Fundamentals of Project Management

Er. A. Prashanthi, B.E.,

Research Associate

Project

Project is a **temporary** endeavor undertaken to create a **unique** product or service.

- Projects are unique.
- Projects are temporary in nature and have a definite beginning and end date.
- Projects are completed when the project goals are achieved or it is determined the project is no longer viable.
- A successful project is one that meets or exceeds the expectations of your stakeholders.

Uniqueness

- Product characteristics are progressively elaborated.
- The product or service is different in some way from other product or services.

Temporary Nature

- It has a definite beginning and end effort.
- It is not an ongoing effort such as in operations.
- It ceases when objective has been attained.
- The team is disbanded upon project completion.

Example

Building a road is an example of a project. The process of building a road takes a finite amount of time, and produces a unique product.

Operations, on the other hand, are repetitive. Generating bills every month, and broadcasting news everyday are examples of operations.

Subprojects are components of a project that often contracted out.

Project Management

Project Management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements.

Project management is accomplished through the use of the processes such as:

- Initiating
- Planning
- Executing
- Monitor and Controlling
- Closing

Project managers or the organization can divide projects into above phases to provide better management control with appropriate links to the ongoing operations of the performing organization. Collectively, these phases are known as the project life cycle.

Project managers deliver projects while balancing the following constraints:

- Scope
- Schedule
- Quality
- Resources
- Customer Satisfaction
- Risk

These all are so intertwined that a change in one will most often cause a change in at least one of the others

For example:

- If time is extended, the cost of the project will increase.
- If time extended with the same cost then quality of the product will reduce.
- If scope is extended then cost and time will also extend.

Changes to any of these legs sets off a series of activities that are needed to integrate the change across the project.

Program Management

A program consists of a group of related projects and Program management is the process of managing multiple ongoing projects. An example would be that of designing, manufacturing and providing support infrastructure for an automobile make.

Program management involves centrally managing and coordinating groups of related projects to meet the objectives of the program.

In some cases Project Management is a subset of Program Management. The project manager may report to the program manager in such cases. A portfolio consists of multiple programs.

Portfolio Management

A portfolio is a collection of projects, programs sub portfolios, and operations that are grouped together to facilitate effective management of that work to meet strategic business objectives. Organizations manage their portfolios based on specific goals.

Senior managers or senior management teams typically take on the responsibility of portfolio management for an organization.

Portfolio management encompasses managing the collections of programs and projects in the portfolio. This includes weighing the value of each project, or potential project, against the portfolio's strategic objectives.

Portfolio management also concerns monitoring active projects for adherence to objectives, balancing the portfolio among the other investments of the organization, and assuring the efficient use of resources.

Need of Project Management

We need project management to manage projects effectively and drive them to success. Project Management starts with the decision to start a project upon weighing its need and viability. Once a project starts, it is crucial to watch the project progress at every step so as to ensure it delivers what all is required, in the stipulated time, within the allocated budget. Other drivers influencing the need of project management are:

- Exponential expansion of human knowledge
- Global demand for goods and services

- Global competition
- Team is required to meet the demand with quality and standard.
- Improved control over the project
- Improved performance
- Improved budget and quality

Project Management Skills

Many of the tools and techniques for managing projects are specific to project management. However, effective project management requires that the project management team acquire the following three dimensions of project management competencies:

- **Project Management Knowledge Competency:** This refers to what the project management team knows about project management.
- **Project Management Performance Competency:** This refers to what the project management team is able to do or accomplish while applying their project management knowledge.
- **Personal Competency:** This refers to how the project management team behaves when performing the project or activity.

Interpersonal Skills Management

The management of interpersonal relationships includes:

- **Effective communication:** The exchange of information
- **Influencing the organization:** The ability to "get things done"
- **Leadership:** Developing a vision and strategy, and motivating people to achieve that vision and strategy
- **Motivation:** Energizing people to achieve high levels of performance and to overcome barriers to change
- **Negotiation and conflict management:** Conferring with others to come to terms with them or to reach an agreement
- **Decision Making:** Ability to take decision independently.

- **Political and cultural awareness:** Important to handle various personal and professional issues.
- **Team Building:** Ability to create a productive team.

Construction Project Management

Construction Project Management 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.

PROJECT LIFE CYCLE & PROCESS

Construction Project Management Fundamentals

Project: A project is a temporary endeavour undertaken to create a unique product or service.

Construction: It is a series of actions undertaken by construction companies and consultants, which produces or alter buildings and infrastructure.

Project Management: The art of directing and coordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, cost, time, quality and participating objectives (Project Management Institute).

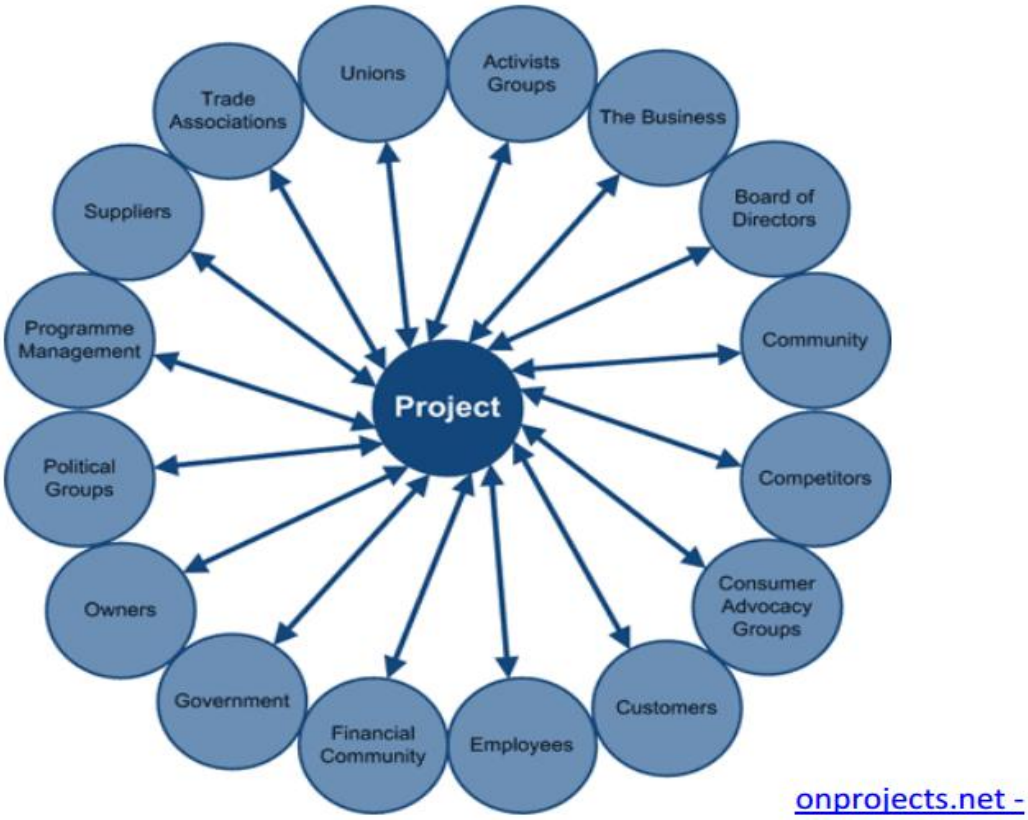
The Role of a Project Manager in Construction

The Construction Management Association of America, a US construction management certification and advocacy body, says the 120 common responsibilities of a construction manager fall into seven categories:

- Project management planning
- Cost management
- Time management
- Quality management
- Contract administration
- Safety management
- Construction management professional practice (managing the project team, defining roles and responsibilities, etc.).

Players of a Construction Project

- Owner or client
- Construction manager
- General contractor
- Sub-contractor or specially contractors
- Designer
- Insurance companies
- Banks
- Suppliers
- Public
- Construction labour force



Players of a Construction Project
(Source: http://onprojects.net/2007/12/12/identifying-stakeholder-analysis-management/)

Project Life Cycle

'Project life cycle' refers to a logical sequence of activities to accomplish the project goals or objectives.

When discussing project management phases, the mention of project life cycle is inevitable. So, what's the difference? The project phases make up a project life cycle, and as such, the phases are tailored to fit a project's needs. According to the Project Management Body of Knowledge (PMBOK), the elements of a project life cycle should define:

- ✓ What work must be accomplished?
- ✓ What deliverables must be generated and reviewed?
- ✓ Who must be involved?
- ✓ How to control and approve each phase?

Determining these elements will take a project from start to finish. It provides a systematic, timely, and controlled process that benefits a project's stakeholders. This helps PMs define what needs to be accomplished before moving onto the next phase of a project.

Phases in Construction Project life Cycle

A standard construction project, in general, has following five major life cycle phases:

1. Initiation
2. Planning
3. Execution
4. Performance and monitoring
5. Closure

Five Phases of Project Management

(Source: https://www.smartsheet.com/demystifying-5-phases-project-management-b**)**

1. Initiation

We must create and evaluate the project in order to determine if it is feasible and if it should be undertaken, at the beginning of the project. Here the project objective or need is identified; this can be a business problem or opportunity.

A suitable response to the need is documented in a business case with recommended solution options. A feasibility study is conducted to examine whether each option clearly identifies the project objective and a final recommended solution is determined.

Many questions related to the issues of feasibility i.e. "can we do the project?" and justification like "should we do the project?" are mentioned and faced.

When a solution is approved, a project is initiated to implement the approved solution. For this, a project manager is appointed. At this stage, the major deliverables and the participating work groups are identified. This is the time when the project team begins to take shape. Approval is then required by the project manager to move onto the detailed planning phase.

2. Planning

The planning phase involves further development of the project in detail to meet the project's objective. In a broader sense identification of each activity as well as their resource allocation is also carried out. A project plan outlining the activities, tasks, dependencies and timeframes is created.

During this phase, the scope of the project is defined and a project management plan is developed. It involves identifying the cost, quality, available resources, and a realistic timetable. The project plan also includes establishing baselines or performance measures. These are generated using the scope, schedule and cost of a project. A baseline is essential to determine if a project is on track.

At this time, roles and responsibilities are clearly defined, so everyone involved knows what they are accountable for. Here are some of the documents a PM will create during this phase to ensure the project will stay on track:

- **Scope Statement** – A document that clearly defines the business need, benefits of the project, objectives, deliverables, and key milestones. A scope statement may change during the project, but it shouldn't be done without the approval of the project manager and the sponsor.
- **Work Breakdown Schedule (WBS**) –This is a visual representation that breaks down the scope of the project into manageable sections for the team.
- **Milestones** – Identify high-level goals that need to be met throughout the project and include them in the Gantt chart.
- **Gantt Chart** – A visual timeline that you can use to plan out tasks and visualize your project timeline.
- **Communication Plan** – This is of particular importance if your project involves outside stakeholders. Develop the proper messaging around the project and create a schedule of when to communicate with team members based on deliverables and milestones.
- **Risk Management Plan** – Identify all foreseeable risks. Common risks include unrealistic time and cost estimates, customer review cycle, budget cuts, changing requirements, and lack of committed resources.

The project manager is the one who coordinates the preparation of a project budget by providing cost estimates for the labor, equipment, and materials costs. This is mainly carried out by project scheduling software like MS project or PRIMAVERA. These scheduling charts would help us to track the stages of our project as time passes. This is also referred to as "**scope management**."

The budget of the project already estimated is used to monitor and control cost expenditures during project implementation.

Finally, we require a document to show the quality plan, providing quality targets, assurance, and control measures, along with an acceptance plan, listing the criteria to be met to gain customer acceptance. At this point, the project would have been planned in detail and is ready to be executed.

3. Execution

This is the implementation phase, where the project plan is put into motion and the work of the project is performed practically on site. It is essential to maintain control and communicate as needed during each implementation stages.

Progress should be continuously monitored and appropriate adjustments are made and recorded as variances from the original plan. A project manager is the one who spends most of the time in this step. Throughout the project implementation, people carry out the tasks, and progress information is being reported through regular project team meetings.

The project manager uses this information to preserve control over the direction of the project by comparing the progress reports with the project plan to measure the performance of the project activities. If any deviation is found from the already defined plan corrective measures are made.

The first option of action should always be to bring the project back to the original plan. If that cannot happen, the team should record variations from the original plan and record and publish modifications to the plan. all through this step, project sponsors, and other key stakeholders are kept informed about the project's status as per the agreed rate and format of communication. The plan should be updated and available on a regular basis.

Status reports should always highlight the probable end point in terms of cost, schedule, and quality of deliverables. Each project deliverable produced should be reviewed for quality and measured against the acceptance criteria.

When deliverables have been produced and the customer has agreed on the final solution, the project is said to be ready for closure.

4. Performance and Monitoring Phase of Construction Project

This stage is all related to the measurement of progress and performance to make sure that items are tracking with the project management scheduling. This phase regularly happens at the same time as the execution phase.

5. Closure Phase of Construction Project

During the final closure, the importance is on providing the final deliverables to the customer. It involves:

- Handing over project documentation to the business
- Termination of supplier contracts
- Releasing project resources
- Communicate the closure of the project to all stakeholders.
- Conduct lessons-learned studies to examine what went well and what didn't.

This type of analysis would make the knowledge of experience to be transferred back to the project organization, which will help future project teams.

Construction Project Life Cycle Process

The purchase of a constructed facility is a major capital investment. The owner can be an individual, a private corporation or a public agency. As the commitment of resources for such a large investment is stimulated by market demands or real needs, the facility is likely to satisfy certain objectives.

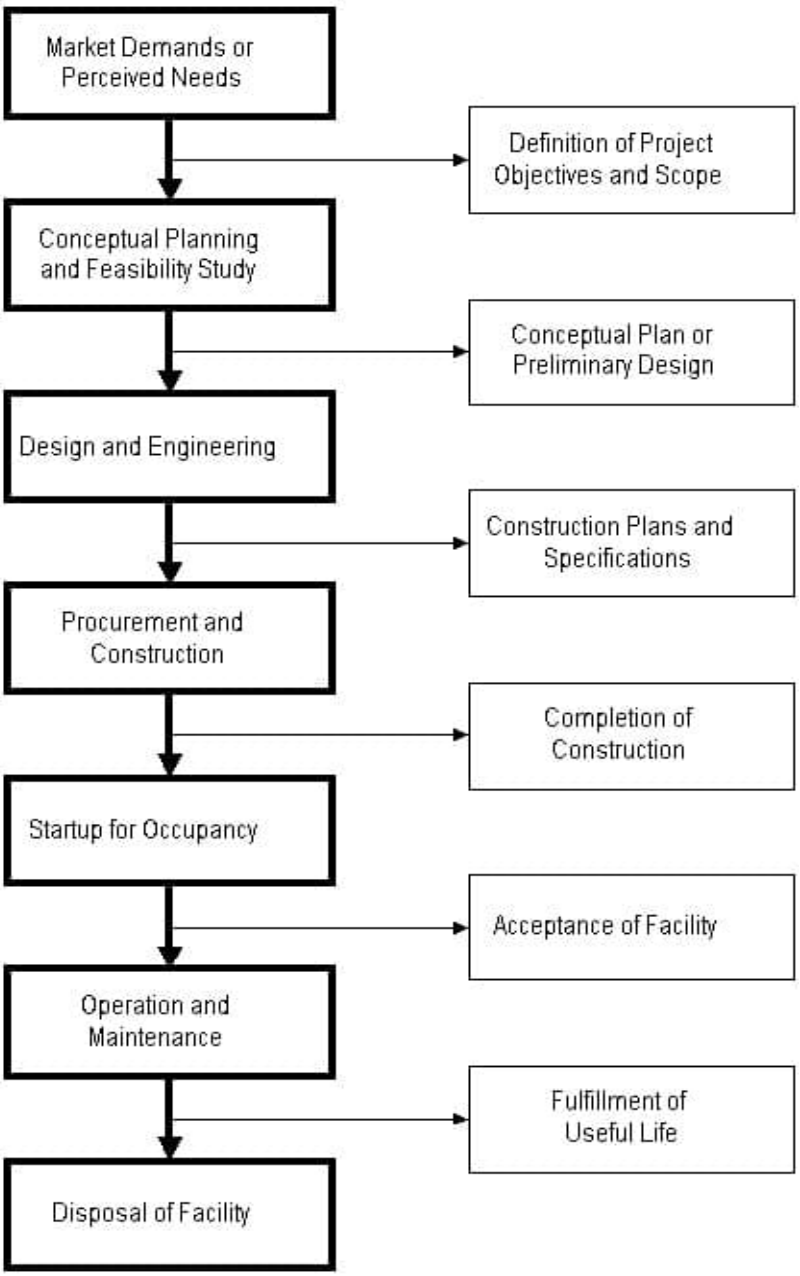
Most of the constructed facilities are custom made in consultation with the owners, with an exception in the case of the residential units that may be sold as built by the real estate developer. He is regarded as the sponsor of building projects, so far as government agency may be the sponsor of a public project and turns it over to another government unit upon its completion.

For project management, the terms "owner" and "sponsor" are one and the same because both have the ultimate power to make all important decisions. It is judicious for any owner to have a clear understanding of the acquisition process to sustain firm control of

the quality, timeliness, and cost of the completed facility, as he is essentially acquiring a facility on a promise in some form of agreement.

A project meets the market demands or requirement on a timely basis. A variety of possibilities may be taken into consideration in the conceptual planning stage.

Hence the technological, as well as the economic feasibility of each option, will be assessed and compared to select the best possible project.



The Project Life Cycle of a Constructed Facility

(Source: https://theconstructor.org/construction/construction-project-life-cycle-phases/14283/**)**

The financing strategies for the proposed options and ideas should undergo a clear examination, which is later programmed with respect to the timing for project completion and based on the cash flow availability.

Once the scope of the project is clearly explained and defined**,** thorough engineering design will provide the blueprint for construction, and the definitive cost estimate will provide the baseline for cost control.

Careful planning and control during the procurement and construction stage, the delivery of materials and the erection of the project on the site must be maintained. Once the construction is completed, there is usually a brief period of start-up of the constructed facility when it is first occupied.

At last, the management of the facility is turned over to the owner for full occupancy until the facility lives out its useful life. That is to check the building durability once the functionality is started. If the building cannot show any defects before the period specified, it was chosen for demolition or conversion.

The stages of development may not be strictly sequential as shown in figure. Certain specific stages require iteration, and the others can be carried out in parallel or in overlapping time frames. This decision mainly depends on the nature, size and urgency of the project.

Moreover, an owner may gain house capacities to handle the work in every stage of the entire process. If it is not possible they may request professional advice and services to guide the work in all stages. Reasonably, most owners choose to handle some of the work in-house. To guide other components of the work, they give the contract to outside professional services as per requirement.

Analysis of the project life cycle from an owner's perspective would help us to focus on the proper roles of various activities and participants in all stages apart from the contractual engagements for different types of work.

References:

1. 'Construction Project Management: Theory and Practice', Kumar Neeraj Jha, Pearson Publication.
2. https://www.smartsheet.com/demystifying-5-phases-project-management-b
3. http://onprojects.net/2007/12/12/identifying-stakeholder-analysis-management/
4. https://theconstructor.org/construction/construction-project-life-cycle-phases/14283/

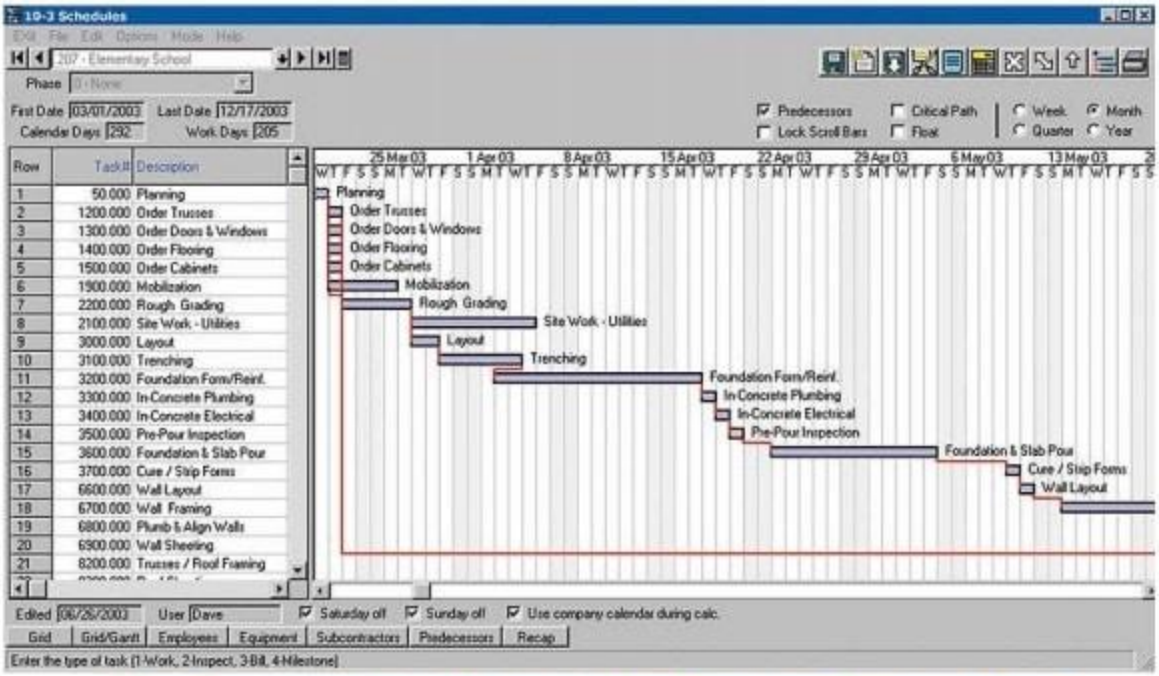
PROJECT SCHEDULE DEVELOPMENT

Construction Project Management Objectives

1. Eliminate or reduce project RISK.
2. Obtain a thorough understanding of PROJECT OBJECTIVES/MILESTONES.
3. Formulate strategy for achieving objectives with available RESOURCES.
4. Develop a framework for MONITORING AND CONTROLLING THE PROJECT.

What is Scheduling?

It is the process of defining activities for a project, through their relationships we can identify the project duration. Scheduling is the fitting of the final work plan to a time scale. It shows the duration and order of various construction activities. It deals with the aspect of 'when to do it'.



Visual representation of the schedule lets you quickly see where you're ahead—or behind—on each project.

A typical construction schedule

(Source: https://theconstructor.org/construction/planning-scheduling-and-construction-management/14/**)**

Why schedule the construction project?

Owner point of view

- Owner requirement
- Communication of the construction plan
- Monitor and measure progress
- Manage change

General Contractor/Subcontractor/ Supervisors/Workers point of view

- Establish production goals
- Manage change
- Communication of the construction plan

Schedule Development Process

There are ten things we must do to create a successful project schedule.

1. **Understand the project**

   Understand what the project is aiming to achieve, read whatever project documentation is available, etc. Knowing your project will help you in many ways, especially when creating a schedule.

2. **Understand the constraints**

   As much as possible, create a list of constraints you believe will impact the performance of the activities of the project. These can be local laws, weather, holidays and many other issues.

3. **Create a list of activities**

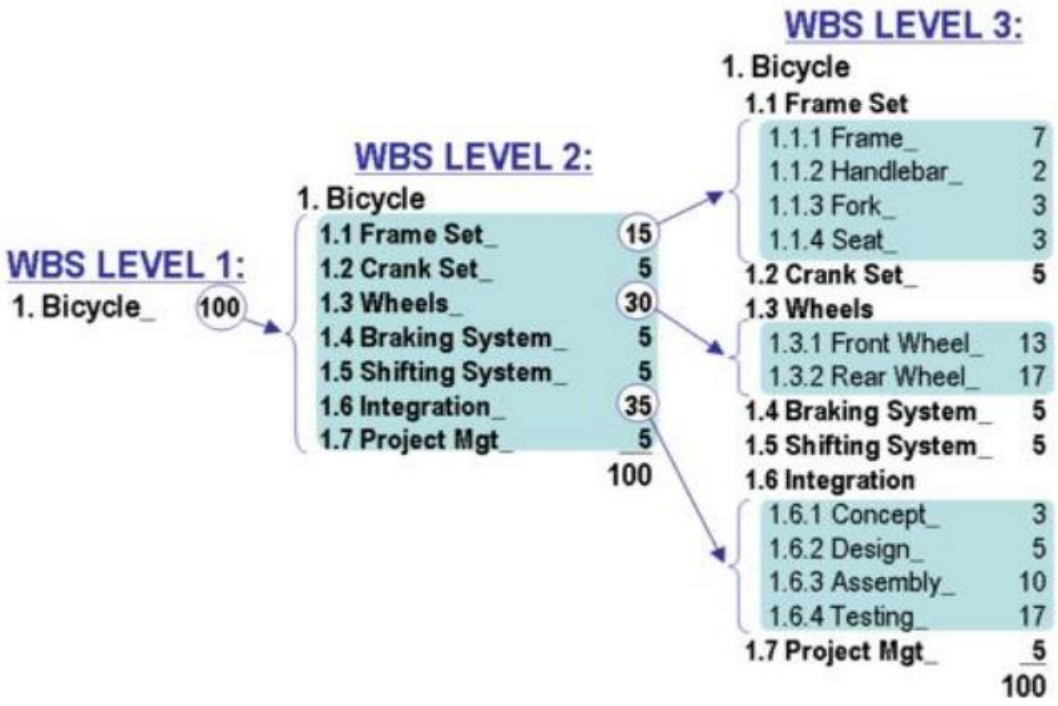
   Break down the project into simpler deliverables or work packages. Then break down the lowest level work packages into activities and create a register for them. This technique is called as ***Work Breakdown Structure (WBS).*** It will be helpful at this stage to describe these activities in more detail once they are listed. Do not create a list of 10,000 activities. If the project is extremely large consider breaking it down into smaller sub-projects.

Work Breakdown Structure (WBS)

The work breakdown structure (WBS) is a hierarchical system that represents the construction project in increasing levels of detail to define, organize and display the project work in measurable and manageable components. WBS helps in organizing what needs to be done in small packages of activities.

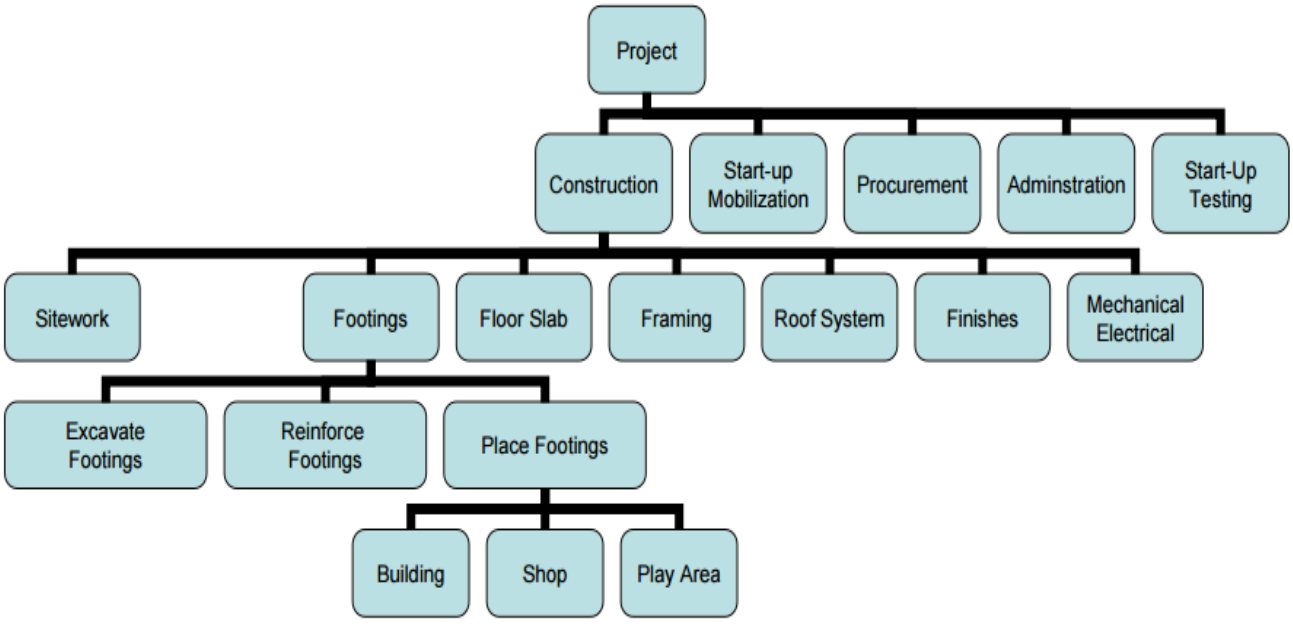
Work Breakdown Structure	
Level 1	Project
Level 2	Subproject
Level 3	Sub-network
Level 4	Activity
Level 5	Sub-activity

Below is an example WBS for manufacturing a bicycle.



A sample WBS for Manufacturing a Bicycle

Below is another example WBS for a construction project.



WBS for aConstruction Project

4. **Sequence the activities**

   Think about how the activities need to be physically sequenced. For example, you cannot backfill a trench that has not yet been dug. Create a sequential list including what kind of dependency applies to each sequence. The activity which is done first is called as the '*Predecessor*' activity. The activity which follows it is called as the '*Successor*' activity.

   There four basic types of dependencies:

- Finish-to-Start: Predecessor must finish before Successor can start. E.g. Land must be purchased before road building can start.
- Start-to-Start: Predecessor must start before Successor can start. E.g. Road excavating must start before bitumen can be laid.
- Finish-to-Finish: Predecessor must finish before Successor can finish. E.g. Laying Asphalt must be completed before line painting can be completed.
- Start-to-Finish: Predecessor must start before Successor can finish. E.g. Road excavating must start before line painting can be completed.

5. **Determine the unit of time that will be used for the project**

   Depending on the length of the project, this unit of time can be an hour, a day, a week, a month, or a year. For example, if a project is to be performed in 5 years, an adequate unit of time is the month.

6. **Determine activity durations**

   Using your chosen unit of time, your sequenced activities and your constraints, determine how long each activity will take. This is when knowledge of your industry and project will really make a difference. Specially in construction projects, there are ways to determine activity duration that go beyond the scope of this post.

7. **Understand what is the expected date of completion**

   By talking to the project sponsor and other stakeholders, make sure you understand and know clearly when your project is expected to be completed.

8. **Determine milestones**

   Again, by communicating with stakeholders such as the sponsor and owner, determine what are the milestones along the duration of the project.

9. **Generate the Schedule**

   The majorly used methods for generating the schedule are:

   - Gantt chart : It is a timeline view that makes it easy to see how a project is tracking. It lets you visualize your project timeline by transforming task names, dates, durations and end dates into cascading horizontal bar charts.
   - Critical Path Method (CPM): This method calculates the minimum project completion time and the start and end dates for all project tasks. It uses a network diagram consisting of circles and arrows to represent the schedule plan. It identifies the critical tasks that, if delayed, will delay your entire project. The critical path method helps you reduce timelines, manage resources, and compare planned with actual.
   - Program Evaluation and Review Technique (PERT): PERT is a sophisticated tool used in planning, scheduling and controlling large projects consisting of a number of activities independent of one another and with uncertain completion times. It is similar to CPM but the main difference is that it considers three different time durations for an activity ranging from optimistic time, pessimistic time and most likely time. It is commonly used in research and development projects.

10. **Remember accountability**

    And finally, keep in mind that you and/or your client will be held accountable to this project schedule as it becomes the pivotal document on which all future disputes and claims will hinge.

Scheduling / Planning Engineer Responsibilities -1

The scheduling/planning engineer has a wide range of duties involving; initial job planning; scheduling of time; scheduling of materials, coordination of subcontractors; monitoring of job progress; analysis of changes and problem solving. Specifically, the

scheduler will produce the contractor's Initial Schedule and then update the schedule throughout construction. He or she will also use the schedule to analyze the impact of change orders, delays, and any other schedule disruptions.

Scheduling / Planning Engineer Responsibilities -2

The scheduler works very closely with the project manager, project execution team, and the subcontractors during the preparations and updating of the construction schedule. Because of this, the scheduler must possess good communication skills. He or she will continually be producing critical scheduling information for the project team's use. Therefore, the scheduler maintains an important support role to the project superintendent, project manager, and all other parties associated with the project.

Scheduling Levels

Level 1: Schedule Executive Summary, also called a Project Master Schedule (PMS). This is a major milestone type of schedule;

Level 2: Schedule Management Summary, also called a Summary Master Schedule (SMS). It depicts the overall project broken down into its major components by area and is used for higher-level management reporting.

Level 3: Schedule Project Coordination Schedule (PCS) also called a Publication Schedule. Initially developed as an integrated Critical Path Method overview of the project.

Level 4: Schedule Execution Schedule, also called a Project Working Level Schedule. Detailed working level schedule, where each schedule is an expansion of part of a Level 3 schedule

Level 5: Schedule Detail Schedule. Further breakdown of the activities of a Level 4 Schedule.

References:

‘Construction Project Management: Theory and Practice’, Kumar Neeraj Jha, Pearson Publication.

1. http://www.remontech.com/10-things-you-must-do-to-create-a-great-project-schedule/
2. https://theconstructor.org/construction/planning-scheduling-and-construction-management/14/
3. http://nptel.ac.in/courses/105106149
4. http://classes.sdc.wsu.edu/classes/cstm462/lectures.htm
5. http://www.projectinsight.net/project-management-basics/task-dependencies

Integrated Master Plan

Dr.A.Ranganathan M.E., Ph.D., M.I.E.,
Research Associate / PWD
IMTI , Trichy – 620 015

The **Integrated Master Plan** (**IMP)** and the Integrated Master Schedule (IMS) are important program management tools that provide significant assistance in the planning and scheduling of work efforts in large and complex materiel acquisitions.[1] The IMP is event-driven plan documents the significant accomplishments necessary to complete the work and ties each accomplishment to a key program event.[2] The IMP is expanded to a time-based IMS to produce a networked and multi-layered schedule showing all detailed tasks required to accomplish the work effort contained in the IMP. The IMS flows directly from the IMP and supplements it with additional levels of detail both then form the foundations to implement an Earned Value Management System.

- The IMP is a bilateral agreement between the Government and a contractor on what defines the "event-driven" program. The IMP documents the key events, accomplishments, and the evaluation "criteria" in the development, production and/or modification of a military system; moreover, the IMS provides sequential events and key decision points (generally meetings) to assess program progress. Usually the IMP is a contractual document.
- Supporting the IMP is the IMS that is made up of "tasks" depicting the work effort needed to complete the "criteria".[3] It is a detailed time-driven plan for program execution that helps to ensure on-time delivery dates are achieved, and that tracking and status tool are used during program execution. These tools must show progress, interrelationships and dependencies.

Purpose and Objective

The primary purpose of the IMP—and the supporting detailed schedules of the IMS—is their use by the U.S. Government and Contractor acquisition team as the day-to-day tools for the planning, executing, and tracking program technical, schedule, and cost status, including risk mitigation efforts.[7] The IMP provides a better structure than either the Work Breakdown Structure (WBS) or Organizational Breakdown Structure (OBS) for measuring actual integrated master schedule (IMS) progress.[8]

The primary objective of the IMP is a single plan that establishes the program or project fundamentals. It provides a hierarchical, event-based plan that contains: Events; Significant accomplishments; Entry and exit criteria; however it does not include any dates or durations. Using the IMP provides sufficient definition for explain program process and completion tracking, as well as providing effective communication of the program/project content and the "*What and How*" of the program.

Rationale

The IMP is a collection of milestones (called "events") that form the process architecture of the program. This means the sequence of events must always result in a deliverable product or service. While delivering products or services is relatively straight forward in some instances (i.e., list the tasks to be done, arrange them in the proper sequence, and execute to this “plan”), in other cases, problems often arise: (i) the description of "complete" is often missing for intermediate activities; (ii) program partners, integration activities, and subcontractors all have unknown or possibly unknowable impacts on the program; and (iii) as products or services are delivered the maturity of the program changes (e.g., quality and functionality expectations, as well as other attributes) this maturity provided by defining "complete" serves as an insurance policy against future problems encountered later in the program.

Often, it's easier to define the IMP by stating what it is not. The IMP is NOT BASED on calendar dates, and therefore it is not schedule oriented; each event is completed when its

supporting accomplishments are completed, and this completion is evidenced by the satisfaction of the criteria supporting each of the accomplishments. Furthermore, many of the IMP events are fixed by customer-defined milestones (e.g., Preliminary or Critical Design Review, Production Deliver, etc.) while intermediate events are defined by the Supplier (e.g., integration and test, software build releases, Test Readiness Review, etc.).

The critical IMP attribute is its focus on events, when compared to effort or task focused planning. The event focus asks and answers the question *what does done look like?* rather than what work has been done. Certainly work must be done to complete a task, but a focus solely on the work hides the more important metric of *are we meeting our commitments?* While meeting commitments is critical, it's important to first define the criteria used for judging if the commitments are being met. This is where Significant Accomplishments (SA) and their Accomplishment Criteria (AC) become important. It is important to meet commitments, but recognizing when the commitment has been met is even more important.

Attributes and Characteristics

The IMP provides Program Traceability by expanding and complying with the program's Statement of Objectives (SOO), Technical Performance Requirements (TPRs), the Contract Work Breakdown Structure (CWBS), and the Contract Statement of Work (CSOW)—all of which are based on the Customer's WBS to form the basis of the IMS and all cost reporting. The IMP implements a measurable and trackable program structure to accomplish integrated product development, integrate the functional program activities, and incorporates functional, lower-level and subcontractor IMPs. The IMP provides a framework for independent evaluation of Program Maturity by allowing insight into the overall effort with a level-of-detail that is consistent with levied risk and complexity metrics. It uses the methodology of decomposing events into a logical series of accomplishments having measurable criteria to demonstrate the completion and/or quality of accomplishments.

Requirements Flowdown

A Government customer tasks a Supplier to prepare and implement an IMP that linked with the IMS and integrated with the EVMS. The IMP list the contract requirements documents (e.g., Systems Requirements Document and Technical Requirements Document (i.e., the system specification or similar document)) as well as the IMP events corresponding to development and/or production activities required by the contract. The IMP should include significant accomplishments encompassing all steps necessary to satisfy all contract objectives and requirements, manage all significant risks, and facilitate Government insight for each event. Significant accomplishments shall be networked to show their logical relationships and that they flow logically from one to another. The IMP, IMS, and EVMS products will usually include the prime contractor, subcontractor, and major vendor activities and products.

Evaluation of an IMS

When evaluating a proposed IMS, the user should focus on realistic task durations, predecessor/successor relationships, and identification of critical path tasks with viable risk mitigation and contingency plans. An IMS summarized at too high a level may result in obscuring critical execution elements, and contributing to failure of the EVMS to report progress. A high-level IMS may fail to show related risk management approaches being used, which can result in long duration tasks and artificial linkages masking the true critical path. In general, the IMP is a top-down planning tool and the IMS as the bottom-up execution tool. It should be noted, however, the IMS is a scheduling tool for management control of program progression, not for cost collection purposes.

PERT for Project Planning and Scheduling

Meenakshi Sundara Arasu,

Associate Professor,

Irrigation Management Training Institute, Trichy - 620 015

PERT, the Project Evaluation and Review Technique, is a network-based aid for planning and scheduling the many interrelated tasks in a large and complex project. It was developed during the design and construction of the Polaris submarine in the USA in the 1950s, which was one of the most complex tasks ever attempted at the time. Nowadays PERT techniques are routinely used in any large project such as software development, building construction, etc. Supporting software such as Microsoft Project, among others, is readily available. It may seem odd that PERT appears in a book on optimization, but it is frequently necessary to optimize time and resource constrained systems, and the basic ideas of PERT help to organize such an optimization.

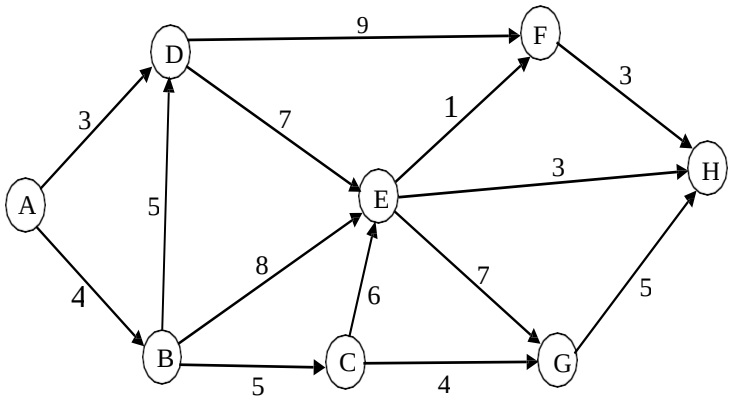
PERT uses a network representation to capture the precedence or parallel relationships among the tasks in the project. As an example of a precedence relationship, the frame of a house must first be constructed before the roof can go on. On the other hand, some activities can happen in parallel: the electrical system can be installed by one crew at the same time as the plumbing system is installed by a second crew.

The PERT formalism has these elements and rules:

- Directed arcs represent *activities*, each of which has a specified *duration*. This is the "activity on arc" formalism; there is also a less-common "activity on node" formalism. Note that activities are considered to be uninterruptible once started.

- Nodes are *events* or points in time.
- The activities (arcs) leaving a node cannot begin until all of the activities (arcs) entering a node are completed. This is how precedence is shown. You can also think of the node as enforcing a rendezvous: no-one can leave until everyone has arrived.
- There is a single starting node which has only outflow arcs, and a single ending node that has only inflow arcs.
- There are no cycles in the network. You can see the difficulty here. If an outflow activity cannot begin until all of the inflow activities have been completed, a cycle means that the system can never get started.

Consider the example given in Figure. Perhaps the pouring of the concrete foundation (activity A-B), happens at the same time as the pre-assembly of the roof trusses (activity A-D). However, the finalization of the roof (activity D-E), cannot begin until both A-D and B-D (assembly of the house frame), are done. Of course B-D cannot start until the concrete foundation has been poured (A-B). All of this precedence and parallelism information is neatly captured in the PERT diagram.



There are two major questions about any project:

- What is the shortest time for completion of the project?
- Which activities must be completed on time in order for the project to finish in the shortest possible time? These activities constitute the critical path through the PERT diagram.

The process of finding the critical path answers the first question as well as the second. Of course we need to know how long each individual activity will take in order to answer these questions. This is why the arcs in Figure are labeled with numbers: the numbers show the amount of time that each activity is expected to take (in days, let's say).

The critical path is of great interest to project managers. The activities on the critical path are the ones which absolutely must be done on time in order for the whole project to complete on time. If any of the activities on the critical path are late, then the entire project will finish late! For this reason, the critical path activities receive the greatest attention from management. The non-critical activities have some leeway to be late without affecting the overall project completion time.

The following steps find the critical path and calculate other useful information about the project.

Step 1. Make a forward pass through the diagram, calculating the *earliest time* (TE) for each event (node). In other words, what is the earliest time at which all of the activities entering a node will have finished? To find TE, look at all of the activities which enter a node. TE is the latest of the arrival times for entering arcs, i.e. TE = max [(TE of node at tail of arc) + (arc duration)] over all of the entering arcs. By definition, TE of the starting node is zero.

Step 2. Make a backward pass through the diagram, calculating the *latest time* (T_L) for each event (node). In other words, what is the latest time that the outflow activities can begin without causing a late arrival at the next node for one of those activities? To find T_L, look at all of the activities which exit a node. T_L is the earliest of the leaving times for the exiting arcs, i.e. T_L = min [(T_L of node at head of arc) − (arc duration)] over all of the exiting arcs. By definition, the T_L of the ending node equals its T_E.

Step 3. Calculate the *node slack time* (S_N) for each node (event). This is the amount of time by which an event could be adjusted later than its T_E without causing problems downstream. $S_N = T_L - T_E$ for each node.

Step 4. Calculate the total arc slack time (S_A) for each arc (activity). This is the amount of time by which an activity could be adjusted later than the T_E of the node at its tail without causing problems later. S_A = (T_L of node at arc head) - (T_E of node at arc tail) - (arc duration)

Step 5. The Critical path connects the nodes at which S_N=0 via at which S_A=0

NETWORK - BASED (GRAPH THEORY) - CPM

Er.M.PADMADEVI M.Tech.

Research Associate

Elements of project management

1. Planning
2. Scheduling
3. Controlling

Techniques of project management

1. Bar chart
2. Elements of network diagram

Introduction

Network scheduling is a technique used for planning and scheduling large projects in the fields of construction, maintenance, fabrication, purchasing, computer system installation, research and development designs, etc. The technique is a method of minimizing trouble spots, such as, production bottlenecks, delays and interruptions, by determining critical factors and coordinating various parts of overall job.

There are two basic planning and control techniques that utilize a network to complete a pre-determined project or schedule. These are: Program Evaluation and Review Technique (PERT); and the Critical Path Method (CPM).

Critical path method is one of the frequently used techniques in project planning. A typical project has many tasks involving lots of different people so project managers have a hard time keeping track of things. It is far too easy for certain activities to fall behind and get lost in the sea of endless jobs. These forgotten tasks and errors in planning can severely affect the time scale of the whole project. A late project will cost money and lead to unhappy customers and bosses. Critical path method helps managers figure out

two very important things. How long it will take to complete the project and what are the critical tasks that must be completed before starting other dependent tasks.

The best way for project managers to avoid poor planning is to incorporate the **critical path method** in their diagrams. Having this as a diagram makes it easy to visualize the important tasks of a project. This is really helpful for managers and makes it easier for the project team to visualize and plan their work accordingly. The main aim is to produce a visual of the entire project broken down into smaller activities which are vital to the completion of the entire project.

Critical Path Method (CPM)

The Project Management Body of Knowledge (PMBOK), an internationally recognized collection of processes and knowledge areas accepted as best practice for the project management profession, defines the critical path as "the sequence of scheduled activities that determines the duration of the project." It is the longest sequence of tasks in a project plan that must be completed on time in order for the project to meet its deadline. If there is a delay in any task on the critical path, then your whole project will be delayed. Although many projects have only one critical path, some projects may have multiple critical paths.

The critical path method is a step-by-step project management technique to identify activities on the critical path. It is an approach to project scheduling that breaks the project into several work tasks, displays them in a flow chart, and then calculates the project duration based on estimated durations for each task. It identifies tasks that are critical, time-wise, in completing the project.

The construction critical path method (CPM) is a tool that many project managers use, often with their construction management software, to help figure out the best steps to take to finish a job efficiently.

The **Critical Path Method** (CPM) is one of several related techniques for doing project planning. CPM is for projects that are made up of a number of individual "activities." If some of the activities require other activities to finish before they can start, then the project becomes a complex web of activities.

Network: Basic components

A network is a graphic representation of a project's operations and is composed of activities and events that must be completed to reach the end objective of a project. The basic components of a network are:

Activity:

An activity is a task, or item of work to be done, that consumes time, effort, money or other resources. It lies between two events, called the 'preceding' and 'succeeding' ones. It is represented by an arrow with its head indicating the sequence in which the events are to occur.

The activities can be further classified into five categories:

1. Parallel activities
2. Serial activities
3. Successor activities
4. Predecessor activities
5. Dummy activities

1. Parallel activities:

2. Serial activities:

3.**Successor activity**: An activity which started immediately after one or more of the activities are completed is known as a successor activity.

4.Predecessor activity: An activity which must be completed before one or more other activities start is known as predecessor activity.

5. Dummy activity: An activity which does not consume either any resource or time is known as a dummy activity. A dummy activity is depicted by dotted line in the network diagram.

Errors to be avoided in constructing a network

Looping: If an activity were represented as going back in time, a closed loop would occur which will result in an endless cycle. This situation can be avoided by checking the precedence relationship of the activities.

Network representation

Each activity of the project is represented by an arc pointing in the direction of progress in project.. For the construction of a network, generally, the following rules are followed:

1. Each activity is represented by one and only one arrow.
2. Each activity must be identified by two distinct nodes i.e. its starting and end node .
3. Nodes are numbered to identify an activity uniquely.
4. Between any pair of nodes, there should be one and only one activity, however more than one activity may emanate from and terminate to a node.
5. Arrows should be kept straight and not curved or bent.
6. The logical sequence between activities must follow the following rules:

Critical Path(CPM) Computations

The purpose of analysis or computation is to find the critical path, i.e., the sequence of activities with the longest duration and to find the float associated with each non-critical activity. This helps in checking actual progress against the scheduled duration of the project.

To achieve this objective we carry out special computations that produce the following information:

- Total duration needed for the completion of the project.
- Categorization of the activities of the project as being critical or non-critical.

An **activity** is said to be critical, if the delay in its start will further delay the project completion time.

A **non-critical activity** allows some scheduling slack, so that the start time of the activity may be delayed within limits without affecting the completion time of entire project.

To carry out the special computations, the following terms shall be used in critical path calculations:

- Earliest occurrence time of event 'i'.
- Latest occurrence time of event 'j'.
- Duration of activity(i, j)

The critical path calculations are done in two ways:

1. Forward pass calculations
2. Backward pass calculations

Critical path: The critical activities of a network that constitute an uninterrupted path which spans the entire network from start to finish is known as critical path.

Float of an activity

The float of an activity is the amount of time by which it is possible to delay its completion time without affecting the total project completion time.

Activity float: It is the float in the activity time estimates. There are mainly three types of activity float:

(i)**Total float**: The total float of an activity represents the amount of time by which an activity can be delayed without delay in the project completion date. It is the positive difference between the earliest finish time and the latest finish time. or the positive difference between the earliest start time and the latest start time of an activity depending upon which is defined.

(ii)**Free float**: It is that portion of total float within which an activity can be manipulated without affecting the float of subsequent activities. It is computed for an activity by subtracting the head event slack from its total float.

(iii)**Independent float**: It is that portion of total float within which an activity can be delayed for start without affecting floats of the preceding activities. It is computed by subtracting the tail event slack from the free float of the activity. If the result is negative, it is taken as zero.

which causes a reduction in the float of the successor activities.

(iv)**Interfering float**: Interfering float can be defined as that part of the total float It is the difference between the latest finish time of the activity under consideration and the earliest start time of the following activity, or zero, whichever is larger.

Special Features of CPM

1. CPM is used for repetitive jobs.
2. CPM is a deterministic model with well known activity times based on experience. It therefore doesn't deal with uncertainty in project duration.
3. CPM is activity oriented as the results of calculations are considered in terms of activities of the project.
4. CPM is employed in construction and business problems.
5. CPM doesn't incorporate statistical analysis in determining time estimates because time is precise and known.

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

CRITICAL PATH TECHNIQUES

Unformatted text preview: The essential technique for using CPM is to construct a model of the project that includes the following: A list of all activities required to complete the project (also known as **Work Breakdown Structure**. The time (duration) that each activity will take to completion.

Critical path analysis ("CPA") is a widely-used project management tool that uses network **analysis** to help project managers to handle complex and time-sensitive operations. The **critical path** of a project will not remain static throughout its life, it **can change during** the course of **project** completion. Unforeseen circumstances sometimes may cause estimated duration of one or more activities to **change**.

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.

Importance of critical path method in project planning

Critical path method is one of the frequently used techniques in project planning. A typical project has many tasks involving lots of different people so project managers have a hard time keeping track of things. It is far too easy for certain activities to fall behind and get lost in the sea of endless jobs. These forgotten tasks and errors in planning can severely affect the time scale of the whole project. A late project will cost money and lead to unhappy customers and bosses. Critical path method helps managers figure out

two very important things. How long it will take to complete the project and what are the critical tasks that must be completed before starting other dependent tasks.

The best way for project managers to avoid poor planning is to incorporate the **critical path method** in their diagrams. Having this as a diagram makes it easy to visualize the important tasks of a project. This is really helpful for managers and makes it easier for the project team to visualize and plan their work accordingly. The main aim is to produce a visual of the entire project broken down into smaller activities which are vital to the completion of the entire project.

All of the activities which are added onto the **network diagram** are ones which have to be completed on time. By adding them on to a diagram it is possible to see how long each section will take. This is essential when it comes to predicting the timescale of the project. The benefits of applying each of the set time critical and essential activities to a diagram include:

- Predicating the time each activity will take and offering a timescale to the client
- Seeing how each section is important to the progress of the rest of the plan
- Assigning the right team and department to their corresponding tasks

It is important to note that at the beginning of the project time taken for each task is the estimated time. During the project the estimated time might vary based on different factors. In such cases it is important to revisit your diagram and again do a critical path analysis. Experienced developers are usually accurate with their estimations so this isn't something that will happen frequently.

How to find the Critical Path

It is essential when planning any project to calculate how long each section will take. This helps to establish the start date of any activities which cannot start until the one which precedes it has been completed. The calculations also determine the latest date

that the activity needs to be completed by in order for the next part to begin. Everything is closely tied together and without a diagram it can be very easy for everyone to lose sight of their goals. Perhaps more importantly the diagram helps individuals to see the effects down the line if they do not stick to the plan at hand.

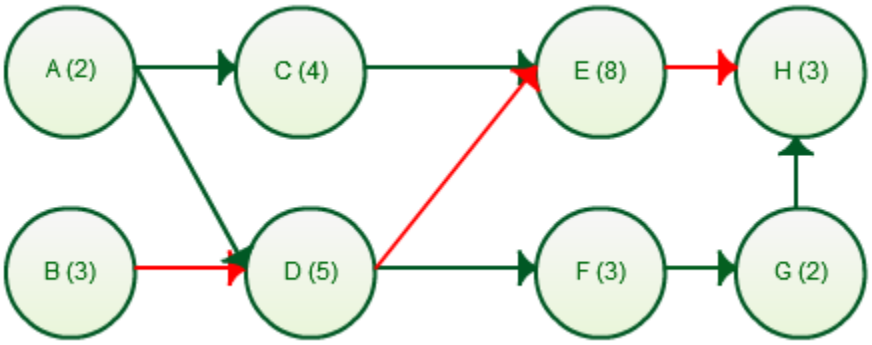
The **network diagrams** can be very helpful in this type of time management. Once you have all of the necessary activities worked out and added to the diagram you can use the critical path method to find the optimal way to finish those tasks.

Perhaps the simplest way of using the critical path method, once you have the earliest and latest start days, is to work backwards. Obviously the last activity is on the critical path as without this section the project will not be completed. You then work backwards throughout each of the activities to locate the line of activities which do not have any float days available to them. However it is much easier to create a table indicating the activity, preceding task and time duration and draw the network diagram based on that.

Activity	Duration (Days)	Immediate Predecessor Activities
A	2	-
B	3	-
C	4	A
D	5	A & B
E	8	C & D
F	3	D
G	2	F
H	3	G

A table to do critical path analysis

Below is a network diagram drawn using the above table.



The network diagram with the critical path highlighted

Critical Path Method Helps to Identify Your Days of Float

The float is worked out by how long the activity takes to complete and how many days are available between the start date of the activity and the one which follows directly afterwards. So if a task will take three days to complete and only has three days available from the start to the following activity this means that there is no float available, therefore it is a critical task. On the other hand float days would be available if you have a task which only took one day to complete but there are four days until the start of the following task. Therefore this task is not time critical and it can be slightly delayed if necessary.

The seven (7) steps in the CPM are:

1. List of all activities required to complete the project (see Work Breakdown Structure (WBS)),
2. Determine the sequence of activities
3. Draw a network diagram
4. Determine the time that each activity will take to completion
5. Determine the dependencies between the activities

6. Determine the critical path
7. Update the network diagram as the project progresses

The **Critical Path** is the longest path of scheduled activities that must be met in order to execute a project, and the earliest and latest that each activity can start and finish without making the project longer. This process determines which activities are "critical" (i.e., on the longest path) and which have "total float" (i.e., can be delayed without making the project longer).

This is important for Program Managers (PM) to know since any problems that occur on the critical path can prevent a project from moving forward and be delayed. Earned Value Management (EVM) analysis focuses on the critical path and near critical paths to identify cost and schedule risks. Other schedule paths might have slack time in them to avoid delaying the entire project unlike the critical path.

The Critical Path is determined when analyze a projects schedule or network logic diagram and uses the **Critical Path Method (CPM)**. The CPM provides a graphical view of the project, predicts the time required for the project, and shows which activities are critical to maintain the schedule.

Using Software to do Critical Path Analysis

The Critical path helps to identify days where it is possible to spend extra time on non-critical parts of the entire project too. So if there are delays in these areas it is still possible to finish on time without anyone else being affected. A complex project has many tasks and estimation has to be done by different people. In such cases it is helpful to use the critical path method in collaboration with team members.

Concepts in Project Monitoring

Er.S.J.Sivakumar, Assistant Professor

Irrigation Management Training Institute, Trichy - 620 015

Monitoring is a process of continuous and periodic surveillance of the physical implementation of a programme, through timely gathering of systematic information on work schedules, inputs, delivery, targeted outputs, and other variables of the programme, in order to have the desired effects and impact.

We monitor the physical implementation of the programme in order to:

- Determine the current status of the program, thus ascertaining that implementation is proceeding as planned. How we determine this is based on the objectives of the program – how far, or near we are to meeting the objectives of the programme.

- We also monitor programs in order to provide the basis for corrective measures to be taken through identifying early indications of deviations, performance gaps and other problems requiring immediate attention for the programme to succeed.

- We also monitor programs in order to verify proper utilization of programme resources, including ensuring that resources are made available on time and are utilized through activities to produce expected deliverables.

- We also monitor programs to verify that activities are undertaken and transformed into outputs. For example, we monitor training sessions through attendance lists to

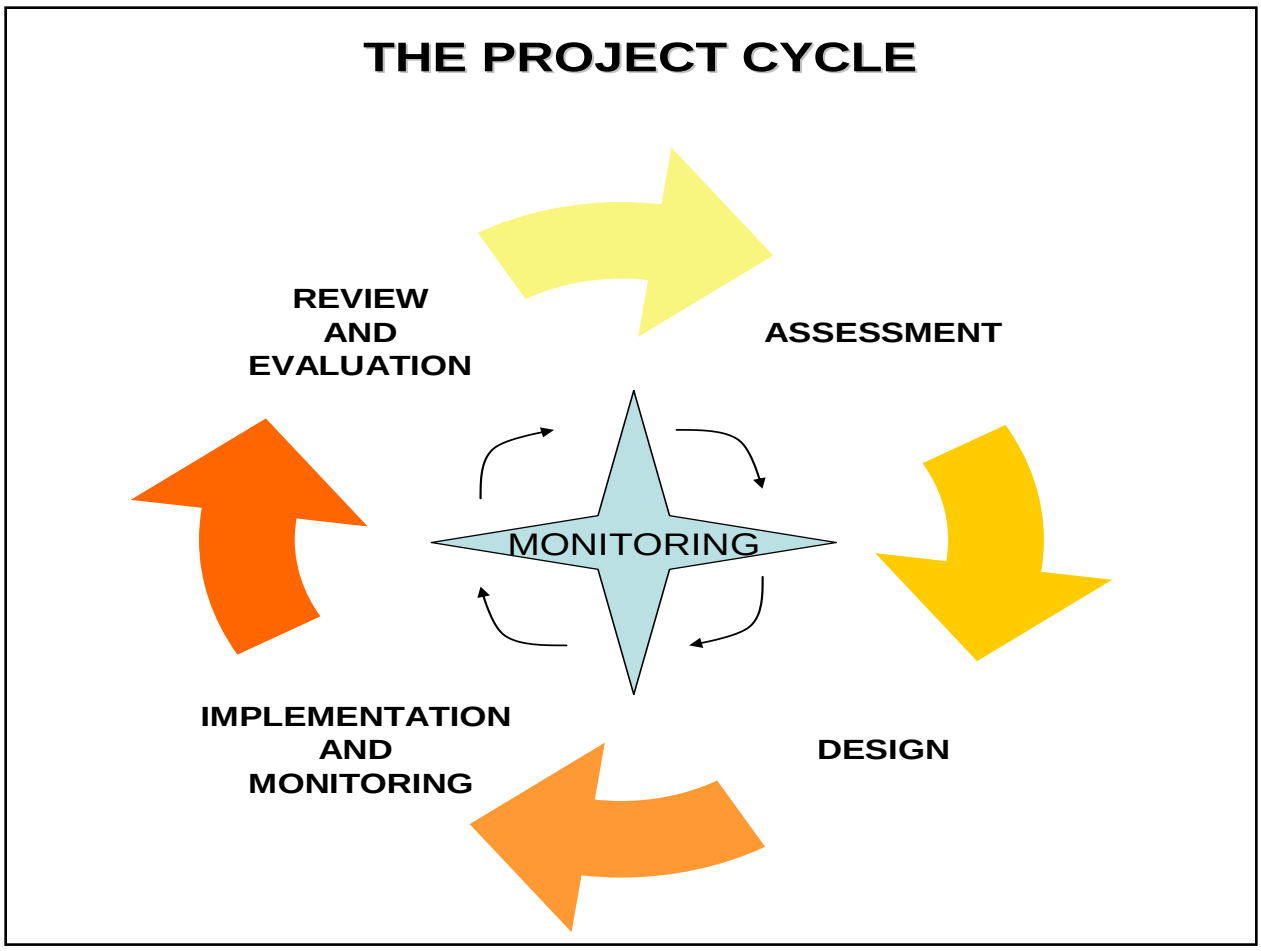
ensure that the correct people attended the training session and that they received the information they were supposed to receive.

For effective implementation of the programme, the following points are important:

- Monitoring of program activities should be done **continuously** at a **scheduled interval**, such as weekly, monthly or quarterly.

- It is also very important to monitor actual activities involved in the implementation of the program in order to avoid things going wrong or unnoticed.

- If monitoring has to be done on a regular basis, it is important to stick to the proposed schedule of data collection to ensure that important aspects of the programme are not missed.



Once all these steps have been followed, you will have a monitoring system for your programme/project in place.

Steps in conducting monitoring activities

- Review existing information related to the project.
- Develop/revise goals and objectives for the programme
- Familiarise yourself with the conceptual framework of the project or develop a conceptual framework for the project.
- Identify monitoring objectives.
- Identify indicators.

- Determine which categories of workers, supervisors or other will be responsible for the collection of each category of monitoring data.
- Develop a timetable for frequency of monitoring.
- Develop/strengthen a management information system.
- Train staff in monitoring activities.
- Develop monitoring instruments.
- Conduct monitoring activities.
- Analyse monitoring and interpret monitoring data.
- Write a report.
- Make recommendations.
- Implement recommendations.
- Identify new indicators based on the recommendations.
- Modify the monitoring system if necessary.
- Continue monitoring.

(Mwadime et al, 1999: 1.22)

To be able to carry out monitoring activities successfully, these steps must be taken into consideration. For example, you need to review existing information about the programme so as to know what the **Goal** and **objectives** of the program are. This will help one to understand what the program is intended to achieve. Monitoring and evaluation therefore should be based on the program objectives.

Secondly one needs to study any available data which will assist one in carrying out monitoring and evaluating activities of the program. The following questions need to be answered:

- What are the components of the program?
- What monitoring activities have been carried out before?

- What indicators have been collected?
- How often were they collected?
- How was data processed and analyzed?

Answers to the above questions will assist you in future monitoring activities.

Familiarising yourself with the conceptual framework of the programme will guide you to the components of the programme that need to be monitored. Some of the information may be readily available, for example, the components of the program and indicators to be monitored, as these may have been identified during programme planning. If a conceptual framework of the program is not available, you may have to develop one using the program components.

Identifying monitoring objectives will assist in identifying what exactly needs to be monitored and how often and by whom. Identification of monitoring objectives will also help you to identify indicators and the categories of workers, supervisors or others who will be responsible for the collection of each category of monitoring data.

It is also important to develop/strengthen a management information system, as this will assist you in determining how the collected information will flow - from who to who - and how will it be stored and by whom. This also includes identification of feedback channels, that is, how will the findings be fed back to the users.

Training of staff in monitoring activities is very important. Trained staff will know exactly what to do. They won't have any excuses for not collecting required information. Data collection is not possible without data collection tools therefore, if these are not already available, they need to be developed. They also need to be discussed with the people who will use them, and staff needs to be familiar with them.

One of the purposes of carrying monitoring activities is to improve program implementation. This therefore means that data collected during monitoring activities need to be analysed, be interpreted into meaningful information and be used to improve programs. At the end of each monitoring cycle, a report should be written stating the

findings from carrying out monitoring activities, the good points that need encouragement and the weak points that need reinforcement. Recommended steps to be taken to improve the program implementation should be clearly stated and newly identified indicators, if available, should be stated in the report.

Evaluation is defined as a process to determine (as systematically and objectively as possible) the extent to which programme needs and results have been or are being achieved, and analyze the reasons for any discrepancy.

Monitoring	**Evaluation**
Continuous	Periodic; at important milestones e.g. mid-term, end of term.
Keeps track of activities and documents progress	In-depth analysis; compares planned versus achieved (objectives versus out puts, outcomes and impact).
Focuses on inputs, activities and outputs, and implementation processes, for example participatory.	Focuses on outputs in relation to inputs, results in relation to cost, processes used to achieve results; overall relevance; outcomes, impact and sustainability.
Answers what inputs and activities were implemented and results achieved.	Answers why and how results were achieved; and why not. Contributes to building theories and models for change.
Focuses on planned results	Captures on planned and unplanned results
Alerts managers to problems and provides options for corrective actions.	Provides managers with strategy and policy options
Self-assessment by programme managers supervisors, community stakeholders and donors.	Internal and /or external analysis by programme managers, supervisors, community stakeholders, donors and or external evaluators.

Integrated Master Schedule (IMS)

Er.M.PADMADEVI M.Tech.,

Research Associate, IMTI.

In project management, a schedule is a listing of a project's milestones, activities, and deliverables, usually with intended start and finish dates. A schedule is commonly used in the project planning and project portfolio management parts of project management. Schedule management is the process of developing, maintaining and communicating schedules for time and resource.

Controlling Schedule is the project management activity in which progress on project activities is compared against Schedule baseline to understand whether project is ahead of the schedule or behind. Based on the deviation you can plan on corrective or preventive actions and manage changes to baseline. Schedule Model is a description of means, methods and tools that determine the timing of tasks and activities which are placed on a given schedule.

In the United States Department of Defense, the Integrated Master Plan (IMP) and the Integrated Master Schedule (IMS) are important program management tools that provide significant assistance in the planning and scheduling of work efforts in large and complex materiel acquisitions.

Project scheduling is concerned with the techniques that can be employed to manage the activities that need to be undertaken during the development of a project. Scheduling is carried out in advance of the project commencing and involves:

- identifying the tasks that need to be carried out;
- estimating how long they will take;
- allocating resources (mainly personnel);
- scheduling when the tasks will occur.

Once the project is underway control needs to be exerted to ensure that the plan continues to represent the best prediction of what will occur in the future:

- based on what occurs during the development;
- often necessitates revision of the plan.

Effective project planning will help to ensure that the systems are delivered:

- within cost;
- within the time constraint;
- to a specific standard of quality.

The critical path = total time for activities on this path is greater than any other path through the network (delay in any task on the critical path leads to a delay in the project).

Tasks on the critical path therefore need to be monitored carefully.

The technique can be broken down into 3 stages:

1. Planning:

- identify tasks and estimate duration of times;
- arrange in feasible sequence;
- draw diagram.

2. Scheduling:

- establish timetable of start and finish times.

3. Analysis:

- establish float;
- evaluate and revise as necessary

Schedule Management Plan

Schedule Management Plan requires thinking proactively before executing the project. It involves thinking through several points, including:

- Individuals involved in the scheduling process
- Approach required to plan schedule of the process
- Use of organizational processes and procedures
- Tools used for scheduling
- Method to manage and control the project to schedule baseline and manage any deviations

The **schedule management plan** is created as a part of Develop Management Plan process in Integration Management. A project manager must create a schedule management plan and it is observed that in real world scenarios most of the project managers miss on this important aspect. A schedule management plan should include the methodology used to create the schedule. The project manager should also describe the use of scheduling software. He should identify the measurement guidelines i.e. should he measure the process progress in hours, days, weeks, months or quarters. The schedule management plan should also include the duration for each activity and the efforts required for those activities. All of this should establish the project baseline. This baseline is to be used to monitor and control the project during various phases.

Project manager should also include a plan to mitigate any variances observed in the schedule. Change Control Procedure should be in place to manage schedule changes. Reporting requirements should also be established. As described earlier, the measures of performance need to be planned in advance and then captured and reported. Schedule management plan is a part of project management plan and can be formal or informal. It expedites the schedule estimation process by providing guidelines on how estimates

should be stated. During the monitor and control phase, the deviation from the schedule baseline can be analyzed and acted upon. Reporting of project is also determined by schedule management plan.

In scope management, we had created a WBS. WBS resulted in Work packages. Work packages are used as inputs in the Define activities process. These work packages are broken down further into activities to ensure that work packages are delivered. Each activity is then estimated, scheduled, monitored and managed. Thus, these activities should be small enough. Sequencing of these activities is the next process. For defining activities, a project manager needs two critical things:

- Scope baseline (scope statement, WBS and WBS dictionary)
- Availability of a project team

Defining the activities involve making the estimates. Involving the team early on in defining activities ensures that the estimates are more accurate.

When the project manager is defining the activities, there may be too many components to adequately break-down the components and schedule it. In these situations, project manager's use a technique called "rolling wave planning". In this method, the project manager need not plan all the details of the project right at the start. He can plan activities to the detail needed to manage the work only when he starts that phase of the project life cycle. Activity list and Activity Attributes are two outcomes of Define Activities process. Activity attributes is the documentation of the details of the activities. Milestones are also to be determined in the Define Activities process.

PROJECT SCHEDULE

The schedule can be shown with or without dependencies (logical relationships) and can be shown in any of the following formats, depending on the needs of the projects:

- Network diagrams
- Milestone chart

- Bar chart (also called Gantt Chart)

MILESTONES

Time-line for each of the defined activities is not considered as a milestone. Milestones are interim deliverables of the project schedule. A summary of milestones is included in the project charter. For controlling the project, a project manager can impose milestones (like a sponsor) during the Sequence Activities or Develop Schedule processes. Deviations from the planned activities are detected when the milestone arrives and the project has not completed the activities required for the milestone. A list of appropriate milestones is created as a part of Define Activities process. This milestone list becomes a part of the project management plan and is added to the project scope statement and WBS dictionary as part of iterations in planning.

CRITICAL CHAIN METHOD

Critical Chain method uses a network diagram and develops a schedule by assigning each activity to occur as late as possible to still meet the end date. You add resource dependencies to the schedule, and then calculate the critical chain. Starting at the end date, you build duration buffers into the chain at critical milestones. These reserves, spread throughout the project, will provide cushions for delays in the scheduled activities. You manage these buffers so that you meet each individual milestone date and thus the project milestone completion date as well.

SEQUENCE ACTIVITIES

The output of Define Activities is a list of activities and milestones. In sequence activities process, these activities and milestones are sequenced in the order of work performance. The output of Sequence Activities is a Network Diagram also known as **project schedule** network diagram. Network diagram and PERT charts are different.

LEADS AND LAGS

A lead may be used to indicate that an activity can start before its predecessor activity is completed. A lag is inserted waiting time between activities, such as needing to wait for completion of the application testing before final roll-out of the application. Sequence Activities process can also result in identification of new risks. It may also lead to updates to activity list and activity attributes.

RESOURCE LEVELING

A resource-limited schedule is produced using resource leveling. If resources are limited, leveling lengthens the schedule and increases the cost and other constraints.

CONTROL SCHEDULE

Schedule control means looking for things that are causing changes and influencing the sources of the change. If the project can no longer meet the agreed-upon completion date (the schedule baseline), the project manager might recommend the termination of the project before any more company time is wasted. Bar charts are weak planning tools, but they are effective for progress reporting and control. Bar charts do not help organize the project as effectively as a WBS and a network diagram do. They are completed after the WBS and the network diagram in the project management process.

The IMS flows directly from the IMP and supplements it with additional levels of detail both then form the foundations to implement an **Earned Value Management System.** Supporting the IMP is the IMS that is made up of "tasks" depicting the work effort needed to complete the "criteria". It is a detailed time-driven plan for program execution that helps to ensure on-time delivery dates are achieved, and that tracking and status tool are used during program execution. These tools must show progress, interrelationships and dependencies. The IMP provides a better structure than either the Work Breakdown Structure (WBS) or Organizational Breakdown Structure (OBS) for

measuring actual integrated master schedule (IMS) progress.IMS provides sequential events and key decision points (generally meetings) to assess program progress.

IMS as the bottom-up execution tool. It should be noted, however, the IMS is a scheduling tool for management control of program progression, not for cost collection purposes.

The Integrated Master Schedule (IMS) is a time-based schedule containing the networked, detailed tasks necessary to ensure successful program/contract execution. The IMS is used to verify attainability contract objectives, to evaluate progress toward meeting program objectives, and to integrate the program schedule activities with all related components. The IMS is traceable to the Integrated Master Plan (IMP), Work Breakdown Structure (WBS), Statement of Work (SOW), Contractor Performance Report (CPR) and Earn Value Management system (EVMS).

The IMS utilizes Critical Path network management techniques to optimize the relationship of critical activities. It uses Events, Accomplishments, and Criteria to show network relationships.

The four (4) steps to developing a IMS:

1. Develop the Integrated Master Plan (IMP)
2. Develop the Work Breakdown Structure (WBS) based on the overall system's Physical Architecture identifying all of the major systems and subsystems down to a configuration item level (CI)
3. Defined configuration item level in terms of calendar time and resources to complete
4. Place developed system time and resources into scheduling software .

PRIMAVERA

Er.M.PADMADEVI, M.Tech.,

Research Associate,IMTI.

PROJECT MANAGEMENT (PM)

It is a multiuser, multi-project system with scheduling and resource control capabilities supporting multi-tiered project hierarchies, resource scheduling with a focus on roles and skills, recording of actual data, customizable views, and user-definable data. It is ideal for organizations that need to simultaneously manage multiple projects and support multiuser access across a department or the entire organization. It supports an enterprise project structure (EPS) with an unlimited number of projects, activities, baselines, resources, work breakdown structures (WBS), organizational breakdown structures (OBS), user-defined codes, and critical-path-method (CPM) scheduling and resource leveling. In addition, the module provides integrated risk management, issue tracking, and management by threshold. The tracking feature enables users to perform dynamic cross-project rollups of cost, schedule, and earned value. Project work products and documents can be assigned to activities and managed centrally. The Report Wizard creates customized reports that extract specific data from its database

Primavera P6 is enterprise project portfolio management software. It includes project management, product management, collaboration and control capabilities, and integrates with other enterprise software such as Oracle and SAP's ERP systems.

About P6

The recognized standard for high-performance project management Primavera **P6** Professional Project Management, handles large-scale, highly sophisticated and

multifaceted projects. Organize projects of up to 100,000 activities with unlimited resources and an unlimited number of target plans.

Enterprise Project Management (EPM) or **Enterprise Project Portfolio Management** (**EPPM**) is a disciplined approach to project & resource management that looks at all the project (and sometimes non-project) work in an organization as a collective whole.

The Project Management module is comprehensive, multi project planning and control software, built on Oracle and Microsoft SQL Server relational databases for enterprise-wide project management scalability. The Project Management module can stand alone for project and resource management, or it can be used in conjunction with other products, including the Timesheet Module, Portfolio Analysis Module, Methodology Management Module and Primavera.

PRIMAVERA'S WEB APPLICATION

The Primavera Web application provides browser-based access to project, portfolio, and resource data across the organization. Every web user can create customized dashboards that provide an individualized and focused view of the specific projects and categories of project data that are most relevant to their role in managing project portfolios, projects, and resources. Project Workspaces and Workgroups extend the model of customizable, focused data views by enabling designated project team members to create a uniform team view of data that relates to one specific project or to a subset of activities within a project. The Primavera Web application provides access to a wide range of data views and features that enable Web users to manage their projects from initial concept review and approval through to completion.

PROJECT LINK

Project Link is a plug-in that enables Microsoft Project (MSP) users to work in the MSP environment while being connected to Primavera's enterprise features. The

functionality enables MSP users to open/save projects from/to the Project Management module database from within the MSP application. Moreover, MSP users have the ability to invoke Primavera's resource management within the MSP environment. Project Link benefits organizations that have a substantial amount of project data stored in MSP but require some users to have the additional functionality and optimized data organization available within Primavera applications

The Project Management module enables organization to store and manage its projects in a central location. The module supports work breakdown structures (WBS), organizational breakdown structures (OBS), user-defined fields and codes, critical-path-method (CPM) scheduling, and resource leveling.

The Project Management module provides

Getting Started

1. EPS
2. OBS
3. Create A New Project
4. WBS
5. Resources
6. Calendar
7. Currency

- An enterprise project structure (EPS), which enables project managers to manage multiple projects, from the highest levels of the organization to the individuals that perform specific project tasks. Multiple users can access the same projects concurrently.
- Centralized resource management, including resource timesheet approval and the ability to communicate with project resources who use Primavera Timesheets
- Integrated risk management

- Issue tracking
- Management by threshold
- A tracking feature that enables you to perform dynamic cross-project rollups of cost, schedule, and earned value
- Work products and documents that can be assigned to activities and managed centrally
- A Report wizard that helps you create customized reports to extract any data from the Project Management database

1. Enterprise Project Structure (EPS)

The Enterprise Project Structure (EPS) forms the hierarchical structure of your database of projects; or in simple terms **a hierarchical based structure that represents how your projects are organized.** Each EPS node (or folder) can be subdivided into multiple levels to represent the work that needs to be done in your organization. The number of levels and their structure depend on the scope of projects and how we want to summarize data.

Use the EPS to

- Perform top-down budgeting and resource and cost analysis
- Organize work breakdown and organizational breakdown structures into one common structure
- Manage multiple projects from the highest levels of the organization to the individuals that perform specific project tasks
- Implement coding standards for flexible reporting
- Maintain appropriate security throughout the enterprise
- Hierarchal structure that identifies the company-wide projects and enables organizing andmanagement of those projects
- EPS can be created up to **50 levels.**Maximum character length for an
- **EPS ID is 20** and for **EPS** Descriptions are **100**

- To create EPS activate Enterprise / Enterprise Project Structure menu.
- Create EPS node by clicking on "**Add"**option in the EPS window.
- Click on the **"Arrow"**buttons to indent **Left/Right** or to shift **Up /Down**.

Set up the EPS Structure

1st step, when create the enterprise project structure, must identify an OBS element, or person responsible for each node and project within the EPS.

Note

- A default root node displays in the top left position in the hierarchy. All projects listed below it are part of the same structure. You can also define multiple root nodes to separate various components of your enterprise. For example, you might want to exclude inactive or what-if projects from the main enterprise. To define a root node, click the left arrow key to move an EPS element to the top left position in the hierarchy, and then add the hierarchy of projects below this node.

2. Organizational Breakdown Structure(OBS)

The **organizational breakdown structure (OBS)** is a global hierarchy that represents the managers responsible for the projects in your enterprise. The OBS usually reflects the management structure of organization, from top-level personnel down through the various levels constituting your business. You can associate the responsible managers with their areas of the EPS – either nodes or individual projects. When you associate a responsible manager with an EPS Node, any projects you add to that branch of the EPS are assigned that manager element by default.

The OBS hierarchy is also used to grant users specific access privileges to projects and the WBS levels within projects.

Represents the management responsible at the EPS/Project/WBS. Each manager in the OBS is associated with his / her area of the EPS, either by EPS node or by project, and the WBS of the particular level of hierarchy.

User access and privileges to the EPS/Project/WBS nodes are Implemented through OBS.OBS can be created up to**25 levels**. Maximum character length for an **OBS** element is **100** .To create OBS activate **Enterprise/OBS** menu.

To add an OBS element click on "**Add"** option in the OBS window.

Note:

There can be only one **"Root OBS"** element. Always match the levels of OBS with that of EPS / PROJECTS / WBS.

Add an OBS element

1. Choose Enterprise, OBS.
   A root OBS element// is automatically assigned to the root EPS node so that a default OBS element can be assigned to each project you add to the EPS root.

2. Click the OBS Name column label to display the OBS hierarchy. The outline symbol in the OBS Name column label indicates a hierarchy display.
3. Select the OBS element immediately above and at the same hierarchy level as the element you want to add, then click Add.
4. Click the General tab, type the OBS Name, then click the OBS Description area to type a description of the OBS element. You can use HTML editing features, which include formatting text, inserting pictures, copying and pasting information from other document files (while retaining formatting), and adding hyperlinks.
5. Click the Users tab to view the users and corresponding security profiles associated with an OBS element. You can also assign users from this tab, if you have appropriate access rights.

6. Click the Responsibility tab to quickly see where responsible managers (OBS elements) are assigned across the enterprise. Select the OBS name for whom you want to see assignments.

Important notes between EPS & OBS

The OBS and EPS are combined together through the responsible manager field on the EPS structure, project folder and WBS level. The Responsible Manager field is the OBS and this determines what users can gain access to the Project. When you create a user, you have to give them Responsible Manager assignments in order for them to see projects.

Your EPS and your OBS need to have a one-to-one relationship. If you give a user a Responsible Manager assignment (OBS) that is not tied to an EPS, Project or WBS level, they will not see any projects when they log into the Primavera Client application or the Web Application.

3. Create A New Project

This is a 2nd step you have to take. But we are not going to add detail activity yet, it just a start up to activate WBS function. Without creating a new project, we can't use WBS button & function.

1)Right click on the EPS Node & click **Add** button. You also may hit **insert** button on your keyboard for short cut.

2)Automatically on **Select EPS** box will fill with EPS name.

Put **Planned Start** date into the box. If you have completion date & you are very firm with it, key in the date in tab **Must Finish By**. Automatically Start & Finish activity will become constraint (0 float).

Then identify the Responsible Manager for this project. The guy that you select will be at the top in OBS & normally is a Project Director. You should refer to Organization Chart to confirm.

1. Specify the Rate Type. Default value is Price/Unit. For beginner level, just follow this value. As summary, this value represent your resource's monetary price. For labor resources, indicate the time unit with a forward slash (/) and the appropriate time unit abbreviation, such as $50.00/h (for 50 dollars per hour).

   Then you have to choose either you want to create a project plan based on existing methodology or start from scretch in Project Architect. In easy word, either you want to start from template (existing portfolio in database) or from zero. However, Project Architect allowed you select, customize, and import methodologies as pre-built project plans from the Methodology Management module. For this exercise,

4. Work breakdown structure (WBS)

A WBS is a hierarchy of work that must be accomplished to complete a project, which defines a product or service to be produced. The WBS is structured in levels of work detail, beginning with the deliverable itself, and is then separated into identifiable work elements.

Each project has its own WBS hierarchy with the top level WBS element being equal to that of each EPS node or project. Each WBS element may contain more detailed WBS levels, activities, or both.

When creating a project, the project manager typically develops the WBS first, assigns documents to each WBS element, and then defines activities for performing the element's work. In addition to document and activity assignments, each WBS element also has an

assigned calendar, specific earned value calculation settings, and an assigned OBS element responsible for all work included in the WBS element.

5. RESOURCE LEVELLING

Resource leveling is a process that helps you ensure that sufficient resources are available to perform the activities in your project according to the plan. During resource leveling, an activity is only scheduled to occur when its resource demands can be met. To accomplish this, tasks may be delayed to resolve resource availability conflicts. Typically, you level during the **forward pass** through a project. This determines the earliest dates to schedule an activity when sufficient resources will be available to perform the task. If forward leveling delays the project's early finish date, late dates remain unchanged unless you clear the checkbox to preserve scheduled early and late dates in the Level Resources dialog box. In this case, a **backward pass** recalculates late dates.

Tip: While resource leveling provides one way to resolve resource conflicts, you may also want to consider alternative solutions, such as changing activity relationships or reallocating resource.

Using Resource Codes

Just like Project Codes and Activity Codes, Primavera provides you resource codes that allow you to organize, group, sort and filter your resource dictionary. The resource codes also allow you to group and sort in the Resource Assignments and Resource Profile views.

Create a Resource Code

1. In Primavera, create a resource code called a Manager by doing the following:
    1. Click on Enterprise in the menu bar, and choose Resource Codes.
    2. Click on Modify.

3. Click on Add.
4. Type Manager as the new resource code name.
5. Click Close.
6. At the top, you will see Manager in the drop down.
7. Click on the Add button, to add names to the manager resource code.
8. After adding all of the names, click on Close in the resource code window.

2. Click on Customize and place the Manager resource code as the first option to group by.
3. Your resource dictionary is now grouped by the code.
4. To go back to how the resource dictionary was originally grouped, click the Display Option bar again and choose Group and Sort, default.

A resource profile can also be grouped by the Manager resource code. This allows the user to click on the manager's name in the profile and see a rollup of all of the limits for the resource under that manager's name. This view makes for a great capacity planning report. To group by the Manager resource code that was created above in the resource profile, follow the instructions below:

1. Open a project.
2. Click on the Activities button in the Directory bar.
3. Turn on the resource profile in the bottom layout.
4. In the resource list on the left side of the resource profile, choose the Directory Bar.
5. Click on the Select View and then choose Resource.
6. Click on the Group and Sort By.
7. Choose the Manager resource code as the first option to group by.
8. Click on OK.
9. In the resource list, you should now see your resources grouped by the Manager name.

10. Click on the Manager name in the list and you will see the rollup information displayed in the Profile view on the right of the screen.

Resources—**MMM**—Men, Materials, Machineries.

6 . GLOBAL & PROJECT CALENDARS

You can create and assign calendars to each resource and each activity. These calendars define the available work hours in each calendar day. You can also specify national holidays, your organization's holidays, project-specific work/non-work days, and resource vacation days. Calendar assignments are used for activity scheduling, tracking, and resource leveling. Whether an activity uses its assigned calendar or the calendar of an assigned resource depends on the activity type you specify. Three calendar pools are defined: **Global, Resource,** and **Project.**

The global calendar pool contains calendars that apply to all projects. The project calendar pool is a separate pool of calendars for each project. The resource calendar pool can be a separate pool of calendars for each resource. You can assign either resource or global calendars to resources, and you can assign either global or project calendars to activities. You can link resource and project calendars to global calendars. Then, if you make changes to a global calendar, your changes apply to all resource and project calendars that are linked to the modified global calendar.

To create project calendar activate **Enterprise / Calendar** menu. To create project specific calendars opt for **Project**.

Click on **ADD** and select one of the Global Calendars as the template for the new Project Calendar.

Select the working days by clicking on **WORKWEEK** and identify the Work and non-work days. Click **OK** to confirm the entries.

To assign the calendar to the activities, open activities view from **HOME** page.

Activate activity detail form from the tool bars and click on **General** tab.

Select the activity and assign the relevant activity calendar.

Class Exercise: Calendar Name Type Work Week Holidays
HO Calendar Global 5 Day26th January, 15th August & 2nd October
Site Calendar Project 6 Day26th January, 15th August & 2nd October.

7. CURRIENCY

Specify the monetary unit or base currency used to store cost data for all projects in the database, as well as the monetary unit or view currency used to display cost data in windows and dialog boxes.

PROJECT CODES & VALUES

Set of codes to organize the projects in the EPS in groups according to specific categories. You can then do Filtering, Sorting, Grouping and Reporting to your projects. Project Code Values can be created up to **25 levels** under each Project Code.

To create project codes activate **Enterprise/Project Codes** menu. Click on the **"Modify"** button to add Project Codes in the "Project Code Definition" window and close it after adding the project codes. Select the Project Code from the drop-down box and add the Code Values under each code.

Add the Project Codes and their values as given in the table below. Open

"Projects "view from HOME page to assign the Project Code Values to any project.

Add activities to your project.

-Right then click to open the project.
-To add activities click the + icon at the upper-right screen so that you can add new new activity. Then just click Next Next Next until Finish but of course you have to read them

so that you can learn what is being asked about in each dialog, or you can just click Finish right away. Repeat this process until your finished adding the new activities.

Note: Maximum character length for any Project Code Value is 20 and Value Description is 100.

Earned Value

The Earned Value tab enables you to specify default settings for calculating earned value. Technique for computing performance percent complete

Activity % Complete: Choose to calculate earned value according to current activity completion percentages.

Use WBS Milestones:

Choose to calculate earned value by defining milestones at the WBS level and assigning a level of significance or weight to each of them. As progress occurs and you mark each milestone complete, the WBS element's performance percent complete is calculated based on the weight of the milestone.

0/100 % Complete: Choose to calculate earned value as 100 percent only after the activity ends.

50/50 % Complete: Choose to calculate earned value as 50 percent after the activity starts and until the activity ends. After the activity ends, the activity's earned value is 100 percent.

Custom % Complete: Choose to calculate earned value as a percentage you specify. This percentage applies after the activity starts and until the activity ends. After the activity ends, the activity's earned value is 100 percent.

Advantages & Reasons to Use Oracle Primavera Software P6:

Primavera P6 is professional and amazing software program, which is employed not by simply planners, and also project professionals, engineers, schedulers, and other people involved with planning, management, project reporting.
