PROJECT MANAGEMENT

By

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FEME6302 **PROJECT MANAGEMENT** (3-0-0)

Module-I Project Management Concepts and Needs Identification

Attributes of a Project, Project Life Cycle, The Project management Process, Benefits of Project Management, Needs Identification, Project Selection, Project organization, the project as part of the functional organization.

Project feasibility Analysis: Technical feasibility, commercial and financial visibility, Environment Analysis.

Module-II Project Planning and Scheduling:

Design of project management system; project work system; work breakdown structure, project execution plan, work packaging plan, project procedure manual; project scheduling; bar charts, line of balance (LOB) and Network Techniques (PERT / CPM)/ GERT, Resource allocation, Crashing and Resource Sharing, capacity planning and expansion capacity decision.

Module III Project Monitoring and Control and Project Performance

Planning, Monitoring and Control; Design of monitoring system; Computerized PMIS (Project Management Information System). Coordination; Procedures, Meetings, Control; Scope/Progress control, Performance control, Schedule control, Cost control, Performance Indicators; Project Audit; Project Audit Life Cycle, Responsibilities of Evaluator/ Auditor, Responsibilities of the Project Manager.

Books:

1. Project Planning, Analysis, Selection, Financing, Prasana Chandra, TMH
2. Project Management, Grey, TMH.
3. Project Management, Richman, PHI
4. Project Management, Vasant Desai, HPH
5. Project Management, Bhavesh M.Patel, Vikash
6. Project Engineering & Management- Prasanna Chandra, Prentice Hall.

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MODULE – I

1.1 ATTRIBUTES OF A PROJECT:

Project:

A project is a temporary work plan devised to achieve a specific objective within a specified period of time to bring about beneficial change or added value. So, it is an initiative to bring about change in product or services. Its purpose is to perform a task with well defined objectives, schedules and budgets. Each project differs in size, nature, objectives and complexity. Normally a project begins with a clear objectives, generating activities around the specific objectives, integrating bunch of resources (i.e., men, machines, materials and money), that are directed towards the fulfillment of objectives. So, project is accomplished by performing a set of activities.

For example, construction of a house is a project. It consists of many projects like digging of foundation pits, construction of foundations, construction of walls, fixing of doors and windows, fixing of sanitary fittings, wiring etc.

Several economists and bankers have defined a project in different ways.

The World Bank defines a project as "an approval for a capital investment to develop facilities to provide goods and services".

The Oxford English Dictionary defines project as "an individual or collaborative enterprise that is carefully planned and designed to achieve a particular aim".

According to Project Management Institute a project as "A temporary endeavor undertaken to create a unique product or service".

According to Harrison project as a "non-routine, non-repetitive, one-off undertaking normally with discrete time, financial and technical performance goals to be achieved".

Thus, a project is a well planned activity that includes a correct consideration of alternatives, identification of key issues, broad participation and enforceability. It should be neat, clear and specific whose objective may be to create, expand or develop certain facilities to increase the production of goods or services to the community.

Examples of Projects:

- Career development (education and training courses)
- Designing and implementing a computer system
- Hosting a holiday party.
- Designing and producing a brochure.
- Executing an environmental clean-up of a contaminated site
- The lunch of a new product.
- The development and introduction of a new services
- The development of a management information system
- The introduction of an improvement to an existing process

Project Objectives:

The objectives (or goals) of any project will be,

- To complete the project within the allotted (or budgeted) funds.
- To complete the project within the scheduled time limit.
- To execute the project in such a way that the project meets the quality standards.
- To ensure that the project is completed to the satisfaction of the end users.
- Avoiding unproven equipments

Project objectives are to be kept in mind by all the members of the project team throughout the period of project implementation. All decisions, whether a major decision or a minor one are to be taken keeping in view the project objectives. The project objectives shall remain as the guiding force for the project team.

Attributes or Characteristics of a Project :

From the above definitions, it can be inferred that, each project is different in itself. Projects are not homogeneous, may be their purpose is similar. The distinctive characteristics of a project are thus:

1. **Projects have clear objectives:** projects have a clearly-defined objective stated in terms of scope, schedule, and costs.
2. **Projects are realistic:** their aims must be achievable, and this means taking account both of requirements and of the financial and human resources available.
3. **Projects are limited in time and space:** A project has a definite time limit. It cannot continue forever and are implemented in a specific place and context.
4. **Projects are collective:** projects are the product of collective effort. They are run by teams, involve various partners and cater for the needs of others.
5. **Projects are unique:** Every project is unique and no two projects are similar.
6. Single- time activity: No project is often repeated. It will performed only once.
7. **Projects Includes risk and uncertainty:** every project is different and they always involve some uncertainty and risk. The degree of risk and uncertainty will depend on how a project has passed through its various life-cycle phases.

8. **Projects require evaluation** – the criteria for evaluation need to be established from the beginning
9. **Projects have life-cycle:** Project will also be reflected and influenced by the life-cycle phases and to which the success or failure in the project can be ascribed.
10. **Projects involve people**, (project manager and project team), not the procedures and techniques, that are critical to accomplishing the project objective.
11. **Customer specific nature:** A project is always customer specific. It is the customer who decides upon the product to be produced or services to be offered.
12. **Optimality:** A project is always aimed at optimum utilization of resources for the overall development of the organization.
13. **Complexity:** A project is a complex set of activities relating to diverted areas. Technology survey, choosing the, appropriate technology, arranging for financial resources, and execution of the project in time contribute to the complexity of the project.
14. **Flexibility:** Change and project are synonymous. Always a project witnesses multiples of modifications and changes in its original plans, programmes and budgets.
15. **Response to Environments:** Projects take shape in response to environments.

PROJECT CLASSIFICATION:

Projects can be classified under different heads, some of which are explained below.

1. Based on the Type of Activity:

Under this category, projects can be classified as *industrial projects and non-industrial* projects. Industrial projects are set up for the production of some goods. Projects like health care projects, educational projects, irrigation projects, soil conservation projects, pollution control projects; highway projects, water supply projects etc. come under the category of non-industrial projects.

Investments in non-industrial projects are made by the Government and the benefits from such projects are enjoyed by the entire society of people. It is difficult to quantify the benefits enjoyed by the society out of non-industrial projects.

2. Based on the Location of the Project:

Under the category, projects can be classified as national projects and international projects. National projects are those set up within the national boundaries of a country, while international projects are set up in other countries. International projects may be either projects set up by the Government or by the private sector. The following are the major forms of international projects.

_ setting up of fully owned subsidiaries abroad

_ setting up of joint ventures abroad

_ setting up of projects abroad by way of mergers & acquisitions

3. Based on Project Completion Time

Based on the constraints on project completion time, projects can be classified into two types, viz., *normal projects and crash projects*. Normal projects are those for which there is no constraint on time. Crash projects are those which are to be completed within a stipulated time, even at the cost of ending up with a higher project cost. For example, construction of canal lining with the condition that the work should be completed before the monsoon starts is a crash project.

4. Based on Ownership:

Based on ownership, projects can be classified into *private sector projects, public sector projects and joint sector projects.* A private sector project is one in which the ownership is completely in the hands of the project promoters and investors. Profit maximisation is the prime objective of private sector projects since the investors invest their money in such projects only with the sole idea of earning better returns.

Public sector projects are those that are owned by the state. The evolution and growth of public sector enterprises is the natural consequences of the efforts of Governments for undertaking development in a country. The growth of public sector enterprises varies from country to country. In a country that follows only the system of private enterprises (USA, for example) there is hardly any public sector enterprise except for essential sectors like defense sectors, public utility services etc.

Joint sector projects are those in which the ownership is shared by the Government and by private entrepreneurs. The main consideration for the Government's investment in joint sector projects is to make use of the managerial talents, entrepreneurial capabilities and marketing skills of the private entrepreneurs. Joint sector offers hope to the private entrepreneurs since the Government shares the investment required for the project.

5. Based on Size**:**

Projects can be classified based on the size into three categories, viz., small projects, medium sized projects and large projects. The size is normally expressed in terms of the amount of investment required. The investment limit for the different categories of projects are announced by the Government and this undergoes periodical changes keeping in view the inflation, the decision to offer certain incentives to projects categorized as 'small' scale projects etc.

As per the directives of the Govt. of India, projects with investment on plant and machinery up to Rs. 1 crore are categorized as ‘small scale projects’ while those with investment in plant and machinery above Rs. 100 crores are categorized as ‘large scale projects’. Projects with investment limit between these two categories are ‘medium scale projects’.

Attributes or Skills of a good Project Manager:

An effective project manager is one who should have the following skills/capacities.

1. Planning and organizational skills
2. Personnel management skills
3. Communication skills
4. Ability to solve problems in their totality
5. Ambition for achievement
6. Ability to take suggestion
7. Understanding the views of project team members and having a sympathetic attitude towards them
8. Ability to develop alternative actions quickly
9. Ability to make self-evaluation
10. Effective time management
11. Initiative and risk taking ability
12. Conflict resolving capacity
13. Team building skills
14. Resource allocation skills
15. Entrepreneurial skills

1.2 PROJECT LIFE CYCLE:

Each project is a unique entity. “It has a beginning, a life, and an end”. Thus it is born, it develops, and it dies. Like human beings, projects are taken to living organisms blessed with life-cycles. Companies performing projects will generally subdivide their projects into several phases or stages to provide better management control. Collectively these project phases are called the project life –cycle. The period between the beginning and end of a project is usually referred to as the project life cycle. Project life cycles generally define:

- What technical work should be done in each phase?
- Who should be involved in each phase?

A particular project receives is not uniformly distributed throughout its life span, but varies from phase to phase. At a particular phase of project life, depending on the requirement of that phase, appropriate attention has to be paid. We, therefore, need to know the various phases in the life of a project.

A). Conceptual phase:

This is the first phase of the project life cycle. This phase involves the identification of a need,idea, problem or opportunity. The idea may first come to the mind when one is seriously trying overcome certain problems. The problems may be non-utilisation of either the availability of funds, plant capacity etc. Many projects are facing diffculties in this phase because the concept phase is truncated(or cut off) before it is finished and attention is prematurely turned towards the means of accomplishing objectives. Therefore, project objectives need to be fully explored and developed in the conceptual phase. The major activities of this phase is:

i) Determine existing needs or potential reqirement of current projects.

ii) Provide initial answers to the question on cost, avaiability, performance levels and its compatibility to other project programmes.

iii) Identify all the resources essential for the effective management .

iv) Determine initial project interface.

v) Design an appropriate organisation structure for the project.

B). Definition phase:

In this phase, solutions to business opportunity are evaluated and the preferred approach is defined. This phase includes initial preparation of all documentation necessary to support the project such as., policies, procedures, job description, budget and funding papers, letters etc. Thus the definition phase represents a beginning-to-end thinking through the project but does not accomplish the project in and of itself. The project definition produces a plainly written, unambiguous description of the project in sufficient detail to support a proposal or request the customer for undertaking the overall project. This phase includes following activities:

i) Preparing of the detailed plans required to support the project.

ii) Estimation of realistic cost, schedule and performance requirements

iii) Spotting out those areas of the project where high risk and uncertainty exist.

iv) Defining, interfacing and of project activities.

v) Ascertaining other necessary sub-systems of the projects.

C. Planning and organising phase:

In this phase, the detailed plans are prepared and tasks are identified, with appropriate milestones, budgets and resources. Planning consists of defining all the works required to be carried out so that all the project participants will understand their role in the project team and carry out the work assigned to them.

Some organisation however, prepare documents such as project execution plan to mark this phase.

Organizing is the process of defining and analyzing the activities of the enterprise, grouping the activities into distinct areas / departments and establishing the authority-responsibility relationships among them. It also involves organizing the resources required for the accomplishment of organizational objectives. In project environment, organizing consists of the following sub processes. Following activities are of major concern in this phase:

i) Defining the scope of the project in terms of the product/services to be delivered by the project.

ii) Forecasting and estimating the resources (men, material, money, machines etc.,) required for the project.

iii) Arriving at an appropriate organisational structure to implement the project.

iv) Identification and management of the resources in order to facilitates the production processes such as inventory, supplies, labour, funds, etc.

v) Preparing detailed cost estimates for all the activities.

vi) Determining the required resources for all the activities.

D. Perform the project:

This is the third phase where the project plan is carried out. It is being concerned with operations; it integrates the project's product or services into existing organizational system. Project management activity during this phase involves:

- Keeping people informed about progress of the project, ensuring project priorities are understood and translated into which activities are "in progress."
- Monitoring the environment, anticipating problems and taking action to counter any issues affecting the project scope, schedule or budget.

- Reviewing change requests with the project team and recommending whether they will be done within the project or not.
- Evaluation of the technical, social and economic sufficiency of the project to meet actual operating conditions.

E. Terminate the project:

The project process is completed and documented, and the finished product is transferred to the care and control of the owner. In this phase project will shut down in a controlled manner. The major activities of the project in this phase are:

- Demonstrate that the project is complete
- Arranging relevant project files in proper form so that they can be referred for future projects.
- Assess the success of the project
- Ensuring that project accounts are maintained up-to-date, amply audited and closed out.
- Assisting project staff in being reassigned.
- Discharging any outstanding dues on behalf of project.
- Collecting dues of fees or payments from the clientele and clearing the account.
- Support departing staff

This phase is quite relevant under multi-project environment. When one project gets completed the resources can be put to use in other subsequent project. This final phase has an impact on other ongoing projects with regard to priority identification.

1.3 PROJECT MANAGEMENT

Meaning: Project management is the scientific application of knowledge, skills, tools, and techniques to project activities to meet project requirements. It is an

organized venture for managing projects. In other words, project management is the facilitation of the planning, scheduling and controlling of all activities that must be done to achieve project objectives within constraints of time and cost. Project management is essentially involved in executing the projects. It involves applying a systematic approach to achieve the objectives of the project, and when project management is done properly, the probability of a successful outcome to the project is increased. *According to Herold Kerzner*, project management is "planning, directing and controlling of company resources for a relatively short term project which has been established for the completion of specific goals".

Characteristics of Project Management:

Successful project management has several significant characteristics. To understand the value of project management, it is necessary to understand the fundamental nature and the core characteristics of project management processes.

1. The undertaking ends with a specific accomplishment.
2. The required activity has a beginning, an end, and a schedule for completion.
3. Resources are limited.
4. People are involved.
5. Phases and activities are sequenced.

Objectives of Project Management:

- define the project
- reduce it to a set of manageable tasks
- obtain appropriate and necessary resources
- build a team or teams to perform the project work
- plan the work and allocate the resources to the tasks
- monitor and control the work
- report progress to senior management and/or the project sponsor

- close down the project when completed
- review it to ensure the lessons are learnt and widely understood

Benefits/ Needs / Importance of project Management:

Project management provides techniques for making trade-offs between conflicting goals and enterprise priorities besides experiencing a better control and coordination. It also helps in reducing developmental time lowering costs, and produces higher order results. Other major benefits of project management techniques include the following:

1. **Better efficiency in delivering services**: Project management provides a "roadmap" that is easily followed and leads to project completion.
2. **Application and use of set tools and Techniques**: It provides a set of tools and techniques at will set out possible mechanisms for the management of project through the various stages of its life-cycle.
3. **Better Flexibility**: It is one of the greatest benefits of project management is that it allows for flexibility. Project management allows mapping out the strategy. For many small-to-midsize companies, this alone is worth the price of admission.
4. **Reducing risks:** The project management team can identify the potential risks, take their time to rectify them and help the company save valuable resources.
5. **Highlight the role of project Manager**: It is useful to highlight the role of project manager in the organization and management of people.
6. **Performance Evaluation:** It is useful to specify world class performance and to take generic lesson from these.
7. **Excellent product quality:** The project management plans the allocated budget, resources and testing methods that keep the pace of production high, both qualitatively and quantitatively.

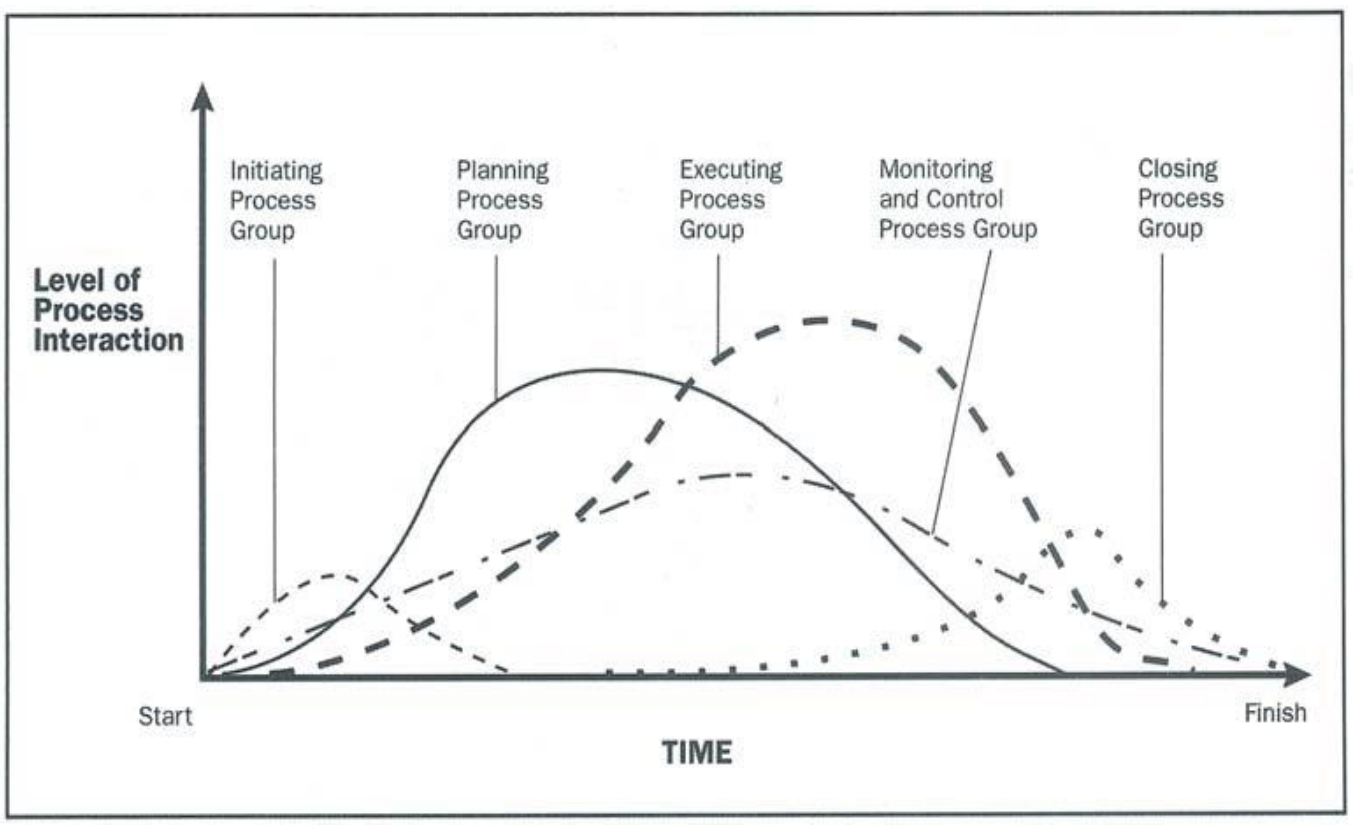
8. **Fast track**: Bring a new product to the market quickly before your competitors.
9. **Project office:** Offers a centre for project management excellence.

It can be concluded that project management as a management discipline, individual competency, organizational culture and a critical source of multiple advantages. The specialized role of project management in bringing agility to organizations that want to innovate, whether it is for new products or new initiatives, cannot be ignored.

Project management process:

Project management is a process of leading a team in planning and implementing a series of related activities that need to be accomplished on a specific date with a limited budget. Because of its nature, coordinating all these activities requires a process approach. Because many times development project take on unexplored territory, assumptions about the project must be listed, evaluated, its risks assessed and contingency plans developed. It also requires a close monitoring of the budget, scope and schedule to deliver the project objectives under the expected quality. Each one of these elements needs to be managed in a systematic manner with the development of plans to identify the roles and resources needed.

A project manager sees to it that everything goes well as planned and if problems may arise as they usually do, a resolution is immediately implemented. To be able to create a successful project, one must go through the project management steps carefully completing each and every project management phases. All projects have to pass through the following five phases:



A. Project Initiation:

Project Initiation is the first phase in the Project Life Cycle and essentially involves starting up the project. In this phase a business problem (or opportunity) is identified and a business case which provides various solution options is defined. A feasibility study is conducted to investigate likelihood of each solution option addressing the business problem and a final recommended solution is forward. Once the recommended solution is approved, a project is initiated to deliver the approved solution. Generally a projects objective has fully explored and developed in this phase. The initiating stage should include a plan that encompasses the following areas:

- analyzing the business needs/requirements in measurable goals
- reviewing of the current operations
- financial analysis of the costs and benefits including a budget
- stakeholder analysis, including users, and support personnel for the project

- project charter including costs, tasks, deliverables, and schedule

B. Project Planning

The plan is the first step in providing the means of satisfying the requirements of the project owner or sponsor. In this phase, detailed plans are prepared and tasks identified, with appropriate milestones, budgets and resources. Many of the decisions and actions taken during this phase relate to project basics, and if the project jumps into the execution phase without freezing the basics, the project is bound to be flounder.

The primary objectives of the planning phase are:

- 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;

C. Project Execution

The execution phase is typically the longest phase of the project (in terms of duration).

Executing consists of the processes used to complete the work defined in the project plan to accomplish the project's requirements. Execution process involves coordinating people and resources, as well as integrating and performing the

activities of the project in accordance with the project management plan. Though the project execution shall as far as possible be done according to the plans originally envisaged, changes / modifications required, if any, are to be incorporated wherever necessary. Since projects are dynamic in nature, flexibility is essential in execution of projects so that the overall objectives of the project are achieved.

D. Monitoring and controlling:

Monitoring and controlling consists of those processes performed to observe project execution so that potential problems can be identified in a timely manner and corrective action can be taken, when necessary, to control the execution of the project.

Monitoring and controlling includes:

- Measuring the ongoing project activities ('where we are');
- Monitoring the project variables (cost, effort, scope, etc.) against the project management plan and the project performance baseline (*where we should be*);
- Identify corrective actions to address issues and risks properly (*How can we get on track again*);
- Influencing the factors that could circumvent integrated change control so only approved changes are implemented.

E. Project Closure:

Projects are temporary endeavors. Hence, they have a beginning and an end. A project comes to an end when the execution is completed and the project objectives are fulfilled. At this point, the project needs to be brought to an end, or closed down. Its resources, both people and technology, need to be released and reallocated. The project should be allowed to close, and a final meeting for the

project team members ought to convene to formalise the closure. For every project there must be a formal process called ‘closing’ for declaring the closure of the project.

SMART Goals in Project Management

Defining SMART Goals

SMART is an acronym for **s**pecific, **m**easurable, **a**greed upon, **r**ealistic, and **t**ime. Project managers utilize SMART goals as a way to measure project phases and outcomes and they can also be used in any project management methodology.

- **Specific** – We know we want to develop a more comfortable running shoe, but what specifically is needed to improve on what’s already on the market? Do the shoes need to be lighter, heavier; are green or recycled materials important? These are all examples of specifically defining the wants of our running shoes.
- **Measure** – How will we measure our running shoes—or evaluate the final product? Here you might list things such as how the shoes will be tested—not only by end users but also comparison testing, costs and prices to cover manufacturing, etc. Project tracking is a big part of the “measure” process when using SMART goals. Not only does project tracking allow you to measure various areas of the project, managers and teams often use mind mapping tools that show how each level of the project will run, what obstacles are out there, and ways to avoid and improve on those obstacles. Consider the measure process as the largest part of your SMART goals because this stage will essentially defines how the project will flow.
- **Agreed Upon** – External and internal stakeholders, teams and key personnel must all agree on what has been decided in the measurement phase. Often associated risks or changes may be identified and in our running shoe

example, if a vendor can't deliver what we want for example, we may have to go back and review the measuring phase.

- **Realistic** – Now is the time to see if the goals set in the project are doable and realistic. Will end users love our running shoes? Can we actually make the running shoes and continue production based on revenues and expenses? Do we indeed have everything we need to complete the project and have we set realistic goals we can actually achieve?
- **Time** – Time or time-based goals are important to define in the SMART goal project planning process. If we want our running shoes in stores by the spring/summer shopping season, will we be able to achieve this deadline? What are some of the stopping blocks we may run into? Here, we define our timeline from start to finish based on our specific wants and needs, how we plan to measure and track our success, are able to agree unilaterally, and feel realistic about the project's outcome and success.

1.4. NEEDS IDENTIFICATION

Needs identification is the initial phase of the project life cycle. It starts with the recognition of needs, problems, or opportunity and ends with the issuance of a request for proposal (RFP). The customer identifies a need, a problem, or an opportunity for a better way of doing something and therefore sees some benefit to undertaking a project that will result in an improvement or advantage over the existing condition.

There are often situations where a company has identified several needs but has limited funds and people available to pursue projects to address all of those needs. In such cases, the company must go through a decision-making process to select those needs that, when met, will result in the greatest overall benefits.

1.5 PROJECT SELECTION

Project selection is the process of evaluating individual projects or groups of projects, and then choosing to implement some set of them so that the objectives of the parent organization will be achieved.

Project selection involves evaluating various needs or opportunities, and then deciding which of these should move forward as a project to be implemented. The benefits and consequences, advantages and disadvantages, pluses and minuses of each opportunity need to be considered and evaluated. Each project will have different costs, benefits, and risks. In the face of such differences, the selection of one project out of a set is a difficult task. Several techniques that can be used to help senior managers select projects. To deal with all of these problems, organizational decision makers use *decision aiding models* that permit them to save time and money while maximizing success.

A number of decision models are available to managers responsible for evaluating and selecting potential projects. All firms, however, try to develop a screening model that will allow them to make the best choices among alternatives. Within the limits of their capabilities, such models can be used to increase profits, select investments for limited capital resources, or improve the competitive position of the organization. They can be used for ongoing evaluation as well as initial selection, and thus are a key to the allocation and reallocation of the organization's scarce resources.

Criteria for Choosing Project Model:

The proper selection of investment projects is crucial to the long run survival of every firm. Project selection models can be used to increase profits, select investments for limited capital resources, or improve the competitive position of the organization. So, when a firm chooses project selection model, the following criteria are most important

1. **Realism**:

The model should reflect the reality of the manager's decision situation, including the

multiple objectives of both the firm and its managers. Without a common measurement

system, direct comparison of different projects is impossible. The model should take into account the realities of the firm's limitations on facilities, capital, personnel, and so forth.

2. **Capability:**

The model should be sophisticated enough to deal with multiple time periods, stimulate various situations both internal and external to the project (for example, strikes, interest rate changes), and optimize the decision. An optimizing model will make the comparisons that management deems important, consider major risks and constraints.

3. **Flexibility**:

The model should give valid results within the range of conditions that the firm might experience. It should have the ability to be easily modified, or to be self-adjusting in response to changes in the firm's environment; for example, tax laws change, new technological advancements alter risk levels, and, above all, the organization's goals change.

4. **Ease of Use**:

The model should be reasonably convenient, not take a long time to execute, and be easy to use and understand. It should not require special interpretation, data that are difficult to acquire, excessive personnel, or unavailable equipment. Expected outcomes should be easily simulated.

5. **Cost**:

Data gathering and modeling costs should be low relative to the cost of the project .

All costs should be considered, and their total should definitely not be greater than the potential benefits of the project.

6. **Easy Computerization**:

It should be easy and convenient to gather and store the information in a computer database, and to manipulate data in the model through use of a widely available, standard computer package such as Excel, Lotus 1-2-3, Quattro Pro, and like programs.

The Nature of Project Selection Models:

There are two basic types of project selection models, *numeric* and *nonnumeric.* Both are widely used. Many organizations use both at the same time, or they use models that are combinations of the two. Nonnumeric models, as the name implies, do not use numbers as inputs. Numeric models do, but the criteria being measured may be either objective or subjective. It is important to remember that the *qualities* of a project may be represented by numbers.

A. Nonnumeric Models: Nonnumeric models are older and simpler and have only a few subtypes to consider. Followings are subtypes of Non-numeric model.

a.) The Sacred Cow:

In this case the project is suggested by a senior and powerful official in the organization. The project is "sacred" in the sense that it will be maintained until successfully concluded, or until the boss, personally, recognizes the idea as a failure and terminates it.

b.) The Operating Necessity:

Here the project is required to keep the system running. If a flood is threatening the plant, a project to build a protective dike does not require much formal evaluation, is an example of this scenario. If the project is required in order to keep the system operating, the primary question becomes: Is the system worth saving at the estimated cost of the project? If the answer is yes, project costs will be examined to make sure they are kept as low as is consistent with project success, but the project will be funded.

c.) The Competitive Necessity

It had become essential to the company for implementation of modernization if the firm wants to maintain its competitive position in the market area. Although the planning process for the project will quite sophisticated, the decision to undertake the project is based on a desire to maintain the company's competitive position in that market.

In a similar manner, many business schools are restructuring their undergraduate and MBA programs to stay competitive with the more forward-looking schools. In large part, this action is driven by declining numbers of tuition-paying students and the need to develop stronger programs to attract them. Investment in an *operating necessity* project takes precedence over a *competitive necessity* project, but both types of projects may bypass the more careful numeric analysis used for projects deemed to be less urgent or less important to the survival of the firm.

d.) The Product Line Extension:

Here, projects are judged on how they fit with current product line, fill a gap, strengthen a weak link, or extend the line in a new desirable way. Decision makers can act on their beliefs about what will be the likely impact on the total system performance if the new product is added to the line.

e.) Comparative Benefit Model:

For this situation, assume that an organization has many projects to consider, perhaps several dozen. Senior management would like to select a subset of the projects that would most benefit the firm, but the projects do not seem to be easily comparable. The organization has no formal method of selecting projects, but members of the Selection Committee think that some projects will benefit the firm more than others, even if they have no precise way to define or measure "benefit."

The concept of comparative benefits, is not a formal model, but is widely adopted for selection decisions on all sorts of projects. Most United Way organizations use this concept to make decisions about which of several social programs. So, here several projects are considered and the one with the most benefit to the firm is selected

Advantages of Numeric Scoring Models

- Allow multiple criteria to be used for evaluation and decision.
- Structurally simple and easy to use.
- A direct reflection of management policy.
- Easily altered to meet changes in the environment and in management policy.

Disadvantages of Numeric Scoring Models

- Output is a relative measure; no utility is reflected, thus no direct indication of project support.
- Generally linear, elements are assumed to be independent.
- Tendency to include too many criteria.

B. NUMERIC MODELS:

A large majority of all firms using project evaluation and selection models use profitability as the sole measure of acceptability. Followings are types of Numeric models.

a.) <u>Pay-back Period</u>:

The payback period for a project is the initial fixed investment in the project divided by the estimated annual net cash inflows from the project. The ratio of these quantities is the number of years required for the project to repay its initial fixed investment. This method measures the period of time for the original cost of a project to be recovered from the additional earnings of the project itself. Under this method, various investments are ranked according to the length of their pay-back periods. Shorter pay-back period is preferred.

For example, (project generates constant cash inflows). Assume a project costs Rs.100, 000 to implement and has annual net cash inflows of Rs. 25,000. Then, here pay-back period is 4 years.

For example, (in case of unequal annual cash inflows): Assume a project which requires a cash outlay of Rs. 10,000 and generates cash inflows of Rs. 2,000, Rs.4,000, Rs.3,000 and Rs. 2,000 in the first, second, third and fourth years respectively.

Here total cash outlay is Rs. 10,000

Total cash inflow for the first 3 years = Rs.2,000 + Rs.4,000 + Rs. 3,000 = Rs.9,000. Within third year total cost is not recovered but the total cash inflows for the four years are Rs. 9,000 + Rs.2,000 = Rs.11,000 i.e., Rs.1,000 more than the cost of the project. So the back period is somewhere between 3 and 4 years. So pay-back period is:

2+ 1,000/2,000 = 3 years and 6 months.

<u>Example:</u>

A Company wishes to buy a machine for a four-year project. The manager has to choose between machine A or machine B. Although both projects have the same initial cost ($35, 000) their cash flows perform differently over the four-year period. To calculate the payback period, simply work out how long it will take to recover the initial outlay (see Table 1 below)

Table 1: Payback Period

Year	Cash-Flow Machine A	Cash-Flow Machine B
0	($35,000)	($35,000)
1	$ 20,000	$ 10,000
2	$ 15,000	$ 10,000
3	$ 10,000	$ 15,000
4	$ 10,000	$ 20,000
Payback period	***2 years***	***3 years***

Machine A will recover its outlay one year sooner than Machine B. Where machines are ranked by the shortest Payback period, machine A is selected in preference to machine B.

b.) Average Rate of Return Method:

The average rate of return is the ratio of the average annual profits(either before or after taxes) to the initial and average or average investment in the project. According to this method, various projects are ranked in order of the rate of earnings or rate of return. The project with the higher rate of return is selected as compared to the one with lower rate of return. This method can also be used to make decision as to accepting or rejecting a project.

c.) Net present value Method: (or discounted cash flow technique)

The net present values of all cash inflows and an outflow occurring during the entire life of the project is determined separately for each year by discounting these flows by a pre-determined rate.

NPV = Total present value of cash Inflows – Present value of initial investment

NPV is an indicator of how much value an investment or project adds to the firm. In financial theory, if there is a choice between two mutually exclusive projects, the one yielding the higher NPV should be selected. Whereas, in case of single project if the net present value is greater than zero, an investment project is acceptable, whereas, if net present value is less than zero, than project will be rejected. Whenever the net present value will be equal to zero the project will be either rejected or selected.

NPV > 0	the investment would add value to the firm	the project may be accepted
NPV < 0	the investment would subtract value from the firm	the project should be rejected
NPV = 0	the investment would neither gain nor lose value for the firm	We should be indifferent in the decision whether to accept or reject the project.

For example, given:

Investment (Initial cost) = Rs. 40,000

Life of the Project = 5 Years

Year	Cash Inflows
1	18000
2	12000

3	10000
4	9000
5	6000

Calculate Net present value at 10% .

Solution:

Year	Cash Inflows	PV@10%	PV of Net cash flows
1	18000	0.909	16362
2	12000	0.827	9924
3	10000	0.752	7520
4	9000	0.683	6147
5	6000	0.621	3726
		Total present value	43679
		(-) Investment	40000
		NPV	**3679**

Deducting the present value of investment from the total present value of cash inflows a net value of Rs. 3679. Here net present value is greater than zero, so the project will be selected.

d.) Internal Rate of Return Method:

The IRR of an investment is the discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment. Under this method, the cash flows of a project are discounted at a suitable rate by hit and trial method, which equates the net present value so calculated to the amount of the investment.

Internal rates of return are commonly used to evaluate the desirability of investments or projects. The higher a project's internal rate of return, the more desirable it is to undertake the project. Assuming all projects require the same amount of up-front investment, the project with the highest IRR would be considered the best and undertaken first. It can be determined by the following mathematical formula:

$$C = \frac{A_1}{(1+r)^1} + \frac{A_2}{(1+r)^2} + \frac{A_3}{(1+r)^3} + \ldots\ldots\ldots + \frac{A_n}{(1+r)^n}$$

.

C = Initial outlay at time Zero.

Where, $A_1, A_2, \ldots A_n$ = Future net cash flows at different periods.

2, 3, ….,n = numbers of years

r = rate of discount of internal rate of return.

Advantages:

i) It considers the profitability of the project for its entire economic life and hence enables evaluation of true profitability.

(ii) It provides for uniform ranking of various proposals due to the percentage rate of return.

Disadvantages: It is difficult to understand and is the most difficult method of evaluation of investment proposals.

e.) Profitability Index:

Profitability index (PI), also known as profit investment ratio (PIR) and value investment ratio (VIR), is the ratio of present value of cash inflows to initial investment of a proposed project. It is a useful tool for ranking projects because it allows you to quantify the amount of value created per unit of investment.

The ratio is calculated as follows:

$$\text{Profitability index} = \frac{\text{PV of future cash flows}}{\text{Initial investment}}$$

$$\text{Or} = \frac{\text{Present value of cash inflows}}{\text{Present value of cash outflows}}$$

$$\text{Or} = \frac{\text{PV of cash inflows}}{\text{Initial cash outlay}}$$

Rules for selection or rejection of a project:

- If PI > 1 then accept the project
- If PI < 1 then reject the project

This various projects are ranked under this method in order of their profitability index, in such a manner that in case of multiple projects, higher profitability index is ranked higher than the other with lower profitability index.

Example:

Investment (Initial cost) = Rs. 40,000

Life of the Project = 5 Years

Year	Cash Inflows
1	18000
2	12000
3	10000
4	9000
5	6000

Calculate Net present value and profitability index at 10% .

Solution:

Year Cash Inflows PV@10% PV of Net cash flows

1	18000	0.909	16362
2	12000	0.827	9924
3	10000	0.752	7520
4	9000	0.683	6147
5	6000	0.621	3726

Total present value	43679
(-) Investment	40000
NPV	**3679**

Profitability Index = 43679 / 40000 = 1.091

As the P.I. is higher than 1, the project proposal can be accepted.

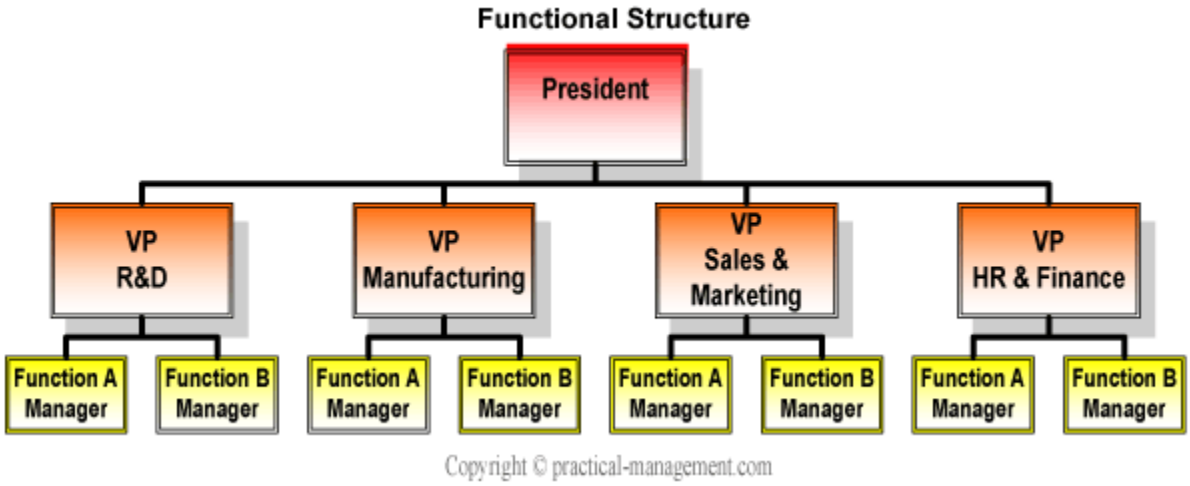
1.6 PROJECT ORGANIZATION

To manage a project, a company or authority has to set up a project organization, which can supply the resources for the project and service it during its life cycle. It refers to the differentiation and integration of activities and authority roles and relationships. While there are various types of organizations used today. Followings are the most prominent form of organizations:

a. Functional Organization Structure/ Hybrid project*:*

Prior to about 1960 most corporate organizations favored a functional organization structure, also called a traditional organizational structure. In this structure teams or groups are created based on common function in a bottom-up manner. This type of organization consists of specialist or functional departments each with their own departmental manager responsible to one or more directors. Such an organization is ideal for routine operations where there is little variation

of the end product. Functional organizations are usually found where items are mass produced. Each department is expert at its function and the interrelationship between them is well established.



Advantage:

(ii) *No structural change*: Projects are handled within the existing organizational structure.

(iii) *Flexibility in the use of staff*: specialists within various functional departments can be temporarily assigned to the project and then return to their normal duties within their functional departments.

(iv) *In depth expertise*: the project can benefit from the use of experts coming from the functional units. Hence it gains potentials of the unit without duplication of scarce resources, maximizing their utilization.

Disadvantages:

(i) *Lack of focus*: Because each functional unit has its own routine work and responsibilities, the project may be given low priority.

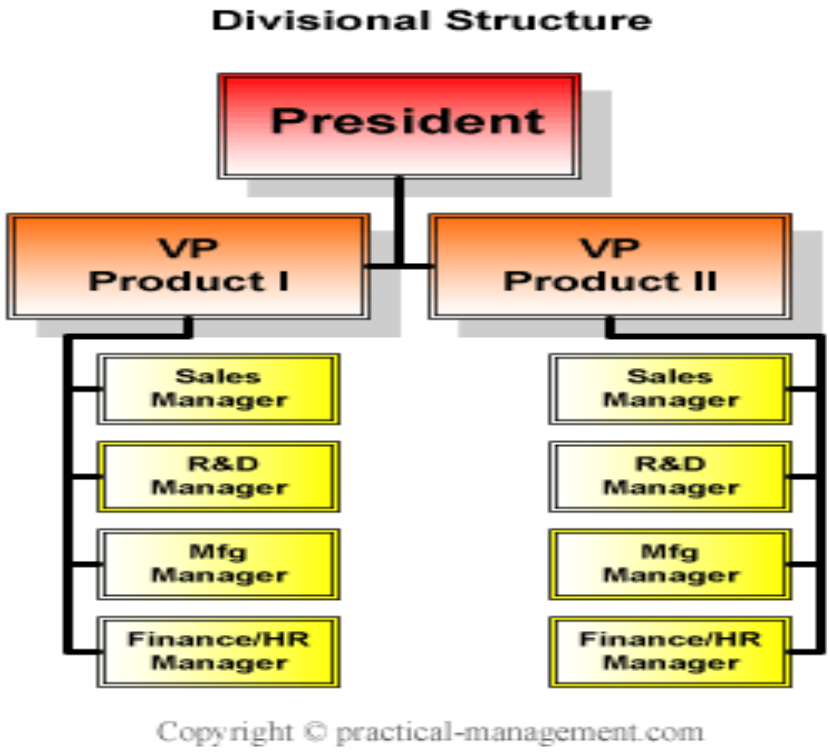
(ii) *Poor integration*: Specialists in functional units may be concerned only with their part of the project and not with what is best for the total project.

(iii) This method does not work very effectively when used in facilitating complex projects.

(iv) *Slow response*: Functional units cannot respond to fast changes in customer demands or the product since only the top level management has broad knowledge and the decision making authority.

b. Divisional Organisation structure:

Under this form of project organization, a separate division or team is set up to implement the project, where each division corresponds to the end product or services provided by the organization. Each division has own set of functional units like research, manufacturing, marketing etc and is completely self contained. Headed by the project manager, this division has its complement of personnel over whom the project manager has full line authority. He recruits necessary people from both within and outside the organization. In effect, this form of organization implies the creation of a separate goal- oriented division of the company, with its own functional departments. It is less hierarchical and formed by decomposing the functional structure along with product lines.



Advantages:

(i) Very strong form of project organization.

(ii) The divisional project organization facilitates the process of planning and control.

(iii) *Fast:* Full attention to the project makes it possible to complete the project as soon as possible.

(iv) *Cohesiveness:* team members share a common goal which results in a high level of motivation and togetherness.

(v) Integration: It brings about better integration of efforts.

(vi) Coordination*:* It helps in departmental coordination.

Disadvantages:

(i) Inefficient of resources: This form of organization, however, may entail an inefficient use of the resources of the firm.

(ii) Internal strike: A dispute can develop between the project team and the parent organization.

(iii) Limited Technological Expertise: Technical expertise is limited to the talents and experience of the specialists assigned to the project.

(iv) Difficult product integration: when organization produces multiple products which might be used together or are part of a larger product, the integration task becomes challenging since there is little coordination between the divisions.

(v) Expensive for small projects

c. Matrix Organization Structure:

Matrix Organization is a project management structure that evolved from the recognition of inherent flaws in the Functional Organization and Divisional

Organization structures. Created in the 1970s, this structure combined the best components of these two structures.

A Matrix structure organisation contains teams of people created from various sections of the business. These teams will be created for the purposes of a specific project and will be led by a project manager. Often the team will only exist for the duration of the project and matrix structures are usually deployed to develop new products and services. In a matrix organization, each project manager reports directly to the vice president and the general manager. Since each project represents a potential profit centre, the power and authority used by the project manager come directly from the general manager.

Different Matrix Forms:

- Functional (also Weak or Lightweight) Form

  Matrices in which the authority of the functional manager predominates and the project manager has indirect authority

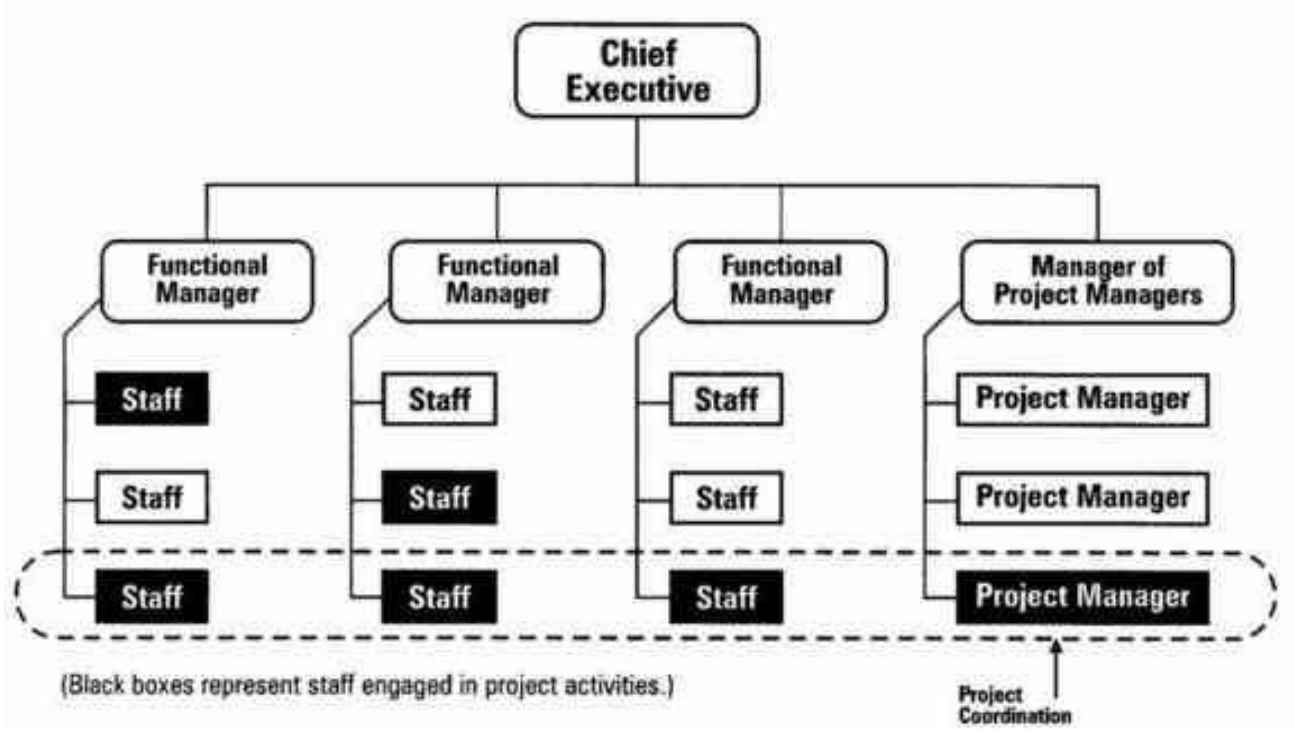
- Balance (or Middleweight) Form

  The traditional matrix form in which the project manager sets the overall plan and the functional manager determines how work to be done

- Strong (Heavyweight) Form

  Resembles a project team in which the project manager has broader control and functional departments act as subcontractors to the project.

Typical Matrix organization



Advantages:

(i) Efficient: Resources can be shared with multiple projects as well as within functional units.

(ii) Strong Project Focus: As compared to functional project setup, this enables a strong project focus by having a formally designated project manager.

(iii) Flexibility: Matrix structure makes possible the flexible utilization of resources of resources and expertise within the organization since the boundaries between the project team and the functional units are not so strict.

(iv) Because key people can be shared, the project cost is minimized.

(v) Stress is distributed among the team.

(vi) Efficient use of support system.

Disadvantages:

(i) A conflict of loyalty between line managers and project managers *over the allocation of resources.*

(ii) Projects can be difficult to monitor if teams have a *lot of independence*.

(iii) *Costs can be increased* if more managers (i.e. project managers) are created through the use of project teams

(iv) *Slow*: Decision making becomes a slow process when various functional departments and project groups have to come to an agreement.

(v) *Infighting*: In matrix form, resources, people and equipment are being shared by various projects and functional tasks, conflict and competition is unavoidable.

1.6 PROJECT FEASIBILITY ANALYSIS:

A Project feasibility study is defined as an evaluation or analysis of the potential impact of a proposed project or program. It is conducted to assist decision-makers in determining whether or not to implement a particular project or program. It involves documenting each of the potential solutions to a particular business problem or opportunity of a project.

The purpose of a Feasibility Study is to identify the likelihood of one or more solutions meeting the stated business requirements. In other words, if you are unsure whether your solution will give the outcome which you want, then a Project Feasibility Study will help gain that clarity. Followings are some of the feasibility steps on assessing a project.

Feasibility Study Steps:

- **Project Description** – Identify the project name and purpose. Include details including stakeholders, and end result expected.
- **Goals** – List long and short-term goals and what processes will be needed to achieve those goals.

- **Timeline** – What will be the estimated time until project completion?
- **Costs and Budgeting** – Include all costs incurred for the project including the cost of the feasibility study itself.
- **Market Analysis** – If applicable, will the market or market environment benefit from the project. If so, list out.
- **Resources** – Identify all the resources both IT, technical, inventory, and human that will be needed to complete the project.
- **Project Process** – How will the project flow? Include flow charts showing project stages.
- **Management and Teams** – Who will manage and who will work on scheduled tasks? Will project management outsourcing be needed?
- **Observations**– Statements that do or don't support the project should be included here.

Before making a final decision to take up a project, the technical, economic, commercial and financial justification of the chosen project shall be ascertained in concrete terms.

a.) Technical feasibility:

Technical feasibility analysis is the systematic gathering and analysis of the data pertaining to the technical inputs required and formation of conclusion there from. The availability of the raw materials, power, sanitary and sewerage services, transportation facility, skilled man power, engineering facilities, maintenance, local people etc are coming under technical analysis. This feasibility analysis is very important since its significance lies in planning the exercises, documentation process, and risk minimization process and to get approval.

Technological feasibility is carried out to determine whether the company has the capability, in terms of software, hardware, personnel and expertise, to handle the completion of the project.

b). Economic feasibility:

This involves the feasibility of the proposed project to generate economic benefits. A benefit-cost analysis and breakeven analysis technique is required on evaluating the economic feasibility of a project. How far the project contributes to the development of the sector, industrial development, social development, maximizing the growth of employment, etc. are kept in view while evaluating the economic feasibility of the project.

In simple terms, economy feasibility is a cursory examination as to whether the investment made on the project will give a satisfactory return to the economy.

c.) Commercial feasibility:

In the commercial feasibility many factors are coming. The scope of the project in market or the beneficiaries, customer friendly process and preferences, future demand of the supply, effectiveness of the selling arrangement, latest information availability an all areas, government control measures, etc. The feasibility involves the assessment of the current market scenario, which enables the project to get adequate demand. Estimation, distribution and advertisement scenario also to be here considered into.

d). Financial feasibility:

One of the very important factors that a project team should meticulously prepare is the financial viability of the entire project. The financial feasibility examines the workability of project proposal in respect of raising finance to meet the investment required for the project, be it equity, (by way of public issue of shares or by other means) or debt, (by way of term loans from financial institutions or by other means). In case of a new project, financial viability can be judged on the following parameters:

- Total estimated cost of the project

- Financing of the project in terms of its capital structure, debt equity ratio and promoter's share of total cost
- Existing investment by the promoter in any other business
- Projected cash flow and profitability
- Investment outlay and cost of project
- Calculations of cost of debt
- Projected profitability
- Break- even point
- Cash flows of the project
- Cost of procuring capital
- Projected financial position

e.) Environmental Feasibility:

Environmental appraisal concerns with the impact of environment on the project. The factors include the water, air, land, sound, geographical location etc. This is an aspect worthy of real attention in the very early stages of a project. Concern must be shown and action must be taken to address any and all environmental concerns raised or anticipated. This component also addresses the ability of the project to timely obtain and at a reasonable cost, needed permits, licenses and approvals.

MODULE - II

PROJECT MANAGEMENT SYSTEM:

Project management systems are software tools that assist in the organization and moderation of a project throughout its life cycle. Most project management systems provide project managers with these basic enhancements:

- Project visibility: shows the project as a whole, allowing one to accurately predict the results of project constraints (scope, time, costs, etc.)
- Resource visibility: shows the resources available in a project, allowing one to properly distribute and prioritize work
- Metric visibility: shows the current status of certain elements of a project in relation to the end goal

Project Management Systems in Different Industries

Because different industries are engaged in different projects, there are a variety of project management systems that are specifically designed to conform to the management methodologies needed. For instance, traditional project management systems are used for projects that implement the standard five-step approach: initiation, planning, execution, monitoring, and completion. Agile project management systems, on the other hand, are less process driven and more adaptable to the dynamic, demand-based environment of agile projects. While solutions exist for each methodology, there are also all-in-one systems that accommodate the needs of projects across every industry.

PROJECT MANAGEMENT SYSTEM EVALUATION CHECKLIST

Commercial project management (PM) systems have been available since the early 1970s. As PC's proliferated in the workplace, so did PM software, which also brought an ease-of-use element to project management. A multitude of PM products are now available on the market, some expensive and some very reasonably priced. However, to say all PM packages were created equally would be a gross exaggeration. Each has a specific niche they address in project management or target a specific industry.

General Requirements

The Project Management system should...

1. Support any type of project - large or small; not just those limited to a specific part of the business (e.g. IT applications).
2. Distinguish between Direct, Indirect, and Unavailable activities.
3. Provide an integrated approach to support all activities of project management, not just some; this includes Planning, Estimating, Scheduling, Reporting, and Control.
4. Promote and enforce in-house project management standards; e.g., use of standard methodologies, labour rates, time reporting, detection of estimate/schedule overruns/under runs, etc.
5. Provide a universally applicable calendar and allow for the specification of a standard reporting cycle.

Planning Support

The Project Management system should...

1. Support various Work Breakdown Structures (WBS) - not just a single methodology. This includes controllable levels of WBS (number of levels of detail). Also, provides a library facility for reusable methodologies that can be automatically loaded upon request. Ideally, the WBS can be tied to specific information resources (such as systems, programs, files, etc.) thereby enabling the ability to record and monitor time for a specific information resource.
2. Support internal project dependencies (work step-to-work step) and external dependencies (project-to-project).
3. Allow for multiple projects, multiple human resources (both internal employees and external contractors) and multiple assignments for a single human resource. (A "many-to-many" relationship between projects and human resources).

Estimating Support

The Project Management system should...

1. Provide for both Detail estimates (for a specific phase of a project) and Order-of-Magnitude (for the entire project).
2. Allow multiple versions of estimates (after all, estimates will inevitably need to be revised).
3. Provide a means to maintain estimating guidelines and generate tentative estimates accordingly.

Scheduling Support

The Project Management system should...

1. Provide for automated calculations using "Effectiveness Rate."
2. Allow multiple versions of schedules (project schedules, like estimates, will change over time).
3. Provide facilities to manage resource allocations. This includes plotting both estimated and actual project assignments, as well as monitoring "effectiveness rates."
4. Be able to calculate critical paths of projects.

Reporting Support

The Project Management system should...

1. Provide facilities to record and verify time on project assignments.
2. Provide for the recording of "Estimate to do" (the amount of time remaining on a given assignment). Note: This is different than "Percent Complete."
3. Maintain historical time data to be used in history reports and to update estimating guidelines.

4. Allow the recording of "out-of-pocket" project expenditures.
5. Provide a scratchpad facility to record project notes as well as formal reports (e.g. Project Proposals, Cost/Benefit Analysis, Project Audits, etc.).

Control Support

The Project Management system should...

1. Post reported time to projects and to human resources reporting it. Also, post time to information resources to monitor activity.
2. Provide various summary reports to analyse projects and human resources, both by project and by department.
3. Provide the ability to bill end-users for project costs (Chargeback). This includes chargeback to multiple users at varying rates.

Computer Related Considerations

The Project Management system should...

1. Be easy to install and test on the computer.
2. Be implemented as a cross-platform solution (operates the same on different computers) thus providing machine portability and independence from hardware manufacturers. It should also be easily accessed by all people participating in project management activities (conceivably the whole company) as an integrated approach.
3. Performs reliably and productively in accordance with specifications.
4. Provide for multi-languages and multi-cultures, such as adapting to local customs for expressing dates, time (am-pm vs. military time), monetary values (Dollars, Pounds, Yen, etc.), and accommodating foreign languages (including the Asian Double Byte Character Set - DBCS).

PROJECT EXECUTION PLAN:

Project execution plan is the road map used by the project team to deliver the agreed project outputs. It outlines the responsibilities of the project team and key stakeholders.

It should be noted that the Project Execution Plan is a dynamic document, and so for it to serve as a communication tool, it has to be kept updated as the project progresses through its design stages. To meet the particular state of affairs of a project, the Project Execution Plan needs to be modified accordingly.

An effective Project Execution Plan brings with it various benefits for the project. It highlights the critical drivers and accordingly helps management focus on a clear path forward to support the project effort. It establishes a support for valuable decision making and communication, thus assisting the management in implementing the planned strategies and policies.

Tools and Techniques for Project Plan Execution

1 General management skills. General management skills such as leadership, communicating, and negotiating are essential to effective project plan execution.

2 Product skills and knowledge. The project team must have access to an appropriate set of skills and knowledge about the project product. The necessary skills are defined as part of planning and are provided through the staff acquisition process

3 Work authorization system. A work authorization system is a formal procedure for sanctioning project work to ensure that work is done at the right time and in the proper sequence. The primary mechanism is typically a written authorization to begin work on a specific activity or work package.

4 Status review meetings. Status review meetings are regularly scheduled meetings held to exchange information about the project. On most projects, status review meetings will be held at various frequencies and on different levels (e.g., the project management team may meet weekly by itself and monthly with the customer).

5 Organizational procedures. Any and all of the organizations involved in the project may have formal and informal procedures useful during project execution.

WORK PACKGING PLAN:

Purpose

The work package plan contains a detailed specification of the tasks, responsibilities and plans for work package, which is based on the overall Project Plan, in order to determine the method, resources, tools and techniques with time aspects to implement and achieve the goals set for work package.

The work package has the following characteristics:

- Represents units of work at the level where the work is performed
- Clearly distinguishes one work package from all others assigned to a single functional group
- Contains clearly defined start and end dates that are representative of physical accomplishment
- Specifies a budget in terms of dollars, man-hours, or other measurable units
- Limits the work to be performed to relatively short periods of time to minimize the work-in
- process effort

Scope

This document is applicable to

- Project Manager to supervise and approve the WP plan.
- Quality Manager to review the WP plan if it fulfil quality requirements.
- Affected WP Leaders to inform them from the expected outcomes of the WP.
- Affected Working Group Managers to review the WP plan and to know main requirements of the WP referring to their deliverables.

- WP participants to know their own work plan.
- Chosen work scenario,
- WP-related meeting,
- WP-related measurement plan,
- other WP-specific plans does not cover
- entire project plan or detailed plan of other WPs –they are in other Plans

WORK BREAKDOWN STRUCTURE (WBS)

This tool is related to planning and scheduling a project. Basically it is a functional decomposition of the tasks of the project. The total work of the project is broken down into major subtasks.

The work breakdown structure is a tree structure, which shows a subdivision of effort required to achieve an objective; for example a program, project, and contract. It starts with the end objective required and successively subdivides it into manageable components in terms of size and complexity, which may include program, project, system, subsystem, components, tasks, subtasks, and work elements. While a WBS is useful for defining the work required for complex projects, it does not show the timing of activities.

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

A well-designed WBS makes it easy to assign each project activity to one and only one terminal element of the WBS. In addition to its function in cost accounting, the WBS also helps map requirements from one level of system

specification to another, for example a requirements cross reference matrix mapping functional requirements to high level or low level design documents.

Purpose of the work-breakdown structure:

The following are some of the reasons for using it:

- It accurately and specifically defines and organises the scope of the project as a whole.
- It helps with the allocation of responsibilities, thus facilitating the monitoring and controlling of the project.
- It allows the team to estimate cost, risk, and time because the team can work from smaller tasks back up to the entire level of the macro project.
- It allows the project manager to check the deliverables with stakeholders, thus ensuring that there is nothing missing or overlapping.
- Subdivision of Work
- Identification of Project Levels
- Work Sharing between Companies
- Economic Geographical Distribution of Funds
- Allocation of Funds
- Identification of Work Packages

TYPES OF WORK BREAKDOWN STRUCTURES

Even though the term "Work Breakdown Structure" has been used as a label for all project scope hierarchical diagrams, there are, in practice, many types other than "deliverable" oriented structures.

Verb-oriented WBS: a task-oriented WBS defines the deliverable of project work in terms of the actions that must be done to produce the deliverable. The first word in

a given WBS element usually is a verb, such as, design, develops, optimizes, transfers, test, etc.

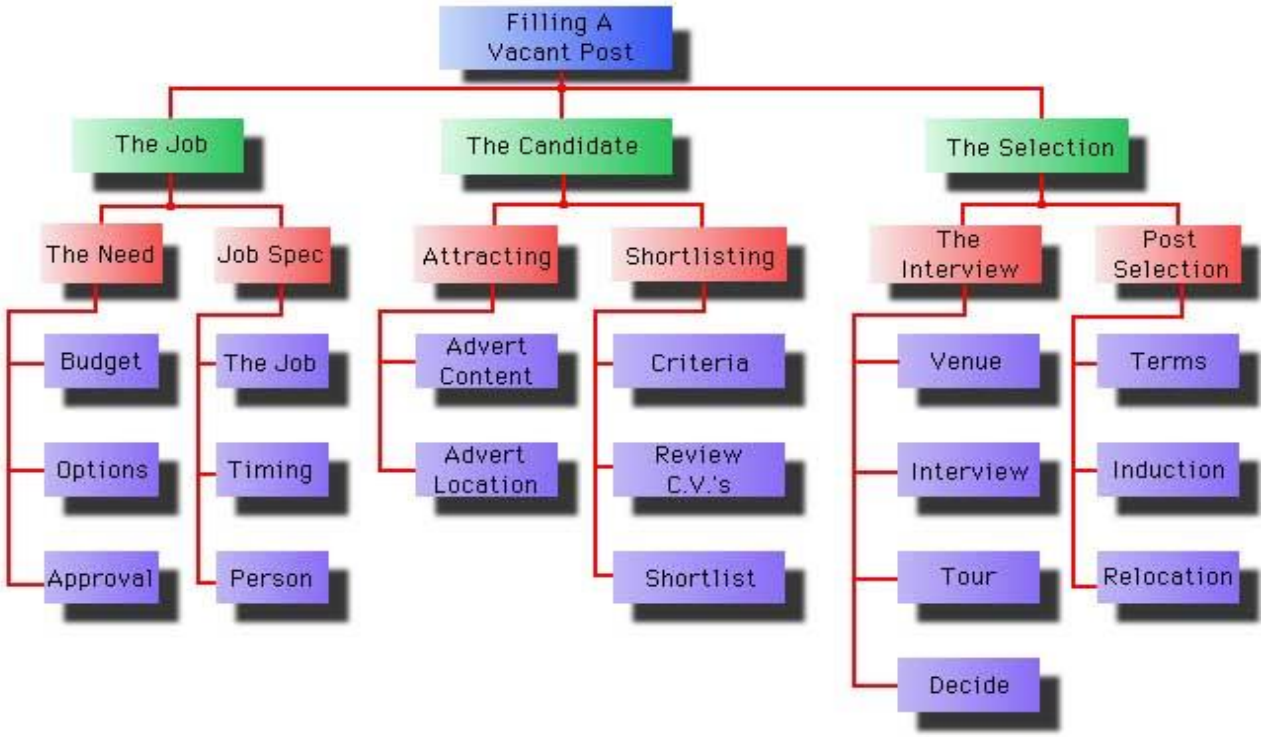
- *Noun-oriented WBS*: a deliverable-oriented WBS defines project work in terms of the components (physical or functional) that make up the deliverable. In this case, the first word in a given WBS element is a noun, such as, Module A, Subsystem A, Automobile Engine, Antenna, etc. Since the nouns are usually parts of a product, this WBS type is sometimes called a "Product Breakdown Structure (PBS). Deliverable-oriented WBS structures are the preferred type according to PMI's definition.

- *Time-phased WBS*: a "time-phased" WBS is one that is used on very long projects. It breaks the project into major phases instead of tasks. In this type, a "rolling wave" approach is adopted and only the near-term phase is planned in detail.

- Other WBS types may include organization-types, geographical-types, cost breakdown types, and profit-center types.

Example: 1

Below is a work breakdown structure for the recruitment of a new person to fill a vacant post.



PROJECT PROCEDURE MANUAL:

Project Procedures Manual is a collected set of the management and administrative procedures needed for the project. For some projects contractors will compile a project manual (otherwise known as a procedures manual or project handbook). This will list the particular procedures that will apply to the project. Listed below are just some of the items that a typical project manual might include:

- Names and addresses of key organizations taking part in the project, not forgetting the customer;
- The names of key personnel in those organizations, particularly highlighting those who are the specific points of contact for various project matters;
- Organization charts;
- Drawing numbering system;
- Project planning and scheduling system to be used;
- Type and frequency of project cost and progress reports to be produced;

- Document distribution matrix;

PROJECT SCHEDULING:

Project Scheduling is the process identifying and organizing the tasks of a project into a sequence of events ensuring a harmonious completion of the venture. Project scheduling is concerned with the techniques that can be employed to manage the activities that need to be undertaken during the development of a project. It enables the project manager to identify risk points, understand the proper linkage of events, assists in resource planning and allows the Project Manager to establish goals for the team and the project.

The task of Project Scheduling is a responsibility of various managers. The Business Area Manager defines the project activities. The Project Manager then organizes the team, works out realistic schedules and resolves any conflicts over resources and priorities. Finally, Business Area Manager assures that the project schedule has been reviewed and agreed on by the functional managers.

Project Scheduling may also employ various scheduling techniques. The Bar chart technique is applied for highly repetitive production operations, where work performance of various departments can be combined on a single chart. PERT/Networking and the Critical Path Method (CPM) are designed for scheduling activities in the development phases, both identifying the critical path, float and slack.

Objectives of Project Scheduling:

- Completing the project as early as possible by determining the earliest start and finish of each activity.
- Calculating the likelihood a project will be completed within a certain time period.
- Finding the minimum cost schedule needed to complete the project by a certain date.
- Investigating the results of possible delays in activity's completion time.

- Progress control.
- Smoothing out resource allocation over the duration of the project.

Project Constraints in scheduling:

In this lesson, we will discuss the essential features of resource planning and management in projects. We begin this lesson by first understanding the different kinds of project constraints, in particular, the types and nature of resource constraints.

The primary impact of project constraints is the likelihood of delaying the completion of the project. There are three types of project constraints: technological, resource and physical.

- The technological constraints relate to the sequence in which individual project activities must be completed. For example, in constructing a house, pouring the foundation must occur before building the frame.
- Resource constraints relate to the lack of adequate resources which may force parallel activities to be performed in sequence. The consequence of such a change in network relationships is delay in the completion date of the project. We will examine the nature of resource constraints in much greater detail in the next section.
- Physical constraints are caused by contractual or environmental conditions. For example, due to space limitations an activity such as painting a wall may have to be performed by only one person (Gray and Larson, 2003).

In general, from a *scheduling perspective*, projects can be classified as either time constrained or resource constrained.

1. Time Constrained scheduling:

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

The problem addressed is a project scheduling problem with strict deadlines on the activities, which we call the Time-Constrained Project Scheduling Problem (TCPSP). In many project scheduling problems from practice, deadlines occur and in order to meet these deadlines, different ways to speed up the project are given, e.g., by working in overtime, hiring extra resource capacity, or even outsourcing (parts of) the project. All these options are costly but often not avoidable. Thus, the question arises how much, when, and what kind of extra capacity should be used to meet the deadlines against minimum cost.

2. Resource Constraints

The most important resources that project managers have to plan and manage on day-to-day basis are people, machines, materials, and working capital. Obviously, if these resources are available in abundance then the project could be accelerated to achieve shorter project duration. On the other hand, if these resources are

severely limited, then the result more likely will be a delay in the project completion time. Depending on the type of resources, the costs of providing an abundance of such resources to accelerate project completion time can be very high. However, if resources are readily available and excess premiums are not incurred to use them on the project, then project cost should be low, as some project costs are resource related while others are likely to be time dependent. In general, projects with a shorter duration are less expensive. The longer the duration of the project, the higher will be overall project cost due to the increase in fixed costs such as overheads. The reality is that as long as the work on a project is ongoing it will continue to draw resources into its orbit. Whatever the parameters of the project, it is unlikely that the relationship between cost and duration is linear. For any particular project, the decision to place the project on the curve between the point of least duration with its associated higher resource requirements and a point of increased duration with its associated lower resource requirements depends on the particular parameters of the project.

PROJECT SCHEDULING TECHNIQUES:

The four scheduling techniques widely used in construction projects are:

- Bar charts
- Line of Balance
- Network analysis(PERT /CPM /GERT)

A. Bar chart

A bar chart or bar graph is a chart with rectangular bars with lengths proportional to the values that they represent. The bars can be plotted vertically or horizontally. It represents data in terms of bars of equal width, whose height varies to represent the size of the data. Also note that the bars can be any width, and sometimes may be just thin vertical line. A bar chart is particularly useful when one or two

categories 'dominate' results. In the diagram above, it is clear that red cars are the most popular

A **bar chart** is used to present categorical, quantitative or discrete data. The information is presented on a coordinate axis. The values of the variable are represented on the horizontal axis and the absolute, relative or cumulative frequencies are represented on the vertical axis. The data is represented by **bars** whose **height** is **proportional** to the **frequency**.

Advantages

- Easy to prepare
- It shows the total plan in impact form.
- It is useful for calculating total resources required for the project.
- summarize a large data set in visual form
- permit a visual check of the accuracy and reasonableness of calculations
- be easily understood due to widespread use in business and the media
- Comparison is made easy and it will save time of the user to make quick comparison of large data.

Disadvantages

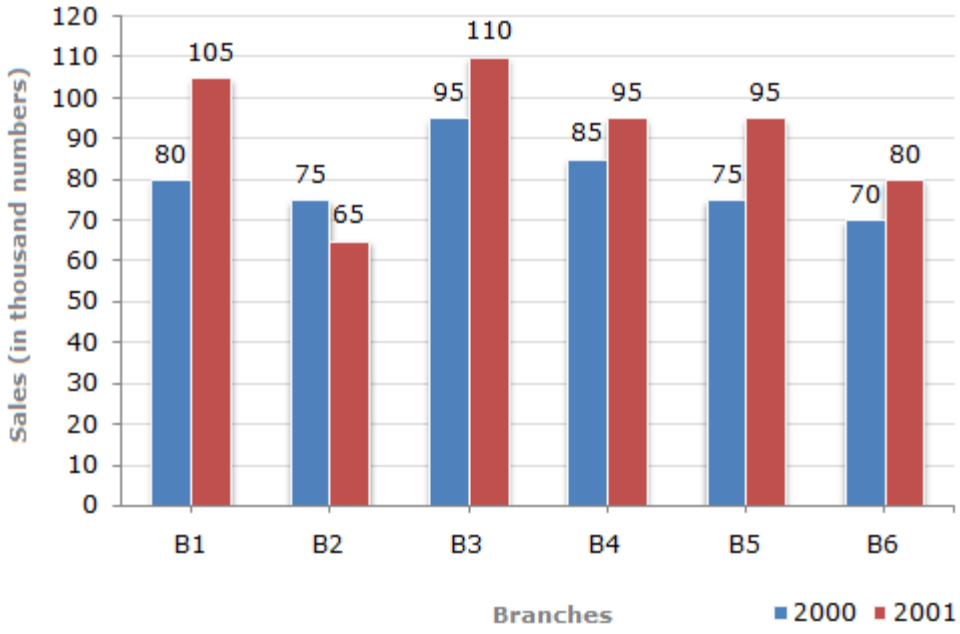
- Do not show interrelationships between activities
- Managing projects becomes difficult without those relationships between activities
- It is difficult to judge the impact of an unexpected event on the rest of the construction process
- require additional explanation
- be easily manipulated to yield false impressions

- fail to reveal key assumptions, causes, effects, or pattern

Example - 1

The bar graph given below shows the sales of books (in thousand number) from six branches of a publishing company during two consecutive years 2000 and 2001.

Sales of Books (in thousand numbers) from Six Branches - B1, B2, B3, B4, B5 and B6 of a publishing Company in 2000 and 2001.



1. What is the ratio of the total sales of branch B2 for both years to the total sales of branch B4 for both years?

A. 2:3 B. 3:5

C. 4:5 D. 7:9

3. What percent of the average sales of branches B1, B2 and B3 in 2001 is the average sales of branches B1, B3 and B6 in 2000?

2. Total sales of branch B6 for both the years is what percent of the total sales of branches B3 for both the years?

A. 68.54%

B. 71.11%

C. 73.17%

D. 75.55%

B. Line of Balance:

History: LOB was devised by the members of a group headed by George E. Fouch. During 1941, the Goodyear Tire & Rubber Company monitored production with LOB. It was successfully applied to the production planning and scheduling of the huge Navy mobilization program of World War ll.

The LOB technique should be considered for use in any project requiring the manufacture of a specific quantity of a product using repetitive processes. It is an effective technique for identifying those activities that require attention and possibly corrective action and can also be used for reporting the status of the manufacturing process and delivery schedule to higher management. The LOB charts should be updated on a periodic basis (weekly or monthly, depending on such factors as the size of the production run, the number of activities/ control points, and the level of automated data management).

Application areas of LOB:

Some application areas where LOB can be applied are listed below:

- Production of aircrafts
- Production of missiles
- Production of heavy machineries/equipments
- Production of special equipment/ machineries

The line of balance technique has been applied in construction work mainly to house building, road works.

Advantages:

- One of the main advantages of this method is that it gives a better indication of the dependence of one activity on another.

- LOB can be used for high level conceptual planning, along with other techniques like CPM and can act as a stand-alone methodology.
- LOB's graphical output is a valuable tool to the level of high management and it shows large amount of data through a unique, simple and interesting presentation
- Points out problems before their impact on finished product deliveries show up, thereby allowing managers to correct problems earlier.
- Allows managers to see, in the middle of a contract, whether they can meet the contract schedule if they continue working as they have been.
- Focuses attention on those production control points where there are problems; this allows a senior manager to pinpoint responsibility for slippages.

Disadvantages:

- People working on a project may not grasp what the LOB is measuring.
- Limited to production and/or assembly-type processes.
- Shows only where the problem is, not what it is.
- A monitoring device; not as easy to use as a planning device.

C. Networking Techniques:

Network scheduling techniques provide the mechanisms necessary to conduct a systematic, disciplined, and thorough review of what will be required to conduct and complete a project. Such an approach is essential for large, complex projects and is also useful in managing smaller, less complicated projects.

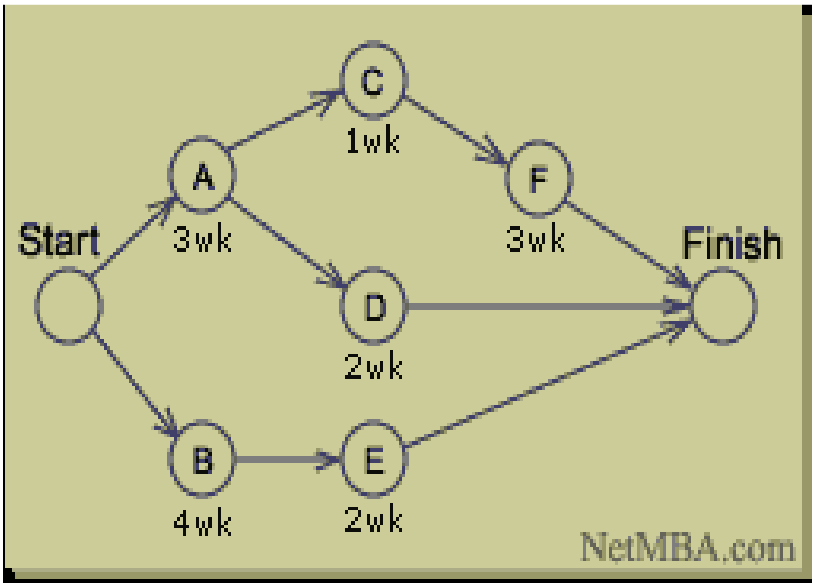
The different types of network scheduling techniques have many similarities. However, each of them provides different types of information that can be useful to managers in evaluating progress, developing alternatives, and managing the allocation of resources within their projects. The following examples show the types of information resulting from each technique and how managers may use them.

i) CPM – (Critical Path Method) :

It was developed by J. E. Kelly of Remington-Rand and M. R. Walker of DuPont to aid in scheduling maintenance shutdowns in chemical processing plants. Over the years, CPM has enjoyed more use than any other network scheduling technique. It is based on the concept of critical path and was designed to focus on the time and resources, particularly cost, necessary to complete the activities of a project.

CPM is commonly used with all forms of projects, including construction, aerospace and defense, software development, research projects, product development, engineering, and plant maintenance, among others.

The Figure 7.3 shows an example of a CPM network diagram:



Critical Path Method (CPM) has the following characteristics.

- It uses one time estimate per activity
- It can be drawn only using AOA diagrams
- It can have dummy events

Steps in CPM

Forward pass:

- To determine early start (ES) and early finish (EF) times for each task
- Work from left to right
- Adding times in each path
- Rule: when several tasks converge, the ES for the next task is the largest of preceding EF times

Backward pass:

- To determine the last finish (LF) and last start (LS) times
- Start at the end node
- Compute the bottom pair of numbers
- Subtract duration from connecting node's earliest start time

CPM Benefits

- Provides a graphical view of the project.
- Predicts the time required to complete the project.
- Shows which activities are critical to maintaining the schedule and which are not.
- Helpful for scheduling, monitoring, and controlling projects
- Evaluates which activities can run parallel to each other
- Determines slack and float times
- Widely used in industry

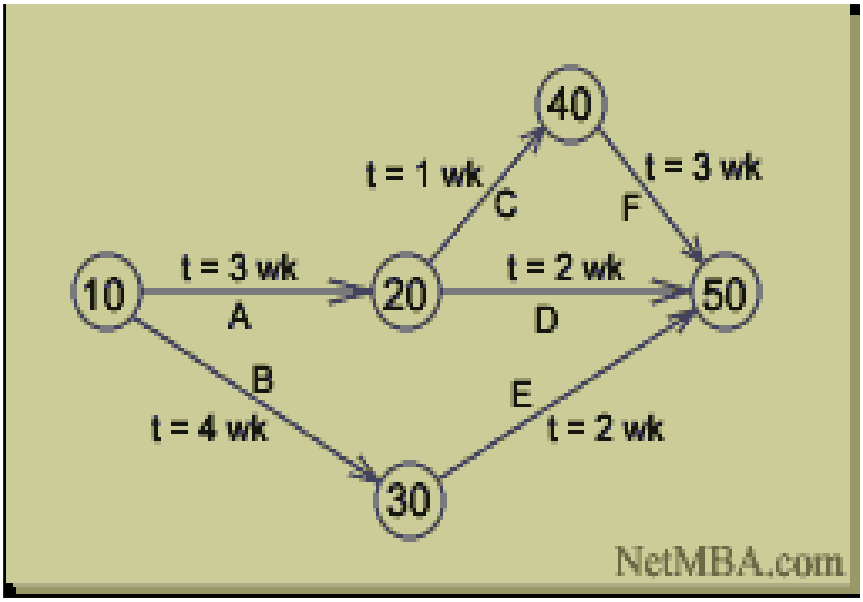
CPM Limitations

- CPM's can be complicated, and complexity increases for larger projects
- Does not handle the scheduling of personnel or the allocation of resources
- The critical path is not always clear and needs to be calculated carefully
- Estimating activity completion times can be difficult

ii) PERT :

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 having thousands of contractors. It has the potential to reduce both the time and cost required to complete a project.

PERT is typically represented as an *activity on arc* network, in which the activities are represented on the lines and milestones on the nodes. The Figure 7.4 shows a simple example of a PERT diagram.



PERT Chart

Program Evaluation and Review Technique (PERT) has the following characteristics.

- It uses three estimates per activity - optimistic, pessimistic and most likely
- It can be drawn only using AOA diagrams
- It can have dummy events

Estimate activity times

Weeks are a commonly used unit of time for activity completion, but any consistent unit of time can be used.

A distinguishing feature of PERT is its ability to deal with uncertainty in activity completion times. For each activity, the model usually includes three time estimates:

- *Optimistic time (OT)* - generally the shortest time in which the activity can be completed. (This is what an inexperienced manager believes!)
- *Most likely time (MT)* - the completion time having the highest probability. This is different from expected time. Seasoned managers have an amazing way of estimating very close to actual data from prior estimation errors.
- *Pessimistic time* (PT) - the longest time that an activity might require.

The expected time for each activity can be approximated using the following weighted average:

$$\text{Expected time} = (OT + 4 \times MT + PT) / 6$$

This expected time might be displayed on the network diagram.

Variance for each activity is given by: $[(PT - OT) / 6]^2$

Benefits of PERT

(i) PERT encourage management control by exception. It concentrates attentions on critical element that may need correction.

(ii) It enables forwards-working control, as a delay will affect the succeeding events and possibly the whole project. The production manager can somehow make up the time by shortening that of some other time.

(iii) The network system with its sub-systems creates a pressure for action at the right spot and level and at the right event.

(iv) PERT can be effectively used for re-scheduling the activities.

Limitations of PERT

- It is a time-consuming and expensive technique.
- It is based on Beta Distribution and the assumption of Beta Distribution may not always be true.
- PERT is not suitable when programme is nebulous and a reasonable estimate of time schedule is not possible.
- It is not useful for routine planning of recurring events such as mass production because once a repetitive sequence is clearly worked out; elaborate and continuing control is not required.
- The expected time and the corresponding variance are only estimated values.

Difference between PERT and CPM

1. PERT considers optimistic, likely and pessimistic time, thereby adding an element of probability to the final figure one obtains.

CPM takes only a single time for any task. This time typically would be the 'likely' time for the task.

2. PERT is a *probabilistic tool* using 3 estimates of duration for completion of activities of a project and is basically a tool for planning and control of time.

Whereas, CPM is a *deterministic tool*, with only single estimate of duration.

3. While PERT is more suitable for R&D related projects where the project is performed for the first time and the estimate of duration are uncertain.

CPM is best suited for routine and those projects where time and cost estimates can be accurately calculated.

4. In CPM, estimates of activity duration are based on historical data

In PERT, estimates are uncertain and we talk of ranges of duration and the probability that activity duration will fall into that range

5. PERT (Programme Evaluation & Review Technique) is event oriented whereas CPM

(Critical Path Method) is activity oriented.

6. PERT is suitable for non-repetitive projects while CPM is designed for repetitive projects.

7. PERT can be analyzed statistically whereas CPM not.

D. Graphical Evaluation and Review Technique (GERT)

Graphical Evaluation and Review Technique, commonly known as **GERT**, is a network analysis technique used in project management that allows probabilistic treatment of both network logic and estimation of activity duration. The technique was first described in 1966 by Dr. Alan B. Pritsker of Purdue University. Compared to other techniques, GERT is only rarely used in complex systems. Nevertheless, the GERT approach addresses the majority of the limitations associated with PERT/CPM technique. Looping is a special feature in GERT but that is not allowed in PERT or other network. The cyclic error in a network diagram is called loop.

The key objective of the GERT is to evaluate on the basis of the network logic and estimated duration of the activity and derive inference about some activities that may not be performed.

GERT is most useful as a computer simulation that provides a probabilistic analysis of the system being modeled. For research and development project, particularly, when the events are subjected to chances of failure or success and actions are to be taken on the basis of anticipated status, the presentation of GERT is widely used.

Advantages of GERT:

- Be more accurate than using a PERT

- Assign multiple resources
- Create loops between tasks
- Gives more flexibility to project planning than PERT/CPM
- Allows any individual activity to either be completed or not completed (Succeed or fail)
- PERT & CPM both require all activities be successfully completed. GERT does not require this.
- GERT Allows looping back (redoing an activity) or skipping an activity entirely.
- There are computerized GERT packages.

Criticism:

The fundamental drawback associated with the GERT technique is the complex programme (Monte Carlo simulation) required to model the GERT system. Development in GERT includes Q-GERTS - allowing the user to consider queuing within the system

Difference between GERT and PERT/CPM

GERT	PERT/CPM
Branching from a node is probabilistic.	Branching from a node is deterministic.
Various possible probability distributions For time estimates.	A formula approximating the shape of the beta probability distribution is used for time estimates.
Flexibility in node realization.	No flexibility in node realization.
Difficult to use as a control tool.	Easy to use as a control tool.

PROJECT MANAGEMENT RESOURCE ALLOCATION

Resource allocation is used to assign the available resources in an economic way. It is part of resource management. In project management, resource allocation is the scheduling of activities and the resources required by those activities while taking into consideration both the resource availability and the project time. Thus,

it is the process of allocating resources among the various projects or business units.

The Key to Effective Project Resource Allocation

1. Determine quickly what resource you will need
2. Determine who the best people are in that are
3. Approach their line manager and check on their availabiliy
4. Assuming they are available put their name down against the relevant tasks in your project plan
5. Get your project plan into the PMO and get it baselined as soon as possible

PROJECT CRASHING:

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. The object crashing is to reduce project duration while minimizing the cost of crashing.
Thus, crashing a project relates to resource commitment, the more resources expended, the faster the project will finish. Here both cost and time of an activity is reduced.

There are several reasons to crash a project:

ii) Initial schedule was too optimistic.
iii) Market needs change and the project is in demand earlier than anticipated.
iv) The project has slipped considerably behind schedule

Objective of crashing

1. To reduce the project duration at minimum cost.
2. while minimizing the cost of crashing, the project team should estimate require time, require the cost, crash time, crash cost for each activities.
3. There may be direct financial penalties for not completing a project on time.

CAPACITY PLANNING

Capacity is defined as the maximum amount or number that can be received or contained. Whereas, capacity planning refers to make a plan on measurement of capacity. The goal of capacity planning is to minimize this discrepancy and to provide satisfactory service levels in a cost-efficient manner.

Depending on the type of project, it's possible that true capacity planning may play a small role in the overall project life cycle. Regardless of which situation a project is planning for three basic steps for capacity planning include:

1. **Determine capacity requirements:** by understanding what work will be performed by the system and then quantify the user experience as it relates to that work
2. **Analyze current capacity:** to determine how it is meeting the requirements of the system and needs of the users
3. **Plan for future capacity:** It forecasts future business activities and system requirements.

Module III

PROJECT MONITORING AND CONTROL AND PROJECT PERFORMANCE

PROJECT MONITORING AND CONTROL

- Project Monitoring –collecting, recording, and reporting information concerning project performance that project manager and others wish to know. It includes the following questions:
    - Why do we monitor?
    - What do we monitor?
    - When do we monitor?
    - How do we monitor?

*Purpose of Monitoring***:**

Project monitoring helps to provide constructive suggestions like.

- Rescheduling the project (if the project run behind the schedule)
- Re budgeting the project (appropriating funds from one head to another; avoiding expenses under unnecessary heading).
- Re – assigning the staff (shifting the staff from one area to other; recruiting temporary staff to meet the time schedule)

- Project Controlling – uses data from monitor activity to bring actual performance to planned performance. It is the process and activities needed to correct deviations from plan. Controlling includes followings three activities.

- time (schedule)
- cost (budget, expenses, etc)
- Performance (specifications, testing results, etc.)

Monitoring and Controlling a project is the process or activities whereby the project manager tracks, reviews and revises the project activities in order to ensure the project creates the deliverables in accordance with the project objectives. Because of the unique and temporary nature of projects, they require active control. The primary results of the Monitoring and Controlling processes are the project performance reports and implementing project changes.

Purpose of Project Monitoring and Control (PMC) is to provide an understanding of the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan. The key benefit is that project performance is observed and measured regularly to identify variances from the project management plan. Monitoring and controlling include.

- Measuring the ongoing project activities.
- Monitoring the project variables (cost, effort, scope, etc.) against the project management plan and the project performance baseline.
- Identify corrective actions to address issues and risks properly.
- Influencing the factors that could circumvent integrated change control so only approved changes are implemented

Tools and techniques that are used by project managers to conduct the Monitoring and Controlling of a project fall into one of *four general categories*. *The first* is the collection of project performance information. *The second* category is the analysis of the project performance to determine whether a project change is needed. Techniques that are used in this category are Project Forecasting and Problem Solving. *The third category* is reporting on project performance. Techniques that support this activity include the use of a Project Management Information System, Management Reviews, and Dashboards. The *final* category is the management of project change.

Design of Monitoring system:

A monitoring system can be described as a set of procedures guiding the information

flows through an organisation to different management levels in order to support decision making and learning.

The main characteristics of a monitoring system:

• *Simple and cost effective* – The system should not be too complicated to follow,

should be understandable and be economical.

• *Producing good quality and consistent information* –

These methods should produce consistent and good quality data on the output, outcome and impact level of the intervention. The data should be suitable for analysis and be usable for steering and learning purposes, which lead to ongoing adaptation of plans and objectives.

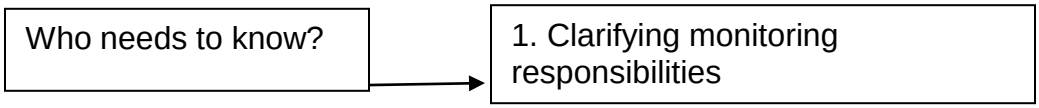
• *Building capacity* – The system should be designed in such a way that it uses and develops the capacity of those involved for the collection, reflection, and analysis of M&E data on the progress and lessons learned from the intervention.

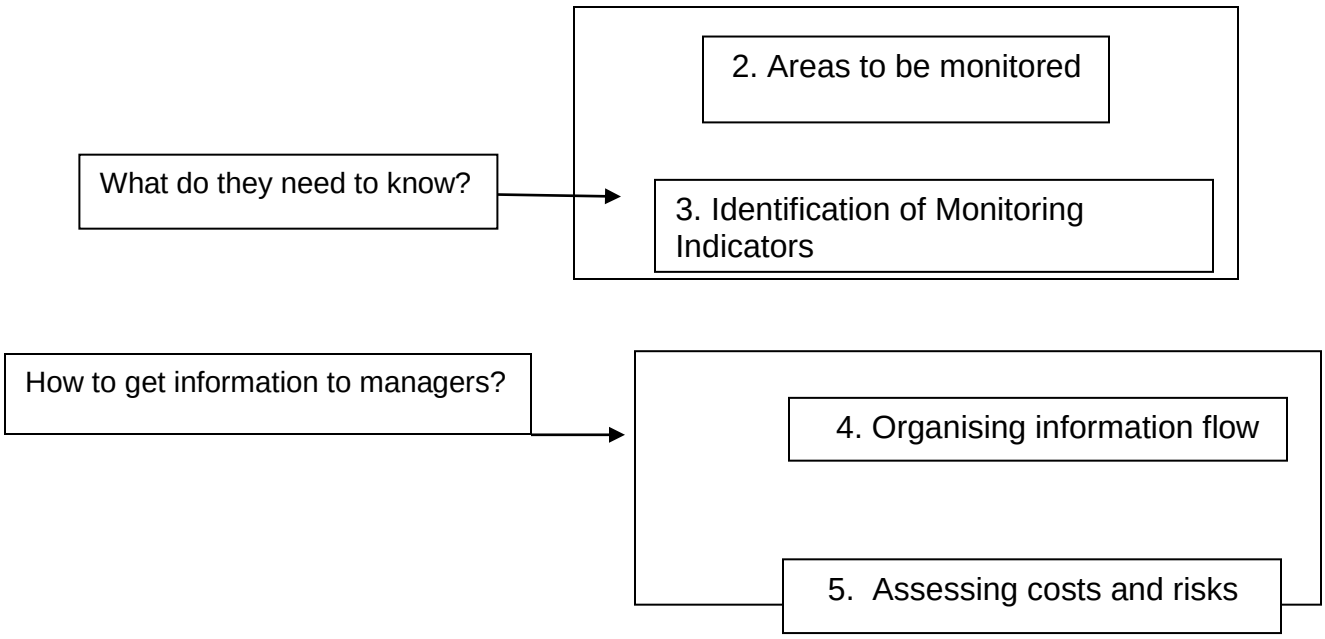
• *Emphasis on analysis, decision making and learning* – The system should not merely be focused on the collection of data but ensure that information is analysed and used for decision-making and learning.

The steps in designing a Monitoring system:

When designing a monitoring system there are 3 main questions, if properly answered will give an outline of what the system should look like. Each main question has some sub questions which renders the system organisation and intervention specific.

Main questions





Question 1: Who needs to know?

"Who are the main users with decision and steering mandate of the monitoring system? "

To answer this question it is necessary to understand the responsibilities of the management level for which the system is intended. Consequently, relevant following sub questions are:

- Who is to be served by the monitoring system
- What are the management's responsibilities (including to whom does management report?

The managers are the main users of the system. They need information and good quality data in order to take decisions regarding the achievement of the results. It is necessary to understand the responsibilities of the management level for which the system is intended. Generally, at every development intervention three levels of responsibilities can be distinguished:

1. Strategic management (policy level) Responsible for:

- the intervention existence and its concept

- the long term plans (3 year and more)
- decisions on overall budgets
- supervising the coordination management

2. Middle-level management (coordination level) Responsible for:

- the intervention organisation
- short term plans (up to 3 year)
- inputs within the limits of the budget
- supervising the implementation
- advising the strategic management on intervention concept, long term plans and budgets

3. Operational management (implementation level) Responsible for:

- specific intervention activities
- budgets related to these activities
- advising coordinating management on short term and long term plans and budgets

Question 2: What do they need to know?

This question can be split up into two sub-questions:

- Which areas should be monitored? Where should the focus of the monitoring be?
- What are the monitoring indicators we are going to use to measure progress?

During this phase it is important to identify the areas to be monitored and which will then become the focus of the Monitoring activities. After having identified the areas, it is important to elaborate the monitoring indicators which will enable the managers to decide what kind of progress is made.

Areas to be monitored

These responsibilities concern the content of the intervention as well as the environment in which the project is carried out. In the line of these different levels it is important to identify the areas to be monitored and for which they have an information need.

Monitoring indicators

An important element of the monitoring system is the monitoring indicators. These monitoring-indicators are the chosen variable(s) by which the answer on the manager's question will be measured. The monitoring in indicator has to respond to technical criteria as validity, measurability, sensitiveness and cost effectiveness.

Question 3: How to get information to managers?

When the manager has identified the monitoring indicators for measuring what he/she_wants to know, he/she has to organise the flow of information. The information flow runs from the collection of data up to the moment the document has been written and has been sent to the persons who need it. The flow of information is based on the next questions

- What data has to be collected?
- Where will the data be collected?
- With which method and by whom will data be collected?
- How will you be informed?
- When will you be informed?

Assessing costs and risks

Once you have an idea of the information processing needs in quantity and quality, it is possible to assess the necessary means: specialised personnel, consultancies, cars, computers, training, offices and equipment etc. Monitoring is not necessarily an expensive activity, but sometimes a regular budget allocation is needed.

COMPUTERIZED PROJECT MANAGEMENT INFORMATION SYSTEM

Project Management Information System (PMIS) are system tools and techniques used in project management to deliver information. The PMIS is the set of communicating methods used by the project team to share plans and results of project activities. The project management information system (PMIS) is intended to store information essential to the effective planning, organizing, directing, and controlling of the project, as well as provide vial information to be used to keep stakeholders informed about the project's status.

The PMIS is used as the clearing house of information on the project including; project plans, project status, project risks, project changes, project meetings, and any other information that project management team believes is relevant to the project team.

Purpose:

- The project management information system (PMIS) is used to plan schedules, budget and execute work to be accomplished in project management.
- Project Management Information System (PMIS) help plan, execute and close project management goals.
- The PMIS is used to compare the baseline with the actual accomplishment of each activity, manage materials, collect financial data, and keep a record for reporting purposes.
- The Project Management Information System provides a standard tool for Program/Project Managers (PMs) to facilitate project planning, execution, and management in accordance with the Project Management Business Process (PMBP).
- Project Management Information System (PMIS) are system tools and techniques used in project management to deliver information.

Information characteristics and attributes :

These characteristics and attributes are the following:

- Accurate. Information in the PMIS should be accurate and represent the situation.
- Precise. The precision of the information needs to be only to the level of granularity dictated by the project decisions.
- Reliable. The information must be derived from a source that gives confidence that it is real and representative of the situation.
- Level of detail. The information should be at a level of detail that permits easy translation to the current project. .
- Graphics, pictures, and illustrations. The use of graphics, pictures, and illustrations can convey information more quickly than narrative text. These items can be supplemented with textual descriptions or highlights.

The PMIS is an essential part of the project and critical to making the project successful. It takes an initial effort to provide the organizational and historical information as well as the project planning data. Once the PMIS is activated for a project, that project assumes responsibility for sustaining the system. It soon becomes out- dated and loses its effectiveness if new information is not entered on a timely basis.

Main Applications of a Project Management Information System

(1) Data base of risks: For each risk, it contains estimates of probabilities, preventive / corrective actions implemented, actual data of occurrence and effectiveness of actions. This approach only works for projects in which we find similar risks. Even then, it is essential to have a high level of motivation and commitment of all project team members to contribute to such an IT-supported system.

(2) Data base of work packages: For each work package, it contains its description and specification, the results of effort estimates, corresponding changes

or claims, actual effort. Again, a high level of motivation, commitment, and contribution of all project team members to such an IT-supported system are essential.

(3) Data base of changes and claims: as a third application, we propose a data base that contains all major changes (change requests and change orders) and / or claims that do not directly correspond to individual work packages, but are significant for the project result. Relevant content for each change or claim could be: underlying event, problem, or deviation; records; analysis results; proposed solutions; actual solution; settlement (in case of a claim).

(4) Compatibility with the organization's IT security policies: In times of information theft, we consider this the other number-one must. Any project management information system must fit into the organization's IT security policy.

(5) Quality control: The management team of the information system shall set and apply strict quality criteria, regularly reviewed by experienced project managers, of what should go into it and what does not fit.

(6) Newsletter: A lively information system needs "public relations", organization-internal marketing; we need to sell that system to potential users. A regular newsletter that is carefully balanced in terms of frequency and volume could be a powerful tool of that marketing. We could send samples to typical potential users in order to find out what is "carefully balanced".

Essential elements of a PMIS

In the design, development, and operation of a project management information system, a few essential elements can be applied:

- Information is needed to manage the project—to plan, organize, evaluate, and control the use of resources on the project.
- Information is needed to satisfy stakeholder queries about the project's status and progress.

- The quality of management decisions in the project is related to the accuracy, currency, and reliability of the information on the project.
- Enterprise guidance and project background information form the basis for planning the project. This information should be a part of the PMIS.
- The PMIS supports the full range of the project life cycle to include pre project analysis and post project reviews.
- Information establishes the basis for all project decisions and commitment of resources. The PMIS is the repository of much of this information.
- Information to manage a project comes from a wide variety of sources, including formal reports, informal sources, observation, project review meetings, and
- The PMIS should interface with larger organizational information systems to permit smooth, efficient interchange of information in support of organizational and project objectives and goals.
- Planning for a PMIS requires that information be selectively included and irrelevant information omitted to preclude an overabundance of data and little relevant information.
- The PMIS should be prospective and capable of providing intelligence on both the current and probable future progress and status of the project.

Challenges to an effective PMIS

There are real challenges in developing and implementing a PMIS. These problems must be avoided or overcome if an effective PMIS is to be developed. Gilbreath cites uses and abuses of information. He opines that misuse of information is common—often sophisticated, and limited only by our imagination. He delineates the acceptable uses and common misuses of information. When correctly used, information helps to:

- Promote understanding among the project team

- Target controls (by quantifying risks, testing proposed controls, and initiating corrective action)
- Dispel project phantoms (artificial failure factors)
- Allow project transactions (such as progress payments)
- Communicate status
- Predict the future
- Satisfy outside inquiries
- Enhance resource usage (efficiencies)
- Validate plans
- Recognize failure

Information is often misused, in order to:

- Deceive or confuse
- Postpone a decision or action
- Create errors in the information department
- Justify errors
- Slow or divert processes

PROJECT CONTROL

1. Project cost control

Almost all the projects needs to be guided right through out, in order to receive the required and expected output at the end of the project. It is the team that is responsible for the project and most importantly the project manager that need to be able to carry out effective controlling of the costs. There are however several techniques that can be used for this purpose. In addition to the project goals that the project manager has to oversee, the control of various costs is also a very important task for any project. Project management would not be effective at all if

a project manger fails in this respect, as it would essentially determine whether or not your organization would make a profit or loss. The essentials of a cost control system are as follows:

- It should be simple and easy to understand.
- It should not consume excessive resources.
- It must encourage honesty and commitment amongst the team.

Cost Control Techniques:

Following are some of the valuable and essential techniques used for efficient project cost control.

- *Planning the Project Budget*

It needs to ideally make a budget at the beginning of the planning session with regard to the project at hand. It is this budget that would have to help for all payments that need to be made and costs that will incur during the project life cycle.

- *Keeping a Track of Costs*

Keeping track of all actual costs is also equally important as any other technique. Here, it is best to prepare a budget that is time-based. This will help you keep track of the budget of a project in each of its phases.

- *Effective Time Management*

Another effective technique would be effective time management. Although this technique does apply to various management areas, it is very important with regard to project cost control. The reason for this is that the cost of the project could keep rising if it will unable to meet the project deadlines; the longer the project is dragged on for, the higher the costs incurred, which effectively means that the budget will be exceeded. The project manger would need to constantly remind his/her team of the important deadlines of the project in order to ensure that work is completed on time.

- *Project Change Control*

Project change control is another vital technique. Change control systems are essential to take into account any potential changes that could occur during the course of the project.

This is due to the fact that each change to the scope of the project will have an impact on the deadlines of the deliverables, so the changes may increase project cost by increasing the effort needed for the project.

- *Use of Earned Value*

Similarly, in order to identify the value of the work that has been carried out thus far, it is very helpful to use the accounting technique commonly known as 'Earned Value'.

This is particularly helpful for large projects, and will help you make any quick changes that are absolutely essential for the success of the project.

2. Schedule Control

Schedule Control is the process of controlling changes to the project schedule". Therefore different aspects must be integrated into the schedule controlling.

- "the current status of the project schedule"
- "the factors that create schedule changes"
- "that the project schedule has changed"
- "the actual changes as they occur"

Controlling the changes includes two aspects: On the one hand one should control (and organize) that time limits are respected. On the other hand one should control (and organize) that changes of the project schedule are introduced by following the methods and procedures being defined in the project management plan.

Schedule Control: Tools and Techniques

.1 Progress Reporting

Progress reporting concerning the actual start and finishing dates and "the remaining durations for unfinished schedule activities" allows to express the status of the whole project. Important is that one has a definitive scale and a set of clear reporting rules which allow to compare the wished and the real state. One of those methods for progress measurement is known as Earned Value Technique**.**

.2 Schedule Change Control System

The schedule change control system defines the procedures by which the project schedule can be changed. It includes the paperwork, tracking systems, and approval levels necessary for authorizing changes. The schedule change control system is operated as part of the Integrated Change Control process (Section 4.6).

.3 Performance Measurement

Performance measurement techniques produce the Schedule Variance (SV) and Schedule Performance Index (SPI) , which are used to assess the magnitude of any project schedule variations that do occur. An important part of schedule control is to decide if the schedule variation requires corrective action.

.4 Project Management Software

Project management software often is able to support reporting and allows to compare plan and reality.

.5 Variance Analyses

Variance analysis is the act of "comparing target schedule dates" with the actually reported dates and the forecasts based upon the reports. The result of such an analysis is also recommended corrective actions.

.6 Schedule Comparison Bar Charts

Schedule comparison bar charts use two charts for each activity: one shows the actual state the other the planned state.

3. Scope/Progress control

The progress control procedures that are defined during the Project Initiation stage form the basis of the progress control during project stages. These procedures cover day to day progress tracking amongst the team, up to Project Board reporting. It is an arguably the most important project management control activity needed to achieve the project's objectives. In its most basic form, Progress Control is associated with the managed completion of all activities required to successfully implement the project and to realise the benefits expected of it.

Objective

- monitor and control progress on the project.
- collects actual work and cost performance information,
- collects latest estimates to completion,
- compares actual performance with plan,
- determines the causes of the deviation,
- promotes re planning,
- Involves all parts of the Project Organization, so that the project work can be carried out as scheduled.

Components of Progress control:

- *Control of risk management activities*.

This refers to the software development risk items identified in the pre-project stage, those listed in contract review and project plan documents, together with other risk items identified throughout the project's progress. Based on these reports, project managers are expected to intervene and help arrive at a solution in the more extreme cases

- *Project schedule control*

This deals with the project's compliance with its approved and contracted timetables. In response to this information, management may intervene by allocating additional resources or even renegotiating the schedule with the customer.

- *Project resource control*

The project manager must maintain control over all resources used in a project. Although non-human resources may be controlled easily, human resources may be more difficult to manage. Resource control is the process of comparing actual performance to the resource plans to determine variances, evaluate possible alternatives, and takes the appropriate action.

- *Project budget control*

This is based on the comparison of actual with scheduled expenditures. As in resource control, a more accurate picture of budget deviations requires that the associated delays in completion of activities be taken into consideration

PERFORMANCE INDICATORS OF PROJECT MANAGEMENT:

These four values provide a reliable measurement of the project's performance.

Schedule Variance (SV): If SV is zero, then the project is perfectly on schedule. If SV is greater than zero, the project is earning more value than planned thus it's ahead of schedule. If SV is less than zero, the project is earning less value than planned thus it's behind schedule.

Cost Variance (CV): If CV is zero, then the project is perfectly on budget. If CV is greater than zero, the project is earning more value than planned thus it's under budget. If CV is less than zero, the project is earning less value than planned thus it's over budget.

Schedule Performance Index (SPI): If SPI is one, then the project is perfectly on schedule. If SPI is less than 1 then the project is behind schedule. If SPI is greater than one then the project is ahead of schedule. A well performing project should have its SPI as close to one as possible.

Cost Performance Index (CPI): If CPI is one, then the project is perfectly on budget. If CPI is less than 1 then the project is over budget. If CPI is greater than one then the project is under budget. A well performing project should have its SPI as close to one as possible.

PROJECT AUDIT:

Meaning:

Professional management of project needs a methodology to carry out a regular check as to whether the project is progressing as schedule, in scope and in time. A good system of project audit will go long way in facilitating prompt and effective project implementation.

W.S. Turner, in his book on project Auditing Methodology, defines "Project audit as a formal and systematic examination of the performance of an ongoing project as compared to its requirements". It also constitutes and independent and authentic source of information and critique on the project. All elements of the project are reviewed in an effort to identify and understand strengths and weaknesses. It supports management in diagnosis and decision-making.

Purpose:

- The main purpose of an audit is to help achieve the goals of the project.
- Project audits can help determine the true state of a project, and whether the project looks to be on track to finish successfully.
- Audits can also specifically point out whether good project management rigor and structure is in place.
- The benefits of a project audit to the project are that it uncovers all the problems (especially when conducted by both internal and external auditors) that the project is facing, and also suggests remedies.
- In general, a project audit is an attempt to uncover the true status of a project. For the organization, this means costs may be effectively saved if issues on a major project are uncovered early.

Objectives of Project audit:

1) Assure Quality of Products and Services

A project audit acts as a quality assurance instrument. It scrutinizes the project life cycle system by evaluating the deliverables produced during various phases of the project from the design phase all the way to the implementation phase.

2) Assure Quality of Project Management

A project audit assures that project management is meeting the standards by evaluating if it follows the organization's policies, processes and procedures.

3) Identify Business Risk

Project audits help identify business risks that may involve budget, time, scope and quality.. It reports the business risks to help the company decide whether to proceed with the project or not.

4) Enhance Project Performance

Auditing the various phases in the project life cycle can help improve performance of the project team. It also improves resource and budget allocation. Identifying priorities, corrective measures and preventative actions can lead to a successful project outcome.

5) Learn

A project audit can lead to learning opportunities through assessments of project management (organizational, team and individual) competency. Providing reviews and feedbacks allow individuals and project teams to reflect on their performance.

Procedures /Process of auditing a project:

1. Initiation and Planning:

2. Enquiry

The process of auditing any project starts out with a formal notification being sent to the project members, informing them of the impending audit. The notification will also inform the project members of the audit team's objective and what compliance issues the team will be examining. After sending project members

notification of the impending audit, the audit team will schedule and conduct a face-to-face meeting with the project head and any administrators. The audit team will examine the project's records and data files ahead of the full audit.

3. Reporting Schedule

After the formality of the initial inquiry is over, the audit team begins a full-fledged inquiry into the project. The team will attempt to glean a further idea of how the project is functioning by going over the project's background documents and conducting interviews with the project head and the project's sponsor. The audit team will also conduct a series of interviews with members of the project, mapping out their individual roles in the project, to get a more detailed idea of the project's hierarchy and the validity of each member's role. During the inquiry and reporting phase of the audit, the audit team will periodically report its finding back to the project's sponsor. The audit team will also examine the project members' efficiency in following their set timelines and will record any inconsistencies in the project's goals and individual project member's performance.

4. Final Report

After sufficient data has been gleaned from the project's data files and group member interviews and the audit team has a firm idea of how the project is supposed to be carried out, the audit team will create a formal draft of its report. After the management team presiding over the audit team has reviewed the formal report and decided whether to recommend any amendments or further inquires into the project, the audit team will construct the final draft. The final draft of the audit report will contain a summary, list background and key issues raised, and provide an assessment of the quality of the project members' performance in carrying out its said goals.

Functions of project auditor:

The project auditor is an expert in measuring, confirming, investigating and reporting the status of a project with a view to reducing the uncertainties that encompass project. He should not arrogate to himself the role of a consultant or technical expert. He should not fill his report with recommendations or suggested action plans should confine himself to interpretation of studied facts. The project auditor is required to give advice to make recommendations. Solicited action plans should be the outcome of the conviction of the enterprise management that the auditor is competent to prepare action plans and has the requisite time and information for verification.

Responsibilities of project auditor/Evaluator:

The project auditors are responsible for verifying the state of the project based on objective evidence. Responsibilities includes are:

- Assemble a small team of experienced experts
- Conducting interviews.
- Analysing project deliverables.
- Analysing project data
- Preparing reports.
- Defining opportunities for improvement
- Conducting root – cause analysis.
- Writing and maintaining the project's quality plan.
- Facilitating team meetings.
- Distribute the report to the project manager and project team for their response
- Auditing products for compliance with guidelines.
- Writing action items concerning risks with the prescribed guidelines.
- Follow up to see if the recommendations have been implemented

PROJECT AUDIT LIFE CYCLE:

Like the project itself, the audit has a life-cycle composed of an orderly progression of well-defined events. Followings are six of these events:

Steps of project audit life cycle:

1. *Project audit initiation:*

This step involves starting the audit process, defining the purpose and scope of the audit, and gathering sufficient information to determine the proper audit methodology.

2. *Project baseline definition*

The purpose of this phase is to establish performance standards against which the project's performance and accomplishments can be evaluated. This phase of the cycle normally consists of identifying the performance areas to be evaluated, determining standards for each area through benchmarking or some other process.

3. *Establishing an audit database*

Once the baseline standards are established, execution of the audit begins. The next step is to create a database for use by the audit team. Depending on the purpose and scope of the audit, the database might include information needed for assessment of project oganisation, management and

4. *Preliminary analysis of the project*

The analysis section includes factual review statements of the project. For example,

- Project mission and objectives
- Procedures and systems used
- Organisation resources used.

5. *Audit report preparation*

Audit reports need to be tailored to the specific project and organisation environment. The major goal of the audit report is to improve the way future projects are managed.

6. *Project audit termination*

As the project nears the end of its life cycle, people and equipment are directed to other activities or projects. The major challenges for the project manager and team members are over. The major activities found in project terminations are developing a plan, staffing, communicating the plan and implementing the plan.

RESPONSIBILITIES OF THE PROJECT MANAGER

The key responsibility of the project manager is to successfully accomplish the project objectives by balancing the competing demands for quality, scope, time, and cost. Project managers can have the responsibility of the planning, execution, and closing of any project, typically relating to construction industry, architecture, computer networking, telecommunications or software development.

The specific responsibilities of the Project Manager vary depending on the industry, the company size, the company maturity, and the company culture. However, there are some responsibilities that are common to all Project Managers, noting:

- Developing the project plan
- Managing the project stakeholders
- Managing the project team
- Managing the project risk
- Managing the project schedule
- Managing the project budget
- Managing the project conflicts
- Planning and organizing project activities.
- Assuring the quality of the project management process.

- Monitor project portfolio to ensure timely updates and performance reporting process
- Improve project management capabilities, knowledge, competence, and skills
- Reduce cost of projects to positively impact the overall portfolio management cost
- Provide PM guidance, training, tools, and techniques to project managers
- Conduct post project reviews, lessons learned, and performance score cards
- Authorising project payment/Expenditure.
- Participating in trade-off studies.
- Implement continuous improvement to the overall project management process