Project time management – the processes required to manage the timely completion of the project
- Two main tasks
    - Scheduling
    - Controlling

Scheduling – Deciding when the planned activities will be performed and identifying those activities which require management attention and monitoring

Controlling – Reviewing the differences between the plan and the performance and taking corrective action

Project – A set of activities with a definite starting and ending point (in time management context)

Activity – A specific task, or job with a definite starting and ending point culminating in a tangible product

Event – The start or completion of an activity. It requires no time in itself

Why scheduling is used
- Studies the project
- Establishes a baseline for the project
- Determines a sequence of activities
- Assesses the implementation methods
- Communication tool
- Establishes realistic cost estimates & cash flow projections
- Manage parties involved in project

Bar charts
- Scheduled were primarily bar charts
- Time along the x-axis and activities listed along the y-axis
- Showed what activities should be underway, but no logic of activities
- Schedules were a mind exercise of very experienced project managers
- As projects became more complex, there became a need for a better planning tool
- Also known as a Gantt chart
    - Developed by Gantt in 1917

Advantages
- Easy and simple to understand
- Clearly represent the schedule of a project

Disadvantages
- Does not show the interrelationship and constraints between activities
- Does not show critical activities
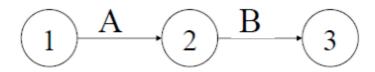- User should have detailed knowledge of the project

CPM – critical path method

Two main types

- ADM (Arrow diagramming method)
    o Round bubbles
    o activity is the arrow
- PDM (Precedence diagramming method)
    o Square bubbles
    o Activity is on the node

ADM

- Arrows represent activities and connect at nodes to show dependencies
- After A finishes, activity B will start
- Node shows an event (such as completion or start)
- Length of the arrow has no significance
- Event not achieved until all activities entering the node have been completed

- Two main applications
    o Maintains the logical sequence of an event
    o Maintains specific activity identification

Duration – Estimated time to complete an activity based on experience, historical data, assumptions, and/or available standards

$$Duration = \frac{Quantity\ of\ work}{Production\ rate}$$

Impact factors

- Method of execution
- Project time limit
- Work sequencing
- External factors (regulator, weather, etc.)
- Site condition (if applicable)
- Quality of supervision
- Labor training & motivation
- Complexity of task

Unit of time – Hour, day (work or calendar)

Dependencies – Finish to start, start to start, finish to finish, start to finish

PDM

Some definitions

Early start (ES) – The earliest an activity can start

Early finish (EF) – the earlier an activity can possibly finish

Late start (LS) – The latest that an activity can start and not impact project completion

Late finish (LF) – The latest that an activity can be completed without impacting the project completion

ES (Early Start)	ID#	EF (Early Finish)
	Description	
LS (Late Start)	Duration	LF (Late Finish)

Forward pass
- starting from the first activity in order to determine ES and EF
- ES of the first activity is 0
- EF = ES + Duration
- ES of the following activity = maximum EF's on predecessors

Backward pass
- Starting from the ending activity in order to determine LF and LS
- LF of the ending activity = EF of the ending activity
- LS = LF – duration
- LF of the previous activities = minimum of the LS of the successors

Lag – the time difference between two events
- Consider removing formwork immediately after concrete pouring
  - You can't the concrete has to harden, have to wait for 3 days before you can remove it
  - Lag = 3 days
- Lag can be positive or negative

Some more definitions

Total float (TF) – Amount of time by which start, or finish, of an activity may be delated without causing project to last longer
- Total float = LS – ES = LF – EF

Free float (FF) – Amount of time by which start, or finish, of an activity may be delated without delaying early start of succeeding activities
- Free float = min ES of the following activities – EF – Lag

Critical path – Longest path(s) in the network. Delay of any activities on the critical path will delay the project finish time (FF = TF = 0)

ES (Early Start)	ID#	EF (Early Finish)
TF (Total Float)	Description	FF (Free Float)
LS (Late Start)	Duration	LF (Late Finish)

Relationship between activities

FS (Finish to Start) – means that an activity start after completion of its predecessor
– The most common relationship

SS (Start to Start) – The initiation of the successor activity depends upon the initiation of the predecessor activity
– That is, two activities can be done concurrently (usually with some lag)

FF (Finish to Finish) – The finish of the successor activity depends upon the finish pf the predecessor activity

SF (Start to Finish) – Not useful in construction, mostly used in high-tech industries