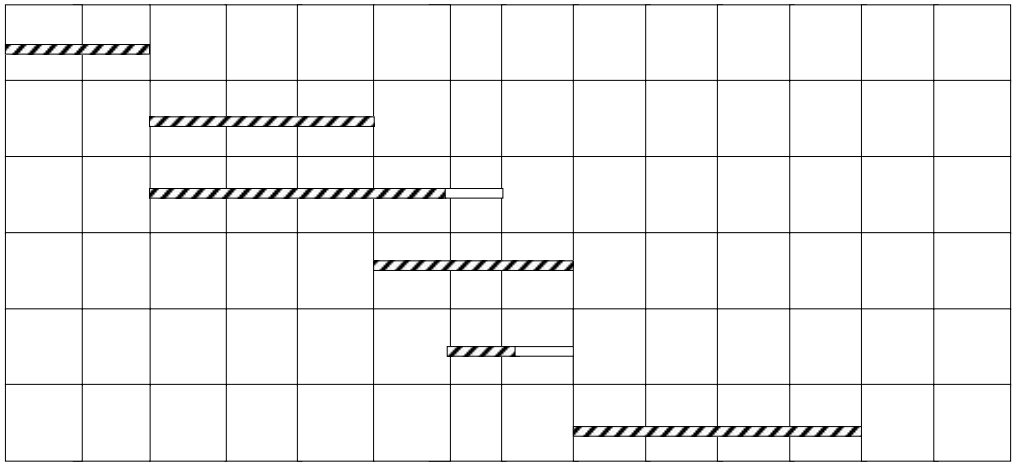


Figure: 8.1 Baseline Gantt chart

Figure 8.2 presents tracking Gantt chat for end of period 6. The Filled bars represent the actual completed task.

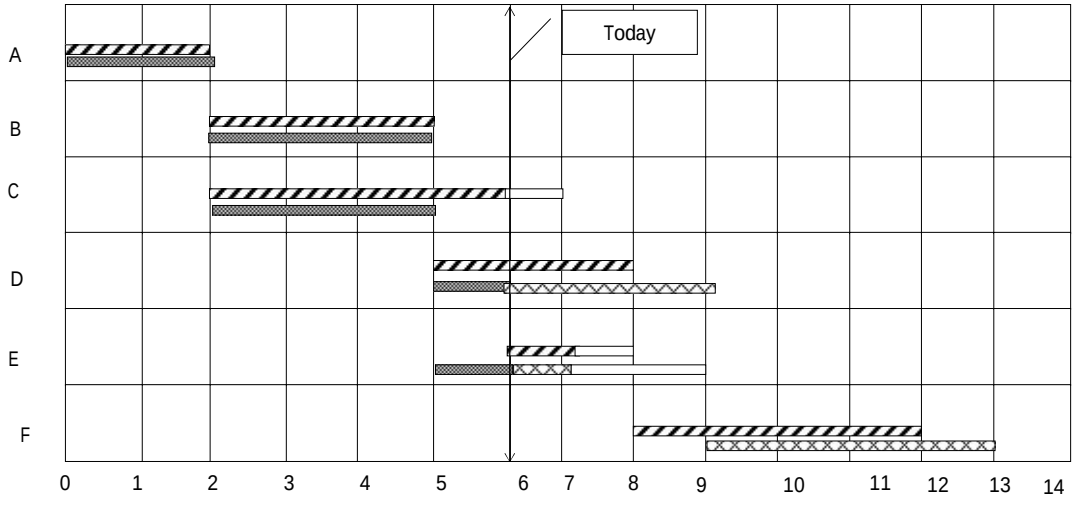
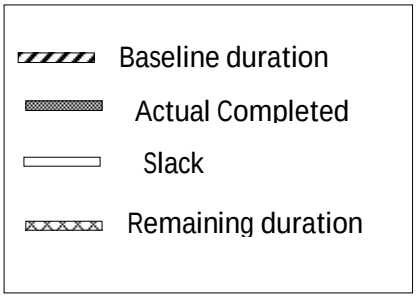


Figure: 8.2 Tracking Gantt chart



8.3.1: Gantt Charts – Summary

Good points

- Simple to draw and read
- Good for static environments
- Useful for providing overview of project activities
- Very widely used
- The basis of the graphical interface for most project planning software.

Limitations

- Difficult to update manually where there are many changes – charts can quickly become obsolete and therefore discredited
- does not equate time with cost
- does not help in optimizing resource allocation
- can lead to false sense of certainty about the project

10.4 Control Chart

Control charts are an efficient way of analyzing performance data to evaluate a project process. Control charts, also known as Shewhart charts named after Walter A. Shewhart. Every process has variation. Some variation may be the result of causes which are not normally present in the process. This could be special cause variation. Some variation is simply the result of numerous, ever-present differences in the process. This is common cause variation. Control Charts differentiate between these two types of variation.

The control chart is a graph used to study how a process changes over time. Data are plotted in time order. A control chart always has a central line for the average, an upper line for the upper control limit (for ahead from scheduled) and a lower line for the lower control limit (for behind the schedule). These lines are determined from historical data. By comparing current data to these lines, we can draw conclusions about whether the process variation is consistent (in control) or is unpredictable (out of control, affected by special causes of variation).

One goal of using a Control Chart is to achieve and maintain process stability. Process stability is defined as a state in which a process has displayed a certain degree of consistency in the past and is expected to continue to do so in the future. This consistency is characterized by a stream of data falling within control limits based on plus or minus 3 standard deviations (3 Sigma) of the centerline.
The control chart is used for:

- Monitor effects of the variables on the difference between target and actual performance of project.
- Analyze and understand process variables
- Determine process capabilities.

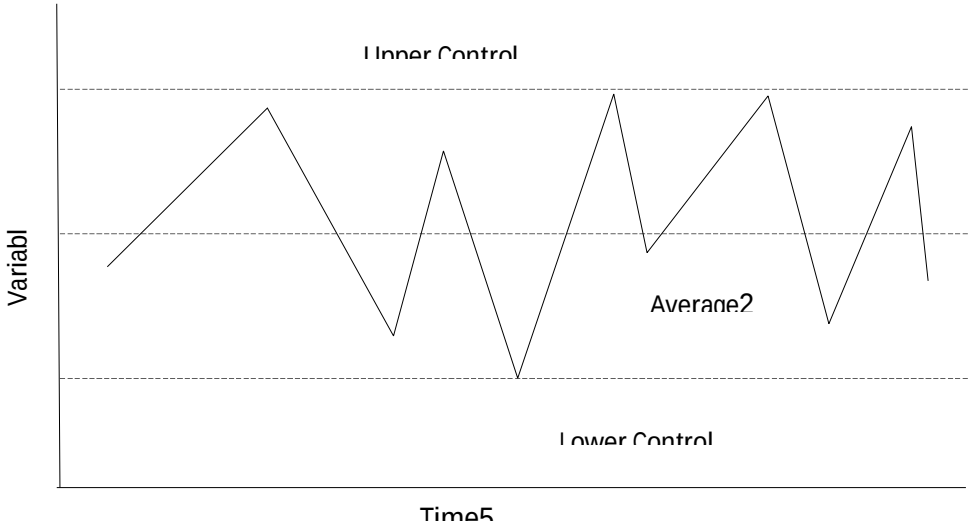


Figure 8.1: A Sample Control Chart

8.5 Critical Path Method

The Critical Path Method or Critical Path Analysis is a mathematically based algorithm for scheduling a set of project activities. It is an important tool for effective project management. Critical path method commonly used with all form of projects, including construction, software development, research project, product development, engineering and plant maintenance, among the others. Any project with the interdependent activities can apply this technique of scheduling.

Critical path method is based on mathematical calculations and it is used for scheduling project activities. This method was first introduced in 1950s as a joint venture between Remington Rand Corporation and *DuPont Corporation*.

The initial critical path method was used for managing plant maintenance projects. Although the original method was developed for construction work, this method can be used for any project where there are interdependent activities. In the critical path method, the critical activities of a program or a project are identified. These are the activities that have a direct impact on the completion date of the project.

CPM can be useful for:

- How long complex project will take to complete
- Which activities are "critical," meaning that they have to be done on time or else the whole project will take longer
- Depict a graphical view of project activities.

Key Steps in Critical Path Method:

1. **Identifying the key activities of project:**
   The Work Breakdown Structure (WBS) can be used to identify the activities involved in the project. This is the main input for the critical path method. Only critical, significant tasks are involved in CPM, including detailed tasks in CPM can make a complex critical path.
2. **Determining the Sequence of Activities:**

   In this step, the correct activity sequence is established. Following points need to be considered:

   - Which task need to perform before any other task (predecessor-successor relation)
   - Task are parallel task or sequential tasks
3. **Drawing Network Diagram:**

   Once sequence of activities is correctly identified, network diagram can be drawn easily. A circle represents the task and an arrow represents the flow of activities. Earlier paper-pencil were used to draw network diagram but now a days number of software are available.
4. **Time estimate for each activity:**
   The time required to complete each activity can be estimated using past experience or the estimates of knowledgeable persons.
5. **Identifying the Critical Path:**
   The critical path is the longest path of the network diagram. The activities in the critical path have an effect on the deadline of the project. If an activity of this path is delayed, the project will be delayed. To determine critical path, four parameter need to collect about each activity in network:

- Earliest start time (ES): The earliest time an activity can start once the previous dependent activities are over.
- Earliest finish time (EF): ES + activity duration (time length)
- Latest finish time (LF): The latest time an activity can finish without delaying the project.
- Latest start time (LS) - LF - activity duration.

  The *float* time for an activity is the time between the earliest (ES) and the latest (LS) start time or between the earliest (EF) and latest (LF) finish times. During the float time, an activity can be delayed without delaying the project finish date.

6. **Update CPM Diagram:**

   As the project progresses, the actual task completion times will be known and the network diagram can be updated to include this information. A new critical path may emerge, and structural changes may be made in the network if project requirements change. This gives more realistic figure for the deadline and the project management can know whether they are on track regarding the deliverables.

Project crashing is a method for shortening the project duration by reducing the time of one (or more) of the critical project activities to less than its normal activity time. This reduction in the normal activity time is referred to as crashing. Crashing is achieved by devoting more resources, usually measured in monetary terms, to the activities to be crashed. Project duration can often be reduced by assigning more labor to project activities, in the form of overtime, and by assigning more resources (material, equipment, and so on). However, additional labor and resources increase the project cost. Thus, the decision to reduce the project duration must be based on an analysis of the trade-off between time and cost.

CPM is helpful in:

- Project Planning and control.
- Time-cost trade-offs.
- Cost-benefit analysis.
- Contingency planning.
- Reducing risk.

Limitations of CPM:

- CPM assumes low uncertainty in schedule dates.
- Does not consider resource dependencies.
- Less efficient use of buffer time.
- Less focus on non-critical tasks that can cause risk.
- Based on only deterministic task duration.
- Critical Path can change during execution.

Critical Path Method Example:

The following table showing few activities and duration:

Table 8.4 : Task and Duration

Task	Successor	Duration	Resource	Lag
Task-1	Task-2	6	R1	0
Task-2	Task-3	4	R2	0
Task-3	Task-6	2	R3	FS+1
Task-4	Task-5	4	R4	0
Task-5	Task-6	4	R2	0
Task-6		8	R5	0

Following figure represents the network diagram for above problem:

Task#	
ES	EF
LS	LF

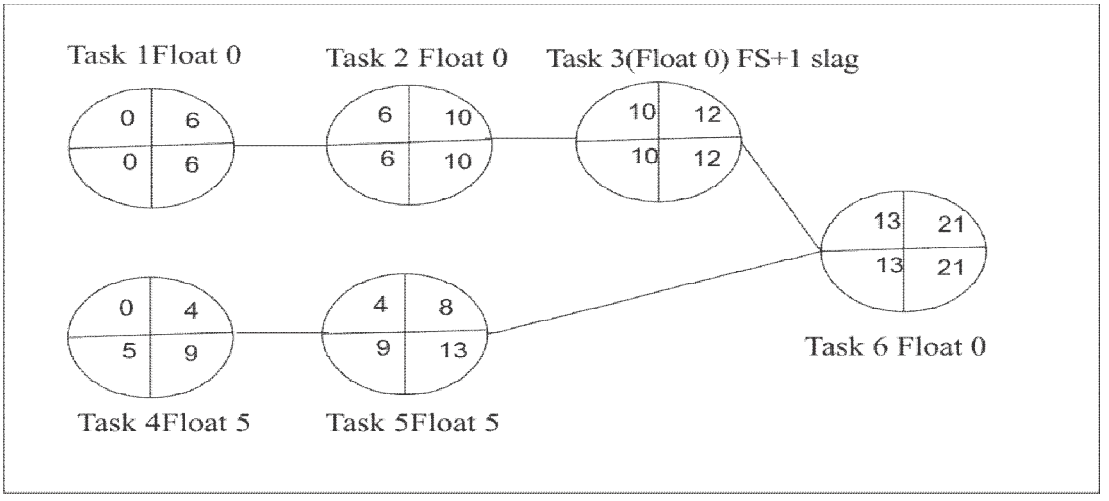


Figure 8.2: CPM Network

Critical Path = Task1+Task2+Task3+ Lag+ Task6 = 5+4+2+1+8 = 21 Days.

8.6 Program Evaluation and Review Technique

CPM assumes low uncertainty in scheduled timings. The Program Evaluation and Review Technique (PERT) is a network model that allows for randomness in activity completion times. PERT was developed in the late 1950's for the U.S. Navy's Polaris project. PERT is a variant of Critical Path Analysis that takes a more skeptical view of the time needed to complete each project stage. PERT process involves following steps:

- Specifying the task/activities
- Determining the sequence of activities
- Constructing Network Diagram
- Estimate the Time
- Critical Path
- Update the PERT chart

There are three estimation times involved in PERT; Optimistic Time Estimate (O), Most Likely Time Estimate (M), and Pessimistic Time Estimate (P).

Optimistic Time Estimate: This time assumes that everything will go according to plan and with minimal difficulties.

Most Likely Time Estimate: This is the time that, in the mind of the functional manager, would most often occur should this effort be reported over and over again.

Pessimistic Time Estimate: This time assumes that everything will not go according to plan and maximum difficulties will develop.

Estimated Time (T_E):

PERT assumes a beta probability distribution for the time estimates. The best estimate of the time required to accomplish a task, accounting for the fact that things don't always proceed as normal (considering uncertainty):

$T_E = (O+4M+P)/6$

At the same time, the possible variance (V) of the estimate is calculated as below:

$V = (P - O)^2 / 6^2$

Applying the PERT Method:

- For every activity in the critical path, T_E and V are calculated.
- Then, the total of all T_Es are taken. This is the overall expected completion time for the project.
- Now, the corresponding V is added to each activity of the critical path. This is the variance for the entire project. This is done only for the activities in the critical path as only the critical path activities can accelerate or delay the project duration.
- Then, standard deviation of the project is calculated. This equals to the square root of the variance (V).
- Now, the normal probability distribution is used for calculating the project completion time with the desired probability.

Advantage of PERT:

- Explicitly define and makes visible dependencies between the WBS activities
- Facilitates identification of the critical path
- Facilitates identification of start date, end date and slack time for each activity.
- The large amount of project data can be organized and presented in diagram for use in decision making

Disadvantage of PERT:

- Too many relationship and dependencies in activities
- Not useful for smaller projects
- When chart become unwieldy, they are no longer used to manage project.

Table 8.5: Summary PERT/CPM

Primary Objectives of PERT/CPM are:
Best Time
Least Cost
Least Risk

Secondary Objective includes:
Studying alternatives
Optimum schedules
Effective use of resources
Communication
Refinement of estimating process
Ease of project control
Ease of time or cost revisions
These objectives are limited by such constrains as:
Calendar completion
Cash or cash flow restriction
Limited resources
Management Approvals

8.7 Critical Ratios

Schedule Performance Index (SPI) and Cost Performance Index (CPI) ratios are critical tools in project management. The budget (Cost) and the schedule (Time) are two important considerations in any project, and since projects that overrun budgets and time frames are not viable for organizations. SPI and CPI ratios are generated from Earn Value System.

Schedule Performance Index:

The ratio of schedule efficiency that indicates the percent of work performed out of the total work scheduled. A number less than 1 indicates that the project is behind schedule. SPI= EV/PV

Cost Performance Index:

The ratio of cost efficiency or value earned per unit actual cost. A number less than 1 indicates that the project is spending more money than budgeted.

CPI= EV/AC

Lastly, compare the schedule and cost performance indices to each other to determine the

Critical Ratio (CR):

CR = SPI x CPI

Where:

SPI= Schedule Performance Index

CPI=Cost Performance Index

EV=Earned Vale (Budgeted Cost of Work Performed)

PV= Planned Value (Budgeted Cost of Work Scheduled)

AC=Actual Cost (Actual Cost of Work Performed)

The Schedule Performance and Cost Performance Indices are wonderful management tools to help ensure that your projects are on track and stay that way.

Table 8.5: Hyderbad Metro Rail Project

Hyderabad Metro Rail Project: Introduction
Based on a number of Traffic and Transportation studies conducted by various agencies, Government of Andhra Pradesh (GoAP) approved development of Hyderabad Metro Rail (MRTS) project in three high density traffic corridors of the city spanning across 72 km in phase-I. Detailed Project Reports (DPRs), Traffic Survey Reports, and other related reports were prepared by Delhi Metro Rail Corporation (DMRC) for the project. The three corridors spanning a length of approximately 72 km to be taken up in phase-I are as under. Corridor I: Miyapur – LB Nagar : 29 kms; 27 stations. Corridor II: JBS – Falaknuma : 15 kms; 16 stations. Corridor III: Nagole – Shilparamam : 28 kms; 23 stations. The Metro Rail system under construction is a completely elevated system, generally run in the central median of the road. The viaduct structure for the elevated system is a box girder carrying two tracks on a single pier located on the median of the road. The track gauge is a Standard Gauge (1435 mm) and the electrical traction is 25 kV AC, 50 Hz overhead traction system. The signaling system caters to the needs of a designed speed of 80 KMPH, with state-of-the-art features consisting of Automatic Train Control (ATC), Automatic Train Protection (ATP) and upgradation facility to Automatic Train Operation (ATO). The system is designed to cater to 50,000 PHPDT for Corridors I and III and 35,000 PHPDT for Corridor II. It will have to be built, operated, maintained and transferred at the end of the Concession Period as per the provisions of the Concession Agreement. The performance specifications and safety standards are enunciated in the Manual of Specifications & Standards (MSS), a well deliberated and published document of GoAP, based on "output oriented" performance philosophy. The miss provides scope for enough design flexibility and innovation, and it forms part of the Concession Agreement.

8.8 Summary

The control process assures that reality meets expectations or plans. Control process involves keeping project activities within limits to assure that certain outcome will in fact happen. Control process is directed to Budget and Time controlling. Controlling the project refers to the actions that we take as the project manager to ensure our project progresses according to the plan and actions we take when a change to the original plan is required. The purpose of the Gantt chart is to illustrate the relationships between the activities and time. Control Chart is a measure of performance- commonly a quality characteristics-over time, showing how it changes compared to a desired mean (average) and upper and lower limits. Critical path is longest activity paths through network. Critical path method (CPM) is a scheduling method based on the estimates of time required to complete activities on the critical path. The method computes early, late and slack time for each activity in the network. CPM is applied to project with low uncertainty. It is common in project management that additional resources are used to either speed up some activities to get the project back on schedule or to reduce the project completion time. Late penalty costs, monetary incentives, cost savings, or strategic benefits are some of the reasons for shortening a project completion time. Crashing an activity refers to the speeding up or shortening of the duration of an activity by using additional resources. These include overtime, hiring temporary staff, renting more efficient equipment, and other measures. Project crashing refers to the process of shortening the duration of the project by crashing the duration of a number of activities. Since it generally results in an increase of the overall project costs, the challenge faced by the project manager is to identify the activities to crash and the duration reduction for each activity such that as the project crashing is done in the least expensive manner possible. Program Evaluation and Review Technique (PERT) is applied mostly to projects characterized by uncertainty. It used beta probability distribution to calculate estimated time for tasks. Critical ratio is generated from earn value analysis. It comprises of scheduled performance index and cost performance index.

8.9 Self-Assessment Questions

1. What do you mean by “Critical Path Method”? Explain in detail.
2. What is difference between PERT and CPM?
3. What is crashing? Describe various reasons why companies consider crashing?
4. What is schedule performance index and cost performance index?
5. What is float time?
6. What are the advantages of Gantt chart?

8.10 Reference Books

- Harvay Maylor; **Project Management**; fourth edition, Prentice Hall, Pearson, New Delhi.
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Unit - 9 : Managing Risk

Structure of Unit

9.0 Objectives

After completing this unit, you would be able to:

- Understand the term Risk in Business
- Understanding the term Risk Management
- Indentifying the Major Business risk exist in India
- Indentifying the Risk Management Process
- Analyzing the Risk Management Tools
- Analyzing the current Risk Management process in India

9.1 Introduction

After 1991, the Indian economy was liberalized and India became the hot destination for foreign nations for the investment and India secured a benchmark on global business destination. Initially, the nation was considered as profitable for business if basic amenities were present there such as low labour cost, availability of labour, infrastructure and freedom of doing business but now; there are certain other factors which have been taken at utmost attention before opening up any business entity in foreign nation. These issues may not be visible initially but can affect in the long run. The issues can be loss of time, manpower, inventory, capital etc which may harm the business entity in such a way that, it could result in total failure. As India is hot destination for investment, the Indian manpower must have knowledge to manage the foreign projects, which will brings revenue and new opportunities to the country. The project management not only brings money and new jobs but lot of tensions and risks also, which have to be eradicated at early stage. The liberlization not only invites foreign projects but the Indian projects are also invited at foreign nation and the Indian company sends specific manpower along with the idea to foreign nation, who must take responsibility to establish and run project over there.

9.2 What is Risk Management?

Risk management is the identification, assessment, and prioritization of risks. This is coordinated and risk appraisal for economics to be carried out for resources to minimize, monitor, and control the probability and/or impact of unfortunate events, Also to maximize the realization of opportunities. Project risk management is an important aspect of project management. Project risk can be defined as an unforeseen event or activity that can impact the project's progress, result or outcome in a positive or negative way. Risk management is "A systematic process to secure the concern's revenue source and capital which could happen due to potential loss and continue the purpose of business entity."

The above statement of Benjamin Franklin states that, only two things are sure, which cannot be avoided, one is death and other is taxes and rest all the things and situations are uncertain. Before implementation of any business idea, now the business houses considers the potential risks and analyze the both, negative and positive aspect of risks. Now a day, Risk management became the core strategic activity of any business enterprise where the concerned organization's strategic team identified the potential risk elements and develops the plans accordingly to mitigate the losses attached with the business activity and achieve the planned business benefit from the portfolio of business activities. During the analysis of risks, it has to be taken care that, potential risk can cause only losses and proper loss management tools have to be considered to analyze the risks.

We have seen ample examples in India, that, whenever the government or any company launches a project, then that project either get approval easily otherwise the project has to move from long stage of approvals. During 2006-2008 period, TATA launched its dream project of NANO CAR in West Bengal but the political leader Mamta Bannerjee protested against that project and finally, TATA has to withdrew from West Bengal even after huge investment and later on Gujarat invited TATA's project and supported them for establishment also. Now, Gujarat is considered as most successful and industrial state.

9.3 Risk Categorization

As per the report presented by IRS and FICCI jointly, the risk has been categorized in three different ways i.e., Strategic, Operational and Safety risk hazards.

A. ***Strategic Risks*** **-** refers to at current and future imaginative risk which may affect the profits or revenue source of organizations. Strategic decision may affect the business decisions adversely. Strategic Risk consists of the following elements-

Political and Governance Instability- Newspapers, media agencies and other international experts have clearly highlighted the weaknesses of Indian government and other political parties rather than supporting them. The discrete information system and increased political parties have developed the political issues rather than solving them or

diluting them. The political and governmental situation became miserable at centre as well as at state level.

One of the known international credit rating agency rated Indian political system as negative and falling and after few more months in 2012, the same agency rated the system as poor, downgraded and non-reliable. The credit rating agency has explained the reason for such ranking was because of red-tapism and corruption as one of the important reason.

Although, Indian government tried its best to boost the economy by mobilizing Liquefied Natural Gas (LPG), Foreign Direct Investment in retail sector and controlling the prices of all fuels etc. India not only tried to improve the investor's confidence but also improved the dollar situation which became miserable once.

During the financial year 2012, the economic situation of India was already very poor and during that time, certain foreign organization closed down its operation and gave push to Indian economy towards the worst situation. As per the report, the companies such as Newyork life, US Mutual fund giant, Fidelity worldwide investments have closed their operations in India because of economic downturn, corruption and bribery system. In fact during June 2012, the foreign nation withdrew their capital by 28% and FDI became slow by 67% as its all time highest. As per certain experts, the global experts and investors were keep on batting about the financial situation and its economic downturn and they were least expecting the revival of economy.

In real estate sector, where one group housing project runs for more than 4 to 5 years and during these period various things affects the development stages. In fact, whenever any huge group housing project is launched then various governmental approvals has to be required from various government departments. Usually, it has been cases that, one particular government supports any particular project development and if in this meanwhile, if any other government comes in operation, then the new government sometimes try to de-support the project development by imposing un-usual rules and regulations.

Terrorism and Insurgency- as per the law, there is no scholarly definition available for terrorism and also there is no explanation regarding its existence as well as the intensity of threat posed by it. Although, the simple explanation is made, as the Terrorism refers to group of trained people who are motivated by any political party to act against the benefits of military or non-military population to coerce the government and individuals and India is facing terrorism from two different parts, international terrorist groups are active along with this local insurgency is also common. The international terrorist groups are active in border area or Islamic regions such as, Jammu and Kashmir, Rajasthan border area and the local insurgencies are active in north-eastern states such as naxalites etc. Although, Naxals or North eastern insurgents operates in their boundary area only but they are capable enough to affect the outside regions also.

Various Naxalites and local insurgents have been identified in the metro cities also and they have been arrested. It has been checked that, Naxals plays important and influencing role in mining areas and mining businesses. They are capable enough to put

the risk of attacks and involve in land acquisitions also. As per the intelligence agencies, the terrorism and insurgencies are as below in current state:

- The new terror group's thought and structure is based on religious fundamental.
- Insurgent groups' targets potential influencer from society in spite of attacking over government or military.
- Such groups are penetrated among local population.
- Usage of weapons and tactics are more sophisticated.
- The terrorist groups are highly educated and motivated manpower.
- Suicide bomber attacks have been reduced and new techniques have been involved.

Business houses gets badly affected by such terror attacks, as during the attack on hotel Tajmahal, the Indian Hotels organization lost its revenue in millions after 26/11 attack, government realized that, business houses are also prone to such terror attacks and after that only, government allowed Central Industrial Security Force (CISF) to guard the business house. Although, Infosys was the first Indian company which appointed CISF personnel in its Bangalore campus in July 2009 and later on 6 other private organizations have deployed more than 900 CISF personnel for their business establishment protection and now more than 100 organizations wants such personnel for their business units. As per the report, currently, Wipro, Essar, L&T, HDFC bank etc and various other organizations have applied for CISF protection. CISF is the government organization which provides certain specific functions such as Bomb disposal squads, Dog Squads etc and these facilities cost extra to the companies who entails these specific services. Other than CISF, now private security agencies are also offering security services across the nation to cater the requirement of corporate world. These private security agencies are equipped with services such as, Executive protection, securing company's property, security consulting etc against any threat possibility.

Natural Hazards- Natural Hazards are considered as certain negative event which occurs naturally without being advance information and have great intensity to impact the people as well as environment. Such natural catastrophic events occur due to gradual change in climatic conditions and even due to certain man-made factors also. The natural hazard trends have been started in India since last decade, where various catastrophic disasters have claimed human lives as well as environmental impact.

During the year 2012, the natural calamities such as floods, storms, earthquakes, cyclones etc have claimed flora and fauna of Indian environment. During the year 2012, India faced approximately 22 flood cases and 36 incidents of earthquake have been noted and during the year 2013, almost 40 cases of earthquake have noted, although, no major damage been occurred to human life and environment but there are chances of increase in intensity of major earthquake for which India is not prepared. Other than this, lots of landslide cases been noticed and majorly, Uttrakhand was recorded as one of the worst hit area in June 2013, with end of lot many villages. As per the Uttrakhand

government report, it was the loss of INR 12,000 Crore. Such disruption or activities against the climate cause imbalances and ripples among the business sector and industries tend to find solace and comfortable zone in terms of their employees, customers, partners etc. Uttrakhand lost most of the revenue from tourism and the tourism of Uttrakhand was badly spoiled in cyclone and flood of June 2013. As per the report of Oxfam, India loose 9-13% of GDP every year only because of natural disasters and due to which the overall GDP of south Asia gets affected. Moreover natural disasters claim infrastructures, such as transportation, power, communication etc which is the most important for any business house.

B. ***Operational Risks*** is the risk which happens due to in-efficiency of organization's internal activity done. The risk happens due to internal politics between the office staff along with system in-efficiency etc. Such risks are :

Information and Cyber Insecurity- Technological advancements is required for the business boosting but this benefit is equally enjoyed by cyber criminals also. As per the report of Norton Cyber crime report, 2012, approximately 42 million people were affected by the cyber criminals and it was a loss of $ 8 billion all over world. As the technology has became advance and everyone is handy with mobile phones, laptops, tabs etc, and this technology have been supported by various social networking sites. Experts states that, cyber crimes attacks moreover to individuals or particular groups mainly.

Foreign cyber criminals have attacked various government websites and hacked important e-mail accounts and stolen secret information from websites of government departments. AS per the Government of India websites, during the year 2012, approximately 14000 websites have been hacked and out of these 14000 websites, 300 websites belongs to different ministries and governmental departments. As per the Computer Emergency Response team, the IT hacking cases have been increased by 60% more than the previous years, and India is considered as top five nations which is mostly attacked by foreign nations. The nations which have been reported to attack the other nations are Pakistan, China, Brazil, Russia, Spain etc.

Other than information theft, the other e-fraud considered as net-banking data theft, money laundering or other financial e-frauds. As per the data of Delhi police, every year more than 200 cases of net baking occurs in India but only few of them use to actually reported, more than INR 30 crore have been lost during last year by Indian customers by the means of credit card data theft and any foreign syndicate is expected behind such things. In the year 2009, the known bank became the victim of cyber crime and lost INR 130 crore by the way of cyber criminals and as per Ministry of Finance; India registered the maximum number of ATM, Debit Card, Credit Card or net banking frauds which were 32,928 cases including 50 nationalize banks. Now, to close down such e-cash frauds, now Reserve Bank of India has mandated certain new regulations where some more authentic information have been asked in form of ATM pin during card payment. This move has controlled the fraud at some limit but not completely.

Other than information theft as well as money theft, the other way to mis-use the technology by spreading rumors. As it has been noted that, during August 2012, mass message have been spread among the people regarding attack expectation on north-eastern people and they were expending towards their own native place to secure themselves.

Corruption and Bribery- India was ranked at 94 among 176 countries in terms of corrupt nation perception index released in 2012 and in 2011, it was considered at place 95 out of 186 nations. India has scored such low marks because of its recent increase in scams and corruption incidents happened in India. In fact, Indian public itself have voted the corruption as biggest problem of nation in NDTV's survey during the general election poll. This problem is bigger than the problem of poverty in India.

Frauds comparison Table

Type of Fraud	Global %	India %
Management conflict interest	21	19
Internal Financial Frauds	19	23
Corruption and Bribery	19	31
Vendor Procurement	20	22
Theft of Assets	25	23
Stealing of Information	23	27

*Source- FICCI, India Risk Survey, 2013

Reserve Bank of India states that, due to corruption, Bribery and other frauds, Indian banks have faced various financial losses, in fact during 2012, the total loss suffered by banks was of INR 4500 crores with approximately 5500 cases of reported frauds. Due all these frauds and scams, Indian business suffered by INR 65,000 crore in year 2012 where 44 scams have been caught in public sector units involving thousands of crore loss to public. Media has regularly reported the violent and serious attacks as result of frauds and scams.

The companies who are more into traditional accounting procedure are involved into fraud act where as the organizations which have implemented modern techniques with new human values using mix technology are working under low budget but with better control over fraud acts. As per the survey, it has been checked that 85% of the organizations which faces decline in their operation is all because of internal fraud mechanism.

In fact, recently, due to recession of 2012 and 2013 showed that, companies were downsizing heavily to detect the frauds and fraudsters whereas the private organizations are more interested in solving their issues internally without involving any other external

or governmental party and are simply throw out the fraudster in spite of taking any strong action against them. The losses developed of such actions are internally absorbed and no reporting is to be done by private organizations.

As we have already discussed when a real estate project is launched then the development phase lasts for minimum 4-5 years, which may extent accordingly. But, once the project land is finalized but before the start of development, the developer has to get approvals from minimum 20- 25 government department and the approvals speed depends upon the amount of bribe and gifts to the officials and other middleman involved in deal.

Business Espionages- Business espionage is the practice which is inspired by the ancient ruling techniques of kings in India. The basic structure of espionage is the same but the implementation method has been changed. Now, espionage method is prevailed in almost all the industry, be it security, financial or any other business house and applicable in all economies.

Business espionage refers to theft of secret, confidential information from any organization or business house without being informed to the respective person of that organization, with the aim of obtaining advantage by affecting that organization negatively. As now, the competition is increasing and in such cut throat situation, companies try to put espionage activities against their potential competitors and create the niche in the market. The information which the company may look as advantageous for them may be client list, new technology implementation, project detail, marketing strategies etc and such activity may cause heavy monetary loss to Espionage Company.

As per the report presented by known spy product selling company, the spying gadgets are in high demand now a days and its sales have been increased by 30% more since last few years and the market or such product manufacturer is around INR 4500 crore. Although, no organization disclose about their information leakages or obtainment of information it is sure shot that, such information and activities are supervised by the top management or officials of the company. Usually various companies, try to take certain actions to stop the espionage against them, as now a days, such espionage activities are done by installing technical instruments but the companies use to do technical surveillances to counter these attacks.

As the competition has been increased in business market and everyone is in process to save his pie of profit and in such situation, the moral values and ethics related to business and healthy competition lose its importance and espionages have became increasingly in fashion by various methods. The espionages may be done by the way of various activities like, poaching, plantation of moles, collection of competitor's information by illegal means, stealing the IPR etc. Espionage activities are considered as new age risks which may affect both organizations and economy as a whole and effective steps have to be taken to prevent these activities.

Intellectual Property Right Theft- Intellectual Property right refers to creation of fresh and original piece of idea and inventing something new and different artistic symbol, images, any design etc and getting that secured under IPR act. Sealing of IPR is very

easy, as it require only copying the idea or design of manufacturer and producing the counterfeit products, drugs, pirated DVDs etc which violate the IPR act.

As the cases of theft of IPR have been increasing and with the same rate companies are losing its actual profit and employees are losing their jobs. AS per the report World Health Organization, world's largest part of drug supply is based on fake pharmaceutical companies who imitate the drug production of IPR protected companies and the piracy is increasing in music and movie world and people usually use pirated software in their computers. Now, counterfeited auto parts and vehicle parts are also increasing day by day.

IPR Theft %

TYPES	CATEGORY	%
Data Base Server	Server	48%
File Server	Server	32%
Finance/ Accounting personnel	People	29%
Human Resource personnel	People	29%
Documents	Offline Data	28%
Regular Employee/ End Users	Offline Data	28%
Web/ Application Server	Server	25%
Mail Server	Server	12%
Directory Server	Server	6%
Executive/Top Management	People	6%
Desktops/ Workstations	User Devices	5%

Source- MacAfee, Threat Report 2012

IPR laws in India is not much effective and there is no actions which can be taken against IPR stealer in terms of monetary penalties, claimant of damages or criminal prosecution etc. the counterfeit producers not only damage the actual corporate producer but it also affects the GDP of country. As per the report of FICCI in 2012, the counterfeiting product market and smuggling market is worth of INR 26,190 crore annually and at global level the IPR have been seized in FY 2011 was 24,800 and in year 2012 were 22,850.

C. ***Safety Risk*** is the risk which is associated with loss of human life either during the work or outside the company. Any risk or threat to employee safety may result as security risk. Safety Risk consists of the following-

Fire- Fire tragedies are common in India and it has the capability to vanish the complete business unit and in fact since last few years, these incidents have claimed lot of innocent lives and property damage. Fire not only devastates the business but it also washes the goodwill of company. Damages in Industries due to fire not only limit to industry and business units but it affects the adjacent units also and has severe environmental effects.

During the year 2010-11, as per the report of FICCI, 22,187 fire cases have been reported and 450 people lost their lives and 2600 persons were injured across the nation. In, India, building fires are very common and the chances of building fires became very prominent because of accumulation of combustible substances, lack of water and lack of fire fighting equipments etc. The possibility of fire incidents are more prone in hot and dry seasons such as March- June due to naked wires and loose joints. The possibility of fire incidents are supported by small short circuits sparks etc which causes major disaster in buildings. Air-conditioning systems in multistory building adds the risk of fire. In May-August 2012, 9 major fire accidents happened in India where lot of revenue has been lost.

The fire incident intensity reduces in winter months, but risk from fire is still the major cause of damage in business and corporate houses. As per the report by Fire department, in Mumbai only, 75% of the fire cases happens because of short circuit or loose wiring and the report further states that, the short circuit because of loose wiring happens mainly in old buildings with dense population and crowded markets.

General public are not much equipped or trained to deal with fire accidents, although there are various rules and regulations which are suppose to be followed for fire safety but these rules are not generally followed. As per the report of Ahmadabad Municipal Corporation, in November 2012, there are no heavy penalties or fines which can be imposed against the defaulters in fire safety measures and due to this negligence, the cases of fire incidents are rising.

Crime- Increasing crime rate is the major hurdle to any economy and safe and secure environment is required for healthy business and industrial life. But since few decades, Crime is became the integral part of India and now people have also accepted this situation as like it is in their veins. Crime not only affects the individual personally but it also affects the society as whole and a recent survey states that, the presence of crime in work place lead to 65% decrease in productivity. Not only this, the result shows that, if the incident happens at distant place also, then also, the productivity of the individual gets affected and they lose their concentration and motivation. The same study showed that, after a criminal incident in an office, the absenteeism of female workers became increasing the male employees were working under stress and anxiety.

The increasing crime rate in India compelled various business houses to engage security agencies to provide the protection cover to office employees and the police have also directed the company authority that, they have to make necessary registration of cabs and the cabs have to be equipped with GPRS systems, so that there should be no lack of security. In fact, the BPOs and call centres have been directed that, either they have to provide the right security to female employees or they should ban the night shifts of female employees. Karnataka was the first state which banned the female employee's night shift due to rising crime rate in state.

Other than crime against women, various kidnapping and abduction gangs are active in India and their criminal activity have been increased by 1.7% since last few years. As per the report by governmental intelligence bureau, currently more than such 700 gangs

are operating in our country. The Indian governmental data fact reveals that, crime in India has increased by more fast pace than the economic situation. As per the census comparison of 2000 and 2011, the crime rate has been increased by more than 25% and that is majorly against the women. The rape case has been grown by 47% and second comes dowry deaths and molestations etc. Theft cases have also been increased but murders and robbery cases have been decreased with little %. Currently, on 15 Jan 2014, one Dutch woman has been gang raped in Delhi which has affected tourism industry.

Work Place Violence and Sexual Harassment- As per the definition of International Labour Organization, work place violence refers to anything which may fall under homicide, rape, kicking, biting, punching, harassing, sexual abuse, racial abuse, name calling, deliberate silence etc.

Workplace violence is not a new trend in India and in last few years, India was victim of such cases which topped the headlines of international agency. In fact in July 2012, itself, one HR manager of Maruti Suzuki Manesar plant was mobbed and killed in office premises itself where 40 others were injured badly. The same cases have been noticed in Indian army also where there were various clash case between officers and soldiers. Workplace violence and dis-satisfaction is common in healthcare sector, where the number of incidents have been noticed of their strikes. In Jan 2013, all the senior residents of Bhabha hospital, Mumbai went on strike and one patient died out of negligence, which resulted in violence by the family members of dead.

During last four years, Delhi police have filed the charge against 30 police officials who are from the range of Assistant Police Commissioner to Constable who were involved in sexual crimes. In fact in August 2012, air hostess of MDLR airlines, Gurgaon committed suicide because of sexual harassment by CMD of the company. As per the survey of Sexual Harassment at Workplaces in India, 2012, the report states that 17% of the female employees admit openly that, they have faced sexual harassment at work place and there are three work areas which are extremely unsafe for females but mostly females are employed in those areas, i.e., Casual Laborers, Domestic Help and Small scale manufacturing industries and majority of the survey people admitted that, females who are working in un-organized sector are more prone to face sexual harassment and they bear such incidents because they do not have legislative knowledge against such cases.

Indian parliament passed a law against sexual harassment on 26 Feb 2013, where the law states that, sexual harassment against any female including domestic help has to be dispose off within 90 days of complaint otherwise INR 50,000 can be imposed against them as penalty and if the same negligence been noted again then the license to do the business can be cancelled.

Accidents- Accidents can be segregated in two different categories, one is Commuting Accidents and other is Occupational Accidents. As per the Ministry of Road Transport & Highways, with in every one minute one road accident happens and in every three minute one person loses his life in road accidents. As per the record, nearly 497000 road accidents have been reported in year 2011 and out of which 142500 people lost their

lives. The reason of such major accidents is because of driver's fault and only very few of them happen because of bad road conditions.

In year 2011, Maharashtra, Tamil Nadu, Madhya Pradesh and Karnataka witnessed the maximum number of road accidents and it has been noticed that, rural areas are more prone to accident as compared to urban areas. The report of road ministry reveals that, major road accident claims young lives. 51% of the accident victim falls in the age group 20-40 years old and according to report of World Health Organization, in year 2012, India lost $ 20 billion because of road accidents.

The second category of accident lies in India due to occupational accidents. The occupational accidents happen if the employees are open to occupational risk which may lead to accidental death, serious injury or any occupational diseases.

As per the report of Global estimates of occupational accidents in the year 2005, approximately 50000 workers lose their lives in occupational accidents and most of the workers die in construction industry. Although, India do not have reliable source of such occupational accidents as these accidents are not common.

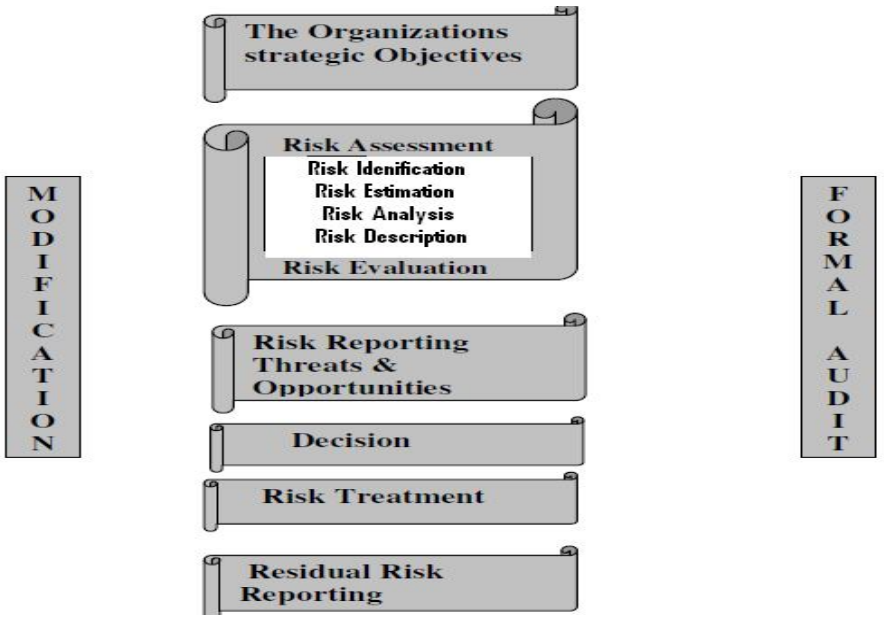
As per the survey of Health ministry, the worker dies due to occupational ailment in spite of occupational accidents. As most of the employees are open to various pollution categories who work in cement or ceramic industry and 22% of the worker gets affected by asthma working in DDT industry and the unorganized sectors are more pronounced to occupational hazards.

9.4 Risk Management Process

Risk management process refers to taking certain steps which may provide the framework to eradicate the risk completely or upto certain level.

- The business decisions and planning should be based on proper calculation, comprehension and making structured understanding of business activity and projects from all round analysis.
- Apply more efficiency based resources and make the business premises more spacious and protected against threats.
- Remove volatile material from combustible area, if such products are not usually required.
- Safeguard the company's assets and goodwill against any posed threat.
- Develop the knowledge group, which can have workshops and fake demo against any natural calamity.
- Operational efficiency must be optimized and try to reduce the wastage.

Risk Management Model



The business house faces external as well internal risk within the organization and the model states the actual shows the examples posed by both the factors and these factors can be further classified on the basis of simplicity and department wise.

9.5 Risk Assessment

Risk assessment is one of the major concern which have to be taken care during the development of any project because, if the risk is not asssessed at the right time then the whole project development may end up nowhere resulting into losses in million or billions. Any project has to assessed from three different angles:

Identify Uncertainities – The project manager has to draw the complete project plan and need to mark all the areas where there may chance of arising of any un-certainity or slag in whole development process. For example, in development of real estate project, the project manager has to draft the complete development plan and must mark that what area may be issue in further project development. The areas could be, Non-availability of construction material, non-availability of required labour, sudden change in governmental plan, uncertain market news, Sudden Incraese in cost of construction material etc.

Analyze Risks- Once the project manager indetifies the expected risk area in project development plan, after that, the project manager has to anayze each risk slag from the view point that, how that is going to impact, completion period, cost, reputation, end-users expectations from the project. For example, if duirng the development of real estate project, if the cost of construction materail increases then how that is going to affect the overall cost and profitability structure and if the development process get slow due to shortage of required labour then how that is going to affect the overall development period.

Prioritize Risks- The project manager once identifies each risk probability and also analyze that, how those risks is going to affect the project development, on the basis of all the above, the project manager has to prioritize the risks. For example, in real estate project development, the major issue for the project manager may be the change in governmental rules and regulations, which may or maynot affect the development process very badly and, so this issue may be prioritize by the risk manager at top and try to search out the alternative solution too. And if in case of non-availability of construction material, the issue is major but may come on second or third number on priority list and the project manager has to search out the alternate soultion too.

9.6 Risk Assessment Tools

Monetary Tools

Risk can be assessed on certain financial terms, because in any project, the final financial benefit is the major measurement source of the success of project implementation. The project's risk can be assessed on three basis:

Payback Method- Payback method is one of the major method which is usually applied by financers of projects before financing the project development. The project investment is accepted or rejected on the basis of payback method. This method describes in how much period, the project will be able to payback the money invested. The formula to calculate the Payback Method is:

Payback period = Invesrment required for a project / Net Annual Cash Inflow

Risk Premium Method- Risk Premium method are generally used by top management in the organization because the calculation focuses on individual's perception towards the project invesment and investment risk. But, this method is usually applied in financial proejcts rather than brick and mortar projects. But, still the top management use this method to satisfy their personal requirement and assessment. The formula to calculate the method is: $E(X) = \sum xP(X)$

Certainty Coefficient Method- The another method to deal with long term project investment is to reduce the forcasting of cash flow at each investment level. For example, if investor has estimated that Rs. 6 Billion is required for next years, then he must play safe game by investing only 4 Billions. The formula to calculate the certainty cofficient method:

Certainty Coefficient Method = [(The Risk Adjusted Factors) X (The Forecast of net cash flow) / (1 + Risk Free Rate)]

Net Present Value- Net Present Value can be explained as the sum of the discounted cash flow minus the initial original investment.

$$NPV = Investment + CF_1/(1+K)^1 + CF_2/(1+K)^2 + \ldots\ldots\ldots\ldots\ldots CF_n/(1+K)^n$$

If the result of NPV is greater then 0 then the project is acceptable, otherwise the project is rejectable.

Benefit – Cost Ratio- The BC ratio refer to the projected monetary benefit with respect to cost and all the profits and expenses are presented in discounted present value.With help of BCR, the project manager can easily calculate the expected monetary benefit against the cost involved in the project.

BCR = Discounted value of incremental benefits / Discounted value of incremental cost

All the projects can be accepted if the BCR is greater then 1 otherwise the project may be loss making entity.

Internal Rate of Return – The IRR is the rate of return at which the project's NPV is equal to zero and the cash flow of project is equal to project's cost. The management has to set the 'hurdle rate" as the minimum acceptability of the project.

$$0 = \text{Investment} + CF_1 / (1+IRR)^1 + CF_2 / (1+IRR)^2 \ldots\ldots\ldots\ldots\ldots\ldots .. CF_n / (1+IRR)^n$$

If IRR is greater then hurdle rate, then the project is acceptable, otherwise the project is rejected.

Non-Monetary Tools

Financial risk in the project during There are various risk assessment and risk management tools are available but to protect the industry against prone risk, certain steps or tools can be implemented.

Basic Risk Audit- The first step in any business risk audit is to search out what can be the potential risk in their business and segregate list has to be compiled on the basis of bad risk and very bad risk. Both lists have to be compared and design the futuristic report as per the assessment adopted by Insurance Company.

Office Premises Safety Risk Audit- The business house can hire the external consultant who can do the fire safe audit, electric safe audit, natural hazards protection safe audit to improve the safety environment and minimize the risk level.

Occupational Risk Audit- The organization must make sure that there should be risk audit related to machinery breakdown, business interruption audit which are potential risk in certain industries and may affect the business house with heavy loss of revenue.

Specific Risk Management Audit- The organization must make sure that, it should take consultancy on certain non-repeating risks also, such as, Flood protection etc.

Risk assessment and risk management should be a continuous operation in building as like the regular business activity, because nobody knows that, the risk may happen any time even when we are not prepared for it. The past, present and futuristic situation has to be assessed properly and design the risk management process accordingly, in fact, the risk management process should be in culture of the organization and its employees. The risk management tool must check the employees as well as every top official properly and present the report. The risk management process must decide the operational tactics and assign the responsibility of every part to employees. The risk management process must be accountable at every level of employee hierarchy.

9.7 Risk Analysis

Whenever any organization propose for any project, then the organization deal on the basis of forecasted benefits and potential of project not on actual cash flow, but, sometimes the positive forecasting may also prove to be wrong, so the organization has to perform certain risk analysis techniques for the upcoming projects. Basically, three risk analysis techniques are used by the organizations:

Sensitivity Analysis - Sensitivity analysis is simply the method for determining how sensitive our NPV analysis is to changes in our variable assumptions. To begin a sensitivity analysis, we must first come up with a base-case scenario. This is typically the NPV using assumptions we believe are most accurate. From there, we can change various assumptions we had initially made based on other potential assumptions. NPV is then recalculated, and the sensitivity of the NPV based on the change in assumptions is determined. Depending on our confidence in our assumptions, we can determine how potentially risky a project can be.

Scenario Analysis - Scenario analysis takes sensitivity analysis a step further. Rather than just looking at the sensitivity of our NPV analysis to changes in our variable assumptions, scenario analysis also looks at the probability distribution of the variables. Like sensitivity analysis, scenario analysis starts with the construction of a base case scenario. From there, other scenarios are considered, known as the "best-case scenario" and the "worst-case scenario". Probabilities are assigned to the scenarios and computed to arrive at an expected value. Given its simplicity, scenario analysis is one the most frequently used risk-analysis techniques.

Monte Carlo Simulation - Monte Carlo simulation is considered to be the "best" method of sensitivity analysis. It comes up with infinite calculations (expected values) given a number of constraints. Constraints are added and the system generates random variables of inputs. From there, NPV is calculated. Rather than generating just a few iterations, the simulation repeats the process numerous times. From the numerous results, the expected value is then calculated.

9.8 Risk Control

Project implementation requires huge investment, planning, manpower but after all this, there is no assurance that, the project will be successful, risk will always be there. Risks cannot be eliminated completely from the project but can be controlled upto certain level. There are usually three basic steps, which are to be followed during Risk control:

Mitigate Risk- Risk mitigation refers to identifying each risk factor, tracking those factors and try to search out secondary option or wayouts which can be implemented during the course of emergency. Risks can be mitigated by:

- Complete Documentary completion
- Expert Advices
- Financial Sustainability
- Secondary options/Wayouts

Plan for Emergencies- Project manager must identify the each loophole of complete project and need to understand eac detail of project. The manager must plan for emergencies in advance and react accordingly. For example, in real estate industry, there is probability of increase in the cost of material, which cannot be avoided. In such cases, the project manager must select the vendors in advance and bind them in agreement for those construction material for certain period of time.

Control

As the risk cannot be avoided in any risk management process but, the risk can be controlled upto certain level and this is the last step in risk management process. The project manager use the risk response methods, risk monitoring and triggering activities and infact watch the control over any new risk possibility. The project manager may make certain changes in the management to control the risk such as change in budgeting, change in duty assigned to people and also even change in working hours.

The project manager must keep check all the possibility of risk arise and the risk assessment must be the important part of his duty. The team member should be made comfortable so that, they can freely discuss their issues and risk possibility with the top management and if the top management have the tendency to punish the person who points out the mistake in system then that organization is more prone to risk. The organization must discuss such issues reluctantly with the officials and do not try to suppress the suggestive measures. The organization member and internal stakeholders must be invited to discuss the problems and other than that, the organization must invite the risk expert atleast two times in an years and by following these steps, the organization will be immune towards the possibility of risks.

The organization members should be assigned the responsibility related to all the possibility of risks. The organization must take care that, no one should pass their responsibility to other person and the other person should not leave the responsibility by saying that 'I am not suppose to do this job'. The project manager mujst develop a mutual relationship between all the team members and make them aware about the intensity of the risk possibility etc.

The organization must take help of project auditors who can detect the problem at very initial level and the audit work will help in determining that, whether the quality work is being done or not and the results are as per the standard and planned requirement. Audit work will help in determining the work is being done with in budgeted limit and help in discovering the weak areas of the project and organization.

The risk control process also offers the change in management system and the change can be devised in totally different from its original planning. The causes and sources of change may vary and also affect the project. The change can be categorize as per below:

- The change can be done by adding any feature or any additional benefit to the existing project.
- The project manager must be ready with any contingency plan in case, if the planned project does not work as per the original design.

- The project may require in change of vendor etc.

Any change in existing project may result in change of team members or even the project leader, so the change cannot be avoided but the project review must be there, which can describe the project at its various stages including reporting, controlling, recording of data etc. The change in control system is usually done to manage:

- To search the reason for the suggested change.
- Preplan the effects over budget and schedule due to change.
- Understand the suggested change from all the view point and either implement or reject the change.
- The smooth flow of communication must be there between the stakeholders related to change.

The project manager must never under-estimate the project risk and in case the steps are not taken at right time then the organization has to face very adverse impact after the completion of project report, so all the required risk and their probable solution has to be assessed at very initial level to minimize the risks.

9.9 Self Assessment Questions

1. What do you understand by Risk Management?
2. What is the Risk management categorization? How many categories are available under this?
3. Explain Strategic Risk Management & its detailed categories with examples?
4. Explain Operational Risk Management & its detailed categories with examples?
5. Explain Safety Risk Management & its detailed categories with examples?
6. What are the basic Risk management processes, write every steps?
7. Explain various Risk Assessment Tools?

9.10 Reference Books

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Unit - 10 : Project Closure & Termination

Structure of Unit

10.0 Objectives

After completing this unit, you would be able to:

- Learn the Steps for Project closure.
- Learn the documentation along with check list formats for project closure.
- Hand over the project to stake holders.
- Review of project learning's for next projects.
- Understand templates & tools available to support closing the project.
- Understand how to gather data to create the Post Implementation Report.
- Understand the meaning of Project Termination.

10.1 Introduction

The last important phase of a project's life cycle is the close-out. It is understood that closing the project is nothing to do at site and only a few documents are to handover. These activities are particularly important on large projects with extensive records and resources. This section does not address processes for transitioning the technical support into maintenance and operation. These tasks are diverse and unique to the specific development environment of a project. The first step of the close-out process is the user's acceptance of the system. This is a critical and important step, as the user decides when the project is completed. Acceptance is based upon the success criteria defined in the very early concept and planning stages of the project. This acceptance should be formal, meaning that user sign-offs should be obtained.

10.2 Why is Closure Important?

Projects, by definition, have a beginning and an end. Without a formal closure process, projects can drag on as stakeholders strive to include 'just a few more requirements'. These unbudgeted add ones can create serious consequences like: significant impacts to schedules and budgets; sponsor interest wanes and the team loses motivation and focus. Any significant changes at this stage of a project should be treated as a second release

and a new project. These changes have to be tightly controlled by the project manager. Hence the following are the formal processes are to be necessarily carried out during the close out phase of the project.

The Project Closeout Phase is the last phase in the project lifecycle. Closeout begins when the user accepts the project deliverables and the project oversight authority concludes that the project has met the goals established.

Hence, Project closeout is carried out for the following key work process to be finalized and closed the project:-

1. **Closing out the financial accounts:**
   It is basically, all financial transactions are closed under the project name and under this project code declared as no more transactions are required to be done. Project is financially closed. However any extension of the project will be carried out at a later stage will be taken under another project code, where the financial transactions can be carried out. Example: Project name: Installation of Nano Car Project. Project Code: based on plant and owners specific however to understand consider it as N-321020. Hence once the project is closed for financial accounts no more transactions are carried out under the project title and the code.
2. **Turnover of the Project Deliverables to operation:**
   The equipment along with respective systems are to be handed over to the operation team lead or to owner. These are handed over one by one system which includes equipment and relevant accessories and acknowledge by operation team. Example: Project Name: Coal fired power plant execution project. Handing over the systems to operation team by project team are Boiler system, Turbine system, Generator system, DM water system and etc. These are handed over after all necessary inspection & commissioning carried out.
3. **Redistributing Resources:**
   Once the project is formally under the closing process, slowly the staff is relived who have completed their assigned task in all respect including documentation and billing process. Equipment like Crane, Hydra and others are released once their work is over during the ending process of project or in-between once the task related to them are over. These resources would be deputed by management on another project which are under the same campus or may be at other site.
4. **Completing, collecting, and archiving project records:**
   It is very useful to collect the all communication, planning and scheduling of the project with actual updating based on site conditions. To be collected in an appropriate indexing for records, analysis and future record. Example: Project Name: Coal fired power plant execution project. System**:** Boiler: All, installation sequence, processes, correspondence with various agency, guidelines are to be recorded in an adequate indexing. Similarly, it is to be done for other systems of coal fired power plant.
5. **Documenting the successes of the project:**
   Documentation for the System which are completed with commissioning and final boxed up are to be handed over to the operation team as well as documentation

centre, which include all discipline (like civil, mechanical. Electrical, instrumentation and other utilities). These are submitted by project team to the operation team and finally these are kept in the documentation centre after review and acknowledge by operation team. Example: Project Name: Urea plant commissioning project. Documents to be handed over: loop wise site drawings and isometrics, Calibration certificates of equipment, NDT Testing reports, hydro test report, lines supports and installation, final box up report.

6. **Documenting lessons learned**

   During the execution of a project there all many odd situations arrived, due to which projects are going through the schedule variance and cost variance against the planned one. Example: Projects Name: Fertilizer Plants in India- Period -1988 onwards. There is some equipment which is imported. This equipment delivery (few of them) may be delayed due to different reasons. Like Licensing process of importing is delayed comparing the planned schedule. The cost of the equipment is enhanced once the dollar value V/s Rupee value devaluated due to escalation in Dollar value. (It has happened practically when three fertilizer projects during -1988 were sanctioned and dollar value during execution stage in 1991-92 escalates with 30-40 % at that time. Dollar value hiked by one dollar equivalent to almost 35 Rs instead of Rs 20.These becomes the learning lessons for the next project in the reference for schedule and cost variance.

7. **Planning for Post Implementation Review**

   It is very important aspect to review of each activity execution schedule V/s planned schedule will give an insight for schedule deviations (as delay or early completion) of activity. This will become basis for new project execution revised planned schedule with reference to each activity. Wherever the planned schedule of activity remains unaltered during execution indicates the best planning schedule for that activity in the total schedule.

10.3 Project Closure Process

Project closeout is the period of construction that provides the systematic transition of the project to the owner until the cessation of all construction activity on the project site (except for any work associated with the correction period, discussed later). Project closeout can be as short as a week for very small projects to as long as three months or more for large, complex projects. The closeout transition has a two- phase process: the pre-substantial completion phase and the post-substantial completion phase.

As the phase names imply, the pivotal point between the two phases is the date of substantial completion. Therefore, depending on the project, the project closeout process should be scheduled based on the scheduled date of substantial completion. The date of substantial completion is very critical in regard to project closeout. Substantial completion is defined as General Conditions of the Contract for Construction, as the stage in the progress of the Work when the Work or designated portion thereof is sufficiently

complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

As the above provision alludes, substantial completion is not limited to a single date multiple dates of substantial completion may be issued for various portions of the work. However, it is the final substantial completion date that is of significance to project closeout.

Contractually, the date of substantial completion establishes the point when the contract time ends. If the date of substantial completion is beyond the contract time, then the contractor may be subject to liquidated damages or penalties if provisions for those are in the contract. Conversely, if the contractor achieves sub spatial completion before the end of the contract time, the contractor may receive a bonus if a penalty/bonus clause exists in the contract.

The contractor is required to notify the Stakeholder / Engineer in charge when the contractor believes that substantial completion has been, or will be, achieved. The Engineer In charge will then conduct an inspection to verify that the work has, in fact, reached substantial completion. If the Engineer In charge concurs with the contractor's assessment, then they will prepare and distribute a Certificate of Substantial Completion that establishes the specific date, as well as other items, such as insurance and maintenance responsibilities, and a list of incomplete items. At this point, the owner assumes responsibility for the work (unless otherwise stated in the Certificate of Substantial Completion) and is permitted to occupy the said project.

Pre- Substantial Completion Phase

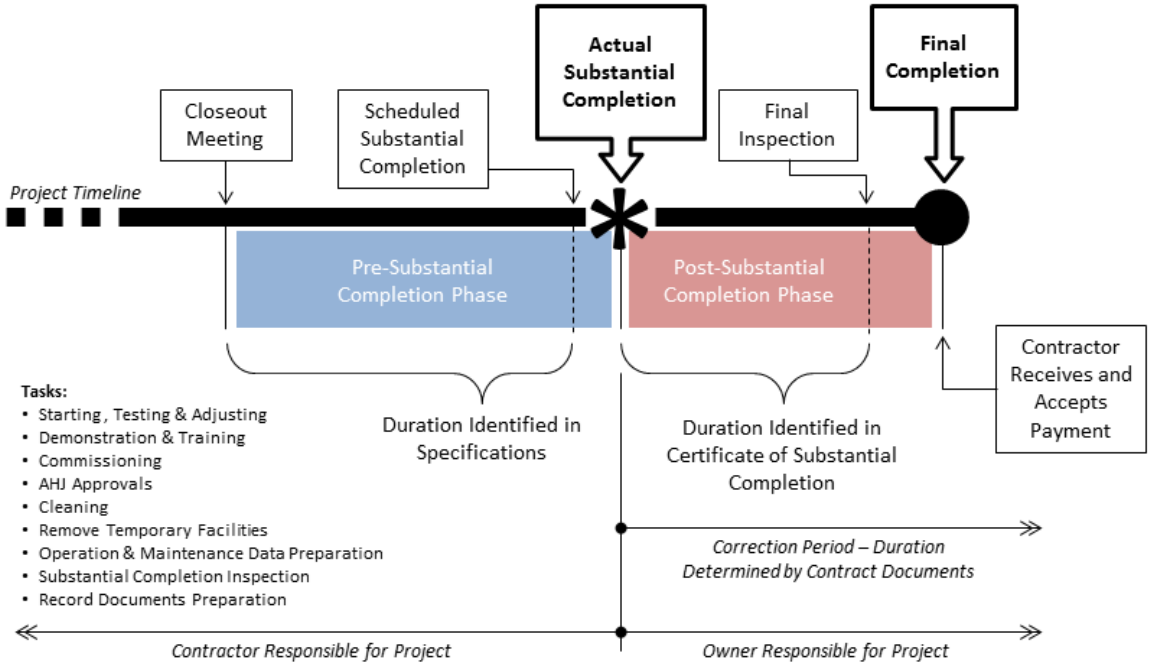
The pre-substantial completion phase is the period of buildup to the eventual transition of the project from the contractor to the owner. During this phase the contractor retains full control of activities on the project site specify the individual tasks that must be accomplished and the items that must be submitted by the contractor prior to establishing the date of substantial completion. The initiation of this phase should be started on a date appropriate to the project that ensures sufficient time to complete required tasks.

Post Substantial Completion Phase

Once the date of substantial completion has been certified by the Engineer, the project enters the next phase of closeout, which will take the project to final completion. At this point, most of the closeout activities have been accomplished. The owner has occupied, or is permitted to occupy, the building and typically assumes responsibility for its operation, maintenance, security, and insurance unless stated otherwise in the certificate of substantial completion. The date of substantial completion also signifies the beginning of the correction period, which is typically as per document. During the correction period the contractor is required to correct any deficiencies discovered. Also, the time periods indicated in project warranties also begin at this time

Indicative diagram of the Project Closeout process

The closeout process starts on the date of the closeout meeting, which is based on the contractor's scheduled substantial completion date. Majority of the closeout tasks occur within the Pre-Substantial Completion Phase. Owner assumes responsibility for the project after substantial completion, but contractor is required to complete punch list items within the Post-Substantial Completion Phase. The scheduled substantial completion and the actual substantial completion may or may not be the same date. In essence, the closeout meeting is to make sure that everyone involved with the project—owner, engineer, consultants, contractor, and subcontractors—knows the details and timing of closeout activities to assure a smooth transition.



10.4 Project Close-out activities

The closeout meeting agenda should cover all requirements in the contract documents associated with the full completion of the project. Activities include the following:

1. Starting, Testing & Adjusting Systems

During this phase of the closeout process, the con- tractor and its subcontractors need to startup all building systems and make any adjustments necessary to ensure proper operation. This may be part of a commissioning process if specified in the contract documents. The con- tractor should notify the engineer when tests and system startups are scheduled so the appropriate design consult- ants can be present. Any tests required by the contract documents and not performed during the regular course of

construction should be accomplished at this time. If a test is associated with system startup, then the test should be accomplished following the startup in accordance with the manufacturer's instructions. Tests should be conducted in sufficient time to allow performance of the test, analysis of results, preparation of reports, and distribution of reports prior to the date of substantial completion.

2. Demonstration & Training

The owner must be capable of operating and main- training the building once the owner occupies it; there- fore, the owner should be properly trained. Demonstration and training can include anything from operating motor-operated roller shades to the complete heating, ventilating, and air conditioning system. The demonstration and training should be provided for owner's personnel who will have direct responsibility for the management of the facility and should be conducted by qualified trainers. Division 01 of specifications should establish requirements for demonstration and training.

3. Punch List

The Contractor shall prepare and submit to the Engineer a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Although contractors are assigned the task of preparing the punch list, Engineer frequently assumes responsibility for the preparation. Reasons why engineer pre- pare punch lists vary from lack of detail in contractor- prepared punch lists to engineer desire for greater control in the process. Regardless of the reason, the punch- list is the contractor's "to-do list" that must be fully accomplished before final completion. The General Conditions require the contractor to notify the engineer when the project is ready for substantial Completion. The engineer and its consultants conduct an inspection that adds to the contractor's punch list. If the Engineer determines that substantial completion has been achieved; the punch list becomes an attachment to the Certificate of Substantial Completion. Example: For Complex Building project there are minor jobs left out or need alteration of finishing. Like: Proper ear thing connection, Back side plasters, cleaning of the waste.

4. Operation and maintenance data

Operation and Maintenance (O&M) data are a compilation of documents that usually consist of manufacturers' printed manuals and instructions that explain how to operate and maintain the systems, equipment, and finishes installed on a project, and typically include manufacturers' warranties. O&M data should be submitted by the contractor and approved by the engineer before demonstration and training is conducted so the data can be used as training materials. Format of the O&M data should be specified in Division 01 of the specifications. The format commonly submitted is a bound hardcopy, but electronic documents saved on CD- ROM or other media are rapidly becoming the norm. Example: Plant Machinery Erected and commissioned. The documents for its operation and procedure for maintenance are taken in details during commissioning of machinery.

5. Record Documents

These are"As-built" documents, record documents are those documents submitted and turned over to the owner as a record of the construction during the closeout process. The term "as-built" is not appropriate for these documents as it gives the connotation that the documents indicate work as it was actually installed. The reality is that the documents convey the installed to best of the contractor's knowledge, since much of the information is provided by subcontractors. Record documents may consist of marked up copies of the drawings and specifications, a complete set of submittals, all addenda and contract modifications, re- ports, and any other documents required by the contract documents. Specifications should identify the required record documents and the format. Like O&M data, record documents are increasingly being submitted in electronic form for ease of storage and retrieval.

6. Commissioning

If commissioning is required, whether it be systems and equipment commissioning or total project commissioning, then the activities for the commissioning process should begin during this phase of the project close- out. Commissioning is typically conducted by a third party (*i.e.* commissioning authority) hired by the owner. The purpose for conducting commissioning during this phase is to determine if the building is ready for occupancy and identify deficiencies that may be added to. The project's punch list. Commissioning activities may be integrated with starting, testing, and adjusting, as well as demonstration and training. Commissioning may also assist in verifying accuracy and completeness of O&M data.

7. AHJ Approval

One of the key elements in determining substantial completion is the approval of the project by authorities having jurisdiction (AHJ). The approval usually comes in the form of a certificate of occupancy for occupied buildings or a certificate of completion or equivalent for unoccupied structures or shell buildings. Without approval by the AHJ, the owner may not "occupy or utilize the Work for its intended use," thus, the definition of substantial completion has not been met.

8. Other Activities- Transfer of utilities

Other tasks that may be required prior to substantial completion may include the transfer of utilities to the owner, delivery of keys and cores to the owner, removal of temporary facilities, and general cleaning of the work. The contract documents may specify other tasks that must be accomplished in order for the engineer to certify substantial completion. Additionally, the contractor may request payment for work completed and release of retain age; however, a Sufficient amount of money (either retain age, money for uncompleted work, or a combination of both) should be held by the owner to cover the cost of completing and Correcting the remaining work if the contractor fails to do so.

9. Final Acceptance

The contractor's main task during this phase of the project is to complete or correct the items identified on the punch list. Since the owner typically assumes responsibility for the security of the project at substantial completion, the contractor may have to schedule access with the owner. Since the period for correction and completion of items on the punch list overlaps the correction period stated in the General Conditions, there may be a need to specify how deficiencies discovered between substantial completion and final completion are handled—they may be added to the punch list to be corrected prior to final completion, or added as corrective work associated with the correction period.

Once all the items on the punch list are completed, the contractor must notify the engineer that the project is ready for the final inspection. This notification is required to be in written form and should be accompanied with a copy of the contractor's final application for payment Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Engineer will promptly make such inspection. The Engineer, after receiving the written notification from the contractor, will inspect the project to verify that all punch list items have been addressed. Additionally, the engineer should ensure that any remaining closeout (*e.g.* extra materials, O&M manuals, record documents, etc.) have been submitted.

10 Final Payment

Upon completion of the final inspection and verification that the project is complete, the Engineer certifies the contractor's application for payment. However, before the application for payment can be prepared and submitted by the contractor. Outstanding proposal requests and change order requests need to be incorporated into a final change order. Any claims in which a disagreement exists can remain open to be handled later through mediation, through arbitration, or in court. Also included in the final change order are any final adjustments to allowances. Outstanding authorizations for allowances are determined and any unused funds are added to the change order as a credit to the owner. Finally, the final change order may also adjust the contract time through requests for extension. If time extensions are approved, they must be included prior to any application of a penalty/bonus or liquidated damages clause. If penalties or liquidated damages are to be assessed, they need to be deducted from the final application for payment before certification by the Engineer. After certifying the final application for payment, the Engineer will forward the certified application to the owner, who, in turn, makes payment within the time period required by the contract documents. When the contractor accepts the payment, then final completion is deemed achieved.

10.5 360 Degree Closure of a Project

Beside the closure activity individually to be completed, It is very important aspect for overall -360 degree closure of the project. This is due to the financial transactions cannot be done; project liability from project team is finalized. All necessary documentation is finalized. No any item, document, drawings consultancy is pending from any agency or contractor. Hence following formal documentary clearance with authority signatory is completed:

1 Administrative Closure

Administrative closure is the process of preparing closure documentation of the product or process deliverables to the customer as well as taking other administrative actions to ensure that the project and its assets are redistributed. Delivering closure documentation does not mean getting approval and acceptance signature on the deliverable. It involves a series of steps to ensure the product meets the customer's requirements that were defined in the Project Requirements document and approved by the customer. The Post Implementation Evaluation Report (PIER) is produced in the Administrative Closure. Other areas included in administrative closure are archiving, facilities and personnel reassignment. Example: Nano car first ramp up production to be checked and confirmed for the total customer satisfaction. Project phase of production is over. However any changes in the process are subsequently be carried out.

2 Post Implementation project Review

A Post Implementation Evaluation Report (PIER) documents the successes and failures of the project. It also provides valuable historical information of the planned and actual budget and schedule. Other selected metrics on the project may be collected using documented procedures. The report also contains recommendations for future projects of similar size and scope. Information within the PIER should include, but not be limited to, the following items:

1. Project Sign off: All the agencies who are involved in the system are going to sign on the relevant documents for clearance of the project with all necessary documentation review.
2. Project Cost Management: Necessary documents to be cleared of for final payment for all agencies after receive of their completion certificate of work.
3. Project Quality Management: Contractors should submit all inspection reports with summary reports system wise or as prescribed by owner's project inspection team.
4. Project disaster recovery plan: In case of catroscopic failure of a unit or plant, a safe and recovery plan to be finalized during end of the project stage in coordination with agencies, engineering consultants and owner's operation team with project team. This document is signed by authority from agency, project team and operation team for final agreement.

3 Project Documentation

All documentation that has information about the project (including design documents, schematics, technical manuals) that have not already been turned over to the operations and maintenance organizations must be completed and forwarded to the Project Manager. After the PIER document has been prepared, the project information is archived. Historic project data is an important source of information to help improve future projects. The information that is archived will vary from project to project. Typically, the following project data is archived:

Project Notebook, Correspondence, Meeting notes Status reports, Contract file, Technical Documents, Files, programs, tools, etc. placed under the use of, Configuration Management. Any other pertinent information to the project. All hard copy records should be stored following the State of Arkansas record retention guidelines. Many of the technical documents and automated versions will be turned over to Agency personnel responsible for maintenance and operation of the system. Summaries of Technical information should be stored electronically for historical reference to facilitate later Review.

4 Financial Closure

Financial closure is the process of completing and terminating the financial and budgetary aspects of the project being performed. Financial closure includes both (external) contract closure and (internal) project account closure. The following sections describe some of the actions that must be taken to ensure financial closeout:-

Project Account Closure

Project account closure is an internal process that formalizes the termination of a project for the staff within the agency. Without setting definitive dates and providing a formal process for closure, projects have a tendency to live past their scheduled completion date. For instance, if a termination date is not set for a project, it is possible that the project might continue indefinitely, allowing personnel to apply resources and labor against it. If this were to happen, a project would not be a project any longer, but could potentially turn into a program without a defined end date. Projects by definition have limited budgets and life- spans, so it is necessary to terminate them at some point.

Setting a Completion Date

Often projects have a completion date imposed upon them at their inception, which by nature makes that date the termination date for the project. The completion date for a project is the date that all project-related activities needed to produce the product should be completed. Beyond this date, there should be no need to apply labor or resources against the project because it will have delivered or turned over to operations. Any further work done on the product beyond this date should be considered an operations and maintenance cost.

Closing Account Charge Codes

Most projects have account numbers associated with them that allow the financial departments to track labor hours and resource procurement. These labor charge codes will need to be deactivated so that no personnel may continue to charge time against the project or use the project charge codes to purchase materials, etc. Closure of the charge accounts should be formalized via written request that the Project Manager turns over to the managing financial organization.

5 Contract Closure

Contract closure is the process of terminating contracts that outside organizations or businesses have with the agency as part of the project being performed. These contracts may be vehicles for providing technical support, consulting, or any number of services supplied during the project that the agency decided not to perform itself. Contracts can be brought to closure for variety of reasons, including contract completion, early termination, or failure to perform. Contract closure is a typical but important part of project management. It is a simple process, but close attention should be paid so that no room is left for liability of the agency.

Collect Documentation

In order to close a contract, it is important to collect all of the pertinent documentation for review. This will include all of the original contracts and supporting documentation such as schedules, contract changes, and performance reports. This documentation needs to be reviewed thoroughly to ensure that there are no unrealized contract issues that could open up legal liability. For specific methods on contract closure please refer questions to the Contract Management Division.

The Financial Audit

The project audit is intended to determine where, in measurable terms, the actual costs on the project may have overrun or under-run and determine the cause of the variation. It is also an investigation into the ethical and financial responsibility of the staff involved with the project. Because many state projects are funded through State taxes and appropriations, it is imperative that all of the project members be held accountable to the highest degree of fiscal responsibility. Furthermore, the financial evaluation also provides an opportunity for project managers and agencies to learn where they can improve financially on the implementation of similar future projects.

6. Celebration of success

One step of the Closeout Phase is the customer's acceptance of the system. This is a critical and important step, as the customer decides when the project is completed. Acceptance is based upon the success criteria defined in the very early concept and planning stages of the project. This acceptance may be very informal or it may be very formal, depending on the defined criteria. There are many ways to reward people for a job well done. The reward might be an informal after work gathering or a lunchtime pizza celebration. Organization management may also want to express recognition of a successful team effort by praising the team at a key meeting or a large gathering of

staff. Team members are proud to have executive management state appreciation, and such recognition sets the stage for future successful work.

10.6 Project Closure Report

A Project Closeout Report documents the completion of closeout tasks and project performance. The report provides a historical summary of the projects deliverables and baseline activities over the course of the project. Additionally, the project closeout report identifies variances from the baseline plan, lessons learned, and disposition of project resources. The project closeout report is intended to provide a concise evaluation of the project.

The project manager typically has responsibility for preparing the report. The project manager gets input from the entire project team, the customers, and other major stakeholders. People performing different functions on the project will have different outlooks on the successes and failures of the project and on possible solutions. The Project Closeout Transition Checklist is used to guide the development of the report. Lessons learned sessions and the User Acceptance Report are also used.

Establishing the date for a future post implementation review of the deliverable is the final element of the closeout report. This date must be coordinate and agreed to by the organization and project manager. Typically, the project manager or project sponsor will conduct a project implementation review after the deliverable has been in service for a period of time adequate for evaluation of the product or service's successful integration into the business. Typically, a six- month period is adequate.

I. Instructions :

A. General Information – Basic information that identifies the project.

Project Title – The proper name used to identify this project.

Project Working title – The working name or acronym used to identify the project. If an acronym is used, define the specific meaning of each letter.

Proponent Secretary – The Secretary to whom the proponent agency is assigned or the Secretary that is sponsoring an enterprise project.

Proponent Agency – The agency that will be responsible for the management of the project.

Prepared by – the person(s) preparing this document.

Date/Control Number – The date the report is finalized and the change or configuration item control number assigned.

B. Project Deliverables - List all product or service deliverables in the first column. In the second column record the date that each deliverable listed in the first column was accepted. Describe any contingencies or conditions related to the acceptance of the deliverables listed in the first column.

C. Performance Baseline - Evaluate how the project performed against each of the performance goals established in the Project Performance Plan. Copy the first two columns from the Project Performance Plan. In the third column, record the results of the measurement of performance prescribed in the Project Performance Plan.

D. Cost (Budget) Baseline - State the actual cost of the project and compare it to the planned cost baseline. In the Variance column, record the difference between planned and actual cost. Provide the reason for the variance in the Explanation column. Include in the explanation information on any approved changes to the cost baseline and their impact on the project. Document and explain all cost and funding variances, including approved changes to the cost baseline.

E. Schedule Baseline - Compare the initial approved schedule baseline against the actual completion dates. Extract the WBS Elements, Start Dates, and Finish Dates from the baseline schedule and record them in the WBS Element, Planned Start Date, and Planned Finish Date Columns. Record the Actual Start Date and Actual Finish Date for each WBS element in the columns with those headings. In the Explanation for Change column, provide a brief reason for any difference(s) and describe the impact on the project.

F. Scope - Document any changes to the project scope and describe the impact of each change on performance, cost, or schedule baselines in the appropriate column.

G. Operations and Maintenance - Describe the plan for operation and maintenance of the product, goods, or service delivered by the project. State the estimated annual cost to operate and maintain the product, good, or service. If the estimated cost differs from the original cost estimate in the project proposal, identify where and why the estimated cost differs.

H. Project Resources - List the resources used by the project in the first column. In the second column, identify to whom the resource was transferred. In the next column, indicate when the resource was transferred. Account for all project resources specified in the Resource Plan and utilized by the project.

I. Project Documentation - Identify all project documentation materials stored in the project library or other repository. Identify the type of media used and the disposition of the project documentation (see Communications Plan).

J. Lessons Learned - Identify lessons learned for feedback to the Commonwealth Project Management process. Lessons learned are identified as problems (or issues). Provide a brief discussion of the problem that identifies its nature, source, and impact. Site any references that provide additional detail. References may include project reports, plans, issue logs, change management documents, and general literature or guidance used that comes from another source. Record the corrective actions taken and results in the last column.

K. Dates for Post Implementation Review and Report - Identify the date for completing the post implementation report and the person responsible for this action.

L. Approval - The person(s) making the report authenticate its contents by signing as appropriate.

II. Templates

A. General Information Template

Provide basic information about the project including: Project Title – The proper name used to identify this project; Project Working Title – The working name or acronym that will be used for the project; Proponent Secretary – The Secretary to whom the proponent agency is assigned or the Secretary that is sponsoring an enterprise project; Proponent Agency – The agency that will be responsible for the management of the project; Prepared by – The person(s) preparing this document; Date/Control Number – The date the report is finalized and the change or configuration item control number assigned.

B. Project Deliverables Template

List all Project Deliverables and the date each was accepted by the user. Identify any contingencies or conditions related to the acceptance.

C. Performance Baseline Template

Document how the project performed against each Performance Goal established in the Project Performance Plan.

D Cost (Budget) Baseline Template

State the Planned Cost and Funding for the project, as approved in the Initial Cost Baseline and the Project Charter. State the Actual Cost and Funding at completion. Document and explain all cost and funding variances, including approved changes to the cost baseline.

E. Schedule Baseline Template

Compare the initial approved schedule baseline against the actual completion dates. Enter the planned start and finish dates from the initial schedule baseline. Document all actual start, finish dates, and explain any schedule variances, including approved changes to the schedule baseline.

F. Scope Template

Document any changes to the Project Scope and their impact on Performance, Cost, or Schedule Baselines.

G. Operations and Maintenance Template

Describe the plan for operation and maintenance of the product, good, or service delivered by the project. State the projected annual cost to operate and maintain the product, good, or service. Identify where and why this projection of cost differs (if it differs) from the Project Proposal. If the operation and maintenance plan is not in place, what is the target date for the plan and what is the impact of not having operations and maintenance for the product, good, or services in place.

H. Project Resources Template

List the Resources specified in the Resource Plan and used by the project. Identify to whom each resource was transferred and when it was transferred. Account for all project resources utilized by the project.

I. Project Documentation Template

Identify all project documentation materials stored in the project library or other repository. Identify the type of media used and the disposition of the project documentation (see Communications Plan).

J. Lessons Learned Template

Identify Lessons Learned for feedback to the Commonwealth Project Management process. Lessons Learned should be stated in terms of Problems (or issues) and Corrective Actions taken. Provide a brief discussion of the problem that identifies its nature, source, and impact. Site any references that provide additional detail. References may include project reports, plans, issue logs, change management documents, and general literature or guidance used that comes from another source.

K. Dates for Post Implementation Review and Report Template

Identify the date for completing the post implementation report and the person responsible for this action.

L. Approvals Template

10.7 Project Termination

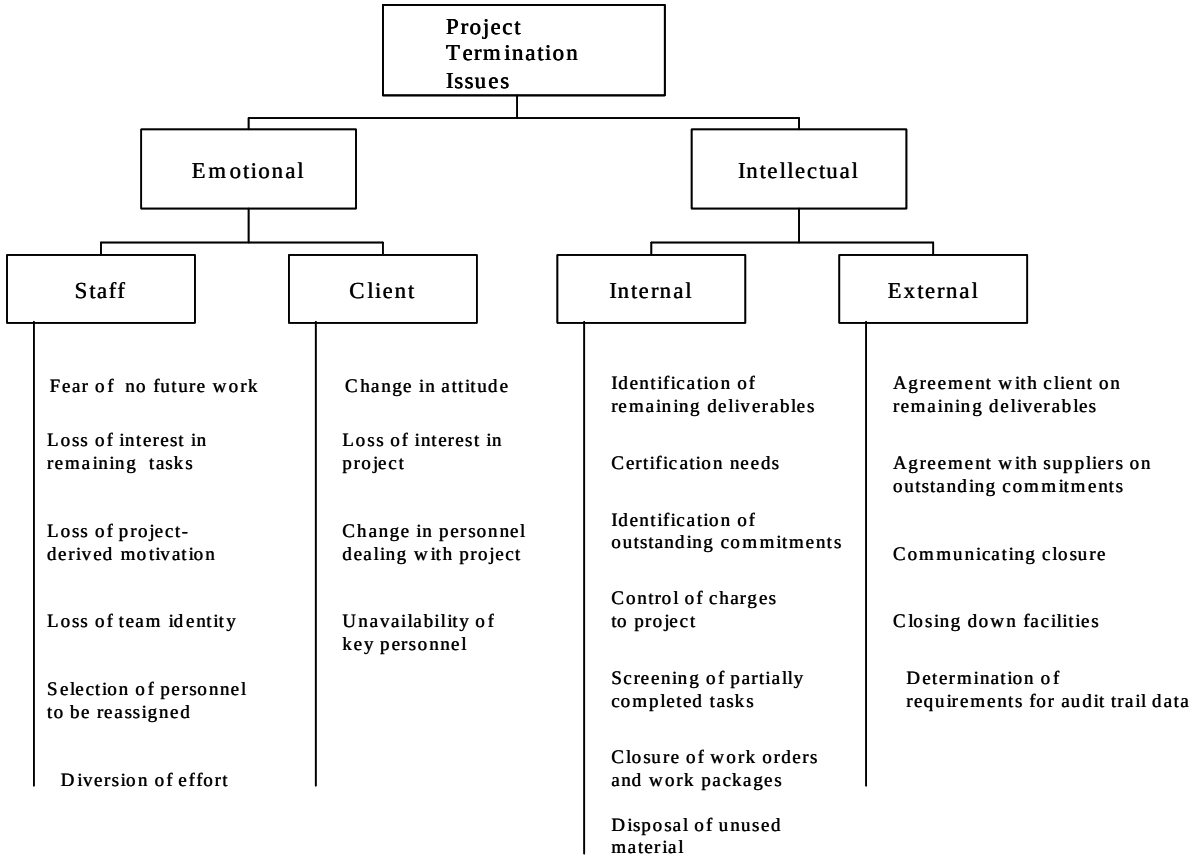
Project success means that the project has met its cost, schedule, and technical performance objectives and has been integrated into the customer's organization to contribute to the customer's mission. Project failure means that the project has failed to

meet its cost, schedule, and technical performance objectives, or it does not fit in the organization's future.

Project Termination Reasons :

1. The project results have been delivered to the customer
2. The project has overrun its cost and schedule objectives
3. The project owner's strategy has changed
4. The project's champion has been lost
5. Enviromental changes that affect the project
6. Advances in the state of the art hoped for in the project has not been realized
7. The project's priority is not high enough to survive in the competition

Projects are terminated due to the two reasons: Emotional and Intellectual. Emotional reasons are started from the staff or client. The staff and client at the planning stage of project realized that the project goals or objectives may not be achieved; hence it is the right stage to terminate or not to go ahead with the project. There is a chart indicating the basic reasons for project termination.



10.7.1 Termination strategies

During termination some senior managers will replace the project manager with an individual who is skilled at closing out projects. He then will conduct reviews to determine the status of the work packages

In addition he has to:

a) Ensure that all project deliverable end products have been provided to the project owner.
b) Review the status of all contracts
c) Work with the project team in developing and distributing a closeout plan
d) Maintain an ongoin surveillance of the closeout activities
e) Notify relevant stakeholders of the termination
f) Ensure that all financial matters on the project have been satisfactorily terminated
g) Assist members of the project team to find other work in the organization
h) Prepare the project history, particularly a ”lesson learned” report
i) Conduct a postcompletion audit of the project to identify strengths and weaknesses in the management

10.8 Summary

In conclusion we find that in order to achieve Project Closure ,the project manager has to ensure the following stages are adequately completed. All Execution to be verified with respect to relevant drawings and documents in time. Punch list is to be made with respect to drawings and to be attended by contractors. All systems /loops to be tested and cleaned before they have taken in to start-up process. Adequate materials reconciliation to be carried out by respective engineer in charge. All pending bills of contractors to be verified by engineer in charge and processed forpayment. A report for handing over the project to operation stake holders to be solicited with celebration with all authority signatures.

10.9 Self Assessment Questions

1 Explain the role of project closure?

2 what are the documents and steps required for project closure?

3 State the templates used for project closure?

4 why project terminates in between explain the Conditions?

5 Prepare a chart for Project Closure for fertilizer industry?

10.10 Reference Books

- Project Management- By Vasant Desai- Himalaya Publishing
- Project Management- By Dennis Lock- Gover House,British Library publication-
- Project Planning & Management-PPM CADD Centre –Ref. Book
- Project Management by Late Mr. Sudhan Choudhary
- Practical Experience –formats & Templates- used in projects

Unit 11 - Project Evaluation

Structure of the Unit

11.0 Objectives

After completing this unit, you would be able to:

- Understand the meaning & concept of Project Evaluation.
- Explain the reasons for conducting Project Evaluation.
- Distinguish various phases of Project Evaluation.
- Explain the methodology/process of Project evaluation.
- Prepare Project Evaluation Report.

11.1 Introduction

The project Management Institute defines a project as "a temporary endeavour undertaken to create a unique product or service". Projects undergo specific stages during their life cycle including planning, implementation, execution and control, commissioning as well as monitoring and evaluation. Project evaluation is a key component of effective project management. In project environment the work must be tracked, evaluated and corrected so that schedules, expenditures and performance can be kept on track. The project manager oversees the work, assesses progress and issues instructions for corrective action. As information is received, he judges the status of the project and communicates this to the related parties. Similarly, as the project draws to a conclusion, the project manager must ensure that all work is formally closed out, commitments are met or compensated for and all remaining loose ends are tied up. This whole process comes under the purview of Project Evaluation. Evaluation and monitoring ensures that all the phases stay on schedule and within budget. Such techniques also determine whether projects have reached their objectives. In addition to the monitoring activities, formal reports are often produced during the evaluation of the project as well as at and after project completion. The process and instruments that should be used for formal implementation and completion evaluations of the projects (i.e. mid-term, ex-post) are discussed in this unit. This unit will also provide sample outlines for con-current and ex-post evaluation reports.

11.2 Meaning

Project is a group of activities having a definite beginning and ending points, initiated to achieve a mission. According to Encyclopaedia of Management, project is "an organized unit dedicated to the attainment of a goal- the successful completion of a development project in time within budget, in conformance with pre-determined programme specifications". Whereas evaluation can be defined as the process of determining the effectiveness in achieving the planned objectives and taking corrective action whenever required. It is a systematic determination of a subject's merit, worth and significance using criteria governed by a set of standards. The primary purpose of evaluation, in addition to gaining insight into prior or existing initiatives is to enable reflection and assist in the identification of future change. In evaluation actual performance is compared with planned performance.

By joining together we can say, that project evaluation is a process which attempts to analyze critically the achievements and results of an on-going or a completed project vis-à-vis the intended objectives. It is a process which:

- Supports a project by measuring the extent of which the objectives are met
- Identifies achievements
- Identifies areas for improvement
- Encourages decisions to be taken, including changes to objectives or the project methodology.

According to Carol Weiss "Project evaluation is the systematic assessment of the operation and/or outcomes of a project compared to a set of explicit or implicit standards, as a means of contributing to the improvement of the project". Donna Deeprose explained it in the book 'Project Management' as "Project evaluation entails supervision, appraisal and feedback to ensure that a project effectively progresses toward its objectives and goals".

Project evaluation gives useful feed back to avoid pitfalls experienced earlier and if recommendations are followed, the project appraisal standards would improve adding more and more successful projects in future. It serves as a periodic assessment of project performance, efficiency, progress, impact and relevance with respect to project requirements.

11.3 Objectives of Project Evaluation

Some projects are divided into phases while others involve only a single phase. If a project includes multiple phases, an evaluation near the end of each phase is done to determine whether to continue the project in the same direction, a different direction or to abandon any further activities. Overall evaluation of the project is extremely useful in providing objective assessment of the performance of the project in terms of the cost and time. In general project evaluation is done to:

- Determine whether projects are being implemented on an efficient and effective basis. Efficiency shows whether the amount of time put into the project is equal to the expected outcome or the economic rate of return achieved by the project is at least equal to expected line of investment. Effectiveness evaluates how much of the intended goal for the project was actually completed and impact measures the outcome of the project.
- Determine quality of the project.
- Provide objective assessment of the performance of the project in terms of cost, time and other technical parameters. These are also helpful tools in determining how a process could be handled better.
- Determine the variance in the performance (Budgeted-Actual).
- Identify the areas of problems (obstacles which may have inhabited in the development of the project) so that their adverse effects can be minimized.
- Identify the key strengths within the different areas of the project and areas which could be developed or improved.
- Identify opportunities before they are lost.
- Recommend for follow-on work.
- Ascertain the merits and limitations of the project team.
- Provide useful feedback for project planning and control.

Thus, evaluation of projects is done: To test the effectiveness of the project, to keep the project work on the right track, and to trace the problems those occur in the implementation of the projected activities

11.4 Evaluation Framework

Projects are goal oriented open systems. The primary purpose of evaluation in project management is to judge the performance (actual performance is compared with planned performance), reveal areas where the project deviates from goals and uncover potential problems to be corrected. On-going and ex-post evaluations should address five sets of issues which, of course, should be adapted to the specific reasons for evaluation in particular projects:

A. Continued rationale for the project- It refers to the extent to which the project design:
   - Continues to reflect the project priorities and relevance of project objectives;
   - Relates to the policy framework;
   - Suggests alternate choice; and
   - Validates the assumptions for the project.

B. Project efficiency- Efficiency relates to the activity and component level during project execution and refers to the extent to which:
   - Inputs were supplied and managed;
   - Activities were organised in the most appropriate manner; and
   - The above was done at the least cost to produce the expected outputs.

C. **Project effectiveness-** Effectiveness relates to the purpose and goal levels after completion, and should refer to the extent to which:
   - The project produced the expected outputs;
   - The outputs achieved lead to project purpose; and
   - Purpose attainment contributed to the goal.

D. **Project effects and impact-** Whereas effectiveness relates to the direct project objectives universe, effects and impacts refer to the effects of the project in other areas. Project effects and impacts refer to the planned and unplanned consequences of the project. In general:
   - Effects relate to purpose-level planned and unplanned consequences:
   - Impact relates to goal-level planned and unplanned consequences.

A brief description of the logical framework is mentioned in following table –

Continuing Rationale/Efficiency/Effectiveness/Effects and impacts

Narrative Summary	Indicators	Means of Verification	Assumptions
Goals			
Purpose			
Outputs			
Inputs			

E. **Lessons learned from the project-** lessons learned are of two types: Operational lessons, which tend to relate efficiency, effectiveness and rationale; Developmental lessons, which focus on effects and impact. Project evaluation is similar to standard costing and variance analysis in cost accounting. In standard costing and variance analysis actual cost is compared with standard cost (pre-decided cost), difference whether favourable or unfavourable are called variances. These variances are broken into its components like price, usage, quantity etc. and decision is taken for further action. Similar to this, project evaluation answers the following questions:

a. What was expected,
b. What has actually happened?
c. How good were our initial estimates? How could they have been improved?
d. Should the project be reformulated? What should have been the position under the circumstances?
e. Is there a proper utilization of resources? And if not, what can be done for doing so?
f. Whether the project manager and core team is performing the right task? Action, if required, for penalties or rewards and future guidance.
g. If the project were to be repeated, what should be done differently?
h. What did we learn from this project? Where should we go from here?

11.5 Methodology of Project Evaluation

In spite of all the latest tools and techniques and helps from sophisticated automation, there are various examples where actual outcomes on the completion of the projects are wide out of the budgeted outcomes. So, evaluation is immensely important. A project evaluation reviews the project process (phases) and determines the effectiveness of a completed project. Project evaluation and its related decisions are not only important, but also are complex topics not to be taken lightly. This varies depending on the complexity of different projects. In general, methodology of evaluating a project can be as mentioned below:

1. **Realisation of need:** As the first requirement, the planning and execution agency as well as chief executive of the project should be convinced about the need and importance of conducting evaluation.
2. **Setting up evaluation agency:** This includes deciding who will perform the evaluation. An evaluation agency/team must be set up either on permanent or on ad hoc basis. This team may consist of internal person or it may be an independent external agency, depending on the capacity and competence required.
3. **Specification for evaluation:** Various phases, programmes and activities of the project should be specified in consultation with the technical specialist in the planning and implementing department of the project. Evaluation team will revisit the organisation's broad mission for the project and will develop reporting processes that measure whether it has been met. A project with financial goal is the most easily measurable, while broader impact- related goals may be more difficult to evaluate. Thus, evaluation goes much beyond the current operations of the project. It looks at objectives set at the time of appraisal and tries to find out if the objectives were met or not.
4. **Measurable milestones and their evaluation:** The proposed evaluation mechanism usually involves milestones. Milestones may be thought of as the completion of project activities or phases like problem identification, research, technology selection, prototype implementation, end product documentation, project reviews, project reporting etc. Measurable and quantifiable aspects about these milestones should be identified and data to be collected should also be determined. Once the milestones have been identified, it is necessary to define how each milestone will be evaluated. This definition involves two components:

The first one is to define the mechanism that will be used to perform the evaluation. This includes how the evaluation will be performed. In this step, a design of the study/ survey should be prepared and the survey may require questionnaires and schedules, selection of samples etc. A relative importance has been assigned to each based on how critical each is to demonstrating a satisfactory end product. It is most important to identify those milestones, which are absolutely critical to project success and to assign a high importance rating. Some of them are as follows:

- **Strategies:** Project management strategies relate to the detailed actions project participants use to reach project objectives. An examination of the effectiveness of

individual tasks and assignments, as measured by their ultimate outcome, provides insight on the effectiveness of a project's strategies.

- **Reaction and satisfaction:** A questionnaire or survey to the related parties can be used for measuring satisfaction with the project.
- **Timetables:** This evaluation includes the overall project timetable, as well as timetables established for incremental project activities.
- **Network charts:** Project manager can analyze the PERT (Project Evaluation and Review Technique) charts and can compare actual project deliverables for project evaluation. Other is CPM (Critical Path Method), which clarifies the critical path of a project, or the most efficient path between project initiation and termination.

The second component is to define the possible results of the evaluation and what constitutes success. For evaluation, essential information should be collected both from primary and secondary sources. Statistical data, other types of quantitative and qualitative information can be used to calculate pre-project and post-project status changes. For example, Return on Investment (ROI) can be used for quantitative evaluation consideration. ROI is "a performance measure used to evaluate the efficiency of an investment in the project". Calculating and interpreting ROI within a project include measuring the ultimate cost of the project against the projected and actual returns. The so collected information is analysed, conclusions are drawn and the results are presented in the form of reports. These reports must be available in a clear, informative manner to company personnel who may work on the same or similar project in future.

Periodic progress reports offer several benefits- (a) They provide timely information so that corrective action can be initiated to tackle potential problems. (b) They generate inputs for further activities. (c) They serve as the basis for calculating variances and explaining variances.

Both quantitative and qualitative evaluation methods have their benefits, though one is usually more appropriate than the other in any given situation. Quantitative evaluation can help remove human bias from a statistic, making it more of a reliable fact than any piece of information gathered qualitatively. Thus, accurate quantitative evaluations can be relied upon as truth. Qualitative evaluations may also entail truths, but these truths are harder to get at, and evaluators may not agree. Still, qualitative information is invaluable precisely because it involves human interaction and interpretation. Many activities in project phases need this interpretation in order to decide how to move forward or to judge the source of data.

5. **Lessons learned:** The lessons learned are an important part of any project evaluation. Sample evaluation questions that relate to lessons learned are:
    - What went well? It is an indication of what the team already knew, learned or where it was lucky.
    - What did not go well? It indicates the topics/activities on which improvement is required. What technical and non technical knowledge was gained? The technical knowledge gained will provide additional tools to assist team members

in their professional advancement. Non technical knowledge should be included in the evaluation of the project since they (team members) can contribute / be more efficient in the future.

- What would be done if the same project were to be repeated? Dissect the project to determine which successful methodology can be used for future projects. For example, if a certain project is very successful due to specific personnel management (e.g. different groups on different facets of the project) , same will also work well for other similar projects.
- What would be done differently if the project were to be repeated?

6. **Follow-up action:** Several possibilities are available concerning potential follow-on work on the project. Regardless of which approach is chosen, the decision should be based on sound engineering judgment with supporting data and just not personal pride or a 'gut feeling'. This runs like -

a. Determine whether the project results were accurate. For this review all the notes, costs, records to make sure that every aspect of the procedure used are taken into consideration.

b. Decide on changes, adjustments or improvements that can be used to improve in future projects. First time projects often set the stage for future projects in a progressive company. These projects will be revised to fit with current scenario.

c. Measure the profitability or success of the project. Short term as well as long term results must be taken into consideration.

d. No further activity (stop) -This alternative may be recommended due to any of the following reasons:

- The financial condition of the company changes.
- Continued activity is neither practical nor cost effective.
- Certain critical expertise is no longer available.
- The original reasons for the project disappear.

Doing an honest evaluation in each of these area can significantly help in not making the same mistake a second time. Regular evaluation of projects: (i) provide a documented log (report) of experience that may be valuable in improving future decision making, (ii) help in discovering systematic biases in judgment, (iii) enable the firm in identifying individuals with superior abilities in planning and forecasting, (iv) serve as a useful training ground for promising executives who need broader business experience and exposure (v) help to access whether the decisions taken by the project manager matches with the intended requirements and (vi) induce healthy caution among project sponsors. Sample outline of anevaluation is shown in appendix-1.

11.6 Phases of Project Evaluation

Evaluation is a continuous process and an integral part of project management. Projects can be evaluated at various stages of their life cycle. Its evaluation phases are divided into the following parts:

11.6.1 Ex-Ante Evaluation (Project Appraisal)

This is the first phase of a new project's evaluation. It is conducted before the implementation of the project. Ex- ante evaluation includes feasibility study, project appraisal and policy assessment. On the basis of the information generated during this phase decision is taken whether to implement, abandon or reformulate the designed project proposal.

11.6.2 On-Going (Con-current or Mid-term) Evaluation

Though a lot of effort has been expended in selecting projects, things often go wrong in the implementation phase. This is evident from the frequent time and cost over-runs witnessed in practice. Hence it is necessary to exercise strict control on in-progress projects. On-going evaluation is done at any time during the project implementation to ensure that things are progressing according to plan. Primary purpose of this evaluation is to keep the project on schedule and budget. It is designed to improve the management of the project to stay on course to meet projected outcomes. Project manager is responsible for conducting this evaluation. Project Audit and variance studies are done to take the relevant decisions: to keep the project on right track or to modify according to the current scenario etc.

11.6.2.1 Project Audit

Project audit is the technique of performance evaluation of an ongoing project. In other words, Formal and systematic examination of the performance of an on-going project as compared to its planned objectives is called as project audit. According to W.S. Turner, "Project audit is defined as a formal and systematic examination of the performance of an ongoing project as per its requirements".

Project audit is a review of the books of accounts, records of transactions and financial and other systems maintained by a Project Coordination Unit (PCU) for the purpose of executing a project. The whole point of a project audit is to get a reality based accurate picture of a project's expenditures, schedules and quality of work. Project audit systems functions independently and reports directly to the top management. It is necessary that project audit should cover the whole spectrum of control. The groundwork for an audit should be laid during the project appraisal phase. It may include the following:

a. Project audit system in an organization may function either as a **continuous** or as a **periodic** basis. When a project audit goes viz-a-viz project commissioning, it is in the nature of preventive audit and is known as continuous project audit. On the other hand a periodic audit system may be performed when the project is just commissioned or when the operations of the project stabilizes or at some other time in the life of the project.

b. Project auditor should be **supported by an independent group** consisting of executives drawn from different backgrounds like planning, engineering, accountancy, marketing and so on. All team members as well as project auditor should be educated in project objectives before they are put on project audit.

c. Audits can vary considerably, depending on the objectives, project activities and expected reports or outcome. These can be classified into three categories:

(i). **Financial Statements Audit:** A financial statement audit assesses whether reported disbursements have been made in accordance with the relevant financial agreements. This audit ascertains whether individual expenditures, which comprise the totals, are properly authorised, appropriately accounted for and fully supported by documentations.

(ii) **Compliance Audit:** It involves reviewing, testing and appraising project's control procedure, including compliance with laws and regulations to which the project is subjected.

(iii) **Operational Audit:** An operational audit is a more thorough examination of management techniques and performance. It may help to identify implementation issues for the purpose of prompt remedial actions at the project level.

d. The **audit report** should include the audited financial statements, the auditor's opinion, a management letter and any special reports required by the organisation. The auditor's opinion for the ongoing project may be unqualified, qualified, adverse or a disclaimer of opinion. The report should contain both the results of enquiries (i.e. the true state of the project) and recommendations for dealing with the problems found.

The basic aim of project audit is to measure the efficiency, effectiveness and accountability of the project. It is done to find the reasons for uncomfortable symptoms in the project, and answers for the questions posed by the sponsor or senior manager. Project audit in an organization will be able to checks the manipulations, pitfalls, malpractices and mistakes which may go unnoticed and may be get repeated . Thus:

- Project audit provides a clear picture of the actual status of the project.
- It helps in discovering systematic biases in judgement.
- A continuous check through project audit on the observance of plans, policies, procedures and practices will ensure management efficiency.
- Project audit is used to ascertain the factors which might lead cost and time overruns. It gives credibility to the financial statements and other management reports. Audit of financial aspects of a project identifies weaknesses in internal controls and financial systems and makes recommendations for improvement.
- It is very useful in identifying problems that might be faced while commissioning the project.
- It can be used to create a good information base for proper execution and implementation of the project.

The soundness of an on-going project of an organization may be evaluated in terms of the following criteria:

1. **Techniques**: Are efficient techniques being employed for the purpose of planning, implementation, decision making and control of the project?
2. **Decentralization**: Is there meaningful delegation and decentralisation which permits decision making at appropriate levels?

3. **Intelligibility**: Are the policies, methods of analysis and procedure understood by different segments of the organization which are involved with project?
4. **Flexibility**: does the project system have sufficient flexibility to respond to the dynamic changes in the environment and to permit variations in approaches for projects with differing characteristics?
5. **Communication**: Are the premises underlying to project communicated to those participate in its process?
6. **Control**: Are adequate controls being exercised in the implementation phase to ensure that slippages are mitigated?
7. **Results**: Are the results of the project consistent with the goals of the organization?
8. **Review**: Is there a systematic review of every phase to provide meaningful feedback for improving the system and its effectiveness?

11.6.3 Ex-Post Evaluation

Each project provides some additional knowledge to the company's data base regarding projects and their management. To be most successful, the company needs to close the loop at various points in the project particularly at its end, to determine success or failure and lessons learned from the project. Without determining these, company is assured of repeating previous mistakes. Ex-post evaluation is done after the completion of the project by analyzing the actual against the projected estimates in respect of cost, time and quality specifications. It covers every aspect of the project starting from project planning, appraisal, decision making, analysis, implementation and social cost benefit analysis etc. This evaluation should have the following attributes: adaptive, long-term, comprehensive, integrated and cumulative. **Adaptive** evaluation is used to continuously assess and adjust project related decisions within the changing context and conditions. **Long term** evaluation monitors impacts that occur over time scale of several years or more. **Comprehensive** ex-post evaluation includes the full array of social economic, environmental, institutional impact of project. **Integrated** ex-post evaluation examines the interactions among these different types of impacts. **Cumulative** evaluation considers how the impacts of one project are related to the impacts of other projects.

Ex-post evaluation is the assessment of a project after its completion. The basic purpose of doing ex-post evaluation is to study the project's impacts and feedback. The overall efficiency, budget specifics, output and expected impacts of the project are reported in this evaluation. The fundamental objective is to record the findings from such evaluation so that these observations can be of immense help in future. The project management cycle actually starts (initial planning) with the ex-post evaluation of the other similar project. Until the ex-post phase, evaluation processes tend to focus at the input and output levels of the logical framework. The special role of an ex-post evaluation is to take a serious look at the purpose level and begin to analyze project contributions to the goal. Ex-post evaluation, or post audits assess the actual impacts of completed projects, programmes and policies for the people, environment and landscapes that are affected by the project. Ex-post evaluation can also help to guide decisions about project design,

operations, refurbishment and decommissioning. Well designed ex-post evaluation can help to draw short and long term lessons for project and resource management.

Ex-post evaluation can be carried out in two phases: (i) soon after the completion of the project –to find the actual outcomes, variances and reasons for such variances, (ii) after the lapse of about two –three years since the completion of the project. Project completion report is the basic instrument used for ex-post evaluation. This evaluation can be carried out by questioning the following:

- Whether the technology goals, market share etc. envisaged in the project is achieved.
- What are the reasons for shortfall in the above mentioned?
- What else could have been done to avoid the shortfall noticed?

Observations in Ex-post Evaluation

Though the observations in ex-post evaluation vary due to the complexity, interest of related parties, and volume of different projects, these may be grouped in three categories:

A. Successful projects

A sound feasibility report should result in a sound and successful projects. Such projects should not only meet all their obligations towards owners, workers, suppliers, government and the society at large but also have sufficient funds to keep them in an adequate state of liquidity. These projects serve the purpose for which they were established and their neighbourhood or spill over affects should be positive and a model for further industrialization.

B. Challenged projects

Unfortunately, there is time-lag between project appraisal and project evaluation. By ex-post evaluation it may appear that there is project overruns of an alarming magnitude. Project overruns include both actual time overrun and actual cost overrun as compared to projected time and projected cost respectively. The usual reasons for project over-runs may be like:

- Under estimated project schedule and project cost;
- Technological changes leading to obsolescence in technology;
- Contractor's genuine problems;
- Adverse site conditions;
- Unforeseen difficulties and problems;
- Lack of integration in project organisation etc.

In such cases, the evaluator conduct in-depth studies to find whether the delays or overruns were un-avoidable or not? In fact, the evaluator tries to find out if there was any element of dishonesty or inefficiency. Sample outline of an ex-post evaluation report is shown in Appendix-2.

C. Abandoned projects

Ex-post evaluation is a systematic determination of a project's merit, worth and significance, using criteria governed by a set of standards. For, various reasons, the project may become terminally sick and no amount of bailout can save them. It may be due to bad location, technological obsolescence, and fiscal anomalies or dis-interested management. Such projects should be abandoned and resources so released be applied for other useful purposes.

Systematically recorded and analyzed observations in ex-post evaluation can be of invaluable guidance for future projects. It may be useful to develop specimens of model projects and avoid wastage of resources to a great extent. It is understood that evaluation findings will be harnessed for qualitative gains in future undertakings. In other words, the point is not to bring past failure into question, but to utilize the lessons that can be gleaned from past successes and failure for a more constructive approach that will lead to be more effective and efficient.

11.7 Project Appraisal vs. Project Evaluation

Evaluation and appraisal are sometimes used interchangeably due to the following reasons: (i) both mean assessment and (ii) at times they overlap especially when we talk of ex-ante evaluation. But both are basically different. Project appraisal is the pre-investment evaluation of estimates/forecasts etc. A project may be financially sound but may be in-appropriate for the economy or society. Before taking decision, project feasibility study or appraisal reports are prepared by using all the relevant indicators (details are given in Unit 3), which helps in taking a decision in favour or against such proposal. Thus, appraisal is the process of examining a proposal before a decision is made. It is the discipline of calculating the viability of the project. Evaluation on the other hand, is the audit and assessment of the actual as against the estimates, bases on which the project was launched and completed. It is a review of the actual operations which covers (a) how successful or otherwise it had been and (b) what lessons do we learn for future.

While appraisal contains 'estimates for future', the evaluation is to find the 'valuation' of what has happened practically. To be in short, appraisal and evaluation are like before project and after project situation respectively.

Barriers in Evaluation

Major barriers in the process of evaluation may be as follows:

a) **Degree of control:** There is always a dilemma regarding the degree of control i.e. too much vs. too little. Too much control may impair the ability of managers and create unnecessary hindrance to efficient performance. On the other hand, too less control may make the evaluation process ineffective and superfluous.

b) **Short term view:** evaluators often tend to rely on short term implications of activities and try to measure the immediate results. Often long term impacts are ignored.
c) **Resistance to evaluation:** the evaluation process involves controlling the behaviour of project team, and hence is likely to be resisted by them.
d) **Difficulties in measurement:** There are certain inherent difficulties in measurement during the process of evaluation. These difficulties mainly relate to: reliability and validity of measurement techniques used for evaluation, inability in getting timely and valid information, lack of quantifiable standards against which performance in every phase of project life cycle is measured or control system may be not uniform.

Evaluation methods can prove costly, time consuming to design and implement and require trained staff to ensure success, reports Louisa Gosling and Mike Edwards in "Toolkits: A practical Guide to planning, Monitoring, evaluation and Impact". The benefits and importance of this technique, however, far outweigh these limitations.

11.8 Summary

Project management includes developing project goals and teams, as well as setting core tasks and priorities. An additional component of project management is project evaluation. A project evaluation reviews the whole process and determines the rationale, efficiency and effectiveness of an on-going or completed project. These evaluations are important, determining whether the project is worth repeating, results were accurate, what changes and adjustments need to be made, and how the process can be used for the success of future projects. The data obtained from project evaluation can impact the project's long term development and change future resource allocations and other core components of a business enterprise's project management methodology. Learning to comprise an effective project evaluation assists in keeping an organization moving forward with new technology and methods of production in an organized and productive manner.

11.9 Self Assessment Questions

1. Distinguish between the Project Appraisal and Ex-post Evaluation.
2. What do you mean by Ex-post Evaluation? Explain the procedure of such evaluation.
3. Briefly describe the purpose and importance of Project Evaluation.
4. What is the difference between Project Audit and Ex-post Evaluation?
5. Write a detailed note on the nature, purpose and phases of Project Evaluation.
6. What are the major barriers in the Evaluation Process? How can these barriers be avoided?
7. "The process of project evaluation does not operate in isolation; it works on the basis of the different organisational systems". Comment.
8. What are the major steps in the Evaluation Process? Discuss at length.
9. Explain the objectives of Ex-post Evaluation.

11.10 Reference Books

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APPENDIX-1

Sample Outline-Project Evaluation

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Abstract

1.0 Introduction

1.1 Background

1.1.1 Purpose of the evaluation

1.1.2 Major stakeholders

1.2 Project Description

1.2.1 Summary of logical Framework

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3.1 Management of project inputs
3.2 Timely and useful information-reporting
3.3 Problem solving
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5.4 Summary of recommendations

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Appendices

APPENDIX - 2

EX-POST EVALUATION REPORT ON PROJECT

Project title Date started

Project No. Date completed

Project Manager

Project Team: Grades Numbers

(Supported by actual organization chart of the project team)

A. Observations:

- Activities and sequence of such activities as actually followed in implementation of the project against the budgeted project schedule.
- Time spent and cost incurred per activity as against the budget. Details of price escalation as against the budget.
- Reasons for variances of more than 10% of the budget, in respect of time, cost and price.
- Resources required for project implementation- whether adequate and were timely available or rationed and/or ultimately- to increase in interest cost.

- Major contractors appointed; whether they were sufficiently experienced and their performance; the compensation paid, whether reasonably competitive.
- Technical uncertainties faced and alternative steps taken.
- Back-up strategies for risk areas undertaken.
- Effects of external factors-e.g. price, political interference, new regulations, community factors faced and their consequences.
- Interference of project owners.

B. Remedial measures suggested:

(Need for such measures followed by the details of actions)

i)
ii)
iii)
iv)
v)

Table of Contents

References

Appendices

Projector Auditor	Project Manager
Signature	Signature
Date	Date

Source: Agarwal N P, Mishra B K, Project Management, RBD Professional Publications, Jaipur.

Unit - 12 : Project Review and Reporting

Structure of Unit

12.0 Objectives

- Understand the term of Project review and report.
- Know what the contents that influence Project review Process.
- Have an Understanding of Project review Process.
- Understand the importance of a Project report.
- Know the framework of a Project report.
- Learn how review Process operates.
- Learn some of the methods of Project review.
- To have a basic Knowledge of Project review Process.
- Have an overview of some issues project review process.

12.1 Introduction

Review means a survey of the part. Project review is a part of project control. It involves judicious operation of a Project with a view of wealth maximization, maximization of return, and increase in the rate of return at low risk level. It is all about control. Project review is a scientific process. It involves a specific approach. In this process, six different dimensions are used to analyze the project. These areas are: technical, economic, organizational, managerial, operational, financial and economical. These aspects are used relatively as per need of the situations. These different aspects are equally important. Project review can be defined as an exercise basically aimed at determining the viability of a project. It also involves reshaping the project if needed. The interrelationship of the technical, financial, economical, socio-economical aspects can be understood by an example. Example- The size of market and the demand estimates are related with plant capacity because these factors determine profitability and production. The exercise of project review means the assessment of a project with a view of several aspects like economical, technical, social and financial viability. In other words, we can say that this is a composite process of all aspects. This process calls for a more system at approach and fine –tuned monitoring systems.

12.2 Project Review

Project review indicates six different aspects like economic aspect, technical aspect, organizational aspect, managerial aspect, operational aspect and financial aspect. In simple explanation of these aspects, we are providing the main stages of the system of project review.

(a) **Economic Aspect**- It is concerned with priority of uses. Basically, the economic aspects of the project are fundamental factors. The reason for this opinion is banking decision process. Reason is this that project are not financed unless the project presents high and secure priority use of local /regional resources. In this regard, it is necessary to mention that financial analysis does not provide related information in respect of priority of uses. An economic analysis represents the whole economical viewpoints. It shows all factors related to a project for assessing investment in the project. Here, we are discussing some economic aspects of a project. These are as follows:

1. Project creates improvement in income distribution.
2. Project creates improvement in national income.
3. Project makes higher standard of living.
4. Project makes higher earnings to the society.
5. Project creates improvement in government revenues.
6. Project provides more opportunities of employment to the society.
7. Project creates more production or output with lower cost.

(b) **Financial Aspect**- It is concerned with the determination of financial viability for systematic and efficient operation of the project. Finance is a life giving element for every organization. In other words, we can say that the role of finance is like blood in human body. Financial institutions examine the project to ensure justification of investment. They study each and every factor for self reliance. The main objective of the review of financial dimensions is quite important in terms of financial viability. The area of this aspect relates with financial requirements and financial outflows. Here, we are discussing some financial avenues for better understanding this concept. These are as follows:

1. Cost of production- In the case of cost of production it is estimated that what would be the original cost of the production. For this, project cost analysis is used. It is concerned with the determination of financial viability for systematic and efficient operation of the project
2. Operation Quality- Financial review evaluates capacity of revenue generations.
3. Return on Investment- In this segment, it should be ensured that investment is going on in right direction.
4. Marketing Avenues for advancement- This reflects marketing services for sustaining in the field.

5. Profitability in respect of the project – It covers allover profitability for revenue earning concern.
6. Available and required budget- This helps in ascertaining the cost of production and profit expectations.
7. Sources of finance- Funds are also important factors for project review process. It deals with raising the funds and optimum use of funds. In this process, reviewer must consider all available sources.
8. Pricing- This is related to fixing of the products price. Price fixation is not a easy job. It is concerned with market. The price should be optimum because the price is the main factor for creating demand.

(c) **Operational Aspect**- It is associated with the capability of the project. It should be considered key factor of the review system.

(d) **Managerial Aspect**- This aspect shows that if the management is not capable for handling the project, than sound project may fail in total. Projects can be improved as per their needs. Financial institutions carefully examine that the promoters are having sound managerial skills in respect of the handling of the project. In this regard, we can say that it is quite necessary for the reviewer that he must ensure managerial capabilities of the promoters. It is concerned with overall managerial approach towards the project.

(e) **Organizational Aspect**- In the process of project review, organizational suitability is assessed for smooth functioning of the project. The main objective of this dimension is to assure that the project is carried out with capable staff. Strong organization is a prerequisite of a project. Financial institutions provide stress for this aspect as they feel that organizational set-up should be well and adequate. In this stage, training requirements for these local staff are also examined. If training programmes are necessary for the project than these can be added for improvement. Project review indicates that the requirement of the project should be fulfilled. Here, we are discussing some organizational aspects for better understanding this concept. Some of them are as follows:

1. Structure of the organization.
2. Type of organization.
3. Initial and future recruitment process.
4. Initial and future training process.

In this regard, we must consider human resource practices applied by the project. Some of them are:

1. Assessment of manpower needs
2. Recruitment process
3. Selection Process
4. Salary or Wage system
5. Special attention in terms of woman workers.

(f) **Technical Aspect**- It is concerned with scale of the project. It is also associated with the technical process. These aspects are as follows:

1. Process of manufacturing
2. Technical Engineering
3. Location of the project
4. Availability of infrastructural facilities
5. Plant and Machinery
6. Capacity of plant and machinery, required tools for setting-up the project.

12.3 Understanding of Project Phases

It ensures that the objective of a project is met by measuring progress. It focuses on taking corrective action if necessary. The project manager should consider interactions between work relationships. Generally projects are temporary in nature, but they are having timely completion. If an entrepreneur wants to be successful in his project of a product or service, he must consider carefully various components of the Phases of a project management. An ideal project is one which is thoroughly reviewed. An entrepreneur or a project manager should consider all phases of a project like.

- **Identification or Selection of a Project**- In this regard, we must consider two aspects of a project. First, an elementary aspect of analyzing the product, its marketing, financial, technical and economical factors. Second, the feasibility components. It covers related information for strategic as well as normal decision making. Here, we are discussing some important aspects of a project. The important dimensions of a project are as follows:
  (a) **Marketing Aspect**- It contains consumer preferences, competitive pressures, relations between demand and supply.
  (b) **Product or Service**- It covers preference or choice of a product or service, technical specifications of the product or service and applications of the product/service.
  (c) **Financial Aspect**- It is concerned with investment in fixed assets, current assets. It also deals with working capital, short and long term financial tools, etc.
  (d) **Technical Aspect**- It is concerned with location, work schedule, plant layout, setup of plant and machinery, manufacturing procedures, scale of production, etc.
  (e) **Economical Aspects**- It is concerned with importance for the society, employment opportunities, scope for development and social responsibility, etc.
  (f) **Feasibility Aspects**- It is concerned with cost and profits, risk factors, financial viability, capital budgeting like internal rate of return, profitability factors like revenue generation, profits, costs, and break even point in terms

of operations. It also deals with financial projections like projected balance sheets, projected profit and loss accounts and various sources of funds. In this connection, we are providing social and economic desirability in respect of social objectives, social advancement with maximum returns. Here, it is necessary to mention that these aspects are interrelated. Simultaneously, they affect each other.

- **Formulation** - In this stage, a detailed investigation must be done in terms of technical, financial, economical, social aspects. In the beginning, the project is examined for its economic viability in terms of technical, financial, economic and marketing factors. If this analysis provides positive report then detailed study or investigation is conducted. It means that it is concerned with the feasibility of the project. It involves preparation of a project. It is right to say that projects should be made with a view how they will be executed. Project formulation is a key factor of project management. In this regard, we can say that project formulation is a significant link between project identification and project appraisal.
- **Implementation** – During project implementation, we should consider following points to develop an integrated view-
  (a) Area selection in terms of socio-economic surveys and different government policy guidelines.
  (b) An economic survey should be implemented in the selected area for selecting opportunities related to available resources like human as well as physical resources for the development of the project.
  (c) Technical and financial feasibility study on selected prospective industries should be considered. In this connection, we must prepare industrial profiles having investment opportunities as well as upcoming threats.
  (d) In this process, we must consider all avenues of exiting entrepreneurs who are interested to change their profile in respect of identification of potentials.
  (e) This is totally depended on allocated resources and project completion period. In this regard, we must consider whole planning.
  (f) For better execution of the project, we must consider training schedules for the development of entrepreneurs so that they can become more competitive in terms of project feasibility, project preparation and environmental changes. Thus, we can say that project planning is very important for implementation of the project.
  (g) In this connection, we must consider consultancy services in the areas of management, production, marketing, financing, technological advancements, project preparation and banking relations.
- **Evaluation** - Appraisal of market, evaluation of financial, technical and economic aspects. Analyzing and assessing the profitability return on investment in the project and break-even points.

- **Selection** - It is concerned with choice of a project with a view of achieving objectives. We can say that a project contains all activities related to –
  (a) Production of products or services
  (b) Capacity of the existing projects
  (c) Productivity of products or services
- **Management** – Project management is considered a special branch of management. It involves differentiation in terms of many factors like the organization structure, the process of planning, organizing, directing, control and human aspects. In respect of the management, we can say that for carrying out work efficiently, it is essential that a scheme of operative activities should be made. It involves planning of whole project. For this type of work, work can be divided into a series of operations. As we all know that planning is an intellectual process. Planning involves scheduling, programming, budget, process, methods, rules, procedures, strategies, etc. Project management is a two way process. It covers financial and administrative activities. Management of projects deal with systematic identification, formulation and appraisal. These three factors are the base of project management and requires for the success of the said project. Finally, we can say that over all managerial aspects are involved in this aspect.

Here, we are considering a short profile of projects. We can divide projects in quantifiable and non-quantifiable projects. Quantifiable projects are related with quantitative assessment. Generally these projects are related with heavy industrial development like power generation, cement industry, mineral production. On the other hand, Non quantifiable projects are those where an assessment is not possible like health, education, defense or social responsible sectors. In India, our planning commission has classified some sectoral projects like agriculture and allied sector, industry and mining sector, irrigation sector, power sector, transport ad communication sector, social service sector. If we want to manage mega projects, we need a more sophisticated approach toward the project specifications. Today, business environment is complex, ever-changing and driven by unexpected forces or we can say that business environment is always changeable. In this environment, we must follow our planning with a view of changes. Here, it is compulsory to mention such points for better understanding this approach. We can say that a good project is one which is social and economical in terms of desirability. It means that a larger society favors the project.

12.4 Checklist for Project Review

The process of project review involves a systematic study of the internal and external environment. The future aspect is also necessary for the review process. The entrepreneur must consider various factors of business environment with a view of project. Here, we are giving a model checklist for project review process. It can be adjusted as per environmental needs. Following factors can be used for a systematic review-

1. Examination of objectives with a view of product or service
2. Listing and descriptions of alternative techniques of productions

3. Specification of product/service and prices
4. Examination of marketing strategy.
5. Specification of sources
6. Specification of source of supplies
7. Review of technology in terms of advancement
8. Review of working capital requirements
9. Review of measures for combating environment issues
10. Examination of past performance of an entrepreneur with respect to project completion, utilization of available resources and return on investment.

12.4.1 Scope of Project Review

Project review is a process of reviewing all the aspects related to a project we can summaries few aspects.

- Size and scale of operations
- Locations for the proposed project
- Availability of Infra structure.
- Financial Requirements.
- Cost of capital, Break-even-point.
- Project design and network analysis
- Level of thinking and decisions in terms of project completion
- Sensitivity Analysis
- Projections of profitability.
- Comparison between other similar projects in terms of project cast
- Social cost analysis.

Therefore, the main stages of the system of project review are reviewing of economic, technological, operational, and financial and management viability of a project. To sum up, project review is a science as well as is art. It requires keen observation, objectivity decision making capacity and a knack for information's every project has three basic characteristics.

- Input
- Output
- Social cost

Therefore, every project should be reviewed in terms of these attributes for successful project management. Entrepreneurial development is necessary for every country in respect of sustainable development. It we are creating a dream into reality it means we are taking risk. Every project is associated with risk every entrepreneur want minimization of risks. Project review helps in achieving entrepreneurial development as well as in minimization of risks. In the worlds of Peter of Drucker- Successful entrepreneurs, whatever their individual motivation be it money power, curiosity or the desire for fame and recognition-try to create value and to make a contribution, still successful entrepreneurs aim high. They are not content simply to improve on what already exists, or to modify it. They try to create new and different values and new

different satisfactions to convert a material into a resource or to combine existing resources in a new and more productive configuration. In this regard we can say that a project is not completed with its implementation project review provides a comprehensive and detailed view of the elements of success and failure of the project.

12.4.2 Problems in the Process of Project Review

A few major problems and issues related to a project report are given below:

- Non co-operation among the staff
- Non- availability of Technical and financial assistance
- Local initiatives
- Project preparation and evaluation process
- Financial and investment avenues
- No functioning of Govt. Departments
- Poor consultancy and counseling services
- Management Restructuring issues
- Incentives by the government
- Incentives by the industrial environment
- Availability of information's related to markets and technology.
- Lack of professionalism on the part of managers
- Lack of expertise on the part of understanding
- Inadequate technical support
- Non availability of updated information's for quick decisions.
- Choice of an idea
- Lack of motivation
- Lack of vision
- Poor organizational structure
- Poor capacity utilization
- Lack of strategies
- Poor project implementation

Beside this, some factors are not in our control like government policies, administrative pins, and lack of sound directions, industrial and economic regulations.

12.5 Project Report

Project report is very useful in terms of investment, expiation and running decisions of an enterprise. It reveals the practicability of a project in respect of relevant aspects like technology, finance and economy. It is necessary for an entrepreneur who wants to start a venture for financial support. The risk aspect is also attached with the Project report. On the basic of a report, we can ascertain risk factor in respect of a Project or investment. The project report is submitted to the financial institutions for the grant of land and concessions as required. We can prepare project report or avail service of professionals. The project report tells us various detailed information for decision

making. The financial institutions insist and check that the project report is financially viable or not. The financial institutions ascertain from the report that the possibility of revenue generation is available or not. Project report reveals that the repayment of allocated funds is possible in a stipulated time or not. From the help of project report, we can ascertain economic and financial viability of the project and managerial skills required for advancement of the organization.

Project report is prepared before commending a project. It is made after evaluating various internal and external relevant factors. It is formulated after the identification and implementation of project or investment it involves assessment of the demand of proposed product to be produced. It assesses costs of investment and estimates the expected return of the proposed investment in respect of profitability. A project report of a new organization provides much relevant information in regards to economic as well as financial decisions. A project report is very useful for entrepreneurs for their decisions or investment. It is also very useful for financial backer banking institutions and departments of state or central government. It provides basis for making decisions terms of investment, extension or advancement of a project. In India, it is a practice that financial institutions have been using this instrument for giving financial support to the entrepreneurs. It is expected from every entrepreneur that he must prepare project report and submit it with application for financial help. The aim of project report is to achieve clear decisions for financing of the proposed project. It is on this basis, we can derive maximum benefits from minimum expenses. The project reports are made for several purposes like.

- New Projects
- Expansion projects
- Modernization Projects
- Diversification projects

The project report is also made for welfare, service research and development purposes.
It is a guide to management. It is prepared by an expert after detailed study of the various relevant aspects of a project. It provides a systematic and detailed analysis of the inputs and out puts of the project. It serves many relevant in puts in respect of goods and services to be produced it gives sound information on technical, commercial, financial and economic aspect of a proposed project. Generally term loans are based on these kinds of project reports.

12.5.1 Scope of Project Report

A project report includes relevant and up to date information on the following factors.

1. Managerial Factors:

It should contain necessary qualification in and experience for handing management. The report should be exhaustive in terms of managerial decisions.

2. Economic Factors:

The project report should contain market analysis of the product or service. The report must emphasize to present economic feasibility for investment. The report should be able in terms of these marketing issues:

- Area of the market.
- Future alterations.
- Growth of the market.
- Government policies.

3. Financial factors

The investment should contain difference between cost of capital and return on investment. Project report should cover sources of fund entrepreneur's contribution and total required funds.

4. **Technical Factors**:

The project report should focus on required technology machinery and tools. The availability of the required technology should be a part of project report. The project report should cover location, size of plant, site and feasibility aspect. Here, we are discussing some factors that influence the location factor. These are as follows:

(a) Raw material supplies
(b) Transportation Systems
(c) Power and fuel supply status
(d) Availability of markets
(e) Strategic Aspects in terms of defense industries
(f) Environmental Factors
(g) Labour laws
(h) Government policies
(i) Availability of human resources
(j) Water
(k) Variations in taxes and fees
(l) Large area of land and services, if needed
(m) Socio-economic factors

5. Production Factors:

It should cover a description of the product or service selected for Production. The product development and design matter should be a part of project report.

12.5.2 Contents of a Project Report

Here, we are providing some basic contents of a project report**.** These contents are useful in terms of understanding of the concept of a project report.

1. The area or scope related to project report.
2. Basic objective
3. Nature of Product or service (Product specifications, users, quality and required standards)
4. Marketing Aspects (Status of demand, Potential in terms of international trade, market trends, stability of price self capacity of Production)
5. Manufacturing Aspects (Production process, production technique.
6. Plant and Machinery (Required infrastructure, tools equipment, supply of energy)

7. Raw Materials (Demand and supply, status, future prospects, compatibility, sources, prices.)
8. Financial Aspects (cost of capital, return on investment working capital requirement, future requirement)
9. Human resources (cost of human resources, requirement of staff)
10. Trading practices and marketing strategies.
11. Government Policies.
12. Economic Aspects.

12.6 Sample of a Project Report

1. Introduction

Name of the organization

- Area or scope
- Product or service
- Process/Method
- Market options
- Location Aspects
- Resources of fund

2. Scheme

(A) Plant and Machinery. Rs.

(Give details regarding capacity. freight insurance, specifications.)

Total Rs.

(B) Testing Equipment /Tool Rs.

(C) Land and Building

(Purchased, rented or leased-give details) Rs.

(D) Other Fixed Investment:

Original Cost of tools/equipments Rs.

Electrification expenses Rs.

Parking expenses Rs.

Forwarding expenses Rs.

(E) Total ((A)+(B)+(C)+(D)

(F) Raw Material

- Indigenous /Domestic Rs.
- Imported, If Any Rs.

(G) Personnel

(I) Direct Cost/Ungues And Quantity Per Month Rs.

	(II)	Indirect Cost/Wages and Quantity Per Month	Rs.
		Total [(I) + (II)]	
(H)	Other Expenses		
	(I)	Transportation Charges	Rs.
	(II)	Advertising Expenses	Rs.
	(III)	Water and Power Expenses	Rs.
	(IV)	Commission to Middlemen/ Distributors	Rs.
(I)	Total Recurring Expenses (F) + (G) + (H)		Rs.
(J)	Required Working Capital for 3 Months		Rs.
	Multiplied By Recurring Expenses		
(K)	Total Investment (Required)		
	(I)	Non- Recurring Expenses	Rs.
	(II)	Working Capital Requirement for 3 Months	Rs.
		Total (I) + (II)	
(L)	Total Cost of Production		
	(I)	Total Recurring Expenses	Rs.
	(II)	Depreciation on Fixed Assets	Rs.
	(III)	Repair/Maintenance Exp, If any	Rs.
	(IV)	Interest on Total Investment	Rs.
	(V)	Office Expenses Etc	Rs.
		Total	
(M)	Status of Profit And Loss Account		
	(I)	Sales	Rs.
	(II)	Cast Of Production	Rs.
	(III)	Profit (I) – (II)	Rs.
		(% of the Total Investment/Capital Employed)	
		Total	

3. **Profitability and Projection**

(i)	Actions or Phases	Rs.
(ii)	Profitability of Phases	Rs.

4. **Basic Infrastructure (Availability**)

(i)	Policies of Government	Rs.
(ii)	Location Merits	Rs.

(iii) Availability of Resources Rs.
(Material, Energy, Water, Labour, Etc)

BEP (Break Even Point)

$BEP = \frac{F}{SP-V}$ {F= Fixed Cost}

{SP= Sales Price Per Unit}

{V= Variable Cost Per Unit}

5. **Name and Addresses of Suppliers**

(i) Raw materials

(ii) Machinery.

(iii) equipments/tools (required)

6. **Keynotes/ Remarks (If any)**

Date :

Place : **Signature of the Expert/ Consultant**

12.7 Use of Network Analysis

The progress of India's economic growth is closely related with customer, competition and change because these three aspects are driving forces for changing business scenario of India. For understanding project review process, we should consider project design and network analysis. Project management involves planning, scheduling and controlling of a specific project. Project design is a very important aspect of a project. In other words, we can say that project design is the heart of a project. Project design helps in identifying the flow of event which should take place for the implementation of the project. It clearly states the individual activities which go into the corpus of the project and their mutual relationship with each other. Network techniques are very important for the management of an enterprise in performing activities related to a project. In other words, we can say that project design is a framework of a project made with detailed information's and develops a systematic work plan for the project. It is helpful in the implementation of the project as scheduled. The network analysis provides systematic lessons for future applications. This has potential for updating project estimates. The use of network analysis provides many merits to a project manager like-

- In the process of physical progress of the projects, there may be some events in different areas of the project which closely affects project progress. There may be some unwanted events and needs correction within the proper time. In this regard, management may think it appropriate and economical to speed up completion of projects.
- This is helpful in time estimates because of two reasons. The first reason is related with a project in which past experience was not appropriate in respect of time estimates. On the other hand, time estimates may be deterministic in respect of past experience of similar type of works in different other projects.

- The network analysis is also helpful in the estimation of costs. We can say that cost estimates depend on the project time estimates. The changes in estimation are always required in terms of economic factors like inflation, supply etc. The project manager should consider personally this aspect because this directly affects overall cost of the project.
- For better understanding of operations and their relationship in respect of a project, the network analysis helps from beginning to end.
- We all know that the whole project must be considered in respect of the sequence of activities and related events. Sequences are not as per our requirements. It involves activities that are to follow one by one.
- In order to understand the whole project, we should consider different segments of the project. The whole project can be put on a single network for integration of the overall detailed activities in a separate network. This reflects that each operational activity has been considered for development of the project.

12.8 Summary

In India, the small industries service institute and small industries development organization are helping in the preparation of reports. If an entrepreneur wants financial concession, he should submit a project report to the financial institutions. In short, we can say that a project report is very useful for decisions in respect of a particular investment. The project report reveals financial technical, managerial and economic feasibility in terms of a project related to a product or service. On the basis of a project report, we can ascertain the possibility of generation is totally depending on the contents of a project reports. The managerial decisions are depend on it. It contains economic and commercial viability of the project in other words, the project report must emphasize on managerial aspect of the venture.

12.9 Self Assessment Questions

1. What do you mean by project review? Explain it.
2. What are the contents of a project report? Explain it.
3. What is the importance of project report? Explain it.
4. What is the use of project report in terms of economic development? Explain it.

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Unit – 13 : Information Technology in Projects

Structure of Unit

13.0 Objectives

After completing this unit, you would be able to:

- Understand the concept of project management software;
- Understand importance of project management software;
- Know about types of project management software;
- Point out various common features available with project management solutions;
- Know about various project management software used world-wide;
- To know about selection criteria of project management software;
- Understand use of Open Project.

13.1 Introduction

Today most of the business organizations use project management tools and software to manage their projects. Project management software is any software solution that allows an individual or a team of people to track a project from its conception to its launch. This type of software typically provides project managers and other team members with a single access point to a wealth of relevant information, including the scheduling of resources, budget management, time management, task assignments, quality control, bug/issue reports, documentation, and collaborative tools. The goal of project management software is to increase efficiency by making the project development cycle more transparent for all involved team members. Each member of a team is typically provided with their own personal view, allowing them to track the specific tasks they are working on, and team members may be given access to other members' assigned task lists, so they can have a better understanding of how far into the development process the project has progressed. By creating a more transparent flow of information between project managers and team members, project management software aims to keep people on task and up-to-date on a project's progress.

Today, there are number of software solutions that can be utilized by any industrial product due to various features available with these solutions. But still some companies like to purchase customized solutions developed for them.

13.2 Project Management Software

Project Management Software is never one-size fits all. Depending on the specific targeted deadlines or benchmarks on a project, or the unique culture of an organization that is embarking on a project, pinpointing the correct type of software is crucial.

Managers should review the types of software available while keeping their specific goals and initiatives in mind:

I. Desktop:

Desktop software allows users to have access to a database from the ease of their desktop PC. This information, whether collaborative or single user, is static information that is accessible only from certain machines equipped with the software. This creates a secure, guarded network of information. It is ideal for companies that have a VPN connection available to their stuff, so that the software can be activated remotely, yet securely, when the stuff is accessing it from outside the office.

II. Web-Based:

Web-based project management software provides amazing portability and remote access to stored data in real time and gives users the ability to make updates from any work station, as opposed to accessing from software installed on specific machine.

This was a good solution for distributed projects across departments and geographies. This way, all the stakeholders of the project have access to project details at any given time. Specially, this model is the best for virtual teams that operate on the Internet.

III. Integrated:

Integrated project management software crosses the range/scope of software needs, including spreadsheets, word processing, databases, time-management calendar keeping and presentation needs with complete graphics. This allows managers to plan every aspect of their project on the same mainframe, with which they can present the results to colleagues, clients and investors.

This can serve as an all-in-one resource for project planning and cut down on the difficulty of converting formats and specifications, when working with foreign content systems or desk-top and cloud-based programs.

IV. Collaborative:

Collaborative project management software allows its users to contribute input and data on the status of a project. This way, managers receive real time inputs from employees. This can be smart tool of enhancing communication in small group. But

for large groups, collaborative can be over crowed with lots of waste inputs from too many users.

V. Single User/ Personal Project Management Software:

Single user project management software is helpful for individual managers to keep track of his task, personal benchmarks, and goals without distraction of other user's input.

13.2.1 Benefits of Project Management Software

When organizations use appropriate project management solutions, and train their employees to use software, the project is likely to meet important deadlines, meet budgets, greater return on investment. Following are the several benefits of using project management software:

- Project managers and team members can manage their project timelines and calendars within a single computer application.
- Shared or individuals Calendars can be created at any time.
- Budgeting information can be maintained with project management software.
- Employees will have access to centralized database.
- Prioritizes can be set to different tasks.
- Project management software will enhance communication among project team members.
- Employees can communicate with one another in real-time and leave each other messages.
- Time spent on every task can be tracked easily.
- Various reports can be generated and printed with the help of project management software.

13.2.2 Popular Features

Each project management solution will offer its own set of features and add-ons. The following list provides a summary of the most popular features:

Web-based Interface - All team members can access the full features of the application anytime and anywhere by going online and logging into their accounts.

Personal Dashboard - Each team member can customize the dashboard, which is similar to a home page, to display the information they wish to regularly access. The information is updated in real-time and may include anything from new messages to task lists and calendars.

Project Dashboard - This screen is typically customized by the management team and provides a graphical view of the project's status. Data is instantly or regularly collected from all team members and used to update the project dashboard to provide team members with up-to-date information.

Multiple Dashboards - This feature benefits individuals and teams that work on multiple projects simultaneously by allowing them to access all of their active projects through a single user interface.

Restricted Access - Choose which team members can access which features and views within the application. For example, it may not be necessary to allow all team members to access budget and expense data.

Budget Tracking - Define and update all aspects of a project's budget and expenses in a centralized location. Reports can also be generated on the status of the budget.

Calendars / Schedules - Individual and group calendars can be used to track deadlines for all assigned tasks. Individual calendars can be updated by project managers and synced with the group calendar. The group calendar can be accessed by all project members and provides them with a view of all of the past, present, and future project tasks and deadlines. Calendar data may also be available in a Gantt Chart view.

Third Party Calendar Integration - Sync a schedule, or calendar, from the project management software with a third party calendar, like Google Calendar, iCal, or Outlook.

Time Tracking - Find out how much time was spent on a task or an entire project and compare actual progress to planned progress. Some solutions allow these reports to be exported as spreadsheets.

Task Lists - Team members can create individual to-do lists, including each item's deadline, and mark them off as they are completed.

Task Assignments - Project managers can automatically assign tasks to project members or request a specific team member to accept the task.

Resource Allocation - Create and manage all resources required for a project. It is also possible to define the worth and availability of each resource, while tracking which resources has been overbooked or under-allocated.

Centralized Document Database - Store a wide variety of files in a single easy-access location. The database can also be used to backup additional project data.

Version Tracking - Tracks and logs all project-related documents, including uploaded attachments, as they evolve over time.

Risk Management - Team members can raise flags over potential risks which may occur and their consequences. Risks can be rejected by project managers or accepted and categorized according to type and risk level. When an obstacle occurs, the task of resolving it can be assigned to the relevant team member.

Instant Messaging - Team members can leave each other private messages and communicate with one another in real-time. All messages are usually saved until the recipient deletes them.

Discussion Boards / Forums / Digital Whiteboards - This tool allows members to publicly communicate with one another and discussion boards can be customized to

include categorized sections, making it easy for team members to join only the discussions that are relevant to them.

Email Notifications - Any time a change is made to the project or a message is received, an automated email notification will be sent out.

Templates - Create project templates to be used as the basis for each new project. Templates can also be used for messages, schedules, reports, task lists, and dashboard customization.

Advanced Reporting - Status reports can be customized to include a wealth of information, including budget, expense, risk management, scheduling, and task data. Reports can be generated for the project as a whole or for individual performance reviews.

Customizable Charts and Graphs - Display all kinds of data, including budget and project health information, in bar graphs, dot charts, and pie charts.

Multilingual Support - Some applications can be translated into multiple languages.

Mobile Device Support - Access the software from a smartphone via an optimized Web interface or an installed mobile phone app.

Add-ons - Purchase additional apps to expand functionality or further customize existing software features. Some add-ons may be used to offer increased third party software integration, such as syncing with accounting or scheduling software.

Professional Support - A support representative may provide initial training as well as ongoing technical support.

13.3 Selection of Project Management Software

There are various project management solutions available. So it will take time and thoughtful criteria to select appropriate solution. The following points should be considered by organizations:

- Decide whether a desktop based solution is right or a web-based solution. Web based solutions provide flexibility to work from any remote location with less investment, whereas maintaining desktop based project management software at different offices will require large investment in hardware and other resources.
- Budget: Companies need to decide their budget limits to spend on project management solutions. They can use an open source/freeware without spending any cost, whereas they can choose highly expensive software. They must consider any maintenance cost required, monthly or annual fees of software.
- Creating a list of features required: After meeting with project team members, organization can prepare a list of expected features in project management software.

- Deciding priorities of needs: it is not possible to find all the desired features in single software, so organization must prioritized their features required. Especially what maximum we can get within our financial limits?
- Decide number of user-licenses required: Organization must decide how many team members will use software? According to that companies must take license of project management solution. In ideal condition every project team member must have their own login.
- Determine how many projects are running simultaneously
- Determine maximum capacity of storage required
- Compatibility of project management software with other software used in organization
- Providing communication facility for team members

Considering all the above basic criteria still it is always suggested to go for trail of software before going for final purchase or agreement.

13.4 Popular Project Management Software

There are number of project management software available. Here we are presenting some of the popular software all over the world:

Microsoft Project Professional: Microsoft Project Professional 2013 is powerful tool to effectively manage important projects. Unlock easy collaboration capabilities to quickly start and deliver winning projects while leveraging the power of MS -Office or SharePoint to work from virtually anywhere. Make communication instantaneous through seamless integration of Lync 2013 to call or instant message team members from Project Professional. Extend Project's functionality with Apps for Office to meet specific business needs. Popular features are:

1) Easily plan & manage projects with intuitive controls and flexible team tools to help organization deliver the intended business value.
2) Quickly focus on what matters, easily select actions to take, and seamlessly browse functions with an enhanced visual experience.
3) Latest Project templates on Office.com to get started quickly.
4) Stay organized by having quick access to recent files and location from the Backstage.
5) Be efficient and prioritize by aggregating everyday work, project tasks, important details, and timelines in a visually rich and contextual interface.
6) With Task Path highlighting in the Gantt chart, you always know how your tasks come together and identify which are most critical to project's success.
7) Create project site with a few simple clicks to quickly share project details with your team, keeping everyone connected and organized.
8) Deliver effective presentations that offer immediate insight into task planning, resource allocation, cost efficiencies, and the many important details of your projects.

9) Use out-of-the-box reports such as Burndown and Resource Overview, or create your own with a familiar Excel-like experience to quickly measure progress and communicate effectively with team, executives and stakeholders.
10) Anticipate Change with forward-looking views into the everyday work going into your projects and the resources needed to get that work done.
11) Enhanced tools like Team Planner help managers see and amend potential problems before they can impact your schedule.
12) Work seamlessly across tools to help everyone on team work together with the information they need to be successful.
13) Easily copy project information to Office applications like PowerPoint and email, or save important plans and details to Office 365 and SharePoint.
14) Communicate in real time with team members down the hall or across the globe with tools designed to transmit critical conversations quickly and securely.
15) Send instant messages to kick off real-time conversations and shared meeting spaces right from project with Lync Online integration between Project and Office 365.

BaseCamp:

Basecamp is a Web-based solution that offers the ability to easily collaborate and track progress via any Internet browser. Due to its ease of use and low pricing plans, it is popular amongst both small and mid-sized companies. However, large companies, such as Kellogg's, National Geographic, Nike, DHL, twitter and Adidas also rely on this solution for their project tracking needs. Basecamp features a wealth of online tools for communication and collaboration, including a public message board, personal messaging, and automated email notifications that can be triggered any time a change to the project has been made or a communication has been received. Other key features include a central database for project-related documents, personal task lists, time tracking, scheduling, project templates, and multilingual support.

QuickBase:

QuickBase project management software is easily customized to fit organization's specific processes and help team with task management. By streamlining data gathering, tracking tasks and communication, QuickBase Web-based project management software reduces the administrative workload of project managers so they can focus on managing projects—not chasing down status updates and consolidating spreadsheets. With QuickBase online project management software, all team members have anytime, anywhere access to the same up-to-date data in one centralized place. So they're always equipped to make timely, informed project management decisions—with less risk of error from outdated information. Free project management apps in QuickBase, Once download the app, it can be used or tailored to exact business situation with no need for coding or help from IT experts.

FogBugz:

Creating a detailed project outline is fast and simple in FogBugz. Managers create a high-level case for each feature you're planning to implement, and then fill in the

detailed work that needs to be done -- the functions managers are going to write, the code they are going to refactor, the algorithms they will need to implement, and so on. FogBugz allows creating subcases to represent lower-level tasks. In the case list, subcases appear under their parent cases in a hierarchical outline format. We can even modify the display of the outline by expanding and collapsing different subsections. FogBugz allows project members and team members to easily track bugs, scheduled items, and customer comments. Additional features include an advanced search, hierarchical task views, the ability to track a project's timeline in multiple formats, and a developer history. It is also possible to receive and sort incoming emails from existing customers and create tasks from messages.

ATTASK:

Enterprise Work Management is an actual solution that eliminates disparate tools and the frustration of silos and gives you visibility you can trust. Using attask's Enterprise Work Management:

- Senior managers can justify their resources and budgets and can better prioritize how resources are used.
- Managers are better able to align their team's work to corporate strategy and can improve their team's productivity.
- Team members are empowered to make better decisions, prioritize more effectively, and work more efficiently.

Key features of this software include a high level of customization, the ability to build multiple dashboards, configurable reports, templates, and resource assignments. A document database, portfolio manager, and time sheets are also included. It is also possible to establish a help desk and track issues within the application.

Enterprise Work Management solution provides a single, central system of truth to help enterprise teams manage and collaborate on their work more efficiently. Its popular user organizations include HBO, Adobe, Bukman, Cisco and Samsung.

Trello:

Trello is one of the fastest, easiest way to organize anything, from your day-to-day work, to a favorite side project, to your greatest life plans. Trello provides easy-to-use interface takes no time to learn, and every action is instantaneous, so there's nothing standing between you and your sweet productive flow. Trello provides collaborating environment, Get the whole group onboard in seconds. See their updates in real time. Trello includes features like a lesson planner, a community bulletin, a repository for inspiration. Some of the famous organizations using Trello are Tumblr, Scoutbooks, Khanacademy etc.

Open Project:

Open project is open source for desktop project management. OpenProj has a familiar user interface and even supports existing MS Project files. OpenProj is interoperable with Project, Gantt Charts and PERT charts.

Podio:

The collaborative work platform that's perfect for managing projects. Unlike traditional project management software, Podio is the tool that empowers managers to work the way they want. Unrivaled flexibility, task handling, and file-sharing combined with social activity streams create one platform for executing any project. Common features provided by Podio include Task management, e-mail management, Project meetings and managing files and document. Solutions like dropbox, skydrive and google drive are using Podio.

Binfire:

Binfire.com was founded in 2008 to bring innovative and affordable online collaboration and project management tools to professionals and small businesses. Binfire is a complete integrated project management and project collaboration application, designed to help both traditional and virtual teams to work together to bring new products and services to the market in the shortest time possible. Binfire's advanced technology creates a virtual office environment to make project team more productive by managing tasks, communication and collaboration for your team. Advanced tools in the current version of the application are listed here:

- Task management
- Project dashboard
- Project Calendar
- Interactive Gantt
- Burndown chart
- Document management
- Interactive whiteboard
- Status reporting
- Project reports
- Activity Stream
- Managing user categories
- Managing permissions

Binfire is a general propose project management and collaboration software and its task management tool could supports a wide Variety of project management methodologies like:

- Work Breakdown Structure
- Waterfall
- Agile
- Scrum

Producteev:

Producteev is the leading social task management solution for teams. It's helped thousands of teams get work done faster and more effectively. Create as many projects as we like, across any number of teams and participants. Keep project tasks organized

and get work done. Coordinate and complete tasks with teams. Assign tasks to teammates. Add due dates, labels and notes. Follow tasks, track progress and measure the results.

Other Popular Project Management Software are:

S.NO.	PM Software Name	S.No.	PM Software Name
1	TeamBox	11	Flow
2	ConceptBoard	12	Wiggio
3	Zoho	13	Goplan
4	Casual..pm	14	Asana.com
5	Proofhub.com	15	Workgroups
6	Orangescrum.com	16	Dooster
7	Breeze.pm	17	Paypanther
8	BrightPod	18	Icoordinator
9	InLoox	19	JIRA
10	Project Kickstart	20	Matchware MindView

Online Project Management Software:

S.NO.	PM Software Name	S. No.	PM Software Name
1	Clarizen	6	TenRox
2	GeniusProject	7	Celoxis
3	AtTask	8	Liquid Planner
4	Project insight	9	EPM Live
5	Daptive PPM	10	Project Manage

Open Source for Project Management:

S.NO.	PM Software Name	S.No.	PM Software Name
1	ProjectLibre	6	Codendi
2	Libreplan	7	ProjectPier
3	Open Project	8	eGroupware
4	]projectopen[	9	KForge
5	Readmine	10	OpenGo

13.5 Gantt Chart and Network through Open Project:

OpenProject is open source project management software easily available on its website. Here we are preparing Gantt chart and Network Diagram for our sample project. Project details are as follows:

ID	Task Name	Predecessors	Duration (Days)
1	Start		0
2	a	1	20
3	b	1	20
4	c	1	10
5	d	2	15
6	e	3,4	10
7	f	4,3	14
8	g	3,4	4
9	h	4	11
10	i	9,8	18
11	j	5,6	8
12	Finish	10,11,7	0

To solve this problem with the help of OpenProject, we need to open program from:
Start→Programs→ OpenProj→OpenProj
Now first we need to create new project from file menu. We need to enter name of new project, manager name, and start date.

OpenProject support following format for open project file:

- Serena (*.pod)
- Microsoft Project (*.mpp, *.mpx)
- *.xml
- Gnome Planner (*.planner)
- *.projects

Open project by default save in *.pod format, but provide save as option into *.pod and *.xml format.
OpenProject also provide print facility to various charts and status reports. Even we can save as *.pdf file also.

13.5.1 Project Management Mobile Applications:

Project management has become something that we can handle on the go. It's becoming standard practice for most robust project management and collaboration tools to at least offer a mobile- optimized version of their website so you can check up on what's happening, no matter where you and your phone are. Many also have full-fledged mobile applications that make it possible to keep your systems constantly up-to-date.

What's particularly good on one mobile device may not be so user-friendly on another. Here is a list of Project Management Apps for mobile platform:

S.N.	Project Management App
1	Outpost
2	Nozbe
3	Project Schedule
4	Mobile Project Manager
5	SmartSheet
6	Ap4 Project Manager

Choice of mobile platform may dictate how we manage our projects: there may or may not be a mobile application available for our project management tool, or even a mobile version of a web application.

13.6 Case Study : Microsoft Project at Intelbras, Brazil

A 100% Brazilian company, Intelbras is the predominant player in the Brazilian telephone, telephone PBX and residential condominium PBX markets. Founded in 1976, Intelbras is a major player in the fields of Telecommunications, Networks, and Electronic Security Systems with a presence throughout Brazil and in several Latin American countries, as well as in Africa. Intelbras products are offered at approximately 9,000 sales outlets and by 10,000 corporate resellers.

Intelbras stands out with its large production capacity distributed over four manufacturing facilities, with its headquarters and Manufacturing Complex II in São José, SC (the metropolitan region of Florianópolis, SC) and facilities located in Santa Rita do Sapucaí, MG, and Manaus, AM.

Intelbras maintains one of the largest private research and development centers in Latin America, as well as one of the largest technical assistance networks in the Brazilian market. Manufacturing Complex II and the Minas Gerais facility are ISO 9001 certified, and its headquarters are both ISO 9001 and ISO 14001 certified.

Intel bras introduces dozens of new products each year, enhances existing products, and undertakes many IT projects. It requires dozens of people, hundreds of documents, and

thousands of tasks to manage each project. For years, Intelbras project managers used a variety of project management tools, ranging from custom applications to Microsoft Excel spreadsheet software. There was no central repository of project data; instead, data was scattered across multiple personal computers and servers. This made it difficult to track project status, identify delays and roadblocks, keep projects on track, and create reports. In fact, it took six to eight weeks to gather the data for and create a single report, during which time the data became less relevant. Also, there was a security risk in storing critical project data on employee PCs; if a computer was stolen or an employee quit, the data would be lost and unrecoverable.

Intel bras was facing problem of centralized data, security of data, generation of customized report and communication between different project teams. The company upgraded to Microsoft Project Server 2013 and Microsoft Project Professional 2013 to gain improved reporting and better integration with Microsoft SharePoint Server. Project managers got easy access to status report, accessed to published tasks, Project professional 2013 has improved interface, instant access to status through built in reports, and link to Microsoft outlook. Intelbras developers can view Project Server sites with a wide range of browsers and can quickly and easily create high-quality reports using Project Professional. Intelbras uses Project Server with SharePoint Server so that all project data is stored in one place and easily accessible. Instead of sending hundreds of email messages daily to track down task status, project managers can sync their Project Professional 2013 data with SharePoint or quickly look on a SharePoint site when they're out of the office.

Benefits from Microsoft Project 2013:

- Reports produced in minutes versus weeks
- Greater efficiency and data safety from centralized project data
- Faster, more flexible communication and collaboration

(Source: http://cic.ms/Dke5Mc)

13.7 Summary

After evolution of information technology Project management has changed also. Now with the help of project management software available project managers can achieve their targets within limits of time and financial resources. Project management solutions provide facilities like scheduling, networking, cost monitoring, tracking, break-down structure and reporting facility.

These are different types of project management soft wares available mainly desktop based and other are cloud based. Although general purpose project management software available with customized features but still large organizations with good financial strengths like to develop or purchase special software developed for them. Selection of Project management software depends on cost, required facilities, priorities, number of projects and number of team members. Project management software and mobile applications support managers to achieve project deliverables on time.

13.8 Self-Assessment Questions

1. What do you understand by project management software?
2. Describe different types of project management software.
3. What are the basic features provided by project management software?
4. What is open source program?
5. Write down five online project management solutions.
6. What factors project manager should consider before selecting project management software?
7. Find out suitable mobile application for different mobile operating systems.

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Unit - 14 Managing International Projects

Structure of Unit

14.0 Objectives

After completing this unit, you would be able to:

- Understand what is overseas projects
- Understand the international project environment;
- Understand challenges faced by international project;
- Know about financial risk associated with international projects;
- Learn diversity management at work place;
- Know about National cultural dimensions
- Understand Global Money Management.

14.1 Introduction

The world is now become global village. Project managers working on international assignment face difficult set of problems. For project manager, there are different stakeholders for international projects. Project manager working on international projects works in diverse political, cultural and economic environment. Some of the common problems international project manager handles are distance from home, friends and family, personal risk, language barrier, social-cultural differences, different legal environment, different weather conditions etc. But international project assignment is challenging opportunity for project management. There are chances of career growth, opportunity for world travel, making new friends, learning about global social-cultural environment. Projects are classified in four categories on the basis of their work area. A developing infrastructure at Afghanistan Government). A *global project* consists of team members from different countries and working on a multinational assignment.

14.2 Challenges for International Projects

There is no separate framework for international projects. Managing international projects can be hugely interesting and rewarding, but they are also a challenge. Here are few things to look out for an international project:

14.2.1 Environmental Factors:

The major challenge for international project manager is to face international environmental factors, those varies from country to country. It is always not necessary that tried and tested best management practices works all over the world. There are several environmental factors those can affect project's success.

I. Political and Legal Environment:

International project manager must have knowledge of laws and regulations of host country. Normally host country's laws favor local workers, suppliers and customers. Any project must comply with all the laws and regulations of federal and state government. Legislations regarding pollutions, packing, monopolies, use of natural resources and licenses of businesses need to be adhered. Importantly project manager must of knowledge of labor laws of host country. Project manager must analyze political environment of host country, where he or she is working. Political stability strongly influences the implementation of project. Successful project manager must have knowledge of political party system in host country, funding of elections. Untied state of America and Great Britten having mainly two party systems where as in India we have multiple party system. In India most of the states are governed by regional parties. International project manager need to cope up with Ideology of political parties and their economic basis (Capitalism, Socialism or Marxist). Donations to the political parties may influence total cost of project. Government corruption, labor unrest and nepotism are some factors that may also influence international project execution.

II. Safety Factors:

International terrorism is one of important consideration while working on any project whether it is in own country or in foreign country. Terrorism is affecting monetary cost as well as human cost also. After 9/11 it is clear for world level human resource that even America is not safe place to work, and Americans are vulnerable to terror anywhere in the world. Another challenge for project manager is local crime at work place. Kidnapping, robbery, despoilment issues are threating for project team. Indian cellular companies are expanding their business to South Africa but they are facing problem of crime there. Project managers need to spend time and money for securities of human resource, equipment's and materials involved in international project. Organizations policies must be clear to negotiate with terrorism and naxalite. Effective risk management is important for successful international project.

III. Mother Nature and Environment:

One of major challenge for international project manager is geography of foreign destination. Mother Nature cannot be ignored. Different countries in world have different climate. Extreme weather conditions can make extraordinary demands on equipment. Project equipment can be breakdown due to higher or lower temperature. Before beginning a project in a foreign land, project planners and managers need to study carefully the unique characteristics of the geography of that country. Project

manager need to consider factors like climate, seasons, altitude and geographic problems while planning project schedule.

IV. Economics:

Basic economic conditions, factors are going to affect international project decisions like selection of site for project. Gross domestic Product (GDP) is commonly used as an indicator of the economic health of a country, as well as to gauge a country's standard of living. Factors such as balance of payments, currency fluctuations, inflation, population growth, education level of labour are important factors to consider for international projects. Bartering system of compensation is still working in some countries. Inflation, cost of living may influence project cost. While going for international project we have to consider issues regarding project team, recruitment of compatible employees, source of international workforce, unemployment rate at project country, labor cost, education and skills level of workforce. Just to evaluate viability of our project we must consider income distribution among population, rural and urban population at project country.

V. Infrastructure:

Services and facilities necessary to perform any economic activity referred as infrastructure. Typically infrastructure facilities are such as transportation facility, water-electricity supply, communication facilities, and education system. Transport infrastructure includes roads, railways, connectivity via airports, ports, dry ports etc. Water infrastructure includes availability of water for domestic and industrial purpose, dams, facility for waste water. One of important infrastructure required for every project is power supply that includes availability of energy sources (solar energy, nuclear energy, wind energy, coal energy etc.), light houses, storage of electricity. Communication infrastructure includes telephone, internet and mobile services and their availability allover country. Important component of every project is project workforce; colleges of different streams (management, engineering, arts, science etc.), universities, education system, standard of education, industry-education interaction are education infrastructure.

VI. Culture:

While going for international project, project management must accept and respect customs, religions, cultures, philosophies, value system of host country. Communication is biggest problem in performing every single project activity. Language differences within different countries are barrier for project operations. A common language may be English, can work as unifying force. Religious factors are also affecting the project execution. Project manager must have knowledge about various religious followed by people in project area. Religious extremist may enforce various restrictions on female workforce or spouse of project team members.

14.3 Managing Workforce Diversity

One of the most important challenges currently facing international projects is adapting to people who are different. While globalization focuses on differences between people

from different countries, workforce diversity addresses differences among people within given countries.

Workforce diversity means that organizations are becoming a more heterogeneous mix of people in terms of gender, age, race, ethnicity and sexual orientation. A diversify workforce for any project includes women, people of color, the physically disabled, senior citizens and gays and lesbians. Managing diversity has become a global concern for project managers.

14.3.1 Four Layers Model of Diversity:

This Four Layers Model (based on Gardenswartz and Rowe) can help the project manager understand that diversity comprises many characteristics of people at work, not only a few. Understanding four layers of diversity will help project managers to bring out individual's talent and abilities that will support the project's goal and mission.

I. Personality:

The inner circle, this includes an individual's likes and dislikes, values and beliefs. Personality is shaped early in life and influenced by heredity, environment and situation. Personality also gets influenced by three other layers of diversity and personality also influences these three layers throughout lifetime and career choices.

II. Internal Dimensions:

These include aspects of diversity over which we have no control. These dimensions include the first things we see in other people, such as race or gender and on which we make many assumptions and base judgments. Internal dimensions are:

- Age
- Race
- Ethnicity
- Physical ability
- Sexual Orientation
- Gender
- Nationality
- Social Class Background
- Religion (by birth religion)

III. External Dimensions:

These includes aspects of our lives which we have some control over, which might change over time, and which usually form the basis for decisions on careers and work styles. This layer tells us much about whom we like to be with, and decisions we make in hiring, promotions, etc. at work. External dimensions are:

- Income
- Personal Habits
- Recreational Habits
- Religion (if changed, other than by birth)

- Educational Background
- Work experience
- Appearance
- Parental status
- Marital status
- Geographic location

IV. Organizational Dimensions:

This layer concerns the aspects of culture found in a work setting. While the "Internal Dimensions" receive primary attention in successful diversity initiatives, the elements of the "External" and "Organizational" dimensions often determine the way people are treated, who "fits" or not in a department, who gets the opportunity for development or promotions, and who gets recognized. Organizational dimensions are:

- Functional level/classification
- Work content/field
- Research area/ field of study
- Work location
- Type of employment
- Duration of employment
- Union affiliation
- Seniority
- Division/Department/Group/Unit

A project manager who is willing to be a successful international project manager must pay attention to all these layers of diversity with the goals of using both differences and similarities to enrich the work environment and bring us closer to our project mission.

Following steps can be taken to manage diversity at work place:

- Building diverse and inclusive workforce, select diversify workforce
- Develop diversified cultural environment at work place, make it part of code of conduct
- Regular training program on diversity and inclusion
- Respectful place to women and minority
- Special training programs for leaders and managers
- Reward best behaviors
- Link diversity management with performance appraisal
- Try to standardize employees' behavior
- Provide "complaint box" for diversity related problem
- Respect for values, culture and religion of every country
- Adaptability of managers and organization
- Engagement program for local public

14.4 Framework for Cross Cultural Environment

One of the most widely referred approaches for analyzing variations among cultures was done in the late 1970s by Geert Hofstede. He surveyed more than 117,000 IBM employees in 40 countries about their work related values. This framework is very important for international manager to understand cross-cultural psychology and cross-cultural communication. He found that managers and employees vary on six value dimensions of national culture. One more dimension was added later on.

I. Power Distance (PDI):

This dimension expresses the degree to which the less powerful members of a society accept and expect that power is distributed unequally. The fundamental issue here is how a society handles inequalities among people. People in societies exhibiting a large degree of power distance accept a hierarchical order in which everybody has a place and which needs no further justification. In societies with low power distance, people strive to equalize the distribution of power and demand justification for inequalities of power.

II. Individualism versus collectivism (IDV)

The high side of this dimension, called *individualism*, can be defined as a preference for a loosely-knit social framework in which individuals are expected to take care of only themselves and their immediate families. Its opposite, *collectivism*, represents a preference for a tightly-knit framework in society in which individuals can expect their relatives or members of a particular in-group to look after them in exchange for unquestioning loyalty. A society's position on this dimension is reflected in whether people's self-image is defined in terms of "I" or "we."

III. Masculinity versus femininity (MAS)

The masculinity side of this dimension represents a preference in society for achievement, heroism, assertiveness and material rewards for success. Society at large is more competitive. Its opposite, femininity, stands for a preference for cooperation, modesty, caring for the weak and quality of life. Society at large is more consensus-oriented. MAS index represents the distribution of emotional roles between the genders.

IV. Uncertainty avoidance (UAI)

The uncertainty avoidance dimension expresses the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity. The fundamental issue here is how a society deals with the fact that the future can never be known: should we try to control the future or just let it happen? Countries exhibiting strong UAI maintain rigid codes of belief and behavior and are intolerant of unorthodox behavior and ideas. Weak UAI societies maintain a more relaxed attitude in which practice counts more than principles.

V. Indulgence versus Restraint (IND)

Indulgence stands for a society that allows relatively free gratification of basic and natural human drives related to enjoying life and having fun. Restraint stands for a society that suppresses gratification of needs and regulates it by means of strict social norms.

VI. Long-term orientation (LTO) vs. short term orientation

It describes societies' time horizon. Long term oriented societies attach more importance to the future. They foster pragmatic values oriented towards rewards, including persistence, saving and capacity for adaptation. In short term oriented societies, values promoted are related to the past and the present, including steadiness, respect for tradition, preservation of one's face, reciprocation and fulfilling social obligations.

VII. Pragmatic versus Normative (PRA)

In 2010, research by Michael Minkov generated this dimension using recent World Values Survey data from representative samples of national populations. This dimension describes how people in the past as well as today relate to the fact that so much that happens around us cannot be explained. In societies with a normative orientation, most people have a strong desire to explain as much as possible. In societies with a pragmatic orientation most people don't have a need to explain everything, as they believe that it is impossible to understand fully the complexity of life.

14.4.1 Working in Different Cultures:

International project managers need to anticipate with different cultures. Americans are considered as parochial. People with a parochial perspective do not consider that other people also have different way of living and working effectively. American project managers are good at dealing with technology but not good at dealing with people. For Americans "Time is money", they are always in hurry. Americans always like to work quickly.

Americans are impersonal and practical while discussing and arguing the business, whereas Mexicans are emotional. Mexicans do not criticize any one directly, rather they prefer silent than show disagreement. Mexicans like indirect speech.

French culture is very much different from American culture. American like achievement, they respect individual person with personal achievement, but in France social class and status is very much important. French people like high social class, educated and knowledgeable persons. The French people even admire people who disagree with them. But Americans attract towards who agree with them. French people trust on firsthand information, personal evaluation of person, where as Americans evaluate a person on his past achievement. Most French organization are centralize and rigid organizations.

Working at Saudi Arabia is completely different from any other country. Arab managers and business men have different view about time. Saudi manger use an expression "Inshallah Bukra" that mean tomorrow, if God will. While dealing with Arab people regarding project, international managers from different countries need to hold sufficient lead time. Saudis are emotional people, during negotiations emotional appeal may work instead of logic.

Chinese people developed as good collective society. They like to be a member of group, so project manager should avoid praising an individual on success, rather Chinese like praise for whole their group. Chinese do not like open display of affection, physical contact and embracing. Americans like self-made, hard working person with own achievements. Americans believe in themselves, they believe they can achieve anything with time, money and technology. Americans like participative decision making, they like to involve people in decision making process, who are going to be affected by decisions. Americans are more practical people, decisions are logic based, result oriented. Asian managers need to adjust their behavior according to project host country. Although above examples are only brief guide lines for project managers. International project managers need to study cultural environment of project country and they can take help from local colleagues also, because it is difficult to learn and adapt new things within few months.

14.5 International Risk Management Issues

Typical risk involved in international projects are socioeconomic factors (environmental protection, public safety, economic stability), organization relationships (contractual relationships, attitudes of participants, communication), and technological problems (design assumptions, site conditions).

International project manager must focus on exchange risk management. Exchange risk results from fluctuations in currency exchange rates or conversion restrictions beyond the control of an individual firm. Maintaining balances of foreign currency runs the risk of value reductions as foreign exchange rates vary.

Project manager needs to take decisions about what project activities to finance, how these activities are going to finance and effective management of available finance resources. For international projects, investment, financing, and money management decisions are complicated because different countries have different currencies, tax system, relations, concerning the flow of capital across their borders, norms regarding the financing of business activities, levels of economic and political risk, and so on.

Capital budgeting quantifies the benefits, costs, and risks of an investment. The firm must first estimate the cash flows associated with the project over time and discount the cash flows to determine their net present value using an appropriate discount rate. Factors to be considered for international projects are following:

- A distinction must be made between cash flows to the project and cash flows to the parent company

- Political and economic risks, including foreign exchange risk, can significantly change the value of a foreign investment.
- The connection between cash flows to the parent and the source of financing must be recognized.

(I) Project and Parent company Cash Flow:

It is not necessary that cash flow to project and cash flow to parent company is the same. Various factors may affect cash flow of project:

- Host country Government may block repatriation of cash flow to parent company
- Project can be taxed at an unfavorable rate
- Host country Government may ask to reinvest certain percent of project cash flow in host country

These restrictions do not affect the net present value of the project itself; they do affect the net present value of the project to the parent company. While evaluating foreign projects, parents companies are interested in cash flow received from projects rather how much they generate. Received cash flow from project will determine cash liquidity of parent company.

(II) Handling Political and Economic Risk:

When analyzing international, overseas projects, the firm must consider the political and economic risk involved in projects. Political risk related to business involves following issues:

- Inconsistency in policies
- Changes in laws and regulations
- Restrictions of fund repatriation
- Import-export restrictions
- Political changes may result into increased tax rates, limit or block subsidiary's remit earnings
- Price control policies, Government interference to existing contracts

Most important economic risk to consider for international project is inflation. Especially for a foreign firm with assets in a country with high inflation, the value of the cash flow received from assets will fall as the country's currency depreciates on the foreign exchange market. Foreign investment risk can be handled in several ways, Finance managers can treat all risk as a single problem by increasing the discount rate applicable to foreign projects in counties where political and economic risk are high. Higher discount rate will result into high net cash flow from project.

(III) Financing Decisions:

While considering financing options for international projects, following issues need to be considered:

- How will be the foreign project be financed?
- If external financing is required, the first must decide whether to borrow from sources in the host country or elsewhere?
- How will the financial structure of the foreign affiliate be configured?

Source of Financing:

If the firm is going to seek external financing for a project, it will want to borrow funds from the lowest-cost source of capital available, such as global capital markets. Use of global capital markets can result in financing from anywhere in the world at the lowest overall cost. However, host-country government restrictions may rule out this option. The governments of many countries require, or at least prefer, foreign multinationals to finance projects in their country by local debt financing or local sales of equity. In countries where availability of capital investment funds (or ‘‘liquidity’’) is limited, local financing raises the cost of capital for a project. However, if foreign debt obligations must be served, the amount of local currency required to do this will increase as the currency depreciates, and this effectively raises the cost of capital.

Financial Structure:

Firms in different countries use different average debt ratio. Selection of debt-equity ratio depends on tax system of project country. An international business should adopt a financial structure for each foreign affiliate that minimizes its cost of capital, irrespective of whether that structure is consistent with local practice.

14.6 Global Money Management

Money management decisions attempt to manage the firm’s global working capital (cash resources) in effective manner. This involves minimizing the cash balances and reducing transaction costs. Different countries have different tax regimes. Many nations follow the worldwide principle that they have the right to tax income earned outside their boundaries by entities based in their country. Double taxation occurs when the income of a foreign subsidiary is taxed both by the host-country government and by the parent company’s home government. However, double taxation is mitigated to some extent by tax credits, tax treaties, and deferral of taxes until profits are actually returned to the home country

Minimizing Cash Balances:

A firm needs to maintain minimum cash balance at all times to fulfill unexpected demand of cash and/or to serve any accounts and notes payable. Firms invest cash in low interest money market accounts to earn interest. These options provide high liquidity, flexibility of cash withdrawal, e.g. negotiable certificate of deposits, treasury bills and Municipal Notes. Firms can earn higher rate of interest by investing cash in long-term financial instruments where firms can withdraw their money before maturity, without or with less penalty.

Reducing Transaction Cost:

Every time international project changes cash from one currency to another, it must bear a transaction cost. Transaction costs are the cost of exchange. These costs include the commission paid to foreign exchange dealers and bank charges for moving cash from one location to another.

14.6.1 Techniques for Global Money Management

Centralized depositories and multilateral netting are common management techniques firms use to manage their global cash resources in an efficient manner.

Centralized Depositories:

A critical decision making international project manager has to do is whether each foreign project should hold its own cash balances or whether cash balances should be held and controlled at a centralized depository.

Benefits from centralized depositories are following:

- By pooling cash reserve centrally, the firm can deposit large amounts in liquid accounts, such as overnight money market accounts.
- If the centralized depository is located in a major financial center (e.g. London, New York etc.), it should have access to information about good short-term investment opportunities, that the typical foreign project would lack.
- By pooling firm's cash reserves, the firm can reduce the total size of the cash pool it must hold in highly liquid accounts, which enables the firm to invest a larger amount of cash reserve in longer term, less liquid financial instruments that earn a higher interest rate.

However, a firm's ability to establish a centralized depository that can serve short-term cash needs might be limited by government-imposed restrictions on capital flows across borders. Also, the transaction costs of moving money into and out of different currencies can limit the advantages of centralized depository.

Multilateral Netting:

Multilateral netting allows a multinational firm to reduce the transaction costs that arise when many transactions occur between its subsidiaries. For example, one project may have revenue of 200,000 while another has a cost of 80,000 units of a local currency. These transactions can be combined, so that only 200,000 - 80,000 = 120,000 of the foreign currency need be converted. Netting reduces transaction costs by reducing the number and amount of transactions.

14.7 Summary

As world has become global village, for every growing organization number of international projects increasing day by day. Managers working on international projects must have knowledge about international business environment. International business environment includes political, economic, social and technological environment of project-host country. International project manager works with diversify work force so it is must to manage diversity and inclusion at their work place. International project manager must run engagement programme for local public. Another challenging task for international project manager is to counter risk associated with exchange rate. Different countries having, different currencies with difference values. Fluctuation in currency rates may affect total cost of overseas projects. International project manager also face problem of multilingual environment. Mangers working on international projects must have knowledge of two or three international languages.

14.8 Self -Assessment Questions

1. What do you mean by "International Project Environment". Explain in detail.
2. What are the different types of international project?
3. What is exchange rate?
4. What are the benefits of centralized depository for international projects?
5. What is four layers model of diversity?
6. What is multilateral netting?
7. What kind of financial sources available for international projects?
8. What steps can be taken to manage diversity at work place?
9. Define working capital and transaction cost.

14.9 Reference Books

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