PROJECT MANAGEMENT

Unit I

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Unit V

Working capital cost for projects – investment analysis – alternate of investment proposal – source of finance for projects – bank view of financing.

References:

1. Prasanna Chandra - Projects
2. Dennis Lock Project Management.
3. Brook – Production Management.

Unit I

1.1 Project Planning:

Project planning is part of project management, which relates to the use of schedules such as Gantt charts to plan and subsequently report progress within the project environment.

Initially, the project scope is defined and the appropriate methods for completing the project are determined. Following this step, the durations for the various tasks necessary to complete the work are listed and grouped into a work breakdown structure. Project planning is often used to organize different areas of a project, including project plans, work loads and the management of teams and individuals. The logical dependencies between tasks are defined using an activity network diagram that enables identification of the critical path. Project planning is inherently uncertain as it must be done before the project is actually started. Therefore the duration of the tasks is often estimated through a weighted average of optimistic, normal, and pessimistic cases. The critical chain method adds "buffers" in the planning to anticipate potential delays in project execution. Float or slack time in the schedule can be calculated using project management software. Then the necessary resources can be estimated and costs for each activity can be allocated to each resource, giving the total project cost. At this stage, the project schedule may be optimized to achieve the appropriate balance between resource usage and project duration to comply with the project objectives. Once established and agreed, the project schedule becomes what is known as the baseline schedule. Progress will be measured against the baseline schedule throughout the life of the project. Analyzing progress compared to the baseline schedule is known as earned value management.

The inputs of the project planning phase include the project charter and the concept proposal. The outputs of the project planning phase include the project requirements, the project schedule, and the project management plan.

Project planning is a discipline for stating how to complete a project within a certain timeframe, usually with defined stages, and with designated resources.

A project plan is a formal document designed to guide the control and execution of aproject. In IT, the term project plan refers to aa Gantt chart or any other document that displays project activities along a timeline. However, considering these documents alone as a project plan is inaccurate.

The primary uses of the project plan are to document planningassumptions and decisions, facilitate communication among project stakeholders, and document approved scope, cost, and schedule baselines. A project plan may be summarized or detailed."

A project management plan is a formal approved document that defines how theproject is executed, monitored and controlled. It may be a summary or a detailed document and may be a compendium of baselines, subsidiary management plansand other planning documents.

Project preparation & appraisal:

A project is planned piece of work that is designed to find information about something to produce something new or to improve upon something. Merchant bankers undertake project counseling & preparation of pre-investment studies, feasibly studies and prepare project reports. Preparation of project reports & appraisal are closely related. A merchant banker should ensure that the project is viable & complies with all the requirements for financing by lending instruments. he should also inform SEBI that he has exercised due diligence with regard to claims about the viability of the project in the prospectus for issue of securities. Project preparation and appraisal involves certain steps: Project identification, project selection, feasibility study & appraisal of project. The appraisal of the projects may be financial appraisal, technical appraisal & economic appraisal.

Project appraisal:

A project appraisal is a proposal for capital investment. It develop facilities to provide goods & securities. The investment proposal is to set up a new unit and to expand and improve existing facilities. A project has to be amenable for analysis and evaluation.

Conception of a project idea should be input based or output based. Input based projects are identified as the basic of information about input and resources which exist in the country. For e.g. information about agriculture, raw materials, forest products, fishing

products, etc. output based projects are defined as basic of needs of population as revealed by a family budget studies or industrial units as found by market studies and statistics related to import & export. Desk resource surveying the existing information is economical. Market surveys assessing demand for the output of project could help both identification & assessing the viability of the project.

The Purpose of Project Management And Setting Objectives

Project Management has developed in order to plan, co-ordinate and control the complex and diverse activities of modern industrial and commercial projects. All projects share one common characteristic - the projection of ideas and activities into new endeavours. The purpose of project management is to foresee or predict as many dangers and problems as possible; and to plan, organiseand control activities so that the project is completed as successfully as possible in spite of all the risks. The ever-present element of risk and uncertainty means that events and tasks leading to completion can never be foretold with absolute accuracy. For some complex or advanced projects, even the possibility of successful completion might be of serious doubt.

The Project Plan formalizes the following:

- Agreement between the Employer, Interns, and Work Experience Advisor
- Project purpose
- Business and project goals and objectives
- Scope and expectations
- Roles and responsibilities
- Assumptions and constraints
- Quality Management approach
- Project Management approach
- Ground rules for the project

Components

Each Project Plan component is essentially a work product resulting from subtasks.

State the purpose of the Project Plan. Indicate in a short statement that the Plan will provide a definition of the project, including the business goals and objectives

Background Information About the Project

Briefly describe the project history. Include information such as previous initiatives, business environment changes (may be related to competition, regulation, resource availability), and the impetus and rationale for the project. Describe, in essence, how the project came about.

Goals and Objectives

Business Goals and Objectives

Goals and Objectives are defined as follows:

Goal:

A goal is an aspiration of the company that states a direction in which the company will focus its efforts in support of its mission.

Objective:

Objectives are short-term targets (typically 12-24 months or less) of defined, measurable achievement.

Project Goals and Objectives

State the goals and objectives expected to be achieved as a result of implementing the project, and describe how meeting them will support the corporate objectives and goals. Set project objectives by establishing why the project has been commissioned and what it is expected to achieve for the enterprise. Identify the specific results to be realized and the benefits to be achieved. Be certain to establish the time frame in which the objectives are expected to be met. Define a visible method to monitor and measure progress in meeting the objectives.

Scope

A clear and concise definition of scope is key to the success of any project. Scope should describe from a quantitative perspective what is to be accomplished. Its purpose is to aid in establishing realistic work plans, budgets, schedules, and expectations. Should identified work arise that falls outside the defined scope, the Project Manager must either deem the work out of scope and defer it, or expand the scope of the project to include the work. The latter choice would result in formal changes to the work plan, resource allocation, budget and/or schedule.

State specifically what work will be done and which parts of the enterprise will and will not be included in the project. If the project is part of a phased approach, it may include deliverables from the previous stage and the scope defined by which objects will be further defined and developed. Focus on the components identified within the Project Plan Scope Definition. Define the scope of the project by determining which criteria constitutes maintenance of the product. This will prevent the occurrence of "scope creep" and never-ending projects.

Project Products/Deliverables List

This is the deliverable scope. Project Products may include formal deliverables as well as informal concrete results. Include in this section a list of the deliverables and their contents (if appropriate) to be produced during the project. Detailed descriptions of each deliverable may be contained within the Appendix. Including a detailed list of deliverables in the Appendix provides a structured approach which ensures that all persons involved in the project understand what is expected. The components of the list should include *for each deliverable*:

- Name and description
- Purpose
- Major task(s) producing/updating the deliverable
- Expected audience
- Sign-off participants

Remember to include project management deliverables, such as the Project Plan.

This is the temporal scope of the project. List and briefly describe significant project accomplishments that will act as primary checkpoints for the project's progress. These are generally the points at which the completion of an activity or group of activities causes the project to reach a milestone by producing a highly visible or significant product or result (e.g., equipment delivery, material delivery, review meeting, approval checkpoint). Not every task completion date in the project will be a milestone, but every milestone should be tied to a deliverable.

Include the estimated time of completion for each milestone. Milestones are targets that should be met. If they are not met, it is likely that the project will not finish on time. Ensure that milestones are clearly identified in the Timeline and Project Plan.

IV. Assumptions

Briefly describe any assumptions made about the project related to resources, scope, expectations, schedules, etc. Assumptions should be specific and measurable.

V. Constraints

Project Constraints

Describe the principal constraints and limitations under which the project must be conducted, concerning the project environment or parameters (timeframes and deadlines, funding, skill levels, resource availability, etc.).

Related Projects

List any other projects that are impacted by the project described in the Plan. Managers of related projects should be kept in the communication loop on all matters related to this project.

Critical Dependencies

It is essential that the dependencies between related tasks and subtasks be understood to ensure that tasks are sequenced correctly and that the critical path of a project is recognized.

Determine the relationship between work performed in a given task or subtask with the work performed in other tasks or subtasks. Identify the predecessor and successor activities.

Identify any tasks within a related project on which this project is dependent and describe the relationship.

VI. Quality Management Approach

Activity Reviews/Walk-throughs

Identify the types of project reviews and walk-throughs that will be conducted. Include items such as test plans and test scripts to be reviewed. Indicate when reviews should occur in relation to other tasks.

Tools and Techniques

List and briefly describe the tools and techniques that will be used on the project to ensure quality. Tools may include specific software packages for project scheduling, testing, etc.

Test Approach

Briefly describe the approach that will be used to test the project results prior to putting them into production. All products developed as a result of the project should be tested.

Performance/Quality Standards

Identify any performance or quality standards which must be met upon approval of the final results of the project. This may include acceptance criteria for the final work product.

Quality Management Roles

Define the specific quality management roles and their accompanying responsibilities that individuals will be assigned to ensure quality on the project.

VII. Project Management

Project Standards

Identify standards agreed to by the Project Team that govern the way in which the project will be conducted. Such standards include status reporting, staff meetings, product review acceptance criteria, and celebration criteria.

Describe which standards, if any, already exist within the enterprise and are appropriate for reuse on the project. Such reusable standards typically include project model management, technology, documentation management and training techniques, naming conventions, quality assurance, and testing and validation. These may be standards that are recognized and embraced by the industry as a whole, or those that are unique to the enterprise.

Project Roles and Responsibilities

Define the roles filled by project team members and the responsibility of each role.

Communications

Describe the roles and responsibilities of each Team Member along with the communication plan to ensure that Team Members understand what is expected of them. Describe the mechanism for communicating responsibilities across the Project Team and within the organization at large (to the extent that it is required).

Develop a specific strategy that promotes communication among Team Members if the Project Team is geographically dispersed, including how each Team Member will report progress specific to each assigned task.

Identify how progress on the project will be determined and how it will be communicated to those involved in or impacted by the project. Identify how often status reports will be distributed and to whom. Determine how often progress meetings will be held and who is expected to attend.

Project Team Contact Directory

This is a list of all Team Members and other individuals involved in or impacted by the project. The list should include their names, physical locations, phone numbers, alternative contact numbers, User-IDs, Mail Stops, home addresses, titles, and any other pertinent information that will enable better communication between the impacted individuals.

VIII. Approvals

Sign-off Sheet

A separate sign- Sign-off must be obtained each time the Project Plan is revised.


Organization
Planning
Timing
Execution
Project Management
Control
Analysis
Strategy
Process
Monitoring
Development

One of the critical factors for project success is having a well-developed project plan. This article provides a 10-step approach to creating the project plan...

not only showing how it provides a roadmap for project managers to follow, but also exploring why it is the project manager's premier communications and control tool throughout the project.

Step 1: Explain the project plan to key stakeholders and discuss its key components. One of the most misunderstood terms in project management, the project plan is a set of living documents that can be expected to change over the life of the project. Like a roadmap, it provides the direction for the project. And like the traveler, the project manager needs to set the course for the project, which in project management terms means creating the project plan. Just as a driver may encounter road construction or new routes to the final destination, the project manager may need to correct the project course as well.

A common misconception is that the plan equates to the project timeline, which is only one of the many components of the plan. The project plan is the major work product from the entire planning process, so it contains all the planning documents for the project.

Typically many of the project's key stakeholders, that is those affected by both the project and the project's end result, do not fully understand the nature of the project plan. Since one of the most important and difficult aspects of project management is getting commitment and buying, the first step is to explain the planning process and the project plan to all key stakeholders. It is essential for them to understand the importance of this set of documents and to be familiar with its content, since they will be asked to review and approve the documents that pertain to them.

Components of the Project Plan Include:

Baselines. Baselines are sometimes called performance measures, because the performance of the entire project is measured against them. They are the project's three approved starting points and include the scope, schedule, and cost baselines. These provide the 'stakes in the ground.' That is, they are used to determine whether or not the project is on track, during the execution of the project.

Baseline management plans. These plans include documentation on how variances to the baselines will be handled throughout the project. Each project baseline will need to be reviewed and managed. A result of this process may include the need to do additional planning, with the possibility that the baseline(s) will change. Project management plans document what the project team will do when variances to the baselines occur, including what process will be followed, who will be notified, how the changes will be funded, etc.

Other work products from the planning process. These include a risk management plan, a quality plan, a procurement plan, a staffing plan, and a communications plan.

Step 2: Define roles and responsibilities. Not all key stakeholders will review all documents, so it is necessary to determine who on the project needs to approve which parts of the plan. Some of the key players are:

- **Project sponsor**, who owns and funds the entire project. Sponsors need to review and approve all aspects of the plan.
- **Designated business experts**, who will define their requirements for the end product. They need to help develop the scope baseline and approve the documents relating to scope. They will be quite interested in the timeline as well.
- **Project manager**, who creates, executes, and controls the project plan. Since project managers build the plan, they do not need to approve it.
- **Project team**, who build the end product. The team needs to participate in the development of many aspects of the plan, such as identifying risks, quality, and design issues, but the team does not usually approve it.
- **End users**, who use the end product. They too, need to participate in the development of the plan, and review the plan, but rarely do they actually need to sign off.
- **Others**, such as auditors, quality and risk analysts, procurement specialists, and so on may also participate on the project. They may need to approve the parts that pertain to them, such as the Quality or Procurement plan.

Step 3: Hold a kickoff meeting. The kickoff meeting is an effective way to bring stakeholders together to discuss the project. It is an effective way to initiate the planning process. It can be used to start building trust among the team members and ensure that

everyone's idea are taken into account. Kickoff meetings also demonstrate commitment from the sponsor for the project. Here are some of the topics that might be included in a kickoff meeting:

- Business vision and strategy (from sponsor)
- Project vision (from sponsor)
- Roles and responsibilities
- Team building
- Team commitments
- How team makes decisions
- Ground rules
- How large the group should be and whether sub-groups are necessary

Step 4: Develop a Scope Statement. The Scope Statement is arguably the most important document in the project plan. It's the foundation for the rest of the project. It describes the project and is used to get common agreement among the stakeholders about the scope. The Scope Statement clearly describes what the outcome of the project will be. It is the basis for getting the buy-in and agreement from the sponsor and other stakeholders and decreases the chances of miscommunication. This document will most likely grow and change with the life of the project. The Scope Statement should include:

- Business need and business problem
- Project objectives, stating what will occur within the project to solve the business problem
- Benefits of completing the project, as well as the project justification
- Project scope, stated as which deliverables will be included and excluded from the project.
- Key milestones, the approach, and other components as dictated by the size and nature of the project.

It can be treated like a contract between the project manager and sponsor, one that can only be changed with sponsor approval.

Step 5: Develop scope baseline. Once the deliverables are confirmed in the Scope Statement, they need to be developed into a work breakdown structure (WBS), which is a

decomposition of all the deliverables in the project. This deliverable WBS forms the scope baseline and has these elements:

- Identifies all the deliverables produced on the project, and therefore, identifies all the work to be done.
- Takes large deliverables and breaks them into a hierarchy of smaller deliverables. That is, each deliverable starts at a high level and is broken into subsequently lower and lower levels of detail.
- The lowest level is called a "work package" and can be numbered to correspond to activities and tasks.

The WBS is often thought of as a task breakdown, but activities and tasks are a separate breakdown, identified in the next step.

Step 6: Develop the schedule and cost baselines. Here are the steps involved in developing the schedule and cost baselines.

1. Identify activities and tasks needed to produce each of the work packages, creating a WBS of tasks.
2. Identify resources for each task, if known.
3. Estimate how long it will take to complete each task.
4. Estimate cost of each task, using an average hourly rate for each resource.
5. Consider resource constraints, or how much time each resource can realistically devoted to this project.
6. Determine which tasks are dependent on other tasks, and develop critical path.
7. Develop schedule, which is a calendarization of all the tasks and estimates. It shows by chosen time period (week, month, quarter, or year) which resource is doing which tasks, how much time they are expected to spend on each task, and when each task is scheduled to begin and end.
8. Develop the cost baseline, which is a time-phased budget, or cost by time period.

This process is not a one-time effort. Throughout the project you will most likely be adding to repeating some or all of these steps.

Step 7: Create baseline management plans. Once the scope, schedule, and cost baselines have been established, you can create the steps the team will take to manage variances to these plans. All these management plans usually include a review and approval process for modifying the baselines. Different approval levels are usually needed for different types of changes. In addition, not all new requests will result in changes to the scope, schedule, or budget, but a process is needed to study all new requests to determine their impact to the project.

Step 8: Develop the staffing plan. The staffing plan is a chart that shows the time periods, usually month, quarter, year, that each resource will come onto and leave the project. It is similar to other project management charts, like a Gantt chart, but does not show tasks, estimates, begin and end dates, or the critical path. It shows only the time period and resource and the length of time that resource is expected to remain on the project.

Step 9: Analyze project quality and risks.

Project Quality: Project quality consists of ensuring that the end product not only meets the customer specifications, but is one that the sponsor and key business experts actually want to use. The emphasis on project quality is on preventing errors, rather than inspecting the product at the end of the project and then eliminating errors. Project quality also recognizes that quality is a management responsibility and needs to be performed throughout the project.

Creating the Quality Plan involves setting the standards, acceptance criteria, and metrics that will be used throughout the project. The plan, then, becomes the foundation for all the quality reviews and inspections performedduring the project and is used throughout project execution.

Project Risks: A risk is an event that may or may not happen, but could have a significant effect on the outcome of a project, if it were to occur. For example, there may be a 50% chance of a significant change in sponsorship in the next few months. Analyzing risks includes making a determination of both the probability that a specific event may occur and if it does, assessing its impact. The quantification of both the probability and impact will lead to determining which are the highest risks that need attention. Risk management

includes not just assessing the risk, but developing risk management plans to understand and communicate how the team will respond to the high-risk events.

Step 10: Communicate: One important aspect of the project plan is the Communications Plan. This document states such things as:

- Who on the project wants which reports, how often, in what format, and using what media.
- How issues will be escalated and when.
- Where project information will be stored and who can access it.

For complex projects, a formal communications matrix is a tool that can help determine some of the above criteria. It helps document the project team's agreed-on method for communicating various aspects of the project, such as routine status, problem resolution, decisions, etc.

Once the project plan is complete, it is important not just to communicate the importance of the project plan to the sponsor, but also to communicate its contents once it's created. This communication should include such things as:

- Review and approval of the project plan.
- Process for changing the contents of the plan.
- Next steps—executing and controlling the project plan and key stakeholder roles/responsibilities in the upcoming phases.

1.2 Applications of Network analysis:

Network analysis is the general name given to certain specific techniques which can be used for the planning, **management** and control of projects. One definition of a**project** (from the **Project Management** Institute) is. A **project** is a temporary endeavour undertaken to create a "unique" product or service.

In the **network** diagram shown below, for the problem we considered before, each node (circle) represents an **activity** and is labelled with the **activity** number and the associated

completion time (shown in brackets after the **activity** number). This**network** is an **activity** on node (AON) **network**.

10 Basic Managerial Applications of Network Analysis, Techniques and Concepts

Some of the basic managerial applications of network analysis are as follows:

Network analysis:

Network analysis is a system which plans the projects by analyzing the project activities.

Projects are broken down to individual tasks or activities, which are arranged in logical sequence. It is also decided that which tasks will be performed simultaneously and which other sequentially.

A network diagram is prepared, which presents visually the relationship between all the activities involved and the cost for different activities. Network analysis helps designing, planning, coordinating, controlling and in decision-making in order to accomplish the project economically in the minimum available time with the limited available resources. The net work analysis fulfills the objectives of reducing total time, cost, idle resources, interruptions and conflicts. Managerial applications of network analysis are as follows:

1. Assembly line scheduling,

2. Research and development,

3. Inventory planning and control,

4. Shifting of manufacturing plant from one site to another,

5. Launching of new products and advertising campaigns,

6. Control of traffic flow in cities,

7. Budget and audit procedures,

8. Launching space programmes,

9. Installation of new equipments,

10. Long-range planning and developing staffing plans, etc.

Network techniques:

A number of network techniques, given below have been developed in recent times:

1. PERT- Programme Evaluation and Review Technique

2. CPM- Critical Path Method

3. RAMS- Resource Allocation and Multi-project Scheduling

4. PEP- Programme Evolution Procedure

5. COPAC- Critical Operating Production Allocation Control

6. MAP- Manpower Allocation Procedure

7. RPSM- Resource Planning and Scheduling Method

8. LCS- Least Cost Scheduling

9. MOSS- Multi-Operation Scheduling System

10. PCS- Project Control System

11. GERT- Graphical Evaluation Review Technique.

What is PERT in Project Management?

PERT is a project management planning tool used to calculate the amount of time it will take to realistically finish a project.

PERT stands for **Program Evaluation Review Technique**. PERT charts are tools used to plan tasks within a project – making it easier to schedule and coordinate team members accomplishing the work.

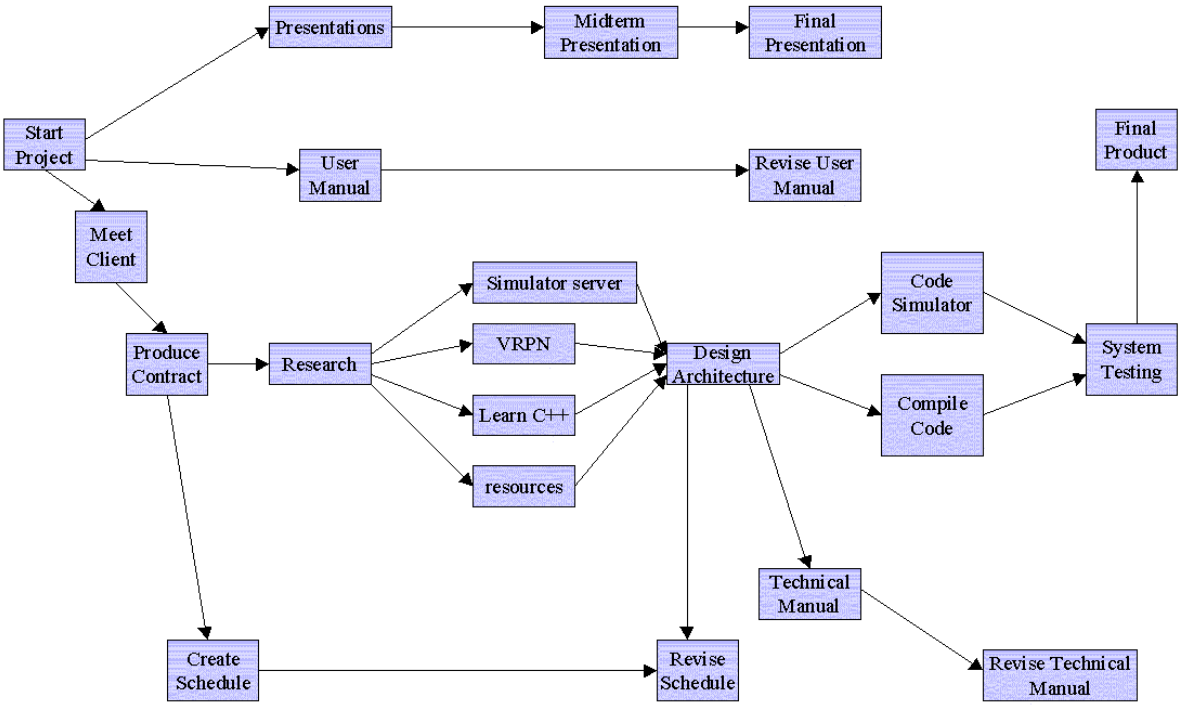
PERT charts were created in the 1950s to help manage the creation of weapons and defense projects for the US Navy. While PERT was being introduced in the Navy, the private sector simultaneously gave rise to a similar method called Critical Path.

PERT is similar to critical path in that they are both used to visualize the timeline and the work that must be done for a project. However with PERT, you create three different time estimates for the project: you estimate the **shortest** possible amount time each task will take, the most probable amount of time, and the longest amount of time tasks might take if things don't go as planned.

PERT is a method of analyzing the tasks involved in completing a given project, especially the time needed to complete each task, and to identify the minimum time needed to complete the total project. It incorporates uncertainty by making it possible to schedule a project while not knowing precisely the details and durations of all the activities. It is more of an event-oriented technique rather than start- and completion-oriented, and is used more in projects where time is the major factor rather than cost. It is applied to very large-scale, one-time, complex, non-routine infrastructure and Research and Development projects.

Program Evaluation Review Technique (PERT) offers a management tool, which relies "on arrow and node diagrams of *activities* and *events*: arrows represent the *activities*or work necessary to reach the *events* or nodes that indicate each completed phase of the total project."

PERT and CPM are complementary tools, because "CPM employs one time estimate and one cost estimate for each activity; PERT may utilize three time estimates (optimistic, expected, and pessimistic) and no costs for each activity. Although these are distinct differences, the term PERT is applied increasingly to all critical path scheduling."


Start Project
Presentations
Midterm Presentation
Final Presentation
User Manual
Revise User Manual
Meet Client
Produce Contract
Research
Simulator server
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Learn C++
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Design Architecture
Code Simulator
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Final Product
Technical Manual
Revise Technical Manual
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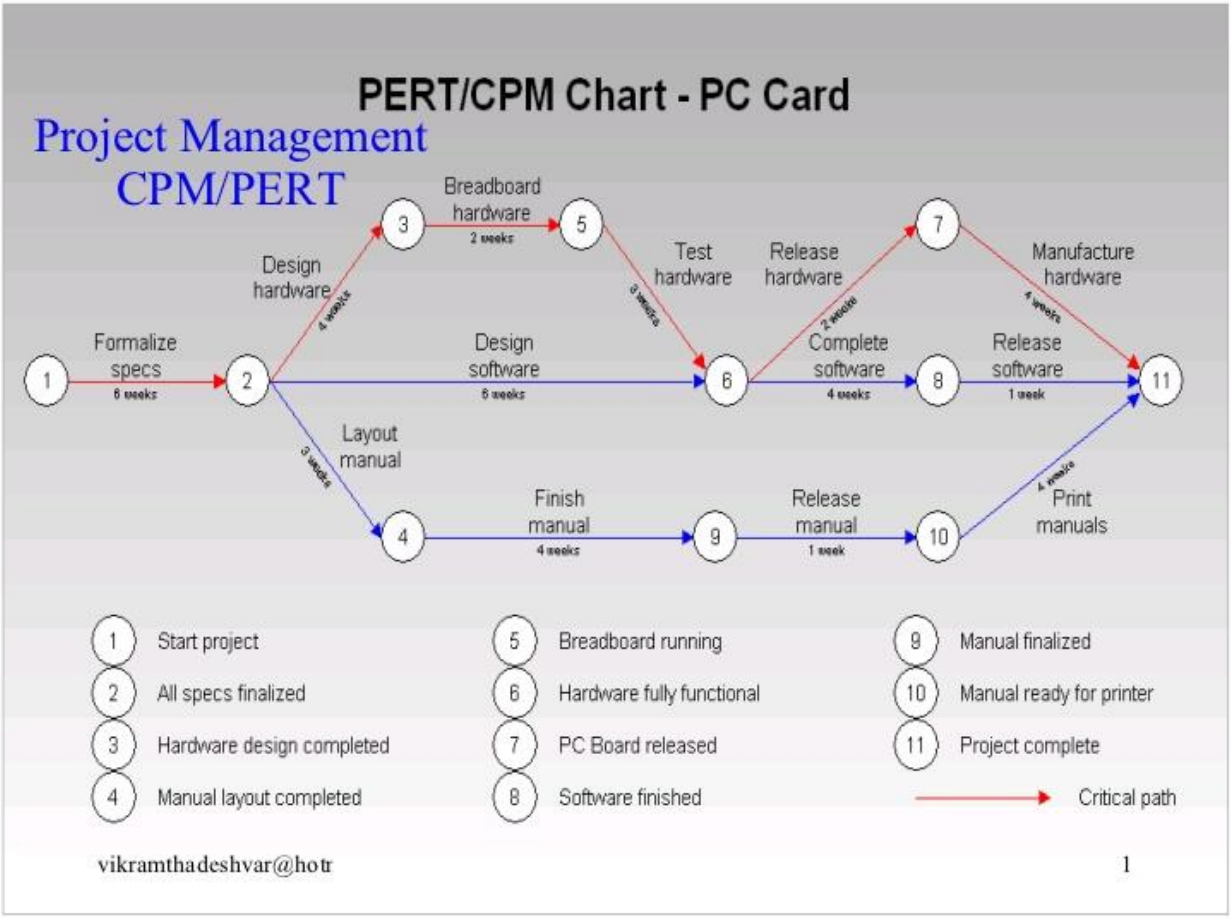

The critical path method (CPM) is a step-by-step project management technique for process planning that defines critical and non-critical tasks with the goal of preventing time-frame problems and process bottlenecks. The CPM is ideally suited to projects consisting of numerous activities that interact in a complex manner.

In applying the CPM, there are several steps that can be summarized as follows:

- Define the required tasks and put them down in an ordered (sequenced) list.
- Create a flowchart or other diagram showing each task in relation to the others.
- Identify the critical and non-critical relationships (paths) among tasks.
- Determine the expected completion or execution time for each task.

- Locate or devise alternatives (backups) for the most critical paths.

1.4 The origins of CPM:

The CPM was developed in the 1950s by DuPont, and was first used in missile-defense construction projects. Since that time, the CPM has been adapted to other fields including hardware and software product research and development. Various computer programs are available to help project managers use the CPM.

In project management, a **critical path** is the sequence of project activities that add up to the longest overall duration. This determines the shortest time possible to complete the project. Also, you **determine** the approximate start time for each task on the **critical path**

Critical path allows you to identify the most **important** tasks in your project. ... Here are three more ways **critical path** can make your project a success: Reduces Timelines: When the **critical path** method is displayed as a bar chart, like a Gantt chart, it is easy to see where the tasks fall in the overall timeframe.

Critical path **activities** are the project tasks that must start and finish on time to ensure that the project ends on schedule. A delay in any **critical** path **activity** will delay completion of the project, unless the project plan can be adjusted so that successor tasks finish more quickly than planned.

The **critical path method** (CPM) is a step-by-step project management technique for process planning that defines **critical** and non-**critical** tasks with the goal of preventing time-frame problems and process bottlenecks. ... Create a flowchart or other diagram showing each task in relation to the others.

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Advantages of Critical Path Method (CPM) in Construction Project Management

Advantages of Critical Path Method (CPM) in Construction Project. **Critical path method** (CPM) have been used for planning and scheduling in construction project management. The use of CPM varies from user to user, with some contractors feeling that **critical path method** (CPM) is a waste of time and money.

Experience with the application of CPM on several projects has revealed the following advantages of Critical Path Method:

1. CPM encourages a logical discipline in the planning, scheduling, and control of projects.
2. CPM encourages more long-range and detailed planning of projects.
3. All project personnel get a complete overview of the total project.
4. CPM provides a standard method of documenting and communicating project plans, schedules, and time and cost performances.
5. CPM identifies the most critical elements in the plan, focusing management's attention to the 10 to 20% of the project that is most constraining on the scheduling.
6. CPM provides an easy method for evaluating the effects of technical and procedural changes that occur on the overall project schedule.
7. CPM enables the most economical planning of all operations to meet desirable project completion dates.

An important point to remember is that CPM is an open-ended process that permits different degrees of involvement by management to suit their various needs and objectives.

Summary:

- A project plan is a formal document designed to guide the control and execution of a project. The primary uses of the project plan are to document planning assumptions and decisions, facilitate communication among project stakeholders, and document approved scope, cost, and schedule baselines.

Explain the project plan to key stakeholders and discuss its key components

Define roles and responsibilities

Hold a kickoff meeting.

Develop a Scope Statement

Develop scope baseline

Develop the schedule and cost baselines.

- **Network analysis:**

Network analysis is a system which plans the projects by analyzing the project activities.Projects are broken down to individual tasks or activities, which are arranged in logical sequence. It is also decided that which tasks will be performed simultaneously and which other sequentially.

- The critical path method (CPM) is a step-by-step project management technique for process planning that defines critical and non-critical tasks with the goal of preventing time-frame problems and process bottlenecks. The CPM is ideally suited to projects consisting of numerous activities that interact in a complex manner.

Unit II

2.1 Construction Project Management (**CM**) is a professional service that uses specialized, project management techniques to oversee the planning, design, and construction of a project, from its beginning to its end. The purpose of CM is to control a project's time, cost and quality. CM is compatible with all project delivery systems, including design-bid-build, design-build, CM At-Risk and Public Private Partnerships. Professional construction managers may be reserved for lengthy, large-scale, high budget undertakings (commercial real estate, transportation infrastructure, industrial facilities, and military infrastructure), called capital projects.

A contractor is assigned to a construction project during the design or once the design has been completed by a licensed architect. This is done by going through a biddingprocess with different contractors. The contractor is selected by using one of three common selection methods: low-bid selection, best-value selection, or qualifications-based selection.

A construction manager should have the ability to handle public safety, time management, cost management, quality management, decision making, mathematics, working drawings, and human resources.

Function

The functions of construction management typically include the following:

1. Specifying project objectives and plans including delineation of scope, budgeting, scheduling, setting performance requirements, and selecting project participants.
2. Maximizing the resource efficiency through procurement of labor, materials and equipment.
3. Implementing various operations through proper coordination and control of planning, design, estimating, contracting and construction in the entire process.
4. Developing effective communications and mechanisms for resolving conflicts.:[4]

The Construction Management Association of America (CMAA) states the most common responsibilities of a Construction Manager fall into the following 7 categories: Project Management Planning, Cost Management, Time Management, Quality Management, Contract Administration, Safety Management, and CM Professional Practice. CM professional practice includes specific activities, such as defining the responsibilities and management structure of the project management team, organizing and leading by implementing project controls, defining roles and responsibilities, developing communication protocols, and identifying elements of project design and construction likely to give rise to disputes and claims.

Planning and scheduling

Project-management methodology is as follows:

- Work breakdown structure
- Project network of activities
- Critical path method (CPM)
- Resource management
- Resource leveling
- Risk assessment

Architecture–engineer

- Work inspection
- Change orders
- Review payments
- Materials and samples
- Shop drawings
- Three-dimensional image

Agency CM

Construction cost management is a fee-based service in which the construction manager (CM) is responsible exclusively to the owner, acting in the owner's interests at every stage of the project. The construction manager offers impartial advice on matters such as:

- Optimum use of available funds
- Control of the scope of the work
- Project scheduling
- Optimum use of design and construction firms' skills and talents
- Avoidance of delays, changes and disputes
- Enhancing project design and construction quality
- Optimum flexibility in contracting and procurement
- Cash-flow management

Comprehensive management of every stage of the project, beginning with the original concept and project definition, yields the greatest benefit to owners. As time progresses beyond the pre-design phase, the CM's ability to effect cost savings diminishes. The agency CM can represent the owner by helping select the design and construction teams and managing the design (preventing scope creep), helping the owner stay within a predetermined budget with value engineering, cost-benefit analysis and best-value comparisons. The software-application field of construction collaboration technology has been developed to apply information technology to construction management.

CM at-risk

CM at-risk is a delivery method which entails a commitment by the construction manager to deliver the project within a Guaranteed Maximum Price (GMP). The construction manager acts as a consultant to the owner in the development and design phases (preconstruction services), and as a general contractor during construction. When a construction manager is bound to a GMP, the fundamental character of the relationship is changed. In addition to acting in the owner's interest, the construction manager must control construction costs to stay within the GMP.

CM at-risk is a global term referring to the business relationship of a construction contractor, owner and architect (or designer). Typically, a CM at-risk arrangement eliminates a "low-bid" construction project. A GMP agreement is a typical part of the CM-and-owner agreement (comparable to a "low-bid" contract), but with adjustments in responsibility for the CM. The advantage of a CM at-risk arrangement is budget management. Before a project's design is completed (six to eighteen months of coordination between designer and owner), the CM is involved with estimating the cost of constructing a project based on the goals of the designer and owner (design concept) and the project's scope. In balancing the costs, schedule, quality and scope of the project, the design may be modified instead of redesigned; if the owner decides to expand the project, adjustments can be made before pricing. To manage the budget before design is complete and construction crews mobilized, the CM conducts site management and purchases major items to efficiently manage time and cost.

Advantages

- CM is working "at risk", therefore have incentive to act in the owner's interest, as well as to efficiently manage construction costs, considering they would be liable for any amount in excess of the GMP
- Ability to handle changes in design or scope

Drawbacks

- If a cost overrun occurred, it could cost the CM a great deal of money
- The CM is allowed some mistake-related contingency, therefore there is a possibility that they will compensate by reducing the scope of the work to fit the GMP
- Since the GMP is settled before design begins, it is difficult for owners to know whether they received the best possible bid

Environmental Protection :Construction work should be environmentally friendly and pollution free.

Safety :Construction work has to be carried out in safety and comfort, with a method that implements the highest safety criteria.

Speed :Construction work should be completed in the shortest possible period of time.

Economy :Construction work must be done rationally with an inventive mind to overcome all constraints at the lowest cost.

Aesthetics :Construction work must proceed smoothly and the finished product should portray cultural and artistic flavour.

2.3 PERT:

Project management technique that shows the time taken by each component of a project, and the total time required for its completion. PERT breaks down the project into events and activities, and lays down their proper sequence, relationships, and duration in the form of a network. Lines connecting the events are called paths, and the longest path resulting from

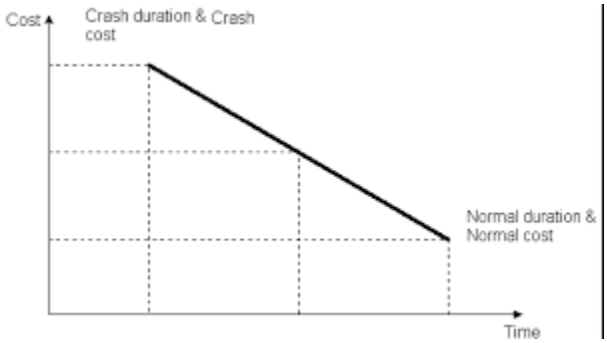
connecting all events is called the critical path. The length (duration) of the critical path is the duration of the project, and any delay occurring along it delays the whole project. PERT is a scheduling tool, and does not help in finding the best or the shortest way to complete a project.

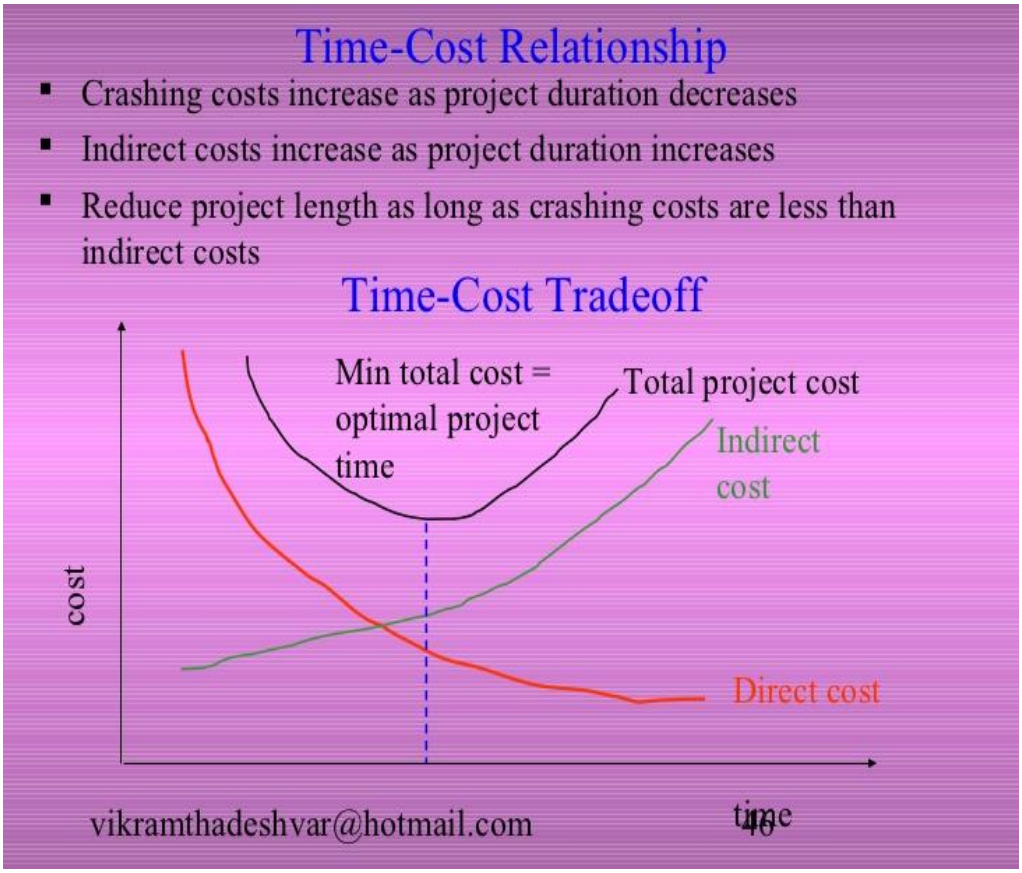
2.4 TIME / COST TRADE OFF:

Time-Cost Trade-Off ,The objective of the time-cost trade-off analysis is to reduce the original project duration, determined form the critical path analysis, to meet a specific deadline, with the least cost. In addition to that it might be necessary to finish the project in a specific time to: - Finish the project in a predefined deadline date. - Recover early delays. - Avoid liquidated damages. - Free key resources early for other projects. Avoid adverse weather conditions that might affect productivity. - Receive an early completion-bonus. - Improve project cash flow Reducing project duration can be done by adjusting overlaps between activities or by reducing activities' duration. What is the reason for an increase in direct cost as the activity duration is reduced? A simple case arises in the use of overtime work. By scheduling weekend or evening work, the completion time for an activity as measured in calendar days will be reduced. However, extra wages must be paid for such overtime work, so the cost will increase. Also, overtime work is more prone to accidents and quality problems that must be corrected, so costs may increase. The activity duration can be reduced by one of the following actions: - Applying multiple-shifts work. - Working extended hours (over time). - Offering incentive payments to increase the productivity.

Working on week ends and holidays. - Using additional resources. - Using materials with faster installation methods. - Using alternate construction methods or sequence. 8.2 Activity Time-Cost Relationship In general, there is a trade-off between the time and the direct cost to complete an activity; the less expensive the resources, the larger duration they take to complete an activity. Shortening the duration on an activity will normally increase its direct cost which comprises: the cost of labor, equipment, and material. It should never be assumed that the quantity of resources deployed and the task duration are inversely related. Thus one should never automatically assume that the work that can be done by one man in 16 weeks can actually be done by 16 men in one week.

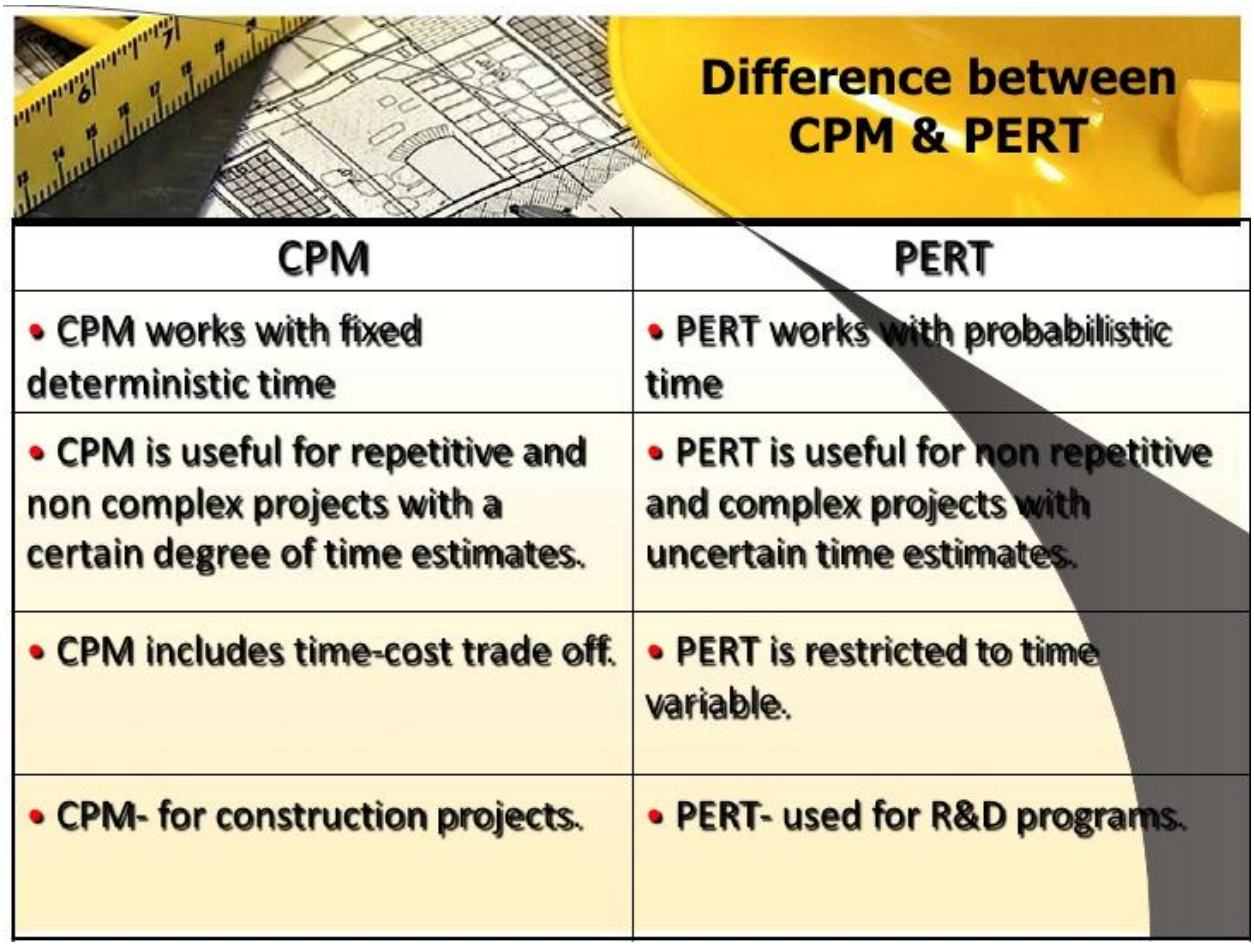
A simple representation of the possible relationship between the duration of an activity and its direct costs appears in Figure 8.1.





Considering only this activity in isolation and without reference to the project completion deadline, a manager would choose a duration which implies minimum direct cost, called the normal duration. At the other extreme, a manager might choose to complete the activity in the minimum possible time, called crashed duration, but at a maximum cost.

Figure 8.1: Illustration of linear time/cost trade-off for an activity The linear relationship shown in the Figure 8.1 between these two points implies that any intermediate duration could also be chosen. It is possible that some intermediate point may represent the ideal or optimal trade-off between time and cost for this activity. The slope of the line connecting the normal point (lower point) and the crash point (upper point) is called the cost slope of the activity. The slope of this line can be calculated mathematically by knowing the coordinates of the normal and crash points. Cost slope = crash cost – normal cost / normal duration – crash duration. As shown in Figures 8.1, 8.2, and 8.3, the least direct cost required to complete an activity is called the normal cost (minimum cost), and the corresponding duration is called the normal duration. The shortest possible duration required for completing the activity is called the crash duration, and the corresponding cost is called the crash cost. Normally, a planner start his/her estimation and scheduling process by assuming the least costly option



Critical Chain Project Management (CCPM), also referred to as **Theory of Constraints**. In essence, CCPM focuses on managing constraints, the relationship between tasks within a project and resources within project. By actively managing these "hotspots" it is believed that CCPM decreases project conflict and tension and provides a more balanced expectation. Though an interesting theory, CCPM is largely unproven and appears to be most applicable in projects concerning highly dynamic tasks that can be grouped in modules. Module structure groups tasks where the completion of a module delivers some degree of function that can be used regardless of the status of the remainder of the project. An example would be software development, where a subroutine that is common to many applications can be completed and useful without the entire project is completed. Because

the relationship between modules is not as critical, the modules themselves can be re-planned and re-scheduled as necessary, adding a degree of efficiency and decreasing conflict within a project or between projects. CCPM also focuses on overall project progress instead of individual task progress. A perceived strength of CCPM is that it is based on an absence of multi-tasking; a single resource is only assigned to a single task/project. A relatively humanistic approach, CCPM calculations also account for the inconsistent nature of human performance (good days, bad days, sick time, training needed, etc). CCPM estimates are much broader (50% probability, 90% probability, etc) and deal exclusively with a single "normal" completion date of the project as a whole. As such, it is believed that by identifying and grouping tasks and limiting constraints the project becomes more manageable while providing incremental value. Critics of CCPM argue that its assumptions (absence of multitasking, tasks may be grouped into semi-independent yet value-filled groups) create unrealistic expectations. In any event, CCPM seems applicable only in those industries where incremental progress can deliver incremental value or function. Clearly, only completing one wing of an airplane, 2 walls of a house or 1/3 of a city-wide traffic risk assessment would provide little value, so CCPM has found little acceptance outside of very specific hi-tech business areas.

The second method in use is a variation of PERT called **Earned Value Method**, introduced by the Department of Defense in the mid 60s. In the business world this method is synonymous with ROI (Return On Investment).Simply put, it examines the relationship between the cost of doing something and the value received by doing it. Earned value does not concentrate on probability of completion at a specific time, nor does it deal with a specific time or range of times, though a by –product of the analysis is a constantly moving completion projection. It tracks tasks and the project as a whole in terms of money by analysis that answers 3 specific questions:

1) How does the cost of work performed compare to the value of the work performed?
2) What is the value (in dollars) of work performed so far?
3) How does the amount of money spent so far on a project compare to what should have been spent?

PERT also provides a probability of completion on any date selected by the user. PERT calculations are simple and straightforward, but tend to get lengthy when many tasks are used. Before the task calculations can be made, however, 2 steps must be taken in any project planning:

1) Define the goal of the project and the tasks required to complete it
2) Place tasks in a logical order and determine the **critical path** (it is helpful to diagram the tasks)

a. The **critical path** is the longest time path through the network of tasks

When these steps are complete, generate a set of duration estimates for each task; each set should contain a pessimistic, most likely and optimistic estimate. To keep the estimates straight, it is useful to label **pessimistic** estimates as $\mathbf{T_P}$, **optimistic** estimates as $\mathbf{T_O}$ and **most likely** estimates as $\mathbf{T_L}$ (any labeling system can be used, but these are fairly intuitive).For each task, calculate the PERT derived expected duration (T_E) based on a formula, $(\mathbf{T_P} + 4\ \mathbf{T_L} + \mathbf{T_O}) / 6 = \mathbf{T_E}$

1) Read this formula as the sum of pessimistic plus 4 times likely plus optimistic divided by 6 equals the expected duration
2) Complete this calculation for all tasks; making sure to group tasks on the critical path separately

a. The **critical path** is the longest time path through the network of tasks
b. The sum of duration of tasks on the critical path will determine the project duration

A second set of calculations are necessary to determine information that will be useful later in the process. These calculations will yield the Standard Deviation (SD) and Variance (V) for each task duration. The SD is the average deviation form the estimated time; as a general rule, the higher the SD is the greater amount of uncertainty exists. The V reflects the spread of a value over a normal distribution. The SD and V will be useful in

determining the probability of the project meeting a desired completion date. The formulae for calculating SD and V are:

1) SD=(TP-T0)/6 {read as (pessimistic-optimistic)/6}
2) $V=SD^2$ (Standard Deviation squared)
3) Compete this calculation for all tasks; making sure to group tasks on the critical path separately

c. The **critical path** is the longest time path through the network of tasks

d. The sum of duration of tasks on the critical path will determine the project duration

When used together, PERT and CPM can provide:

1) A range of time estimates (PERT)
2) Likely time estimates (PERT and CPM)
3) Cost estimates (CPM)
4) Time and costs if crashed (CPM)
5) Probabilities of completion on time for a range of times (PERT)
6) A clear path of tasks that are critical to the project (PERT and CPM)
7) A central focus for solid communications on project issues (PERT and CPM)

2.5 What is the probability of completing the project

The Three time estimate for different activities of a project are given below:-

Activity	T_0	T_m	T_p
1-2	2	5	8

Activity	T_0	T_m	T_p
2-3	4	9	20
2-4	4	7	16
2-5	8	11	20
3-6	3	7	17
4-6	7	10	13
4-5	0	0	0
5-7	3	5	13
6-7	2	3	10
7-8	2	4	6

Z	**-2**	**-1**	**0**	**1**	**2**
P %	-2.28	15.87	50	84.13	97.72

What is the probability of completing the project in 35 Days?

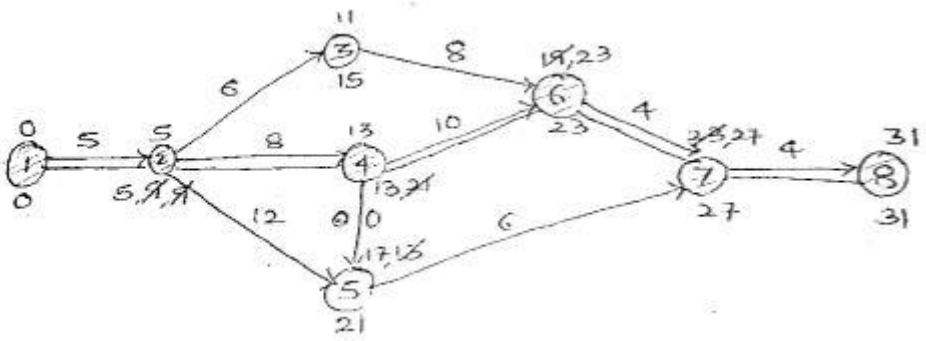
Step 1 :-

For critical activity only

$\sigma = \frac{tp - to}{6}$

Activity	T_0	T_m	T_p	$te = \frac{t0 + 4tm + tp}{6}$	σ	σ^2
1-2	2	5	8	5	1	1
2-3	4	9	20	6		
2-4	4	7	16	8	2	4
2-5	8	11	20	12		
3-6	3	7	17	8		
4-6	7	10	13	10	1	1
4-5	0	0	0	0		
5-7	3	5	13	6		
6-7	2	3	10	4	1.33	1.768
7-8	2	4	6	4	0.66	0.435
						$\sum\sigma^2 = 8.203 \sum\sigma 2 = 8.203$

Step 2:-



Project duration = 31 days

Critical path =1-2-4-6-7-8

Step 3:-

The probability of completing the project in 35 days is

~~z~~ = scheduled time-project durationϵ

S.T.= 35 Days

P.D.= 31 Days

$\epsilon = \sqrt{\sigma^2} = \sqrt{8.203} = 2.86$

~~z~~ = $35-312.86=1.398$

From table given in question, interpolation

1	84.13
1.398	P%=?
2	97.72

$\therefore P\%=89.54\%$

2.6 Resource Allocation

Resource allocation, also called resource loading, commits certain resources to project plan activities. More than one resource and type of resource can be allocated to each activity. Some project phases and activities require fewer resources than others, and these requirements can vary during the length on the work. For example, roles committed to a software development project might include a team leader, change facilitator, business analyst, process owner, process specialist, process modeler, solution architect, solution

designer, programmer, training specialist, technical writer and end user. However, the training specialist and technical writer might not be required to join the team until the deployment phase of the project. Therefore, these two resources are allocated to the deployment phase of the project only.

2.7 Resource Leveling

After using the resource allocation process to define project resource requirements, resource leveling is used to relate the requirements to available resources. This leveling process ensures that resource demand does not exceed available resources during a particular time frame, and in light of individual activity interdependencies. During resource leveling, resource requirements are expressed in terms of the hours and days during which the resource is required. For example, assume that during the resource allocation process, a programmer is allocated for eight hours each day to a project. However, the original plan assigns three different eight-hour tasks to the programmer on the same day. Using resource leveling, the three tasks are rescheduled to occur on three different days. As a result, the problem of the overallocation of the resource is resolved.

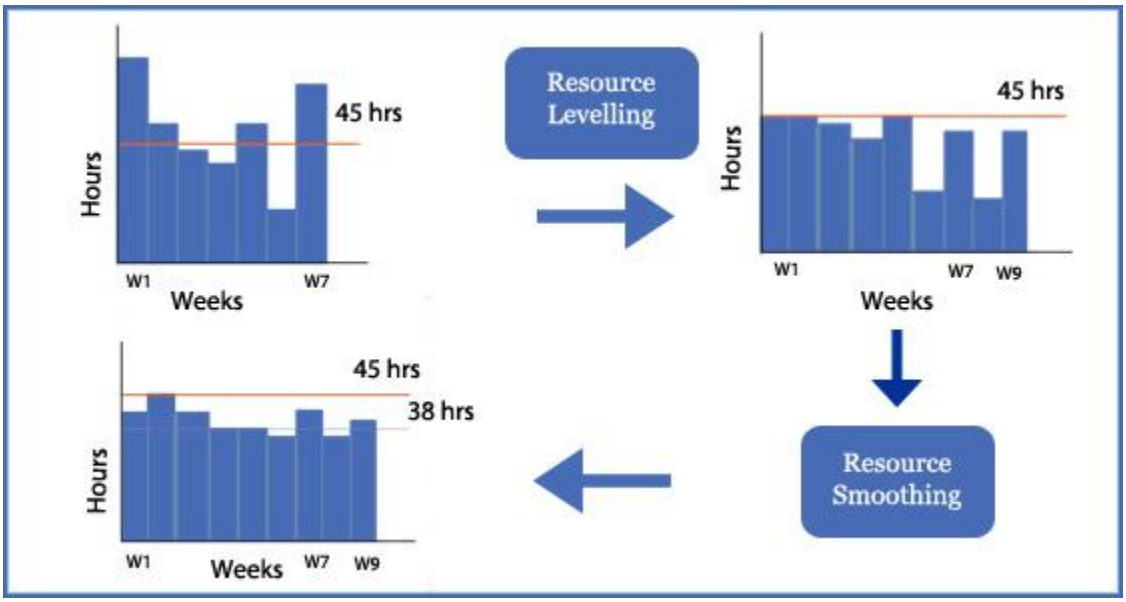
Resource Leveling Approaches

One of three resource leveling techniques are typically used to correlate resource requirements to available resources: critical path, fast tracking and crashing. Using the critical path method, required project activities are specified, the time required to complete each activity is stated, and activity dependence is identified. In turn, fast tracking enables tasks to be run simultaneously, and crashing is used to assign additional resources to a project stage or activity. Each technique is used to ensure particular project objectives are accomplished on time.

Benefits of Resource Allocation and Resource Leveling

Resource allocation and leveling support the proper allocation of business resources during a project's life cycle. The appropriate allocation of resources attempts to ensure that delays in the completion of tasks will be avoided. As a result, the on-time completion of project tasks is more likely. Such completion of tasks avoids conflicts in team member assignments, which can lead to budget overruns. Through the avoidance of over- and

under-allocation of resources, it is more likely that a project is completed on time and within the budget.



Resource leveling

"A technique in which start and finish dates are adjusted based on resource constraints with the goal of balancing demand for resources with the available supply."

Resource Smoothing

"A technique that adjusts the activities of a schedule model such that the requirements for resources on the project do not exceed certain predefined resource limits."

Differences between Resource Leveling and Resource Smoothing

Resource leveling	Resource Smoothing
It applies the resource constraints to the project and may result in change in project duration.	We apply resource smoothing after doing resource leveling and we make use of slack, and will not result in change of project duration.
Resource Leveling is primarily driven by resource constraints, like you do not have more than 45 hours of the given resource for a week.	Resource smoothing is more to do with desired limits, like we do have 45 hours available for given resource but we wish that we allocate 38 hours per week so we have some breathing space.
The allocation limits identified in resource leveling must be applied.	The desired limit identified in resource smoothing may not be applied in some cases, if we do not have slack.
The resource leveling is done first and then we do the resource smoothing. Since we need to first accommodate the resource constraints before we can optimize it.	We apply resource smoothing after applying resource leveling.

Summary:

The purpose of CM is to control a project's time, cost and quality. CM is compatible with all project delivery systems, including design-bid-build, design-build, CM At-Risk and Public Private Partnerships.

Advantages

- *CM is working "at risk", therefore have incentive to act in the owner's interest, as well as to efficiently manage construction costs, considering they would be liable for any amount in excess of the GMP*
- *Ability to handle changes in design or scope*

Drawbacks

- *If a cost overrun occurred, it could cost the CM a great deal of money*
- *The CM is allowed some mistake-related contingency, therefore there is a possibility that they will compensate by reducing the scope of the work to fit the GMP*
- *Since the GMP is settled before design begins, it is difficult for owners to know whether they received the best possible bid*

  - *Project management technique that shows the time taken by each component of a project, and the total time required for its completion. PERT breaks down the project into events and activities, and lays down their proper sequence, relationships, and duration in the form of a network.*
  - *Time-Cost Trade-Off , The objective of the time-cost trade-off analysis is to reduce the original project duration, determined form the critical path analysis, to meet a specific deadline, with the least cost.*
  - *Resource allocation, also called resource loading, commits certain resources to project plan activities. More than one resource and type of resource can be allocated to each activity.*
  - ***Resource Smoothing***

"A technique that adjusts the activities of a schedule model such that the requirements for resources on the project do not exceed certain predefined resource limits."

3.1 What is Facility (or Plant) Location?

Facility location or plant locations is the process of determining a geographical site for a firm's operations achieving maximum operating economy and effectiveness.

THE NEED FOR LOCATION DECISIONS

. Location decisions represent an integral part of the strategic planning process of every organization. Even though it may appear to be the one time problem of new organizations, even existing organizations often face the problem of choosing a proper location for their new units or for relocating the existing plants. The reasons for making location decisions are:

(i) When business is newly started.

(ii) When a business firm wants to expand its markets by adding new locations to the existing systems (manufacturing, service, distribution etc..,).

(iii) When an organization experiences growth in demand for its products or services and the existing facility or plant is not able to expand in the existing location to meet the demand.

(iv) Some firms need to relocate due to rising costs of inputs or distribution of outputs or due to depletion of basic inputs such as raw materials, fuel (say iron ore and coal mines for steel plants or crude oil resource for oil refineries).

(v) Shift in markets may cause firms to relocate.

(vi) Other social and economic reasons such as shortage of labour supply, shortage of electric power, changes in life style of customers etc.

THE NATURE OF LOCATION DECISIONS

The location decisions often depend on the type of business. For location decisions for manufacturing firms, the strategy is usually minimizing costs, whereas for retail and service organizations, the strategy focuses on maximizing revenue. The strategy for

location of a warehouse is combination of cost and speed of delivery. In general, the objective of location strategy is to maximize the benefits of location to the firm.

Location decisions are not made frequently. Location options include

(i) Expanding an existing facility instead of going to a new location,

(ii) Maintaining current sites while adding another facility elsewhere and

(iii)Closing the existing facility and moving to another location.

Location decisions usually involve long and costly studies of alternative locations before the final decision is made regarding the site. There is no clear-cut best location, but rather there are several good alternative locations. Since many alternative sites each with its strengths and weaknesses emerge as good choice, the location decision becomes a trade-off decision. This means a firm can gain one type of location benefit by giving up another. Hence, the final decision regarding the selection of the site can only be made after carefully weighing the pros and cons of each location alternative.

OBJECTIVES OF LOCATION DECISIONS

(i) Profit oriented organizations have the objectives of maximizing the potential profits.

(ii) Non Profit organizations strive to achieve a balance between cost and level of customer service the provide.

(iii) To identify the "best" location for a firm or to find a number of acceptable locations from which to choose one.

(iv) To maximize the benefit of location to the firm.

(v) To have completive advantage.

Importance of Location Decisions

(i) Involve a long-term commitment.

(ii) Often have an impact on investment required, operating costs and revenues at well as operations.

(iii) A wrong choice of location might result in excessive transportation costs, shortage of qualified labour, loss of competitive advantage, inadequate supplies of raw materials etc.

(iv) For services, a poor location could result in lack of customers and/or high operating costs.

GENERAL PROCEDURE FOR MAKING LOCATION DECISIONS

An organisation's approach to location decision often depends on its size and nature or scope of its operations. Large established organizations adopt a formal approach to location decisions.

The general procedure for making location decisions consists of the following steps:

(i) Decide on criteria to use for evaluating location alternative such as increased revenues or community service.

(ii) Identify crucial factors such as location of source of raw materials or location of markets.

(iii)Develop location alternatives

a) Identify the general region for a location.

b) Identify a small number of community alternatives

c) Identify sites among the community alternatives.

(v) Evaluate each alternative and make a choice.

FACTORS AFFECTING LOCATIONS DECISIONS

1. **Deciding on domestic or international location:**

First the management must decide whether the facility will be located internationally or domestically. Now a days, with the globalization of business this choice

is significant because a location in any country in the world will be considered to have competitive advantages derived form location. If the decision is to choose an international location, the next logical step is to decide about the country for location depends on such factors as:

(i) Political stability

(ii) Export and import quotas,

(iii) Exchange rates

(iv) Cultural and economic considerations

(v) Availability of natural resources, eliminate, cost of labour etc.,

2. <u>Regional location decision:</u>

The selection of a particular region may involve choosing among many national regions or among several regions within a much smaller geographical area.

(i) **Availability of raw materials and nearness to the source of raw materials:** This will reduce the cost of transportation of raw materials from its source to the place where the plant is located. For example, Steel, sugar, paper and cement industries which use bulky raw materials should be located near the sources of raw materials.

(ii) **Nearness to the Market:** For many firms producing consumer non-durable items such as bread, ice-cream, packed foods etc., it is necessary to be located near the market to reduce the transportation costs as well as reduce the time required of transportation. Also, when finished goods are bulky, heavy, fragile or perishable, the firms must be located nearer to market to increases the speed of deliver. For instance, bottling plants of soft –drink companies are located within the cites.

(iii) **Proximity to Suppliers**: Firms are located near their suppliers because of perishability, transportation costs, or bulkiness of materials.

(iv) **Availability of Power**: Power is essential for any manufacturing firm. Coal, oil and natural gas are sources of electric power in addition to generation of power through hydro electric power station. Some industries such as Aluminium extraction plants consume heavy amount of electricity and hence require adequate supply of electricity at a cheep rate.

(v) **Transport Facilities:** Transport facilities are essential for transportation of raw materials and supplies and employees to the plant as well as for carrying finished goods from the plant to the market place. The location of the plant must be well connected by rail, road and sea. For example, pertroleum refineries and fertilizer plants are located near the parts because they need shipping facility either to bring raw materials (such as crude oil) to the plant or ship the finished products (fertilizers) to other destinations (ports).

(vi) **Suitability of Climate:** Certain industries require particular climatic conditions because of the nature of their production. For example, humid climate is required for cotton textile and jute industries. Also, dust free climatic conditions are favourable for electronic industries. Even though the desired climatic conditions can be provided artificially, it would be quite costly to do so and hence natural climatic conditions are preferred. d

(vii) **Government Policy:** Some states in backward regions of our country, have encouraged industrialists to locate their industries in the backward regions (economically backward states). The central government may influence plant location in backward states by their licencing policy, freight rate policy, institutional finance and subsidies etc.

(viii) **Competition Between States:** Manystatescompete among themselves to attract new industries by offering investment subsides, cheap power and land, sales tax exemption, longer loan repayment period and low interest rates etc., small and medium sized plants are attracted by these incentives.

3. **Selection of Community:**

The Selection of a locality or a Community in a region is influenced by the following factors:

(i) **Availability of Labour :**Labour having the appropriate levels of skills needed for the industry is an important consideration. The skilled labour influences the plant location (their availability and cost). This factor may not be very important if the skilled labours are mobile (i.e willing to move). The attitude of labour (workers), union activates and industrial disputes play a major role in attracting an industry to be located in a community.

(ii) **Civic Amenities for Employees:** Employees need facilities such as housing, medical facilities, sports and recreational facilities, educational facilities. Such facilities will attract skilled labour and other employees to the plants which are located in places where all employee amenities are available.

(iii) Existence of Complementary Ancillary and Competing Industries: Complementary and ancillary industries can accept job orders which are subcontracted by major industries. Also, the big industries can get raw materials, tools and supplies form the small scale industries located in the vicinity or in the same community. Competing industries which encourage healthy competition are advantageous to the new plants because they can jointly tackle certain problems regarding raw materials, labour, power wastage, disposal, pollution control etc., and also collectively negotiate with labour unions or government agencies.

(iv)**Finance and Research Complementary, Ancillary and Competing Industries:** Complementary and ancillary industries can accept job orders which are subcontracted by major industries. Also, the big industries can get raw materials, tools and supplies form the small scale industries located in the vicinity or in the same community. Competing industries which encourage healthy competition are advantageous to the new plants because they can jointly tackle certain problems regarding raw materials, labour, power, wastage, disposal, pollution control etc., and also collectively negotiate with labour unions or government agencies.

(v) Availability of Water: Some industries such as chemical and paper industries require plenty of water for industrial use and hence must be located where water is available in abundance. Regularity of supply, cost and purity are considered regarding water supply to the plant.

(vi) **Availability of Fire fighting Facilities:** Since industrial units are prone to fire hazards, adequate fire fighting facilities must be available.

(vii) **Local Taxes and Restrictions:** The municipality or local administration have its own tax structure for industries and regulations regarding waste disposal, effluents and smoke emanated from the industries.

4. **Selection of Exact Site:** The selection of exact site for a plant is influenced by the following consideration:

(i) **Area of land available, soil, topography and cost of land** for certain industries such as Agro industries, fertile soil is necessary. For industries requiring large area of land, availability of land and cost of land are important considerations. Topography is also considered because a hilly, rocky and rough terrain is unsuitable and involves expenditure to level the site.

(ii) **Disposal of Waste:** Some industries such as chemical plants, leather industries, breweries, steel plants etc, have the problem of disposal of effluents and the site selected should have provision for this.

(iii) **Community Attitude:** The people living in the nearby areas surrounding the proposed site for the industry should not oppose the location of the plant. The reasons for negative attitude could be pollution, health hazards (such as radiation) dangerous fumes emanating from the industries etc.

1. RURAL SITES: Even though rural sites may not offer as many facilities as offered by urban sites, they have the following advantages:

a) Land is available at cheaper rate and additional vacant land can be purchased of expansion.

b) Taxes are negligible.

c) Labour is cheaper

d) Since land cost is low, single story buildings can be constructed.

e) Less labour problems because of absence of strong labour unions.

f) Lesser municipal restrictions regarding emission of smoke, pollution standards, wastage or effluents disposal. However, there are some disadvantages of ral sites Thery are

i) Scarcity of supply of skilled labour because of lack of civic amentias to employees.

ii) Lack of good transportation and communication facilities.

2. **Urban Sites:** The advantages of urban sites are:

a) Good transportation and communication facilities.

b) Availability of skilled labour.

c) Availability of civic amenities for employees

d) Availability of banking facilities

e) Availability of complementary and ancillary industries for outsourcing

f) A large local market may be present.

g) Availability of water, power etc.,

h) Availability of technical and educational institutions for tainting and education the employees.

The Disadvantages of urban sites are:

a) Land cost is high and adjacent land may not be available for expansion.

b) Higher municipal taxes and restrictions regarding effluents, smoke and wastage disposal.

c) Labour unions are more and labour unrest is frequent.

d) Necessity to build multistory-buildings because of constraints of land and cost of land.

e) High labour costs.

3. Suburban Sites:

These offer a compromise between the urban and the rural sites and have the advantages of both reduce the disadvantages of both urban and rural sites.

3.2 TECHNOLOGY

Technology is the resource of profound importance not only in production but also to profitability and growth of the entire business organization. Technology drives productivity and also drives change in the world. Technological change is a major factor in gaining competitive advantage. The development and innovative use of technology can provide a firm a distinctive competence. Competitive advantage can be achieved not just from creating new technology nut also by applying and integrated existing technologies. Technology is an significant ingredient in virtually all production and operation management decisions. Advances in computer technologies (Bothe hardware and software) automation, robotics, lazers, information and communication technologies have had broad – reaching impact across all industries. To state competitive, manufacturing and service organizations must adopt ne technologies.

Firms that have used technology as a competitive weapon have effectively integrated their technology strategy and business strategy. As these firms invent and developed new technologies, they offer new products and services.

THE MEANING OF TECHNOLOGY

Technology is defined to be know –how, physical things and procedures used to produce products and services. No- how mean knowledge and judgment and how, when and why to employ equipments processers, and procedures.

Knowledge include craftsmanship and experience, physical things are equipments and tools, procedures are ht e rules and techniques for operating the equipment and performing the work.

Technologies require a support network to be implemented. A support network consists of physical. Informational and organizational relationships that make technology complete and allow it to function as intended.

Advanced technology refers to the application of the latest scientific are engineering discoveries to the design of production and operation processes.

Technology and technique do not mean the same. Technique is the totally of the methods rationally arrived at and having absolute efficient where as technology is the organization and application of knowledge for the achievement of practical purposes some of the examples of technology are manufacturing or production technology, design technology, computer technology, communication technology, nuclear technology, satellite communication technology, space technology, missile technology and laser technology and the like.

ROLE OF TECHNOLOGY IN PRODUCTION AND OPERATIONS MANAGEMENT

Advances in technologies create new product and services and reshape process. Technology takes many forms, beginning with ideas, knowledge, and experience and then utilizing them to create new and better ways of doing things. Technology provides distinctive competency and competitive advantage to a firm over others. The impact of technology is pervasive.

Influence of Technology on the Production Organizations: A vital factor in production organizations is whether the technology involves capital intensive operation (i.e., large investment in plant and machinery) or labour – intensive operations. Technology will affect: (i) the organization of production. (ii) the capital investment in plant and equipments, buildings etc., (iii) the scale (or volume) of production operations, (iv) the influence of labour relations in production operations.

Influence of Technology on Production Strategy: The management of production is vitally concerned with the technology of the production processes. It must organize

according to the technology adopted and by the adoption of productive system which is either capital intensive or labour intensive. Also, it must design a highly sophisticated production control system for batch production, or a material management system for high capacity assembly line operations.

Technology and organization structure:

The Organisation is not simply a technical or social system. It requires structuring and integrating human activates around various technologies. The technical system is determined by the easy requirements and shaped by the specialization of knowledge and skills required the types of machinery and equipmentsinvolved, the information processing requirements and the layout of facilities.

Any change in the technical system affects the organizational elements. The impact of technology on the organization – its goals, structure, psychological system and managerial system will be quite significant.

CLASSIFICATION OF TECHNOLOGY

Technology can be classified as : (i) manual technology, (ii) mechanical technology (or mechanization), (iii) Automated technology (or automation), (iv) current technology, (v) appropriate technology, (vi) state-of-the-art technology, (vii)advanced technology, (viii)obsolete technology (or out-dated technology), (ix) capital-intensive technology, (x) labour intensive technology etc.

Manual technology is the use of a muscular power to do work which was prevailed before industrial revolution. Mechanized technology or mechanization uses machine power in place of muscle power and is the first step towards automation. Examples of mechanization are power operated tools, tool changing devices, powered material handling equipments such as conveyors, job cranes for loading and unloading heavy job etc. Automated technology or automation is any from of equipment or machine which will

carryout a preset program or sequence of operations and at the same time measured and correct its actual performance in relation to that program. Current technology is any technology currently used by a firm in its operation. Appropriate technology is the technology which meets the requirements of time, place and objectives of a firm at a particular point of time. appropriateness is an inherent quality in technology. Depending on the social, political, economic, and other conditions prevailing in a country at a technology becomes appropriate even though on the priorities of the country, a technology becomes appropriate even though it may not be an advanced technology or state-or-the art technology. (For example, hither capital-intensive or labour-intensive technology is the appropriate technology to be adopted by a firm or industry or a country).

State-of-art technology is a modern technology which has been adopted by many developed countries in the world. This technology ill enable the firm to produce state-of the art products using state –of-the art design. It is also known as proven technology. Advanced technology is the infest technology based on the latest scientific or engineering discoveries and used in the design and production processes. It is also known as new technology which is developed by a firm which is a technology leader in its field of operation. Example of advance technologies are space technology , missile technology , information technology , laser¸ technology ,bio- technology , and so on

obsolete technology is an out dated technology which has been replaced by a superior technology , thereby resulting in obsolescence of the old technology which has been replaced.

Capital-intensive technology involves huge investments in capital assets such as equipment and machinery, materials handling and storage systems, information handling (storage and retrieval) systems, communication systems and office automation equipments.

Labour-intensive technology does not involve investment inn huge capital intensive systems but make use of abundant labour (manpower) available in the country. For example, in India, textile and mining industries adopt labour –intensive technologies.

The choice of technology : the choice of technology depends on several factors, both internal and external to the organization choosing the technology . the various internal factors are : (i) availability of funds for investments,(ii) product life cycle and technology - life cycle position, (iii)present plant capacity and technology adopted(i.e., current technology).

Technology can be quite capital intensive and require high investment in equipments, machines and processes. The question is whether the firm can afford to invest in a new technology which may be highly expensive. Also, saturation or decline stage in its life cycle. New technologies for processing technology chosen should be capable of matching with the existing technology when a new technology is adopted.

The external factors involved in the choice of technology are: (i) government policies and regulations, availability of resources much as raw materials, energy, skilled labouret., required for using the new technology, (ii) market scenario(market demand, customer requirement of product quality etc).

Technology Life-Cycle: Like a product has its life cycle, technology also has a life cycle, the various phases or stages in a technology life cycle are:

(i) Innovation in which stage a ne technology (product or process technology) is developed
(ii) Syndication during which stage , the technology is demonstrated and slowly commercialized,
(iii) Diffusion stage in which a new technology gradually replace the current technology and
(iv) Substitution stage in which the current technology which becomes obsolete and its completely replace by the new technology

Design Technology

The recent development in the technology of product design comprises certain troll provided by the information sciences that contribute to better, cheaper, and faster design of products. They are :

(i) Computer – aided design (CAD).

(ii) Computer – aided design and manufacture(CAD/CAM).

(i) Computer Added Design (CAD) : it is an electronic system using computers for designing new parts or products or modifying existing once, replacing the traditional drafting work done by a drafts man on a drafting board. The CAD consists of a powerful desktop computer and graphics software that enables the designer to manipulate geometric shapes.

(ii) The designer can create drawing and view them from any angle on display monitor CAD. Software have been developed for designing electronic circuit printed-circuit-board design, designing and drafting 3dimension drawings and also for analysis of heat and stress in mechanical design

Advantages of CAD are:

(i) Allows designer to save time and money by shorting design and development cycle time.

(ii) Eliminated prototype model building to crew the design .

(iii) Allows designer to determine the costs and test such variable as stress, tolerance, product variability, interchangeability and service ability

(iv) Low cost of design even for a custom-built, low volume product.

(v) Eliminates manual drafting completely.

(vi) Makes review of numerous in design possible before final commitments are made because of the speed and ease with which sophisticated designs can be manipulated.

(vii) Faster development, better products and accurate flow of information to other departments.

(viii) Products and cost can be determine at the design stage itself.

Two extensions of CAD technology are:

(a) Design for manufacture and assembly (DFMA) and (b)3-d object modeling. DFMA software focuses on the effect of design on assembly. It enables designer to examine the integration of product design before the product is manufacture or assembled

3-d modeling allows the building of small models which is useful for prototype development. It rapidly builts upon model in very thin layers of syntactic materials for evaluation and considerably reduces the time and cost recovered for prototype development using the manufacturing process.

(iii) Computer Aided Design and manufacture (CAD/CAM): computer-aided-manufacture(CAM) refers to the use of computer software to direct and control manufacturing equipments. Hen computer-aided-design (CAD) information is translated

into instruction for computer-aided-manufacturing(CAM), the result of these two technologies is referred to as CAD/CAM system.

Adavantages of CAD/CAM system include:

(1) Product quality: CAD permits designers to investigate more alternatives and evaluate the designs from the point of view of potential problems and dangers.

(2) Shorter design time: a shorter design face reducer cost and enables a faster response to the market.

(3) Production cost reduction: reduced inventory, better use of personal through improved scheduling and faster implementation of design changers lower costs.

(4) Data base availability: accurate data base can be built up to provide the same information for use by all concerned.

(5) New range possibilities: the ability to rate 3 dimensional design drawing to check clearances, top relate parts and attachments etc., will provide new capability to manufacturing.

(6) Minimum involvement of direct workers because informations are directly translated into instructions for automated production machines.

(7) Higher quality and productivity.

CAD/CAM implies a merger of CAD and CAM and an interaction between the two system which results in the automation of the transistion from product design to manufacturing the

The integrated CAD/CAM enables analysis and interchange of information rapidly between a “CAD system” and a “CAM system”. It is a totally integrated package for computer aided design and manufacturing.

It considered manufactureability aspects of part such as processing steps, machine capabilities, tool changers, holding fixtures requirements and assembly requirements while designing the product. The new product design can be stored in a common database and through CAM, the new products can be manufacture quickly and economically and introduced in to the market. Thus, CAD/CAM promises great product flexibility low production costs and improved product quality.

(v) PRODUCTION technology(OR MANUFACTURING AUTOMATION)

(vi) In addition to the development in design technology, a number of advances are made in technology used to enhance production. Some these advancements in production technology are:

(i) numerical control and computer numerical control(NC and CNC),

(ii) automated process control

(ii) Vision systems(automated inspection system),

(iii) Robots,

(iv) Automated, identification system(AIS),

(v) Automated storage and retrieval system(ASRS),

(vi) Automated guided vehichle (AGV),

(vii) Automated flow lines,

(viii) Automated assembly systems,

(ix) Flexible manufacturing systems (FMS),

(x) Computer intergrated manufacturing(CIM)

(xi) Enterprise resource planning.

The above aspects of production technologies are discussed in detail in the following section

(i)Numerical control and computer numerical control many machines such as lathe, milling, drilling and boring mach9nes are now designed for electronic control called numerical control (NC).the numerically control(NC) machines have control system which read instructions and translates them in to machine operation. When these machines are programmed own mini computer and have to store these program they atre called computer numerical control (CNC)machines.

Advantages N/C machines:

(i) Smaller machine setup time (ii) machine motions and tool changing are controlled by instruction on a control systems (iii) increased productivity and higher quality, (iv) suitable for low volume production.

Advantages of CNC machines : (i) instructions may be and stored and handled more efficiently , (ii) micro computer system control the machine setting and operations rather

than the human beings (iii) realtime and of –line diagnostic possibilities may be built in to the CNC systems, (iv) machining data and operator instructions may be displayed on the screen of computer

Application of NC/CNC machines : these machines are used to machine parts: (i) with complex matching requirements,(ii) requiring high precision, (iii) in development stages where many changes may be needs, (iv) normally recovering extensive tooling, (v) recovering fast or slow matching speeds, (vi) made from expensive raw materials and (vii) recoverd insmall waranntties of repetitve batches.

(ii) Automated process control: makes use of information technology to monitor and control a physical process. It is also used to determine and control temperature and pressure and quantity in petroleum refineries, cement plants, chemical plants, steel mills, nuclear reactors etc., process control system operates in a number of ways: (a) sensors collect data (b) analog devices read data periodically (say once a minute or once a second) (c) measurements are translated in to digital signals which are transmitted in a to a digital computer (d) computer programs read the digital data and analysis the same, (e) the resulting output may take numercial forms which include messages on computer consoles or printers or signal to motors to change valve setting, warning light or sirens et.,

(iii) Vision systems (automated inspection systems): these are machines are equipments that have been integrated into the inspection of products of controlling qualities. They combined video camera and computing technology to take physicaldimension, of parts, compare the measurement to standards and determine whether the parts meet quality specification. Vision system are also used for visual inspections in food processing organization automated inspection system facilitates hundred percent inspection which will lead to improved product quality and reduced inspection costs.

(iv) Robots : robotics are ronbotary is a fast developing field of technology in which human like machines perform production tasks. A robot is a reprogrammable, multifunctionalmanipulate deign to move materials, parts, tools are specialized devices through variable programmed motions for the performance of an variety of tasks robots are machines which are flexible have the ability to hold, more and grab items. They are

controlled by micro computerswhich when programmed guide the machine throughtheir predetermined operations

Advantages : robots: (i) do not strike work, (ii) do not mind hurt , dirty, dusty working condition s(iii) can work at high speed ,(iv) will not sue if injured ,(v) can work long hours without breaks , (vi) can be used for welding , painting, assembly work, loading , unloading, material handling and other repetitive, monotonous work.

(v) Automated identification system(AS): these used barcodes radio frequency magnetic stripes, optical character reorganization and machine vision to sense and input data into computers. These systems replace human beings to read data from products, documents, parts, and containers and interpret the data. An example is the system used to identify and read the barcode on an item in the cheque-out counters at grossory stores. A scanner read the idenfication number from barcode on the item, access the computer database and sense the price of the item to the cash register and updates the inventory data in the inventory system.

(vi) Automated storage and retrieval system (ASRS): Computer control warehouse use ASRS which provide for the automatic placement withdrawal of parts and products into and from designated storage place in the warehouse such systems are commonly used in distributed facilities of retailers.

(vii) Automated guided vehicles (AGVs): these are automated materials handling and delivery systems which can take the form of mono-rails , conveyors, drivers less trains, pallet trucks and unit load carriers. AGVs are electronic guided and controlled vechiles used to move parts and equipments AGVs. Usually follows either embedded guided wires or paint strips through operation until, theirdestination are reached.

(viii) Automated flow lines : an automated flow lines includes several automated machines which are linked by automated transfer machine and handling machines. The rawmaterialsneeded automatically faced the individual machines and operation are carried out without human interventions. After an item is machined on one machine on the line, the partially completed item is automatically transferred ot the next machine on the line in a predetermine sequence until the job is completed. Major components such us automobile are produced using automated flop lines

These systems are also known as fixed automation are hard automation because the flow lines are designed to produce only one type of component or product. These systems are suitable for products with high and stable demand because of very high initially investment required and the difficultychanging over to other products but production system which provides greater flexibility for example, flexibile manufacturing system are more favored fixed automation

(ix) Automated assembly systemsin this system automated assembly machines or equipment are linked together by automated materials handling equipments. Examples, of automated assembly equipments are roboticvenders are components insertion unit which are used to join one are more part components or assembly. The partly assembled product is moved to the next assembly equipmentsautomatically by the automated material handling equipment and this process is repeated until the hole assembly is completed automated assembly system require unique product design which are suitable to the systems unlike product design suitable for manual assembly operation.

Plant Layout

Plant Layout, also known as "Facilities Layout" refers to the configuration of departments, work-centres and equipment and machinery with focus on the flow of materials or work through the production system.

Plant layout or facility layout means planning for location of all machines, equipments, utilities, work stations, customer service areas, material storage areas, tool servicing areas, tool cribs, aisles, rest rooms, lunch rooms, coffee/tea bays, offices, and computer rooms and also planning for the patterns of flow of materials and people around, into and within the buildings.

What is Layout Planning? Layout planning involves decisions about the physical arrangement of economic activity centres within a facility. An economic activity centre can be anything that consumes space, a person or group of people, a machine, a work station, a department, an alise, a store room and so on. The goal or layout planning is to allow workers and equipments to operate more effectively.

The questions to be addressed in layout planning are:

(i) What centres should the layout include?
(ii) How much space and capacity does each centre need?
(iii) How should each centre's space be configured?
(iv) Where should each centre be located?

The location of a centre has two dimensions;

(i) Relative location i.e., the placement of a centre relative to other centres and
(ii) Absolute location, or the particular space that centre occupies within the facility.

THE NEED FOR LAYOUT DECISIONS

The need for layout planning arises both in the process of designing new plants and the redesigning existing plants or facilities.

Most common reasons for design of new layouts are:

(i) Layout is one of the key decisions that determine the long-run efficiency in operations.
(ii) Layout has many strategic implications because it establishes an organisation's competitive priorities in regard to capacity, processes, flexibility and cost as well as quality of worklife, customer contact and image (incase of service organizations).
(iii) An effective layout can help and organization to achieve a strategic advantage that supports differentiation, low cost, fast response or flexibility.
(iv) A well designed layout provides an economic layout that will meet the firm's competitive requirements.

Need for redesign of layout arises because of the following reasons.

(i) Ineffective operations (high cost, bottleneck operations).
(ii) Accidents, health hazards and low safety.
(iii) Changes in product design/service design.
(iv) Introduction of new products/services.
(v) Changes in volumes of output or product-mix changes.
(vi) Changes in process, methods or equipments.
(vii) Changes in environmental or legal requirements.

(viii) Low employee morale.

OBJECTIVES OF A GOOD PLANT LAYOUT

1. Higher utilization of space, equipment and people (employees).
2. Improved flow of materials, information and people (employees).
3. Improved employee morale and safe working conditions.
4. Higher flexibility (to change the layout easily).
5. Improved production capacity.
6. Reduced material handling costs.
7. Reduced congestion ore reduced bottleneck centres.
8. Reduced health hazards and accidents.
9. Efficient utilization of labour, reduced idle time of labour and equipments.
10. To provide product flexibility and volume flexibility.
11. To provide ease of supervision.
12. To facilitate better coordination and face to face communication where needed.
13. To allow ease of maintenance.
14. To utilize available space efficiency and effectively.
15. To improve productivity.

SIGNIFAFICANCE OF LAYOUT CHOICES

Layout choices help greatly in communicating an organisation's product plans and competitive priorities. Layout has many practical and strategic implications. Altering a layout can affect an organization and how well it meets its competitive priorities by:

(a) Facility the flow of materials and information
(b) Increasing the efficient utilization of labour and equipment
(c) Increasing customer convenience and sales (in service organizations such as retail stores)
(d) Reducing hazards to employees

(e) Improving employee morale

(f) Improving communication.

The type of operations carried out in a firm determines the layout requirements.

Some of the fundamental layout choices available to mangers are:

(i) Whether to plan the layout for the current of future needs.

(ii) Whether to select a single-story or multistory building design

(iii) What type of layout to choose? and

(iv) What performance criteria to emphasise?

FACTORS INFLUENCING LAYOUT CHOICES

Primarily the layout of a plant is influenced buy the relationship among materials, machine and men. Other factors influencing layout are type of product, type of workers, the type of industry, management policies etc. some of these factors are discussed in detailed below:

(i) **Materials** : Plant layout includes provision for storage and handling of raw materials, supplies and components used in production. The type of storage areas, racks, handling equipments such as cranes, trolleys, conveyors or pipelines etc., used – all depend on the type of materials, used – such as solid, liquid, light, heavy, bulky, big, small etc.

(ii) **Product**: The type of product i.e., whether the product is light or heavy, big or small, liquid or solid etc., it influences the type of layout. For example, ship building, Aircraft assembly, Locomotive assembly etc., requires a layout type different from that needed to produce refrigerators, cars, scooters, television sets soaps, detergents, soft deink etc. The manufacturing process equipments and machines used and the processing steps largely depend on the nature of the product and hence the layout design depends very much on the product.

(iii) **Workers**: the gender of employees (men or women) the position of employees while working (i.e., standing or sitting), employee facilities needed such as locker rooms, rest rooms, toilets, canteens, coffee/tea bays etc., are to be considered while designing the plant layouts.

(iv) **Machinery and Equipments**: the type of product, the volume of production, type of process and management policy on technology, determines the type of machines and equipments to be installed which inturn influence the plant layout.

(v) **Type of Industry**: Whether the industry is classified under (a) Synthetic, (b) Analytical, (c) Conditioning and (d) Extraction industries and again whether the industry has intermitted production or continuous production has a relevance to the type of layout employed

(vi) **Location**: the size and terrain of the side elected for the plant influences the type of buildings (single story or multi story) which in turn influences the layout design. Also, the location of the plant determines the mode of transportation from and into the plant (such as by goods trains, truck, or ships) and the layout should provide facilities for mode of transport used. Also, the layout should provide for storage of fuel, raw materials, future expansion needs, power generation requirements etc.

(vii) **Managerial Policies** regarding volumes production, provision for future expansion, extent of automation, make-or-buy decisions, speed of delivery of goods to customers, purchasing and inventory policies and personnel policies influence the plant layout design

Principles of Plant Layout

The factor discussed above influence the choice of a particular type of layout. While accepting the selected layout, the layout engineer should be guided by certain principles. The layout selected in conformity with layout principles should be an ideal one. These principles are:

(i) **The principle of Minimum Travel**: Men and materials should travel the shortest distance between operations so as to avoid waste of labour and time and minimize the cost of materials handling.

(ii) **Principle of Sequence**: Machinery and operations should be arranged in a sequential order. This principle is best achieved in product layout, and efforts should be made to have it adopted in the process layout.

(iii) **Principle of Usage**: Every unit of available space should be effectively utilized. This principle should receive top consideration in towns and cities where land is costly.

(iv) **Principle of compactness**: There should be a harmonious fusion of all the relevant factors so that the final layout looks well integrated and compact.

(v) **Principle of Compactness**: There should be harmonious fusion of all the relevant factors so that the final layout looks well integrated and compact.

(vi) **Principle of safety and Satisfaction**: The layout should contain built in provisions for safety for the workmen. It should also be planned on the basis of the comfort and convenience of the workmen so that they feel satisfied.

(vii) **Principle of Flexibility**: The layout should permit revisions with the least difficulty and at minimum cost.

(viii) **Principle of Minimum Investment**: The layout should result in Savings in fixed capital investment, not by avoiding installation of the necessary facilities byt by an intensive use of available facilities.

Types of Layout

A layout essentially refers to the arranging grouping of machines which are meant to produce goods. Grouping is done on different lines. The choice of particular line depends on several factors. The methods of grouping or the types of layout are:

(i) Process layout or functional layout or job shop layout;

(ii) Product layout or line processing layout or flow-line layout;

(iii) Fixed position layout or static layout;

(iv) Cellular manufacturing (CM) layout or Group Technology layout;

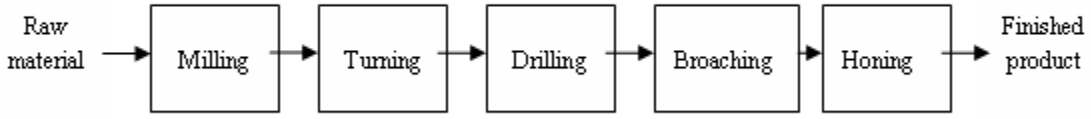
(v) Combination layout or Hybrid layout.

These types of layouts are discussed in the following paragraphs.

Process Layout

Also called the functional layout, layout for job lot manufacture or batch production layout, the process layout involves a grouping together of similar machines in one department. For example, machines performing drilling operations are installed in the drilling department; machines performing turning operations are grouped in the turning department; machines on. In this way, there would be a electro-plating department, a painting department, a machining departments and the like, where similar machines or equipments are installed in the plants which follow the process layout. The process arrangement is signified by the grouping together of like machines based upon their operational characteristics. For example, centre lathes will be arranged in one department turret latches in a second department and milling machines in a third departments.

DIAGRAM



A quantity of raw material is issued to a machine which performs the first operation. This machine may be situated anywhere in the factory. For the next operation, a different machine may be required, which may be situated in another part of the factory. The material should be transported to the other machine for the operation. Thus,. Material would move long distance and along crisscrossing paths. At one stage, the material may be taken to a separate building, say, for heat treatment, and then brought back for grinding. If machines in one department are engaged, the partly finished product awaiting operations may be taken to the store and later reissued for production. Partly finished goods would be waiting for processing in every department, like commuters waiting for buses in a city.

Machines in each department in attend to any product that is taken to them. There machines are, therefore, called general purpose machines. Work has to be allotted to each department in such a way that no machine in any department is idle. In a batch production layout, machines on general purpose machines. The work which needs to be done is allocation to the machine according to loading schedules, with the objective of ensuring idea of Taylor and from the historical point of view, process layout precedes product layout. This type of layout is best suited for intermitted type of production.

While grouping machines according to the process type, certain principles must be kept in mind. These are:

(i) The distance between departments needs to be as short as possible with a view to avoiding long-distance movement of materials.

(ii) Though similar machines are grouped in one department then departments themselves should be located in accordance with the principle of sequence of operations. For Example, in a steel plant, the operations are smelting , casting, rolling etc., these different departments may be arranged in that order to avoid crossovers and backtracking of materials.

(iii) Convenience for inspection.

(iv) Convenience for supervision. Process layout may be advantageously used in light and heavy engineering industries, made to order furniture industries and the like.

Advantages

1. Reduced investment of machines as they are general purpose machines.
2. Greater flexibility in the production.
3. Better and more efficient supervision is possible through specialization.
4. There is greater scope of expansion as the capacities of different lines can be easily increased.
5. This type of layout results in better utilization of men and machines.
6. It is easier to handle breakdown of equipment by transferring work to another machine or work station.
7. There is full utilization of equipments.
8. The investments on equipments would be comparatively lower.
9. There is greater incentive to individual worker to increase his performance.

Disadvantages

1. There is difficulty in the movement of materials. Mechanical devices for handling materials cannot be conveniently used.
2. This type of layout requires more floor space.
3. There is difficulty in production control.
4. Production time is more as work in progress as to travel from place to place in search of machines.
5. There is accumulation of work in progress at different places.

Product Layout

Also called the straight-line layout or layout fore serialized manufacture, the product layout involves the arrangement of machines in one line, depending upon the sequence of operations. Materials are fed into the first machine and finished products come out of the list machine. In between, party finished goods move from machine to machine, the output of one machine becoming the input for the next. It is the feast for the eyes to watch the way sugarcane, fed at one and of the mill comes out as sugar the other end. Similarly, ion paper mill, bamboos are fed in to the machine at one end and paper comes out at the other end.

In product layout, if there are more than one line of production, there are as many lines of machines. There emphasis here, therefore, is on **special purpose machines** in contrast to general purpose machines, which are installed in the process layout. Consequently, the investment on the machine in the straight line layout is higher than the investment on machines in a functional layout. Exhibit 3.3 illustrates the product layout.

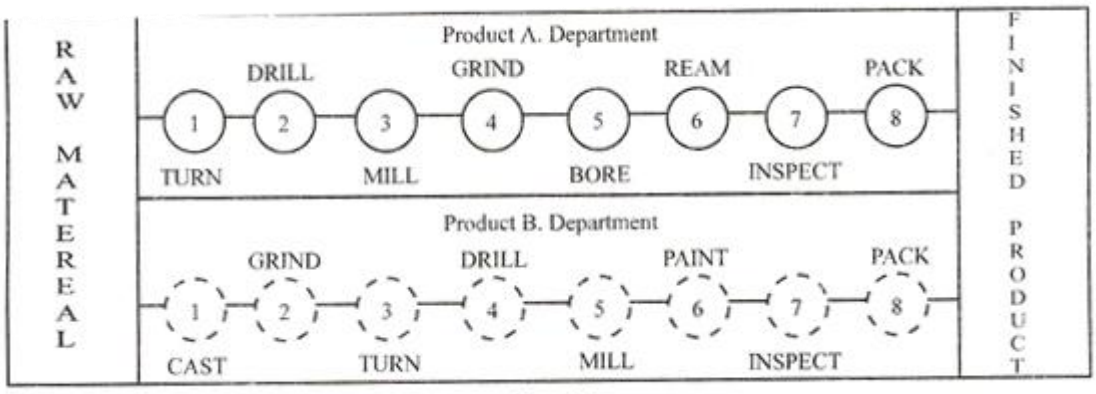


Fig. 3.3

The grouping of machines should be mine, on product line, keeping in mind the following principles:

(i) All the machine tools or other types of equipment must be place at the point demanded by the sequence of operations

(ii) There should be no points here one line crosses another line;

(iii) Materials may be fed where they are required for assembly but not necessarily all at one point; and

(iv) All the operations, including assembly, testing and packing should be included in the line.

The product layout may be advantageously followed in plant manufacturing standardized products on a mass scale such as chemical, paper, sugar, rubber, refineries and cement industries.

Advantages

1. There is mechanization of materials handling and consequently reduction in material handing cost.
2. This type of layout avoids production bottlenecks.
3. There is economy in manufacturing time.
4. This type of layout facilitates better production control.
5. This type of layout requires less floor area per unit of production.
6. Work-in-progress is reduced and investment thereon is minimized
7. Early detection of mistakes are badly produced item is possible.
8. There is greater incentive to the group of worker to raise their level of performance

Disadvantages

1. Product layout is known for its inflexibility.
2. This type of layout is also expansive
3. There is difficulty also supervision.

4. Expansion is also difficult

5. Any breakdown of equipment along the production line can disrupt a whole system.

Combination Layout:

A combination of process and product layouts combines the advantages of the both types of layouts. Moreover, these days pure product or process layouts are rare. Most of the manufacturing sections are arranged in process layout with manufacturing lines occurring here and there (scattered) wherever the conditions permit. A combination layout is possible where an item is being made in different types and sizes.

In such cases machinery is arranged in a process layout but the process grouping (a group of number of similar machines) is then arranged in a sequence to manufacture various types and sizes of products. The point to note is that, no matter the product varies in size and type, the sequence of operations remain same or similar. Figure 4.3 shows a combination type of layout for manufacturing different sized gears.

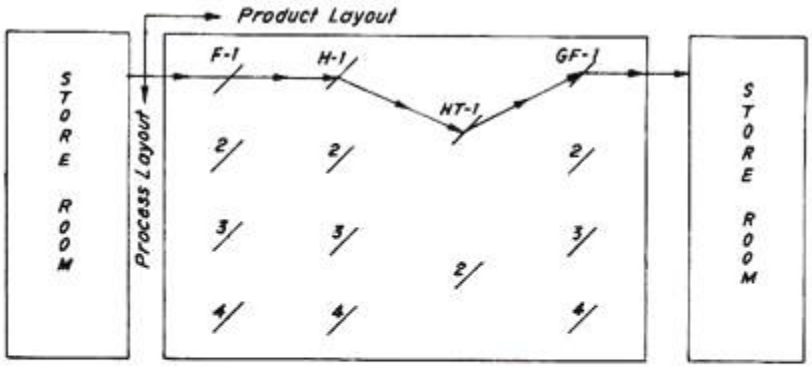


Fig. 4.3. A combination layout for making different types and sizes of gears.

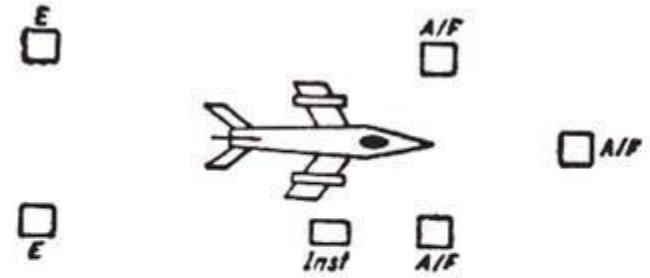
F = Blank forging hammers.
H = Hobbing machines for cutting gear teeth.
HT = Heat treatment furnaces.
GF = Gear finishing machines.

A combination layout is also useful when a number of items are produced in same sequence but none of the items are to be produced in bulk and thus no item justifies for an

individual and independent production line. For example, files, hacksaws, circular metal saws, wood saws, etc. can be manufactured on a combination type of layout.

Type # 5. Fixed Position Layout:

Layout by fixed position of the product is inherent in ship building, aircraft manufacture (Fig. 4.4) and big pressure vessels fabrication. In other types of layouts discussed earlier, the product moves past stationary production equipment, whereas in this case the reverse applies; men and equipment are moved to the material, which remains at one place and the product is completed at that place where the material lies.



E - Engines
A/F - Air-frame
Inst - Instruments

Fig. 4.4. Layout by fixed position of products.

Advantages:

(i) It is possible to assign one or more skilled workers to a project from start to finish in order to ensure continuity of work.

(ii) It involves least movement of materials.

(iii) There is maximum flexibility for all sorts of changes in product and process.

(iv) A number of quite different projects can be taken with the same layout.

Disadvantages:

(i) It usually involves a low content of work-in-progress.

(ii) There appears to be low utilization of labour and equipment.

(iii) It involves high equipment handling costs.

3.4Work study

Industry everywhere has been striving hard to discover new work methods and techniques which could help produce goods of required quality at reasonable costs. The search has resulted in finding techniques such as work simplification, job design, value analysis and the like. All these are collectively called methods engineering or industrial engineering' The other names used are 'work design', work study methods analysis and operation analysis. Methods engineering is closely affiliated with the functions of work measured (or time study) and method study. This chapter is developed to detailed discussion of these approaches.

For the sake of simplicity or for avoiding confusion, we use the term or study which comprises two techniques known as method study and or measurement throughout this chapter.

Importance of work study

In today competitive business environment, it is necessary that the employees work harder be more productive so that, the production costs can be kept low to meet globalcompetiton. Operations managers have to continuously strive for low production costs, high product quality and improve every facet of manufacturing. In this direction improving labour productivity and reducing costs by improving work methods and simplifying the needs special attention by operation mangers. To facilitate this, work study technique (now known as industrial engineering) has been developed over a period of time.

Definition of work study

Work study is defined as that body of knowledge concerned with the analysis of the work methods and the equipments used in performing a job, the design of the optimum work

methods and the standardization of proposed work methods. Works study has contributed immeasurably to the search for better methods, and the effective utilization of this management tool has helped in the accomplishment of higher productivity.work study is the management too tot achieve higher productivity in any organization , whether manufacturing tangible products are offering services to its customers.

Work study is also understood as a a systematic, objective and crictal and examination of the factors affecting productivity for the purpose of improvement it makes use of techniques of method study and work measurement to ensure the best possible use of human and material resources in carrying out specific activity

Work study is defined by standard institution as follows "a generate term for those technique, particularly method study and work measurement which the use in the examination of human work in all its contest and in which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to effect". Objectives of work study

(i) The main objective of work study is to improve productivity of current jobs and maximize productivity of jobs designed for the future, subjects to constrains.

(ii) To reduce waste through standardization of work elements of the job.

(iii) To increase industrial productivity through job standardisation.

(iv) To analysis the present method of doing a job systematically, in order to develop a new and better method (referred to as methods study or methods analysis).

(v) To measure the content of the job by measuring the time required to do the job for a qualified worker and hence to establish the standard time for the job for the elements as well as whole job (referred to as work measurement).

(vi) To improve labour (or operational) efficiency.

(vii) To enabled optimal utilization of plant and equipments.

(viii) To ensure most effective utilization of human effort.

(ix) To determine efficient work methods.

(x) To evaluate human effort.

(xi) To establish standards of performance of employees

(xii) To standardized, the method material and equipments used in the production process and also to establish an optimum sequence of operations and the plant layout the minimizes the material handling time and cost.

(xiii) To increase productivity by ensuring the best possible use of all resources (human, machine and material)to achieve best quality product/service at minimum possible cost.

Scope of work study

Work study as a discipline or management tool is concerned with

(i) Better ways of performing job/tasks.

(ii) Exercising control over the out by setting standards of performance in terms of output(goods and service) per unit of time period(i.e., per hour , per day etc.,).

The technique used to improve the method of performing job or tasks is known as "method study" or "method analysis" or " operation analysis" or "work simplification". It also involves the study of the motion of the limbs of the worker while he performs a job and hence it is also known as "motion study"

The technique used to measure the work content of the job in terms of standard time units (seconds, minutes, or hours) and there by establish the standard output of a worker in terms of standard units of output or standard hours of work per shift of working or per day of work, is referred to as "work measurement" (or popularly as time study). Exhibited 16.1 illustrate the scope of work study.

The purpose of work study is to determine the best and most effective methods of accomplishing and operation or function necessary to do a job . The criteria for the best method could be an increase in job satisfaction and employee morale, reduction in fatigue, decrease in number of accidents and personal injuries, minimization of usage materials, tool breakage or consumables and supplies. work study aims at increase in productivity by reducing the time taken to carry out any operation or task and complete a job or work.

One of the most important strategic decisions made by companies engaged either in manufacturing goods or in providing services is where to locate their operations. All firms

need to address the location decision because location greatly affects both fixed and `variable costs. Also, it has a major impact on the overall profitability of the firm. For instance, depending on the product and type of production or service taking place, transportation costs alone can total as much as 25 percent of the product's selling price. Other costs that may be influenced by location include taxes, wages, raw material costs and rents. A well known consulting firm McKinsey believes "location ultimately has the power to make or break a company's business strategy".

Once management is committed to a specific location, many costs are firmly decided and are difficult to reduce later as they are location dependent. For instance, energy costs, labour costs etc., are determined by the location where the plant is situated, consequently, hard work to determine an optimal facility (or plant) location is crucial to the success of any business organization.

3.5..Waste Management Or Effluent disposal system

Effluent sewers also currently serve fewer people than septic systems, which also use septic tanks, but simply **dispose** of the **effluent** by draining it into a leach field. About one quarter of United States homes **dispose** of their wastewater with septic tanks.

Wastewater disposal systems also known as septic **system**, takes the sewage from your home or business, treats it, and then releases it into the ground

Some key advantages of MBR process in comparison to other common wastewater treatment plants, are summarized as follows:

• Produces extremely high quality effluent that is ideal for effluent reclamation and reuse.
• Plant is efficient, easy to operate, highly reliable and has low maintenance needs.

• Very small footprint for plant tankage and equipment such that the whole facility can usually be installed inside a building.

• Small, "package plant" systems can be engineered and installed quickly and are ideal for de-centralized treatment using multiple small plants.

• A single, centralized plant can be engineered for future capacity expansions that can be done in small incremental steps at modest cost.

MEMBRANE BIOLOGICAL REACTOR (MBR) Membrane biological reactor process (MBR), also called immersed membranes, submerged membranes or microfiltration, is an activated sludge process that utilizes a physical barrier, a plate-type membrane, to separate the wastewater solids from the liquid. Membrane microfiltration technology for wastewater treatment is relatively new in the United States, however it has been in use in Europe and Japan for many years. MBR wastewater process equipment is being implemented for use or testing in increased many areas.

Summary:

- ✓ *Advances in technologies create new product and services and reshape process. Technology takes many forms, beginning with ideas, knowledge, and experience and then utilizing them to create new and better ways of doing things.*

- ✓ *Plant Layout, also known as "Facilities Layout" refers to the configuration of departments, work-centres and equipment and machinery with focus on the flow of materials or work through the production system.*

  Process layout
  Product layout
  Combination layout
  Fixed position layout

- ✓ *Work study is defined as that body of knowledge concerned with the analysis of the work methods and the equipments used in performing a job, the design of the optimum work methods and the standardization of proposed work methods.*

- ✓ ***Wastewater disposal systems** also known as septic **system**, takes the sewage from your home or business, treats it, and then releases it into the ground*

4.1 Cost–benefit **analysis**. To determine if an investment/decision is sound (justification/feasibility) – verifying whether its benefits outweigh the **costs**, and by how much; To provide a basis for comparing**projects** – which involves comparing the total expected **cost** of each option against its total expected benefits. A cost analysis (also called cost-benefit analysis, or CBA) is a detailed outline of the potential risks and gains of a projected venture. Many factors are involved, including some abstract considerations, making the creation of a CBA more of an art than a science, though a quantitative mindset is still a must-have. A CBA is useful for making many types of business and personal decisions, especially ones with a potential for profit (though this need not be the case). Although conducting a CBA can be a complex task, you do not need to be a business major to learn how to do so. Anyone who's willing to brainstorm, research, and analyze data can make a top-quality CBA.

1. **Define your CBA's unit of cost.** Since a CBA's aim is to determine whether a certain project or venture is worth the cost it would take to enact, it's important to establish what exactly your CBA measures in terms of "cost" at the outset. Usually, a CBA measures literal cost in terms of **money**, but, in cases where money is not an issue, CBAs can measure cost in terms of time, energy usage, and more.

2. **Itemize the tangible costs of the intended project.** Almost any project comes with costs. For instance, business ventures require initial monetary investments to buy goods and supplies, train staff, and the like. The first step of a CBA is to make a thorough, exhaustive, itemized list of these costs. You may want to investigate similar projects to find costs to include on your list that you may not otherwise have considered. Costs can be one-time events or ongoing expenses. Costs should be based on actual market prices and/or research when possible, but should be intelligent, researched estimates when this is not possible.Below are the types of costs you'll want to include in your CBA:

- The price of goods or equipment associated with the venture
- Shipping, handling, and transportation costs
- Operating expenses
- Staffing costs (wages, training, etc.)

- Real estate (rented offices, etc.)
- Insurance and taxes.
- Utilities (electricity, water, etc.)

3. **Itemize any and all *intangible* costs.** It is rare for a project's costs solely to be composed of tangible, real expenses. Usually, CBAs *also* take into account a project's intangible demands - things like the time and energy required to complete the project. Though these things can't actually be bought and sold, real-world costs can be assigned to them by determining the amount of money one would hypothetically be able to make if they were used for another purpose. For instance, though taking a year off from a job to write a novel is technically free, one must take into account the fact that doing so means going without wages for a year. Thus, in such a situation, we're basically exchanging *money* for *time*, buying a year for ourselves at the price of a year's wages.

   Below are the types of intangible costs you'll want to consider for your CBA:

- The cost of the time spent on a project - i.e., the money that *could* be made if this time was spent doing something else
- The cost of the energy spent on a project
- The cost of adjusting an established routine
- The cost of any possible lost business during the implementation of the projected venture
- The risk factor value of intangibles like safety and customer loyalty

4. **Itemize the projected benefits.** The purpose of any CBA is to compare the benefits of a project to the costs - if the former clearly outweigh the latter, the project will probably be given the go-ahead. Itemizing the benefits is done in the same way as the cost portion of the analysis, though you will most likely need to rely on educated estimates more than you will with the costs. Try to back up your estimates with evidence from research or similar projects and assign a monetary amount to any tangible or intangible ways in which you will see a positive return on your venture.

   Below are the types of benefits you'll want to consider in your CBA:

- Income produced
- Money saved
- Interest accrued
- Equity built

- Time and effort saved
- Repeat customer business
- Intangibles like referrals, customer satisfaction, happier employees, a safer workplace, etc.

One of the main functions of project management is to forecast and track costs to avoid cost overruns. While poor execution of project management tasks can lead to increased costs, you can link less obvious reasons to the processes of project management and the underlying nature of complex projects. Effective project management identifies such possible sources of cost overruns early and mitigates their effect.

Estimates

A common reason for cost overruns is the inaccuracy of cost estimates. When the bids for subcontracts or the actual costs come in, they are often higher than anticipated. Such cost overruns are due either to incorrect estimates or to changed conditions in the marketplace. You can review cost estimates before placing orders to identify mistakes or changed conditions. An overall review may find that increases in some areas are compensated by decreases in others. You may be able to adjust requirements to reduce costs or seek out lower-cost suppliers. Advising the business owners or managers of possible higher costs at this stage gives them the option of making changes and maintaining their budgets.

Design

Sometimes, the designs or drawings that form the basis of the project are not realistic. You may find that a combination of specified features is difficult to achieve or that drawings show an incorrect arrangement. Executing the project as specified will either cost extra or cause problems that must be resolved later at additional cost. As project manager, you have to continuously compare plans with executed work to find such discrepancies early and correct them.

Planning:

The project progresses according to a plan that assigns durations to project tasks. If the projected durations can be too short, the project take longer than anticipated and cause cost overruns. Monitoring project tasks on the critical path, which is the task sequence from

project start to finish that takes the longest to complete, helps reduce the risk of delays. Project tasks off the critical path have slack times, or free times between tasks, that you can use to compensate for delays.

Scope:

Changes in the scope of supply within a project frequently cause cost overruns. These changes result from new requirements that the owners introduce and fixes for functions that don't work as specified. As project manager, you must make sure the owners understand that additional requirements result in higher costs, which you can classify as improvements rather than cost overruns. When you discover that parts of the project don't work as specified, you must explore different solutions and present them to the owners. Sometimes, you can find acceptable levels of functionality that don't cause cost overruns.

4.2 Project cost:

Project cost control aims to achieve a business objective on time and within the set budget. In other words, project cost control focuses on maximizing effectiveness and minimizing expense. Business owners can control the costs of a project by carefully planning a suitable budget, monitoring project activities and finding solutions to any shortfalls or miscalculations that jeopardize the project's success

Monitoring Team Activities

As the project commences, the project manager must monitor each contributor to keep the project on budget and on time. For instance, if a worker fails to complete a necessary task on time, the manager must know about the delay immediately before problems develop down the pipeline. Meeting individually on a regular basis can help the manager stay abreast of progress. Asking for daily or weekly reports is another way to stay in touch. Group meetings also might be necessary to ensure workers aren't working at cross purposes or performing redundant tasks. For instance, some workers might not be aware how strategic shifts have changed project requirements.

D**amage Control**

No budget can handle every eventuality. The key to effective project cost control is being flexible enough to find solutions to inevitable problems. For example, perhaps a supplier failed to deliver necessary project equipment on time. To minimize the threat to the budget, a project manager must solve the problem quickly or find a workaround. In other words,

project cost control requires an ability to repair or abandon doomed strategies as quickly as possible, before they jeopardize the success of the project.

Considerations

A host of factors can threaten a project and its budget, so project managers must be vigilant. Experience handling projects is perhaps the best preparation, but new project managers can take some steps to improve their skills. Documenting every step of the process, for example, helps a manager identify where problems began and form better plans in the future. Periodic reviews of the team's performance by upper management, clients or the business owner also might help by providing an objective take on the team's performance.

In project management, a **task** is an activity that needs to be accomplished within a defined period of time or by a deadline to work towards work-related goals. A task can be broken down into assignments which should also have a defined start and end date or a deadline for completion. One or more assignments on a task puts the task under execution. Completion of all assignments on a specific task normally renders the task completed. Tasks can be linked together to create dependencies.

Tasks completion generally requires the coordination of others. Coordinated human interaction takes on the role of combining the integration of time, energy, effort, ability, and resources of multiple individuals to meet a common goal. Coordination can also be thought of as the critical mechanism that links or ties together the efforts on the singular level to that of the larger task being completed by multiple members. Coordination allows for the successful completion of the otherwise larger tasks that one might encounter.

In most projects, tasks may suffer one of two major drawbacks:

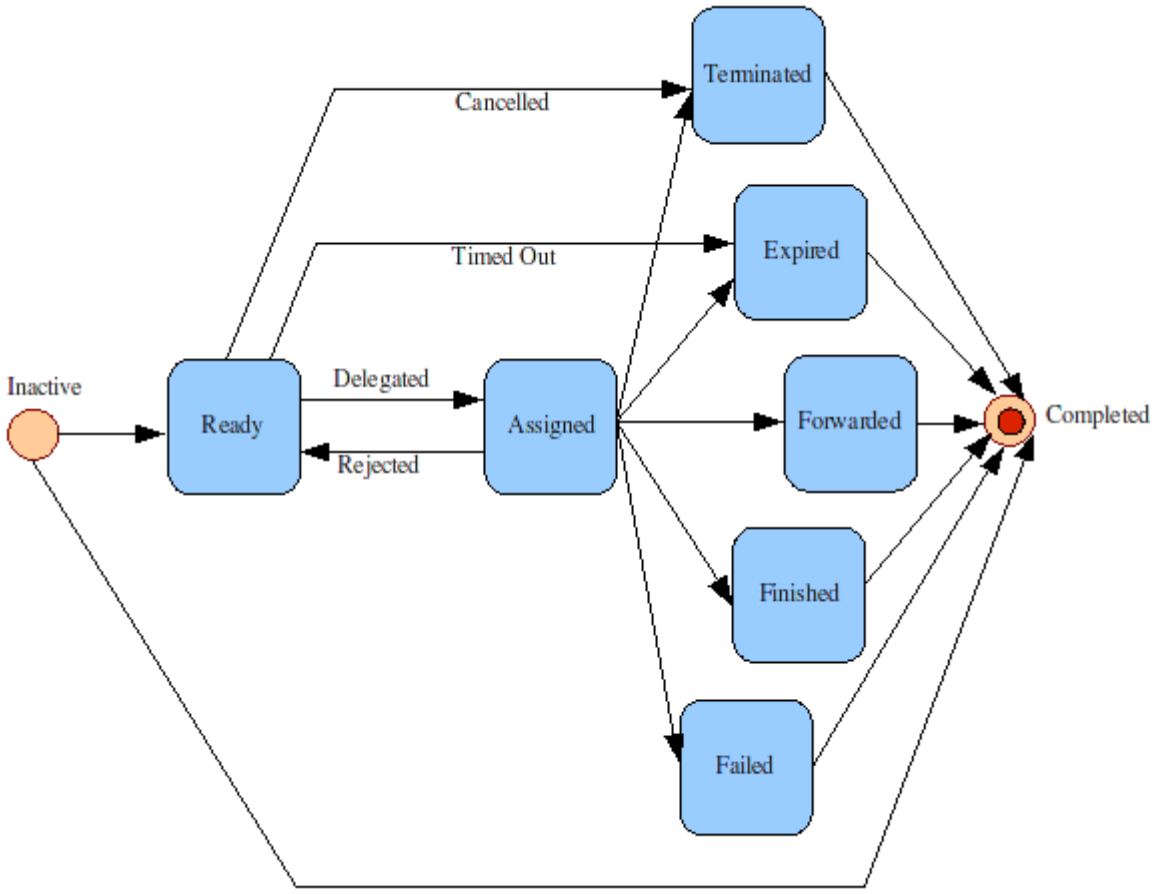
- Task dependency: Which is normal as most tasks rely on others to get done. However, this can lead to the stagnation of a project when many tasks cannot get started unless others are finished.
- Unclear understanding of the term *complete*: For example, if a task is 90% complete, does this mean that it will take only 1/9 of the time already spent on this task to finish it? Although this is mathematically sound, it is rarely the case when it comes to practice.

4.3 Task management is the process of managing a task through its life cycle. It involves planning, testing, tracking and reporting. Task management can help either individuals achieve goals, or groups of individuals collaborate and share knowledge for the accomplishment of collective goals. Tasks are also differentiated by complexity, from low to high.

Effective task management requires managing all aspects of a task, including its status, priority, time, human and financial resources assignments, recurrency, notifications and so on. These can be lumped together broadly into the basic activities of task management.

Managing multiple individual or team tasks may require specialised software, for example workflow or project management software. In fact, many people believe that task management should serve as a foundation for project management activities.

Task management may form part of project management and process management and can serve as the foundation for efficient workflow in an organisation. Project managers adhering to task-oriented management have a detailed and up-to-date project schedule, and are usually good at directing team members and moving the project forward



Activities supported by tasks

As a discipline, task management embraces several key activities. Various conceptual breakdowns exist, and these, at a high-level, always include creative, functional, project, performance and service activities.

- Creative activities pertain to task creation. In context, these should allow for task planning, brainstorming, creation, elaboration, clarification, organization, reduction, targeting and preliminary prioritization.

- Functional activities pertain to personnel, sales, quality or other management areas, for the ultimate purpose of ensuring production of final goods and services for delivery to customers. In context these should allow for planning, reporting, tracking, prioritizing, configuring, delegating, and managing of tasks.
- Project activities pertain to planning and time and costs reporting. These can encompass multiple functional activities but are always greater and more purposeful than the sum of its parts. In context project activities should allow for project task breakdown, task allocation, inventory across projects, and concurrent access to task databases.
- Service activities pertain to client and internal company services provision, including customer relationship management and knowledge management. In context these should allow for file attachment and links to tasks, document management, access rights management, inventory of client & employee records, orders & calls management, and annotating tasks.
- Performance activities pertain to tracking performance and fulfillment of assigned tasks. In context these should allow for tracking by time, cost control, stakeholders and priority; charts, exportable reports, status updates, deadline adjustments, and activity logging.
- Report activities pertain to the presentation of information regarding the other five activities listed, including graphical display.

4.4 A **cost estimate** is the approximation of the cost of a program, project, or operation. The cost estimate is the product of the cost estimating process. The cost estimate has a single total value and may have identifiable component values. A problem with a cost overrun can be avoided with a credible, reliable, and accurate cost estimate. A cost estimator is the professional who prepares cost estimates. There are different types of cost estimators, whose title may be preceded by a modifier, such as building estimator, or electrical estimator, or chief estimator.

In project management, project cost management is a major functional division. Cost estimating is one of three activities performed in project cost management.

In cost engineering, cost estimation is a basic activity. A cost engineering reference book has chapters on capital investment cost estimation and operating cost estimation. The fixed capital investment provides the physical facilities. The working capital investment is a revolving fund to keep the facilities operating.

In system, product, or facility acquisition planning, a cost estimate is used to evaluate the required funding and to compare with bids or tenders.

In construction contracting, a cost estimate is usually prepared to submit a bid or tender to compete for a contract award.

In facility maintenance and operation, cost estimates are used to establish funding or budgets.

In an attempt to manage liability risk, some firms avoid the use of the word estimate and instead refer to the estimate as an "Opinion of Probable Cost.

Various projects and operations have distinct types of cost estimating, which vary in their composition and preparation methods. Some of the major areas include:

- Construction cost (i) detailed construction estimate (ii) abstract construction estimate
- Manufacturing cost
- Software development cost
- Aerospace mission cost
- Resource exploration cost
- Facility operation cost
- Facility maintenance and repair cost
- Facility rehabilitation and renewal cost
- Facility retirement cost

Estimate quality refers to the delineation of quality requirements for the estimate. These requirements are set out in accordance with formal quality assurance standards. There may also be other expectations for the estimate which are not specific requirements, but may affect the perceived quality of the estimate. Published quality requirements generally have

to do with credibility, accuracy, confidence level, precision, risk, reliability, and validity of the estimate, as well as thoroughness, uniformity, consistency, verification, and documentation

4.5 OVER HEAD

Meaning of overhead:

The word overhead connotes that which cannot be allocated but which can be appropriate to cost units. Overhead cost are the operating costs of business enterprise which is cannot be identified with particular units. The indirect portion of the total constitutes the overhead cost which is the aggregate of indirect materials costs, indirect wages and indirect expenses. overheads are all expenses other than direct expenses`

Overhead cost is the aggregation of indirect material.Indirect labour and indirect expenses. According to the terming of cost accountany, overhead is defined as the aggregate of indirect material cost,indirect wages and indirect expenses".overhead is otherwise called as so on.An item of cost with can not be identified with a particular cost unit is known as overhead.eg:shortage of materials, carriage inward, etc.,Sometimes direct expenses may be treated as overheads as it is not convenient to large them as direct cost, eg: screws,nuts, bolts et.,

definition:

Overheads are defined as the aggregate of indirect material cost indirect wages and indirect expenses"-IMA London.

Overheads may be defined as the cost of indirect materials,indirect labour and such other expenses including series as cannot conveniently be larged to a specific unit- Harold .j. wheldon.

overhead is defined by office terminology as follow: expenditure on materials, labour or series which can be identified with cost object, is treated as overhead or indirect expenditure.

overhead is also known as "indirect costor " or "burden" and "oncost"

Elements of overheads:

overhead include three elements namely indirect material,indirectlabour and indirect expenses. indirect material cost is the cost which cannot be identified with and assigned to an specific job, work order or process e.g. nails,nuts,and boats,glue, thread.

indirectlabour cost is the cost which cannot be identified with and assigned to any specific job, work order or process sample supervisors, salaries, foreman's salaries, idle time wages etc.

indirect expenses are the expenses withcannot be identified with and assigned to any specific job, work order to process examples: factory rent repairs and maintenance of plant and machinery., stores handling expenses, depreciation of plant etc.

Steps in overhead:

1. classification ofoverhead.

2. collection ofoverhead

3. allocation and apportionment of overhead.

4. Reapportionment of series department cost to production departments.

5. absorption of overhead by production units.

Classifiation of overheads:

The IMA Terminology defines the term classification as the arrangement of items in logically groups having to their nature orpurpose".classification is the arrangement of items in groups. costclassification is the process of grouping cost according to their common charateristics and establishing in seriesof special groups according to which costs are classified

overhead may be classified into five groups:

I On the basis of function, overhead isclassified into four types.

1) Prodution overheads.

2) Administrative overheads.

3) Selling overheads

4)Distribution overheads

1.Prodution overheads:

It refers to all those indirect expenses which are incurred in connection was "Factory on with manufacturing operations.It is otherwise called as manufacturing overhead or work overhead.it consists of indirect material, indirect labour and indirect expenses whichare included in producing an articles. it is the aggregate of part of cost of production. it is also known as "Factory on cost" or works on cost" eg. factory rent, factory, lighting, supervision salary etc.

Administrative overheads.

It refers to all those expenses which are incurred in the direction, control and administration of an enterprise and which is not directly related to research and development and distribution and selling activity of the enterprises. It is also known as office overhead or administrative expenses. These expenses are associated with running the generaloffice. eg: office rent, office lighting, salary of general manager, printing and stationery,insurane, legal expenses etc.

Selling overheads:

selling overhead refers to the cost of selling function, it comprises marketing cost and selling cost. It is the cost of reacting demand, promoting sales and relating customers e.g. Advertisement, salaries of salesmen, commission on sales, market research etc

Distribution overhead

It refers to all those expenditures which are incurred from the time the product is completed in works until it reaches its destination. In other words, it refers to all expenses incurred for executing orders. Distribution expenses relate to the total indirect cost associated with the distribution of finished products. e.g: cost of warehousing finished product, cost of prodution,despatch depreciation of delivery and transportation cost etc.

II on the basis of elements:

Indirect Material:

Indirect material costs refer to call those material cost whichcannot be allocated but which are to be apportioned to or absorbed by cost centres or cost units.

Indirect wages:

Indiret wages are those wages which cannot be allocated but which are to be approportioned to or absorbed by cost centres or cost units.

Indirect expenses:

Expenses which cannot be allocated but which are to be apportioned to or absorbed by cost centres or cost unit

overhead is classified into three groups:

1.Fixed overheads:

Fixed overheads are those expenses which remain constant irrespective of the volume of output or prodution.That is, will not carry according to volume of prodution.Fixed overhead refers to those expenses that remain unchanged in total for a given period irrespective of volume prodution. Fixed costs are not affected by changes in the volume of output or sales. The amount of fixed expenses does not depend upon the volume of prodution. It has the following features:

(a) the total amount of fixed overhead remains constant.

(b) The fixed overhead expenses per unit will carry.e.g. Rent of fatory , salary of superisor et.

(c) Fixed expenses remain constant only within a certain range of plant capacity. It is alsoknown as period cost.

(d)It cannot be controlled bya specified member of an undertaking.e.g. supervisorcannot control the fixed expenses of his department.

(e) change in the basic price level affects the fixed nature of fixed nature of overhead.

variable overheads:

variable overhead costs are those with will according to the volume of production. All direct elements of costs are variable in nature.When the production goes up then the overhead also increases and when the production decreases, then the overhead also increases and when the represent those costs that carry indirect proportion to the volume of output. variable cost refers toa cost which carries witha measure of activity. There is a linear relationship between article cost and the level of activity.eg., Indirect material, indirect labour etc.,

Features :

The total amount of variable overhead depends upon the volume production that is total amount will vary according to the volume of outputvariable overhead cost per unit remains constant.it is also known as product cost.itcan be controlled by the action of a specfied members of the undertaking

III semi-variable overheads:

Semivariable overhead refers to those expenses which are neither fixed orvariable in relation to the volume of production that is they are partly variable and apartly fixed. they are neither wholly fixed nor wholly variable. up to a certain volume of production, they are

fixed and thereafter they huge and after that they remain constant up to a certain level of production. The IMA variable components and which is partly affected by a change both fixed and activity. These expenses remain fixed for certain levels of output and vary with other levels disproportionately

eg; Telephone Repairs and maintenance, power and fuel electricity stores, et., semi variable overhead may be segregated into fixed and variable overhead under the following methods.

comparison method.

analytical method

graphic method (line of best fit)

method of least squares.

high and low points method.

collection of overheads:

overhead expenses will be incurred by several departments in an organisation.

These overheads are to be collected for the purpose of allocation and apportionment. Different items of overhead may be collected from the following documents.

store requisition

vouchers and invoices

cash book

salary or pay bills

journal entries.

other registers and reports.

Alloation and approtionment of overheads:

allocation of overheads:

it refers to the allotment of those expenses which can be identified wholly to cost centres or cost units. The term allocation means the allotment of whole item of expenses without decision to a particular department or cost centre. example: the cost of repairs an maintainence of a particular machine should be hanged to that particular department in which inthe machine is install.

Apportionment:

It refers to the process of charging expenses in an suitable proportion of items of cost to various cost centres or cost units. Approtionment is done in respect of those items withcannot be allocated to any scientific cost entre or cost units. Example: the rent of a factory can be allocated to a single department it is to be apportioned on the basis of area occupies by each department in an organisation.

Material cost:

The term materials refers to raw materials used for production, sub-assemblies and fabricated parts. Inventory means the raw materials, work-in-process goods and completely finished goods that are considered to be the portion of a business' assets that are ready or will be ready for sale.

Material Control aims at efficient purchasing of materials, their efficient storing and efficient use or consumption. Objectives in a good system of material control can be:

• Materials of desired quality available when needed for efficient and uninterrupted production.

• Material to be purchased only when need exists and in economic quantities.

• Purchase of materials to be made at the most favorable prices under the best possible terms.

• Materials are protected against loss by fire, theft, etc.

• Materials should be stored in such a way that they provide minimum of handling and cost.

Pricing of materials may change from time to time.

Materials are usually acquired by several deliveries at different prices. Actual costs can then take on several different values. Therefore, the materials pricing system adopted should be the simplest and the most effective one.

First-in-first-out(FIFO) Last-in-first-out(LIFO) Weight average cost (WAVCO) Specific identification/unit cost method

This method assumes that the first stock to be received is the first to be sold. The cost of materials used is based on the oldest prices. The closing stock is valued at the most recent prices.

This method assumes that the last stock to be received is the first to be sold. Therefore, the cost of materials used is based on the most recent prices. The closing stock is valued at the oldest prices.

EOQ is the order quantity that minimizes total inventory carrying costs and ordering costs. Ordering costs are costs that are incurred on obtaining additional inventories. They include costs incurred on communicating the order, transportation cost, etc. Carrying costs represent the costs incurred on holding inventory in hand. They include the opportunity cost of money held up in inventories, storage costs, spoilage costs, etc. EOQ = 2*O*Q C Where EOQ = Economic Order Quantity O= order cost per order Q = Annual quantity required in units C =Carrying cost per unit per annum

What is Labour cost?

Labour cost represents human contribution. Labour cost is sensitive in nature. The reason is that the labour cost is fully based on the human behavior i.e. labour behavior.

The control of labour costs requires the control of the labour behavior. Therefore, the management should study human behaviour, performance of labour, time and motion study, labour turnover, labour approach in order to control the labour cost.

Labour cannot be stored for future reference. It is very much similar to the perishable nature of materials. Some materials may lose its quality and not used for the purpose of

production. Such materials will be waste one. Likewise, once labour is lost, the same cannot be recovered and not effectively used in the days to come.

If labour is kept idle, the management should pay remuneration or wages for such idle time. Hence, the management incurred two losses. They are loss of labour working hours and monetary loss. Hence, the management is very keen in the control of labour cost.

Classification of Labour Cost

The labour cost may be classified in the following ways.

1. Direct Labour Cost

Direct Labour cost is that portion of salary or wage, which can be identified with and charged to a single unit cost of production.

Characteristics of Direct Labour Cost:

The direct labour cost has the following characteristics.

a. It has direct relationship with the product or process or cost unit.
b. It can be measured quantitatively.
c. It is sufficiently material in amount.

2. Indirect Labour Cost

It is not identifiable within the production of goods and services even though directly incurred. These costs are incurred in the production place. Sometimes, some cost center may render service to the production departments or production activities. Such cost centers purchase, engineering and time keeping.

3. Controllable Labour Cost

A labour cost can be controlled by the management during production period and even during absence of production. A standard time and time rate may be fixed and request the labour to complete the job or order within such time. If so, the labour cost can be controlled to some extent.

4. Non-Controllable Labour Cost

A labour cost, which cannot be easily controlled by the management. A job or order can be completed by a group of labours. The efficiency of such group of laboursdiffer in nature. A labour can use his/her efficiency in full as per the prevailing environment in the product place. If so, the cost cannot be controlled by the management.

Information required for Labour cost control

The following information is required for labour cost control effectively

1. Cost of recruitment of labour.
2. Training cost of workers.
3. Labour Turnover.
4. Idle Time.
5. Over Time.
6. Shift Work.
7. Labour Efficiency.
8. Number of workers.
9. Wastage.
10. Spoilage.
11. Wages Paid.

Methods or ways of Labour cost control

The management to control the labour cost effectively may exercise the following ways.

1. Proper production planning.
2. Fixing of standard time.

3. Fixing of clear-cut wage structure.

4. An agreement with workers.

5. Preparation of labour budgets i.e. Labour Cost Budget and Labour Hours Budget.

6. Performance reports of labour.

7. Fixing of specific incentive payment.

What is 'Production Cost' or cost of production:

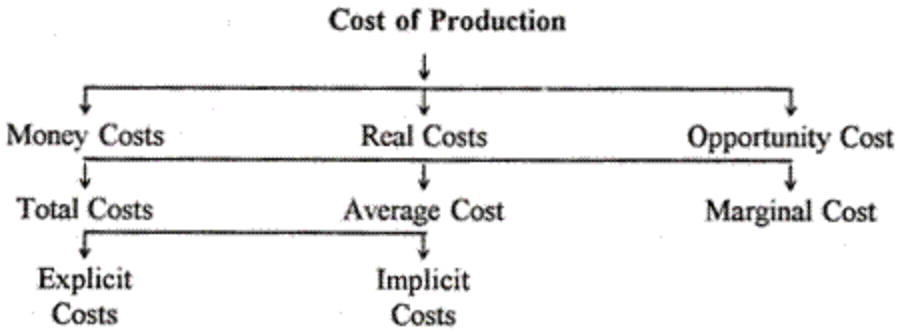
Production cost refers to the cost incurred by a business when manufacturing a good or providing a service. Production costs include a variety of expenses including, but not limited to, labor, raw materials, consumable manufacturing supplies and general overhead. Additionally, any taxes levied by the government or royalties owed by natural resource extracting companies are also considered production costs.

BREAKING DOWN 'Production Cost'

Also referred to as the cost of production, production costs include expenditures relating to the manufacturing or creation of goods or services. For a cost to qualify as a production cost it must be directly tied to the generation of revenue for the company. Manufacturers experience product costs relating to both the materials required to create an item as well as the labor need to create it. Service industries experience production costs in regards to the labor required to provide the service as well as any materials costs involved in providing the aforementioned service.

In production, there are direct costs and indirect costs. For example, direct costs for manufacturing an automobile are materials such as the plastic and metal materials used as well as the labor required to produce the finished product. Indirect costs include overhead such as rent, administrative salaries or utility expenses.

Cost of production is the total price paid for resources used to manufacture a product or create a service to sell to consumers including raw materials, labor, and overhead.



For a business owner, knowing their cost of production is a vital step in creating and maintaining a profitable business. By knowing the cost of every step in production, management can optimize production processes, delivery schedules, and general business activities in an effort to make better products more efficiently than in the past.

Summary:

- ***Cost**–benefit **analysis**. To determine if an investment/decision is sound (justification/feasibility) – verifying whether its benefits outweigh the **costs**, and by how much; To provide a basis for comparing **projects** – which involves comparing the total expected **cost** of each option against its total expected benefits. A cost analysis (also called cost-benefit analysis, or CBA) is a detailed outline of the potential risks and gains of a projected venture.*
- ***Task management** is the process of managing a task through its life cycle. It involves planning, testing, tracking and reporting. Task management can help either individuals achieve goals, or groups of individuals collaborate and share knowledge for the accomplishment of collective goals.*
- *A **cost estimate** is the approximation of the cost of a program, project, or operation. The cost estimate is the product of the cost estimating process. The cost estimate has a single total value and may have identifiable component values.*

- *Overhead cost are the operating costs of business enterprise which is cannot be identified with particular units. The indirect portion of the total constitutes the overhead cost which is the aggregate of indirect materials costs, indirect wages and indirect expenses. overheads are all expenses other than direct expenses`*
- *Labour cost represents human contribution. Labour cost is sensitive in nature. The reason is that the labour cost is fully based on the human behavior i.e. labour behavior.*
- *Production cost refers to the cost incurred by a business when manufacturing a good or providing a service. Production costs include a variety of expenses including, but not limited to, labor, raw materials, consumable manufacturing supplies and general overhead.*

5.1 What is 'Working Capital'

Working capital is a measure of both a company's efficiency and its short-term financial health. Working capital is calculated as:

Working Capital = Current Assets - Current Liabilities

The working capital ratio (Current Assets/Current Liabilities) indicates whether a company has enough short term assets to cover its short term debt. Anything below 1 indicates negative W/C (working capital). While anything over 2 means that the company is not investing excess assets. Most believe that a ratio between 1.2 and 2.0 is sufficient. Also known as "net working capital".

BREAKING DOWN 'Working Capital'

If a company's current assets do not exceed its current liabilities, then it may run into trouble paying back creditors in the short term. The worst-case scenario is bankruptcy. A declining working capital ratio over a longer time period could also be a red flag that warrants further analysis. For example, it could be that the company's sales volumes are decreasing and, as a result, its accounts receivables number continues to get smaller and smaller. Working capital also gives investors an idea of the company's underlying operational efficiency. Money that is tied up in inventory or money that customers still owe to the company cannot be used to pay off any of the company's obligations. So, if a company is not operating in the most efficient manner (slow collection), it will show up as an increase in the working capital. This can be seen by comparing the working capital from one period to another; slow collection may signal an underlying problem in the company's operations.

The working capital formula is:

Working capital = current assets – current liabilities

The working capital formula tells us the short-term, liquid assets remaining after short-term liabilities have been paid off. It is a measure of a company's short-term liquidity and important for performing financial analysis, financial modeling, and managing cash flow.

Below is an example balance sheet used to calculate working capital, where "CA" is Current Assets, "CL" is Current Liabilities, and "WC" is Working Capital.

Current Assets:		
Cash	$20,000.00	**CA**
Accounts Receivable	15,000.00	
Inventories	45,000.00	
	80,000.00	**-**
Current Liabilities:		
Accounts Payable	$25,000.00	**CL**
Short-term borrowings	5,000.00	
Accrued liabilities	10,000.00	
	40,000.00	**=**
Working Capital	**$40,000.00**	**WC**

Working capital is the difference between a company's current assets and current liabilities. It is a financial measure, which calculates whether a company has enough liquid assets to pay its bills that will be due in a year. When a company has excess current assets, that amount can then be used to spend on its day-to-day operations. Current assets, such as cash and equivalents, inventory, accounts receivable and marketable securities, are resources a

company owns that can be used up or converted into cash within a year. Current liabilities are the amount of money a company owes such as accounts payable, short-term loans and accrued expenses, which are due for payment within a year.

Positive vs negative working capital

Having positive working capital can be a good sign of the short-term financial health for a company because it has enough liquid assets remaining to pay off short-term bills and to internally finance the growth of their business. Without additional working capital, a company may have to borrow additional funds from a bank or turn to investment bankers to raise more money.

Negative working capital means assets aren't being used effectively, and a company may a liquidity crisis. Even if a company has lots invested in fixed assets, it will face financial challenges if liabilities come due too soon. This will lead to more borrowing, late payments to creditors and suppliers and, as a result, a lower corporate credit rating for the company.

Main factors affecting the working capital are as follows:

(1) Nature of Business:

The requirement of working capital depends on the nature of business. The nature of business is usually of two types: Manufacturing Business and Trading Business. In the case of manufacturing business it takes a lot of time in converting raw material into finished goods. Therefore, capital remains invested for a long time in raw material, semi-finished goods and the stocking of the finished goods.

(2) Scale of Operations:

There is a direct link between the working capital and the scale of operations. In other words, more working capital is required in case of big organisations while less working capital is needed in case of small organisations.

(3) Business Cycle:

The need for the working capital is affected by various stages of the business cycle. During the boom period, the demand of a product increases and sales also increase. Therefore, more working capital is needed. On the contrary, during the period of depression, the

demand declines and it affects both the production and sales of goods. Therefore, in such a situation less working capital is required.

(4) Seasonal Factors:

Some goods are demanded throughout the year while others have seasonal demand. Goods which have uniform demand the whole year their production and sale are continuous. Consequently, such enterprises need little working capital.

(5) Production Cycle:

Production cycle means the time involved in converting raw material into finished product. The longer this period, the more will be the time for which the capital remains blocked in raw material and semi-manufactured products.

Thus, more working capital will be needed. On the contrary, where period of production cycle is little, less working capital will be needed.

(6) Credit Allowed:

Those enterprises which sell goods on cash payment basis need little working capital but those who provide credit facilities to the customers need more working capital.

(7) Credit Availed:

If raw material and other inputs are easily available on credit, less working capital is needed. On the contrary, if these things are not available on credit then to make cash payment quickly large amount of working capital will be needed.

(8) Operating Efficiency:

Operating efficiency means efficiently completing the various business operations. Operating efficiency of every organisation happens to be different.

Some such examples are: (i) converting raw material into finished goods at the earliest, (ii) selling the finished goods quickly, and (iii) quickly getting payments from the debtors. A company which has a better operating efficiency has to invest less in stock and the debtors.

Therefore, it requires less working capital, while the case is different in respect of companies with less operating efficiency.

(9) Availability of Raw Material:

Availability of raw material also influences the amount of working capital. If the enterprise makes use of such raw material which is available easily throughout the year, then less working capital will be required, because there will be no need to stock it in large quantity.

On the contrary, if the enterprise makes use of such raw material which is available only in some particular months of the year whereas for continuous production it is needed all the year round, then large quantity of it will be stocked. Under the circumstances, more working capital will be required.

(10) Growth Prospects:

Growth means the development of the scale of business operations (production, sales, etc.). The organisations which have sufficient possibilities of growth require more working capital, while the case is different in respect of companies with less growth prospects.

(11) Level of Competition:

High level of competition increases the need for more working capital. In order to face competition, more stock is required for quick delivery and credit facility for a long period has to be made available.

(12) Inflation:

Inflation means rise in prices. In such a situation more capital is required than before in order to maintain the previous scale of production and sales. Therefore, with the increasing rate of inflation, there is a corresponding increase in the working capital.

5.2 Investment Analysis:

Investment Banks

Non-Investment Grade Bonds (Unsecured Debentures)

Investment Risk

Comparison Analysis

Customer Analysis

Investment Analysis Definition

Investment analysis, defined as the process of evaluating an investment for profitability and risk, ultimately has the purpose of measuring how the given investment is a good fit for a portfolio. **Investment analysis** can range from a single bond in a personal portfolio, to the investment of a startup business, and even large scale corporate projects.

Investment analysis means the process of judging an investment for income, risk, and resale value. It is important to anyone who is considering an investment, regardless of type. *Investment analysis methods* generally evaluate 3 factors: risk, cash flows, and resale value.

The first factor evaluated in any investment analysis is risk. The reason for this is simple: if the risk of the investment is too great then loss is quite likely. In this case, cash flows and resale value generally do not matter because the investment is worth nothing. To evaluate risk, one simply uses a variation of this formula:

Rate of occurrence x the impact of the event = Risk

Despite this, risk is not a definite factor. One must evaluate all the factors related to the investment: market, industry, governmental, company, and more. In this way evaluating risk is as much of an art as a science.

The second factor of investment analysis is cash flows. Cash flows occur in many ways: dividends from a publicly traded stock, interest payments on a bond, or even free cash flow which can be distributed to the investors in a small business (again, in the form of dividends). Cash flows are one of the methods of repayment on an investment.

Thus, an investor will want to evaluate cash flows to see if they repay the investment while also repaying the assumed value of the risk on the investment. Many methods of evaluating cash flows exist: future value of cash flows and Discounted Cash Flow Analysis. Others provide each investor with a method of analysis based in the type of investment being considered. Regardless, ignoring the analysis of cash flows is a quick path to loss of investment capital.

The third factor of investment analysis is resale value. Profit from resale is made through a gain in the market value of the asset. When the asset is sold to another investor for a value higher than the original purchase price, profit from resale value has occurred. In the process of investment analysis, an investor will want to measure the expected rate of growth on the asset to make sure that the value of this and any associated cash flows are larger than the loss of investment and the estimated value of the risk of the investment.

All of these methods of investment analysis are applicable to any investment: stocks on the stock market, treasury bills, the purchase and growth of a business, or even currency trading. Though each has a purpose-built method for investment analysis, each requires this if the investor is to be sure that the risk is worth the reward. Though **investment for real estate decisions** will be different than for a stock, the basic concept is the same.

DEFINITION of 'Capital Investment Analysis'

A budgeting procedure that companies and government agencies use to assess the potential profitability of a long-term investment. Capital investment analysis assesses long-term investments, which might include fixed assets like equipment, machinery or real estate. The goal of this process is to pinpoint the option that is most likely to be the most profitable for the business. Businesses may use techniques such as discounted cash flow analysis, risk-return analysis, risk-neutral valuation and utility theory in a capital investment analysis.

BREAKING DOWN 'Capital Investment Analysis'

Capital investments are risky because they involve large, up-front expenditures on assets intended for many years of service and that will take a long time to pay for themselves. If a capital investment is financed, it must earn an even greater return, to compensate for the interest the company must pay on the financed funds. Furthermore, a poor investment decision may not be reversible. For all of these reasons, it is crucial that a company perform a capital investment analysis before making any high-stakes capital investment decision.

5.3 What is an 'Alternative Investment'

An alternative investment is an asset that is not one of the conventional investment types, such as stocks, bonds and cash. Most alternative investment assets are held by institutional investors or accredited, high-net-worth individuals because of the complex natures and limited regulations of the investments. Alternative investments include private equity, hedge funds, managed futures, real estate, commodities and derivatives contracts.

BREAKING DOWN 'Alternative Investment'

Many alternative investments have high minimum investments and fee structures compared to mutual funds and exchange-traded funds (ETFs). There is also less opportunity to publish verifiable performance data and advertise to potential investors. Most alternative assets have low liquidity compared to conventional assets. For example, investors are likely to find it considerably more difficult to sell an 80-year old bottle of wine compared to 1,000 shares of Apple, due to a limited number of buyers.

Investors may have difficulty valuing alternative investments due to transactions often being unique. For example, a seller of the extremely rare 1933 Double Eagle $20 gold coin may have difficulty determining its value, as there are only 13 known to exist as of 2016. Alternative investments are prone to investment scams and fraud due to their unregulated nature, therefore it is essential that investors conduct extensive due diligence.

Alternative Investments for Diversification and Hedging

Alternative investments typically have a low correlation with those of standard asset classes, which makes them suitable for portfolio diversification. Because of this, many large institutional funds such as pensions and private endowments have begun to allocate a small portion of their portfolios, typically less than 10%, to alternative investments such as hedge funds. Investments in hard assets such as gold and oil also provide an effective hedge against rising inflation, as they are negatively correlated with the performance of stocks and bonds.

(ALTERNATIVE INVESTMENT FUNDS) REGULATIONS

To create regulations for alternative investment funds under the title SEBI (Alternative Investment Fund) Regulations which would register and regulate the formation of investment funds which raises capital from a number of High Net Worth investors with a view to investing in accordance with a defined investment policy for the benefit of those investors, inter-alia in the following categories:

(i) Venture Capital Fund (ii) PIPE Funds (iii) Private Equity Fund (iv) Debt Funds (v) Infrastructure Equity Fund (vi) Real Estate Fund (vii) SME Fund (viii) Social Venture Funds (ix) Strategy Fund (Residual Category, including all varieties of funds such as hedge funds, if any).

5.4 Sources of Finance for projects:

There are various sources of finance such as equity, debt, debentures, retained earnings, term loans, working capital loans, letter of credit, euro issue, venture funding etc. These sources are useful in different situations. They are classified based on time period, ownership and control, and their source of generation.

Sources of finance are the most explorable area especially for the entrepreneurs who are about to start a new business. It is perhaps the toughest part of all the efforts. There are

various sources of finance, we can classify on the basis of time period, ownership and control, and source of generation of finance.

Having known that there are many alternatives of finance or capital, a company can choose from. Choosing right source and the right mix of finance is a key challenge for every finance manager. The process of selecting right source of finance involves in-depth analysis of each and every source of finance. For analyzing and comparing the sources of finance, it needs understanding of all the characteristics of the financing sources. There are many characteristics on the basis of which sources of finance are classified.

On the basis of a time period, sources are classified into long term, medium term, and short term. Ownership and control classify sources of finance into owned capital and borrowed capital. Internal sources and external sources are the two sources of generation of capital. All the sources of capital have different characteristics to suit different types of requirements. Let's understand them in a little depth.

ACCORDING TO TIME-PERIOD:

Sources of financing a business are classified based on the time period for which the money is required. Time period is commonly classified into following three:

LONG TERM SOURCES OF FINANCE

Long-term financing means capital requirements for a period of more than 5 years to 10, 15, 20 years or maybe more depending on other factors. Capital expenditures in fixed assets like plant and machinery, land and building etc of a business are funded using long-term sources of finance. Part of working capital which permanently stays with the business is also financed with long-term sources of finance. Long term financing sources can be in form of any of them:

- Share Capital or Equity Shares
- Preference Capital or Preference Shares
- Retained Earnings or Internal Accruals
- Debenture / Bonds
- Term Loans from Financial Institutes, Government, and Commercial Banks

- Venture Funding
- Asset Securitization
- International Financing by way of Euro Issue, Foreign Currency Loans, ADR, GDR etc.

MEDIUM TERM SOURCES OF FINANCE

Medium term financing means financing for a period of 3 to 5 years and is used generally for two reasons. One, when long-term capital is not available for the time being and second, when deferred revenue expenditures like advertisements are made which are to be written off over a period of 3 to 5 years. Medium term financing sources can in the form of one of them:

- Preference Capital or Preference Shares
- Debenture / Bonds
- Medium Term Loans from
- Financial Institutes
- Government, and
- Commercial Banks
- Lease Finance
- Hire Purchase Finance

SHORT TERM SOURCES OF FINANCE

Short term financing means financing for a period of less than 1 year. The need for short-term finance arises to finance the current assets of a business like an inventory of raw material and finished goods, debtors, minimum cash and bank balance etc. Short term financing is also named as working capital financing. Short term finances are available in the form of:

- Trade Credit
- Short Term Loans like Working Capital Loans from Commercial Banks
- Fixed Deposits for a period of 1 year or less
- Advances received from customers
- Creditors
- Payables
- Factoring Services

- Bill Discounting etc.

ACCORDING TO OWNERSHIP AND CONTROL:

Sources of finances are classified based on ownership and control over the business. These two parameters are an important consideration while selecting a source of finance for the business. Whenever we bring in capital, there are two types of costs – one is the interest and another is sharing of ownership and control. Some entrepreneurs may not like to dilute their ownership rights in the business and others may believe in sharing the risk.

OWNED CAPITAL

Owned capital also refers to equity capital. It is sourced from promoters of the company or from the general public by issuing new equity shares. Promoters start the business by bringing in the required capital for a startup. Following are the sources of Owned Capital:

- Equity Capital
- Preference Capital
- Retained Earnings
- Convertible Debentures
- Venture Fund or Private Equity

Further, when the business grows and internal accruals like profits of the company are not enough to satisfy financing requirements, the promoters have a choice of selecting ownership capital or non-ownership capital. This decision is up to the promoters. Still, to discuss, certain advantages of equity capital are as follows:

- It is a long term capital which means it stays permanently with the business.
- There is no burden of paying interest or installments like borrowed capital. So, the risk of bankruptcy also reduces. Businesses in infancy stages prefer equity capital for this reason.

BORROWED CAPITAL

Borrowed capital is the capital arranged from outside sources. These include the following:

- Financial institutions,
- Commercial banks or
- The general public in case of debentures.

In this type of capital, the borrower has a charge on the assets of the business which means the company will pay the borrower by selling the assets in case of liquidation. Another feature of borrowed capital is regular payment of fixed interest and repayment of capital. Certain advantages of borrowing capital are as follows:

- There is no dilution in ownership and control of business.
- The cost of borrowed funds is low since it is a deductible expense for taxation purpose which ends up saving on taxes for the company.
- It gives the business a leverage benefit.

ACCORDING TO SOURCE OF GENERATION:

INTERNAL SOURCES

Internal source of capital is the capital which is generated internally from the business. These are as follows:

- Retained profits
- Reduction or controlling of working capital
- Sale of assets etc.

The internal source has the same characteristics of owned capital. The best part of the internal sourcing of capital is that the business grows by itself and does not depend on outside parties. Disadvantages of both equity capital and debt capital are not present in this form of financing. Neither ownership dilutes nor fixed obligation / bankruptcy risk arises.

EXTERNAL SOURCES

An external source of finance is the capital generated from outside the business. Apart from the internal sources finance, all the sources are external sources of capital.

Deciding the right source of finance is a crucial business decision taken by top-level finance managers. The wrong source of finance increases the cost of funds which in turn would have a direct impact on the feasibility of project under concern. Improper match of the type of capital with business requirements may go against the smooth functioning of the business. For instance, if fixed assets, which derive benefits after 2 years, are financed

through short-term finances will create cash flow mismatch after one year and the manager will again have to look for finances and pay the fee for raising capital again.

Bank view of finance:

Finance is a field that deals with the study of investments. It includes the dynamics of assets and liabilities over time under conditions of different degrees of uncertainty and risk. Finance can also be defined as the science of money management. Finance aims to price assets based on their risk level and their expected rate of return. Finance can be broken into three different sub-categories: public finance, corporate finance and personal finance.

Personal finance may also involve paying for a loan, or debt obligations. The six key areas of personal financial planning, as suggested by the Financial Planning Standards Board, are:

1. **Financial position**: is concerned with understanding the personal resources available by examining net worth and household cash flow. Net worth is a person's balance sheet, calculated by adding up all assets under that person's control, minus all liabilities of the household, at one point in time. Household cash flow totals up all the expected sources of income within a year, minus all expected expenses within the same year. From this analysis, the financial planner can determine to what degree and in what time the personal goals can be accomplished.
2. **Adequate protection**: the analysis of how to protect a household from unforeseen risks. These risks can be divided into the following: liability, property, death, disability, health and long term care. Some of these risks may be self-insurable, while most will require the purchase of an insurance contract. Determining how much insurance to get, at the most cost effective terms requires knowledge of the market for personal insurance. Business owners, professionals, athletes and entertainers require specialized insurance professionals to adequately protect themselves. Since insurance also enjoys some tax benefits, utilizing insurance investment products may be a critical piece of the overall investment planning.

3. **Tax planning**: typically the income tax is the single largest expense in a household. Managing taxes is not a question of if you will pay taxes, but when and how much. Government gives many incentives in the form of tax deductions and credits, which can be used to reduce the lifetime tax burden. Most modern governments use a progressive tax. Typically, as one's income grows, a higher marginal rate of tax must be paid. Understanding how to take advantage of the myriad tax breaks when planning one's personal finances can make a significant impact in which it can later save you money in the long term.
4. **Investment and accumulation goals**: planning how to accumulate enough money – for large purchases and life events – is what most people consider to be financial planning. Major reasons to accumulate assets include, purchasing a house or car, starting a business, paying for education expenses, and saving for retirement. Achieving these goals requires projecting what they will cost, and when you need to withdraw funds that will be necessary to be able to achieve these goals. A major risk to the household in achieving their accumulation goal is the rate of price increases over time, or inflation. Using net present value calculators, the financial planner will suggest a combination of asset earmarking and regular savings to be invested in a variety of investments. In order to overcome the rate of inflation, the investment portfolio has to get a higher rate of return, which typically will subject the portfolio to a number of risks. Managing these portfolio risks is most often accomplished using asset allocation, which seeks to diversify investment risk and opportunity. This asset allocation will prescribe a percentage allocation to be invested in stocks (either preferred stock or common stock), bonds (for example mutual bonds or government bonds, or corporate bonds), cash and alternative investments. The allocation should also take into consideration the personal risk profile of every investor, since risk attitudes vary from person to person.
5. **Retirement planning** is the process of understanding how much it costs to live at retirement, and coming up with a plan to distribute assets to meet any income shortfall. Methods for retirement plan include taking advantage of government allowed structures to manage tax liability including: individual (IRA) structures, or employer sponsored retirement plans.

6. **Estate planning** involves planning for the disposition of one's assets after death. Typically, there is a tax due to the state or federal government at one's death. Avoiding these taxes means that more of one's assets will be distributed to one's heirs. One can leave one's assets to family, friends or charitable groups.

Corporate finance:

Corporate finance deals with the sources funding and the capital structure of corporations, the actions that managers take to increase the value of the firm to the shareholders, and the tools and analysis used to allocate financial resources. Although it is in principle different from managerial finance which studies the financial management of all firms, rather than corporations alone, the main concepts in the study of corporate finance are applicable to the financial problems of all kinds of firms. Corporate finance generally involves balancing risk and profitability, while attempting to maximize an entity's assets, net incoming cash flow and the value of its stock, and generically entails three primary areas of capital resource allocation. In the first, "capital budgeting", management must choose which "projects" (if any) to undertake. The discipline of capital budgeting may employ standard business valuation techniques or even extend to real options valuation; see Financial modeling. The second, "sources of capital" relates to how these investments are to be funded: investment capital can be provided through different sources, such as by shareholders, in the form of equity (privately or via an initial public offering), creditors, often in the form of bonds, and the firm's operations (cash flow). Short-term funding or working capital is mostly provided by banks extending a line of credit. The balance between these elements forms the company's capital structure. The third, "the dividend policy", requires management to determine whether any unappropriated profit (excess cash) is to be retained for future investment / operational requirements, or instead to be distributed to shareholders, and if so, in what form. Short term financial management is often termed "working capital management", and relates to cash-, inventory- and debtorsmanagement.

Corporate finance also includes within its scope business valuation, stock investing, or investment management. An investment is an acquisition of an asset in the hope that it

will maintain or increase its value over time that will in hope give back a higher rate of return when it comes to disbursing dividends. In investment management – in choosing a portfolio – one has to use financial analysis to determine *what*, *how much* and *when* to invest. To do this, a company must:

- Identify relevant objectives and constraints: institution or individual goals, time horizon, risk aversion and tax considerations;
- Identify the appropriate strategy: active versus passive hedging strategy
- Measure the portfolio performance

Financial management overlaps with the financial function of the accounting profession. However, financial accounting is the reporting of historical financial information, while financial management is concerned with the allocation of capital resources to increase a firm's value to the shareholders and increase their rate of return on the investments.

Financial risk management, an element of corporate finance, is the practice of creating and protecting economic value in a firm by using financial instruments to manage exposure to risk, particularly credit risk and market risk. (Other risk types include foreign exchange, shape, volatility, sector, liquidity, inflation risks, etc.) It focuses on when and how to hedge using financial instruments; in this sense it overlaps with financial engineering. Similar to general risk management, financial risk management requires identifying its sources, measuring it.

Financial services

An entity whose income exceeds its expenditure can lend or invest the excess income to help that excess income produce more income in the future. Though on the other hand, an entity whose income is less than its expenditure can raise capital by borrowing or selling equity claims, decreasing its expenses, or increasing its income. The lender can find a borrower—a financial intermediary such as a bank—or buy notes or bonds (corporate bonds, government bonds, or mutual bonds) in the bond market. The lender receives interest, the borrower pays a higher interest than the lender receives, and the financial intermediary earns the difference for arranging the loan.

A bank aggregates the activities of many borrowers and lenders. A bank accepts deposits from lenders, on which it pays interest. The bank then lends these deposits to borrowers. Banks allow borrowers and lenders, of different sizes, to coordinate their activity.

Finance is used by individuals (personal finance), by governments (public finance), by businesses (corporate finance) and by a wide variety of other organizations such as schools and non-profit organizations. In general, the goals of each of the above activities are achieved through the use of appropriate financial instruments and methodologies, with consideration to their institutional setting.

Finance is one of the most important aspects of business management and includes analysis related to the use and acquisition of funds for the enterprise.

In corporate finance, a company's capital structure is the total mix of financing methods it uses to raise funds. One method is *debt financing*, which includes bank loans and bond sales. Another method is *equity financing* – the sale of stock by a company to investors, the original shareholders (they own a portion of the business) of a share. Ownership of a share gives the shareholder certain contractual rights and powers, which typically include the right to receive declared dividends and to vote the proxy on important matters (e.g., board elections). The owners of both bonds (either government bonds or corporate bonds) and stock (whether its preferred stock or common stock), may be *institutional investors* – financial institutions such as investment banks and pension funds or private individuals, called *private investors* or *retail investors*.

Public finance

Public finance describes finance as related to sovereign states and sub-national entities (states/provinces, counties, municipalities, etc.) and related public entities (e.g. school districts) or agencies. It usually encompasses a long-term, strategic perspective regarding investment decisions that affect public entities. These long-term, strategic periods usually encompass five or more years. Public finance is primarily concerned with:

- Identification of required expenditure of a public sector entity
- Source(s) of that entity's revenue
- The budgeting process

- Debt issurance (municipal bonds) for public works projects

Summary:

- *Working capital is a measure of both a company's efficiency and its short-term financial health. Working capital is calculated as:*
- *Working Capital = Current Assets - Current Liabilities*
- *The working capital formula tells us the short-term, liquid assets remaining after short-term liabilities have been paid off. It will meet the company day to day expenses.*
- *Investment analysis, defined as the process of evaluating an investment for profitability and risk, ultimately has the purpose of measuring how the given investment is a good fit for a portfolio.* ***Investment analysis*** *can range from a single bond in a personal portfolio, to the investment of a startup business, and even large scale corporate projects.*
- *An alternative investment is an asset that is not one of the conventional investment types, such as stocks, bonds and cash. Most alternative investment assets are held by institutional investors or accredited, high-net-worth individuals because of the complex natures and limited regulations of the investments.*
- *sources of finance such as equity, debt, debentures, retained earnings, term loans, working capital loans, letter of credit, euro issue, venture funding etc. These sources are useful in different situations. They are classified based on time period, ownership and control, and their source of generation.*

    - *Share Capital or Equity Shares*
    - *Preference Capital or Preference Shares*
    - *Retained Earnings or Internal Accruals*
    - *Debenture / Bonds*
    - *Term Loans from Financial Institutes, Government, and Commercial Banks*

Personal finance may also involve paying for a loan, or debt obligations. The six key areas of personal financial planning, as suggested by the Financial Planning Standards Board, are:

- ***Financial position***

- ***Adequate protection****:*
- *Tax planning*
- *Investment and accumulation goals*
- *Retirement planning*
- *Estate planning*

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