Chapter 3 : Time

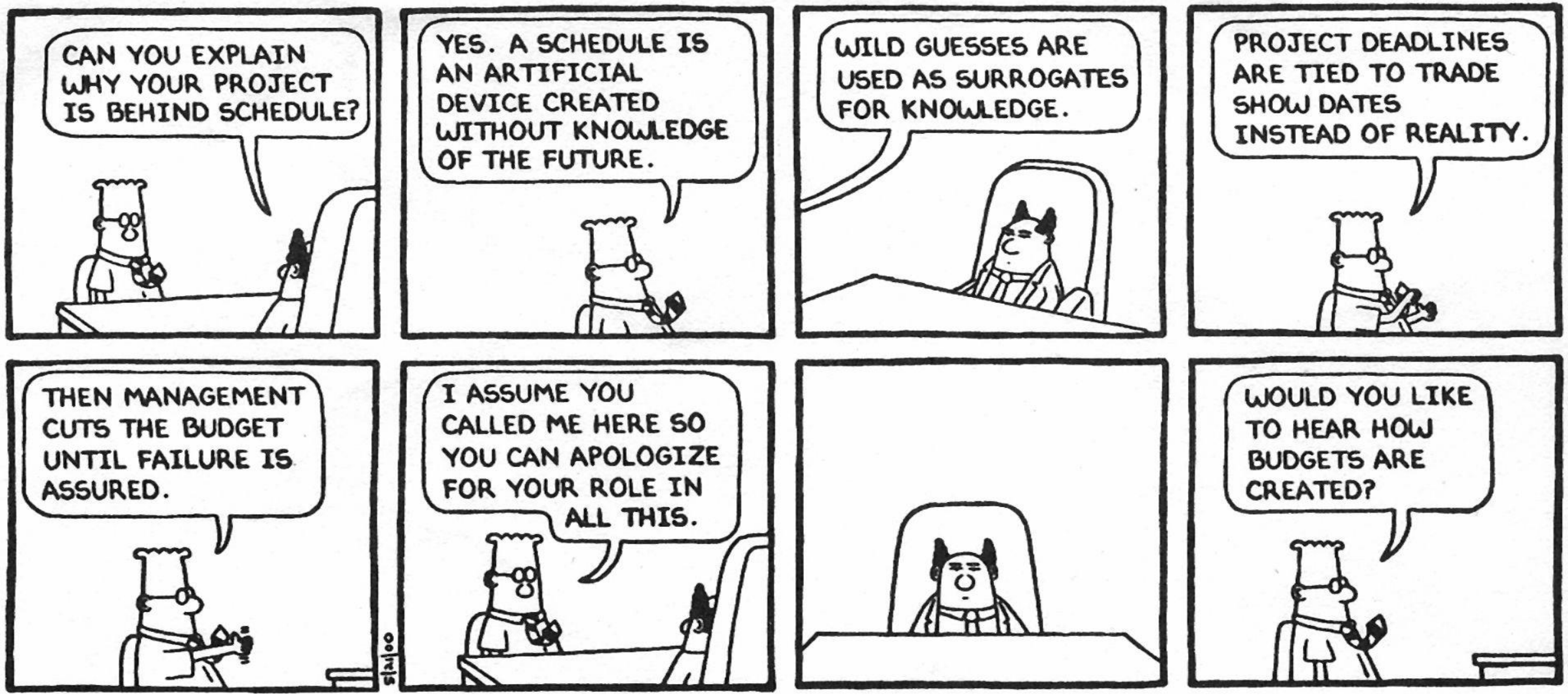
1. Planning definition
2. Planning building
3. Planning Monitoring and Control

Planning according to D.Eisenhover

"In preparing for battle, I have always found that plans are useless, but planning is indispensable"

President D.Eisenhower (1890-1969)

Planning according to Dilbert



Chapter 3 : Time

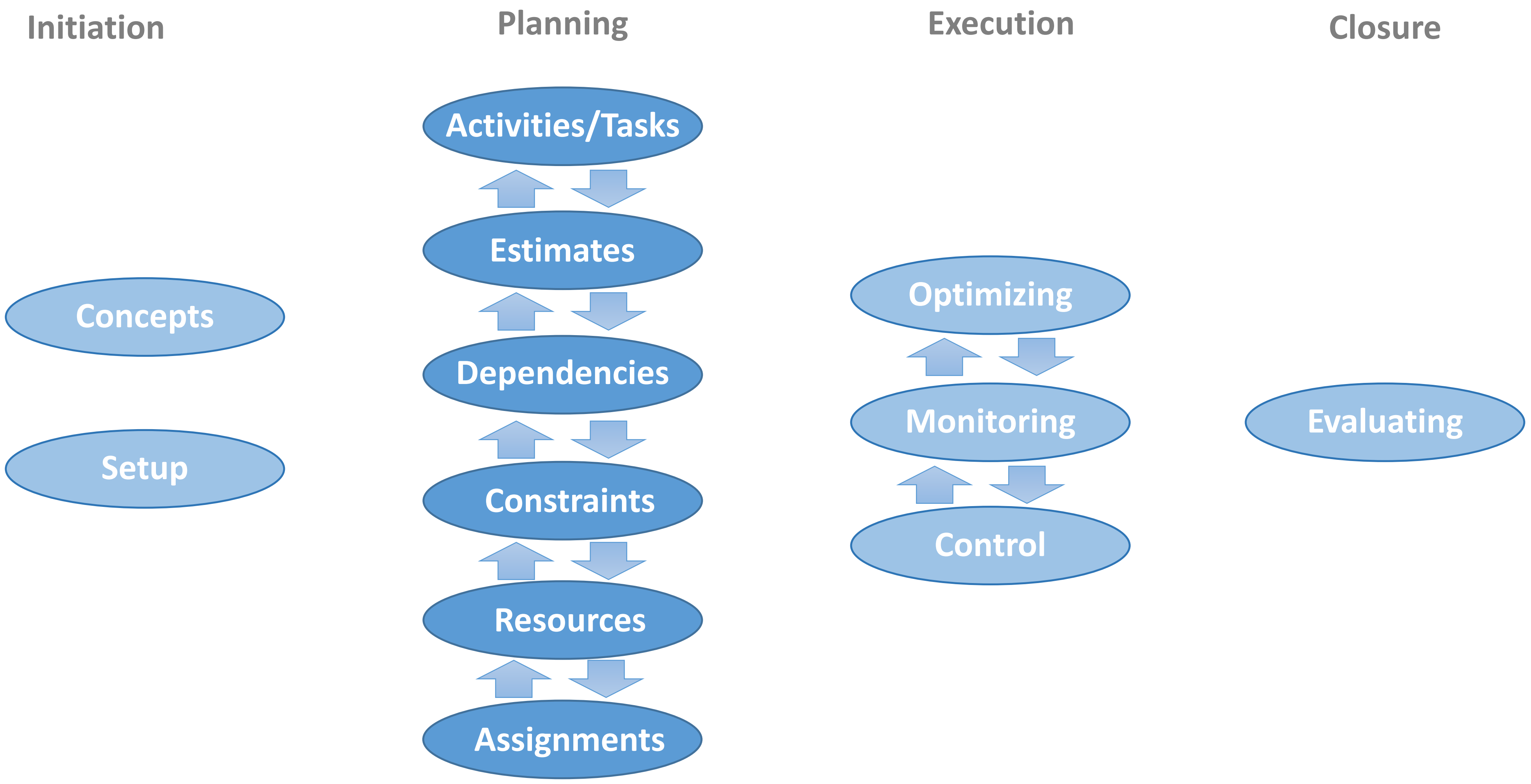
1. **Planning definition**
2. Planning building
3. Planning Monitoring and Control

3.1 Planning definition

- ❑ What needs to be done ?
  - ↳ Tasks and Deliverables
- ❑ In which order ?
  - ↳ Dependencies
- ❑ How long will it take ?
  - ↳ Duration or Work Estimates

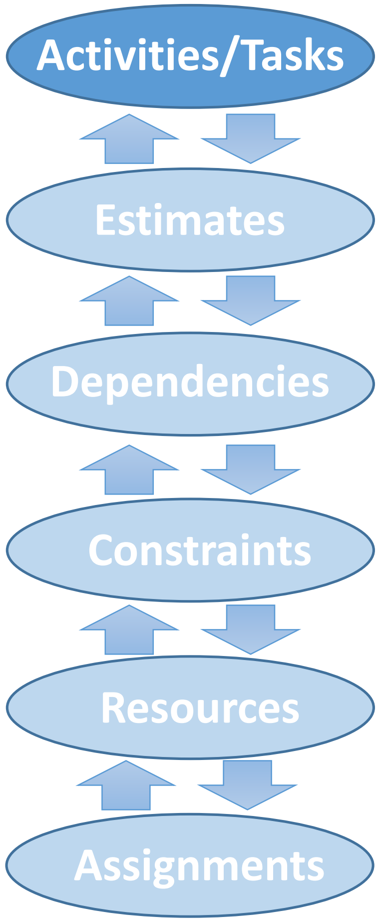
- ❑ When will it happen ?
  - ↳ Start and Finish dates
- ❑ Who is going to do it ?
  - ↳ Resources and assignments
- ❑ When must it happen?
  - ↳ Constraints

3.1 Planning Definition



3.1 Planning Definition

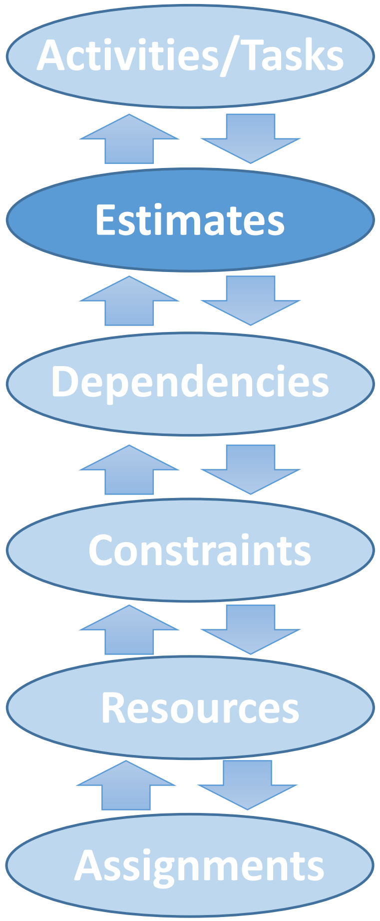
Planning



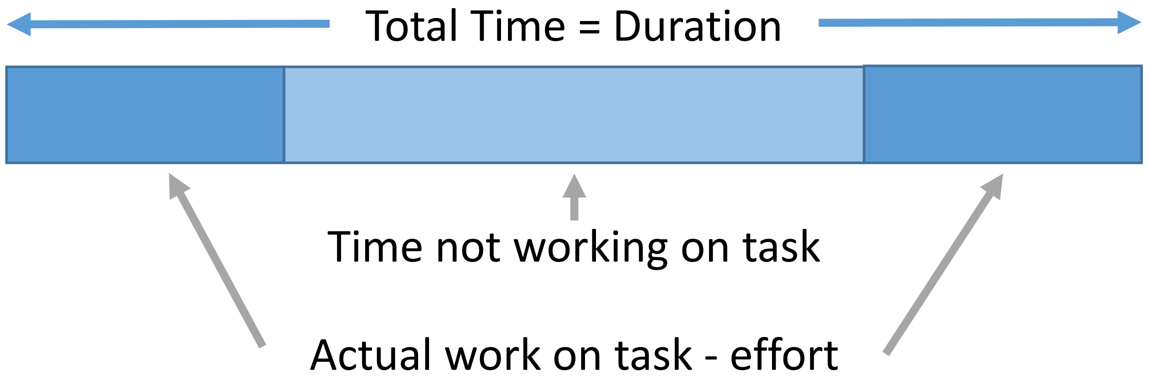
- **Activity definition**
  “The Process of identifying and documenting the specific actions to be performed to produce the project deliverables” (PMBOK® Guide – 5th Edition)
  - Identify the activities or tasks required to achieve the various deliverables
    - Actions to be performed
    - Decompose these into the work breakdown structure (WBS)
  - Identify key milestones in the activities
    - Major events or dates
  - Identify the deliverables
    - Tangible results or products

3.1 Planning Definition

Planning



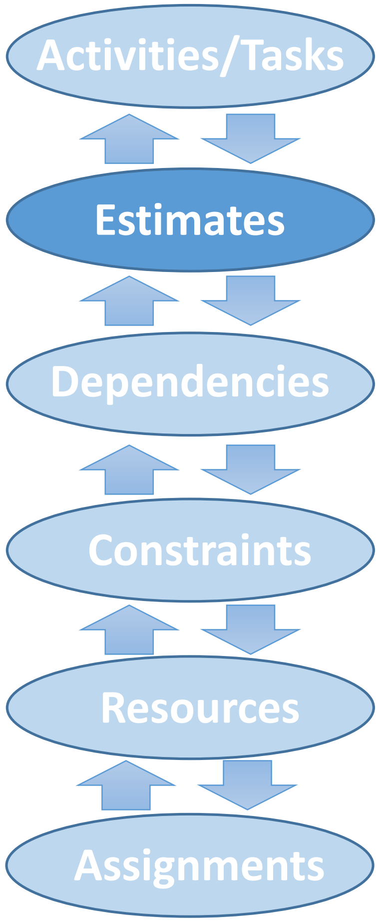
- **Activity duration estimating :**
  - Estimate the amount of time needed to execute the activity → There is a difference between **duration** (usually expressed as workdays / workweeks) and **effort** (often expressed in hours / days / weeks)



Comment : If resources are assigned full time, duration is minimized. Productivity is higher.

3.1 Planning Definition

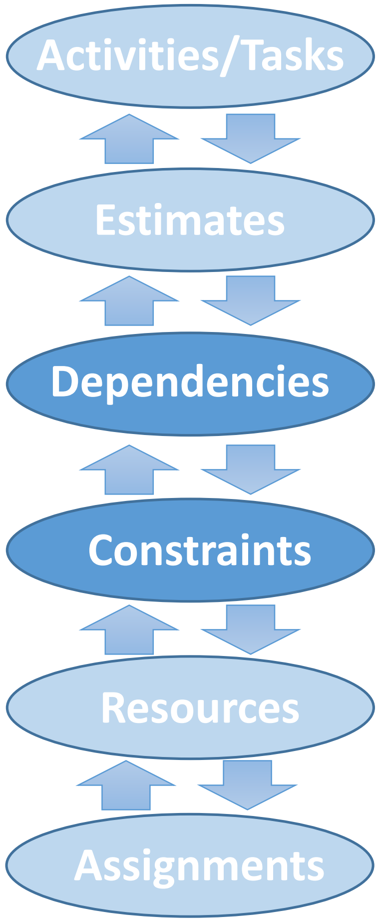
Planning



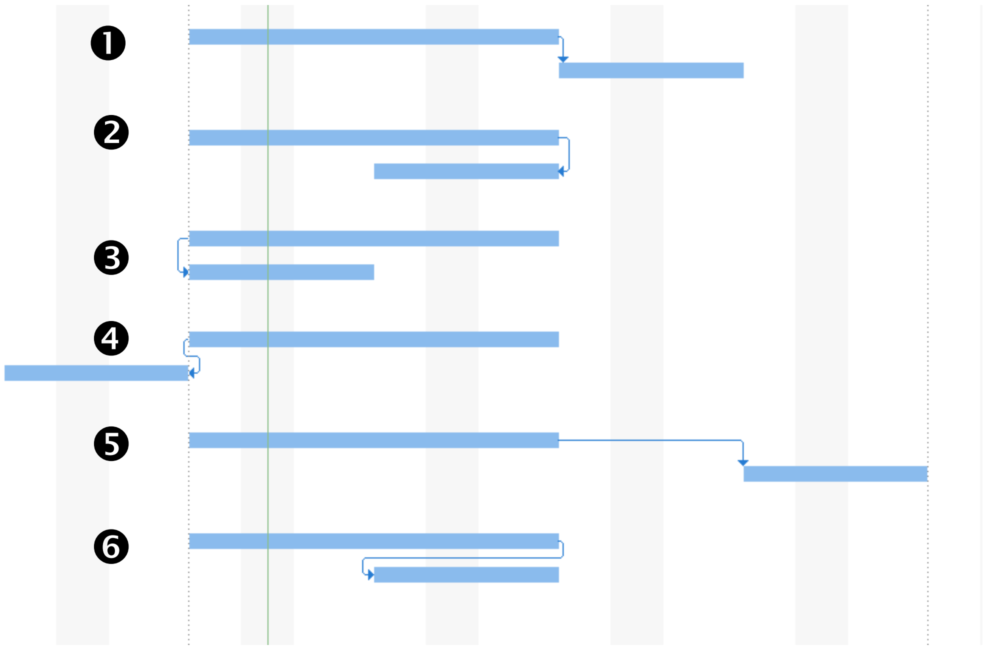
- **Activity duration estimating :**
  - Estimation tools & techniques include :
    - **Expert judgement** : it can provide duration estimate information or recommended maximum activity durations from similar projects
    - **Analogous estimation** (eg. past projects) : it uses parameters such as duration, budget, size, weight and complexity from previous, similar products to estimate the duration of the current project.
    - **Parametric estimation** (eg. statistical database) : it uses a statistical relationship between historical data and other variables to calculate an estimate for activity parameters.
    - **"Three-points estimates" : This technique is called PERT (Program Evaluation and Review Technique) :**
      - Three-points estimates using **a Beta distribution** : the Expected (T_E) activity duration is calculated by using a weighted average of 3 estimates (O = Optimistic estimate, M= Most Likely Value, P = Pessimistic estimate)
      $T_E = (O+P+4\times M)/6$
      - Three-points estimates using a **triangular distribution** provide an average of Optimistic / Pessimistic and Most Like Estimates :
      $T_E = [O+P+M] / 3$

3.1 Planning Definition

Planning

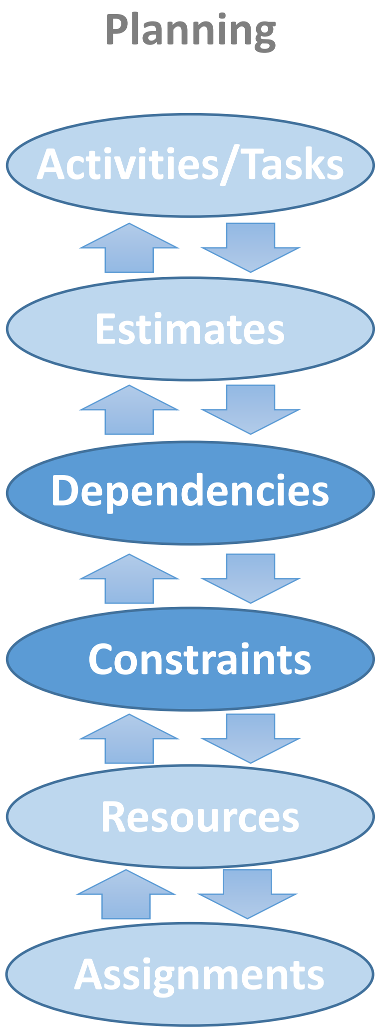


- **Activity Sequency & Constraints**
  - Identifying in what order the activities must be executed : Finding the dependencies and see what can be done in parallel
  - Dependency :
    - Types :
      - Mandatory or “hard” dependencies
        → no choice / this is a constraint
      - Discretionary or “soft” dependencies
        → best practice
    - Internal vs external
    - Links :
      1. **Finish-to-start (common)**
      2. Finish-to-finish
      3. Start-to-start
      4. Start-to-finish
      5. **Lag = wait time**
      6. **Lead = Acceleration time**

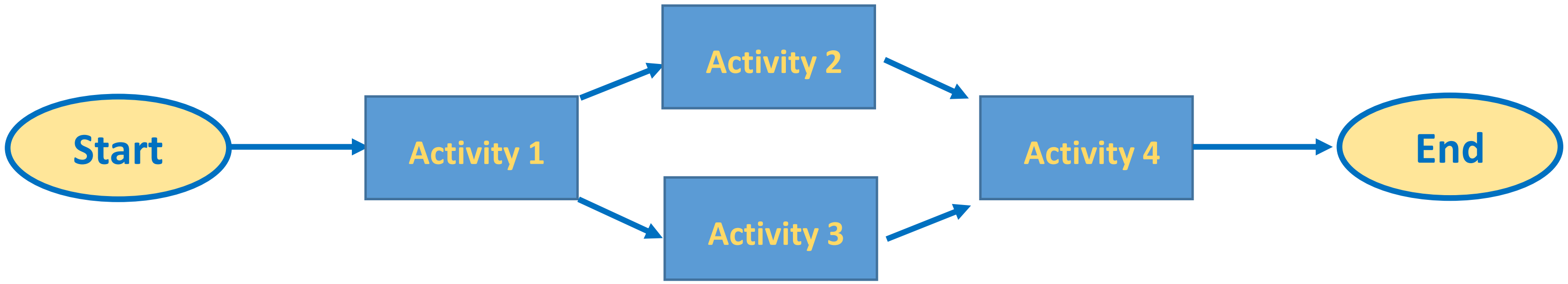


  - Output is normally some form of **logical network diagram or flow-chart** (eg GANTT)
    - In which you can identify the critical activities path based on their priorities

3.1 Planning Definition



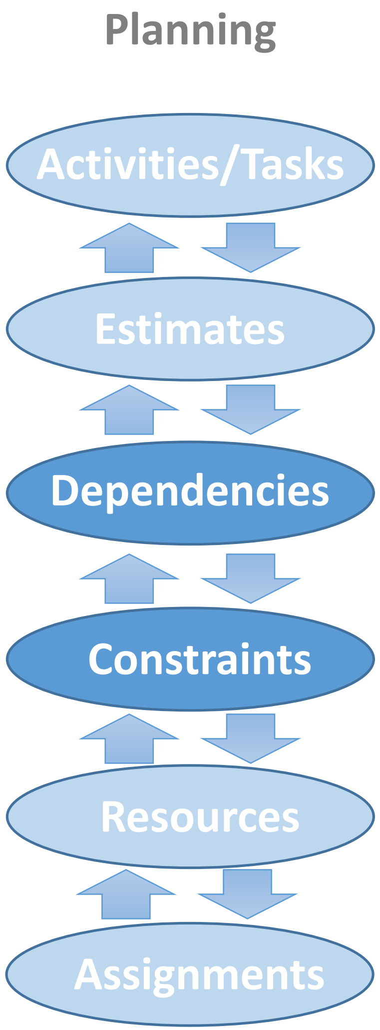
- **Activity Sequency & Constraints**
  - PDM = Precedence Diagramming Method



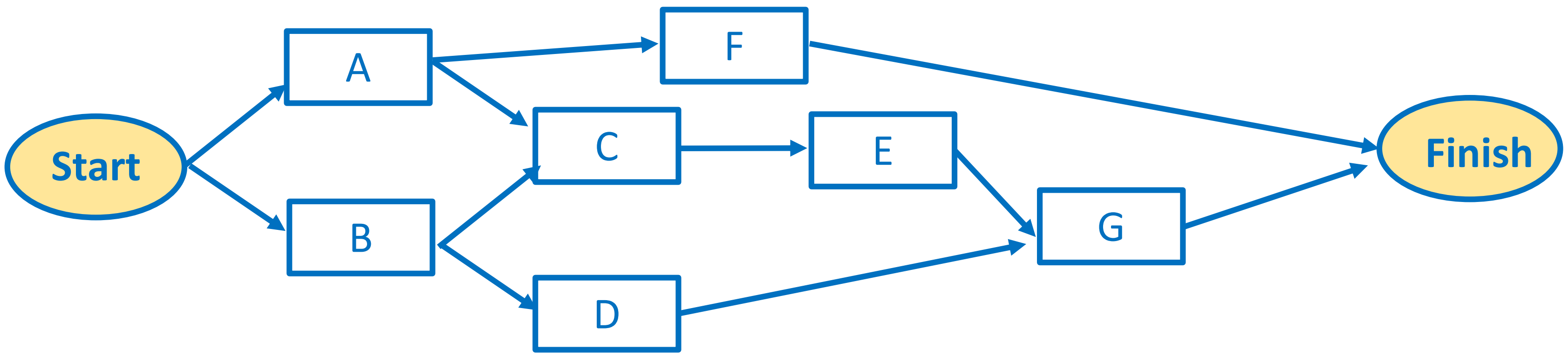
- **Events:** The Start and End oval shapes signify events. An event is a point in time having no duration, which is also known as a milestone. A Precedence Diagram will always have a Start and an End event.
- **Activity**: There are four activities (Activity 1, 2, 3, and 4), each activity is represented by a node.
- **Dependencies**: Each node (Activities and Events) is connected by using uni-directional arrows. This signifies the relationship between activities. The relationship between activities can either be predecessor or successor. For example in the image, Activity 1 has no dependency, Activities 2 and 3 are dependent on Activity 1, while Activity 4 is dependent on Activities 2 and 3.

Note: Since the activities are represented by the node, Precedence Diagrams are also called “**activity-on-the-node" (AON) diagrams**.

3.1 Planning Definition



- **Activity Sequency & Constraints**
  - PDM = Precedence Diagramming Method



1 – the Project starts with a start Milestone, Start

2 – the first 2 activities are A and B which may start at the milestone

3 – Activity C may start after A and B are completed

4 – After B is completed, Activity D may start

5 – Completion of Activity C permits the start of Activity E

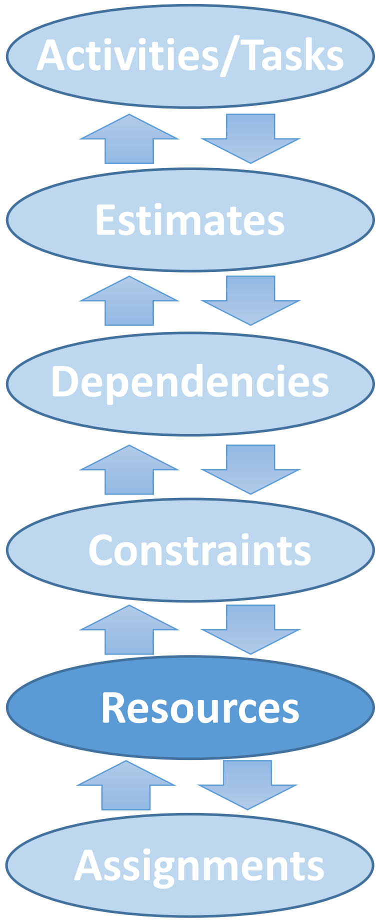
6 – Activity F also starts after A is completed

7 – Activity G has 2 predecessors : Activity E and D which must be completed before it starts

8 – The project is completed with the Milestone Finish which is preceded by the completion of F and G.

3.1 Planning Definition

Planning



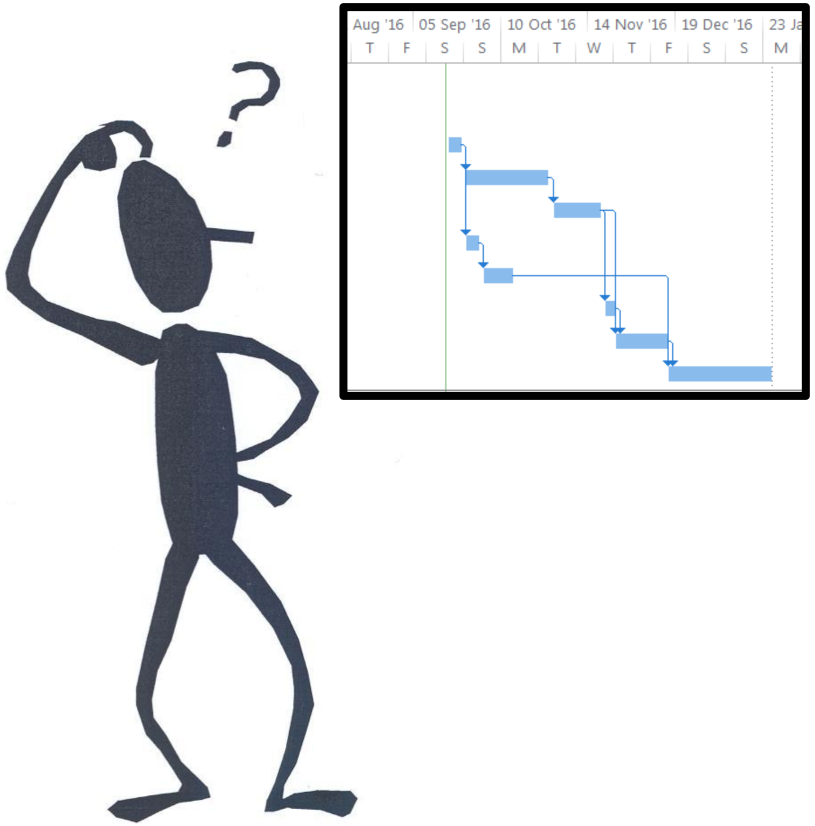
- **Activity resource estimating**
  - Assuming a perfect world and an unlimited resource pool …
    - Estimate the amount of resources needed per activity (number of people)
    - Identify the critical competencies required
    - Identify what equipment or tools are required to perform the activities

  - Estimate activity resource requires to :
    - Determine type of resources : human, material …
    - Answer of below questions :
      - How many of each ?
      - When needed ?
      - For how long ?

Chapter 3 : Time

1. Planning definition
2. **Planning building**
3. Planning Monitoring and Control

3.2 Planning Building



- Different Methods can be used to create a schedule :
  - Critical Path Method
  - Critical Chain Method
  - Schedule Compression
  - “What if ?” for scenario analysis

3.2 Planning Building

- **Critical Path Method**
  - Critical Path Method scheduling was developed in 1957, to address challenges on complex projects. Being one of the most used scheduling techniques in the construction industry, the Critical Path Method is a useful tool that can lead you to achieve your project results.

    A critical path method will provide you - with a graphical view of the project- **the time required to complete an activity** and **determine the activities that will become critical to the project if not completed within the specified time.**

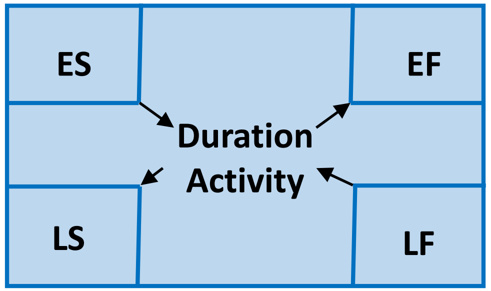
  - To build it, you can use as basis the network of activity developed from the Precedence Diagramming Method. For that, you have performed the below steps :
    - Identify the Activities
    - Determine the Sequence of the Activities
    - Create the Network
    - Estimate Activity Completion Time

    AND
    - **Identify the Critical Path :** 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**.

3.2 Planning Building

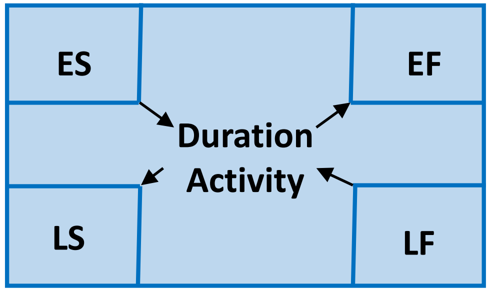
- **Critical Path Method**
  - **Identify the Critical Path :** The critical path can be identified using these parameters:

    - **ES – Early Start**: earliest time to start a predetermined activity, given that prior activities must be completed first
    - **EF – Early Finish**: earliest finish time for the activity → early start + duration
    - **LF - Late Finish**: latest time the activity must be completed without delaying the entire project
    - **LS – Late Start**: latest start date that the activity must be started without delaying the project → LF – duration



3.2 Planning Building

- **Critical Path Method**
  - **Identify the Critical Path :**



- **Calculate forward pass** : Early start + duration = Early Finish

- **Calculate Backward pass** : Late Finish – duration = Late Start

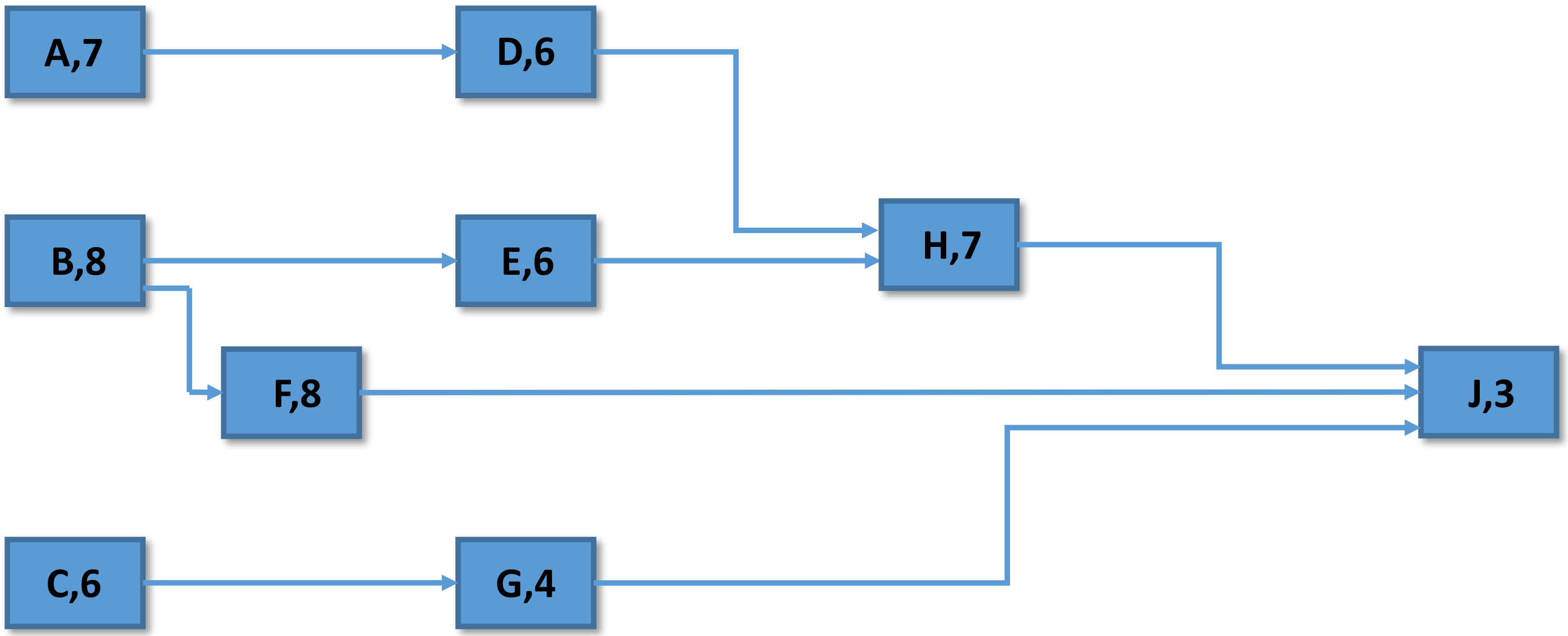
- **Calculate the float per activity** : Float on any activity is calculated either by LS – ES or LF – EF.
Float is the degree of flexibility for that particular activity only, ie, the amount of time that a schedule can be delayed or extended from its ES date without delaying the project finish date.
Activities with zero float are activities on the critical path.

The critical path is the path for which ES=LS and EF=LF for all activities in the path.
A delay in the critical path delays the project.

3.2 Planning Building

❑ **Critical Path Method : exercise**

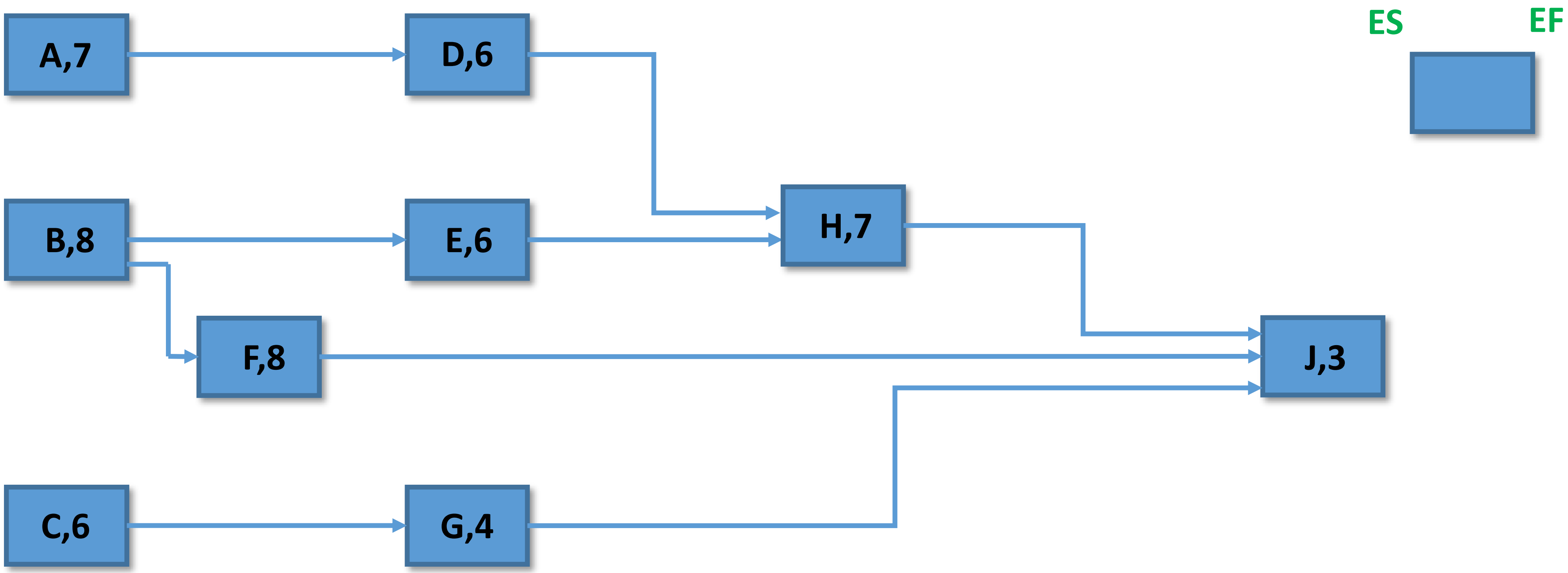
- To determine the Project critical path, it is first necessary to perform a forward pass and a backward pass through the network
- After, calculate the float on each activity and the critical Path



3.2 Planning Building

- ❑ **Critical Path Method : exercise**

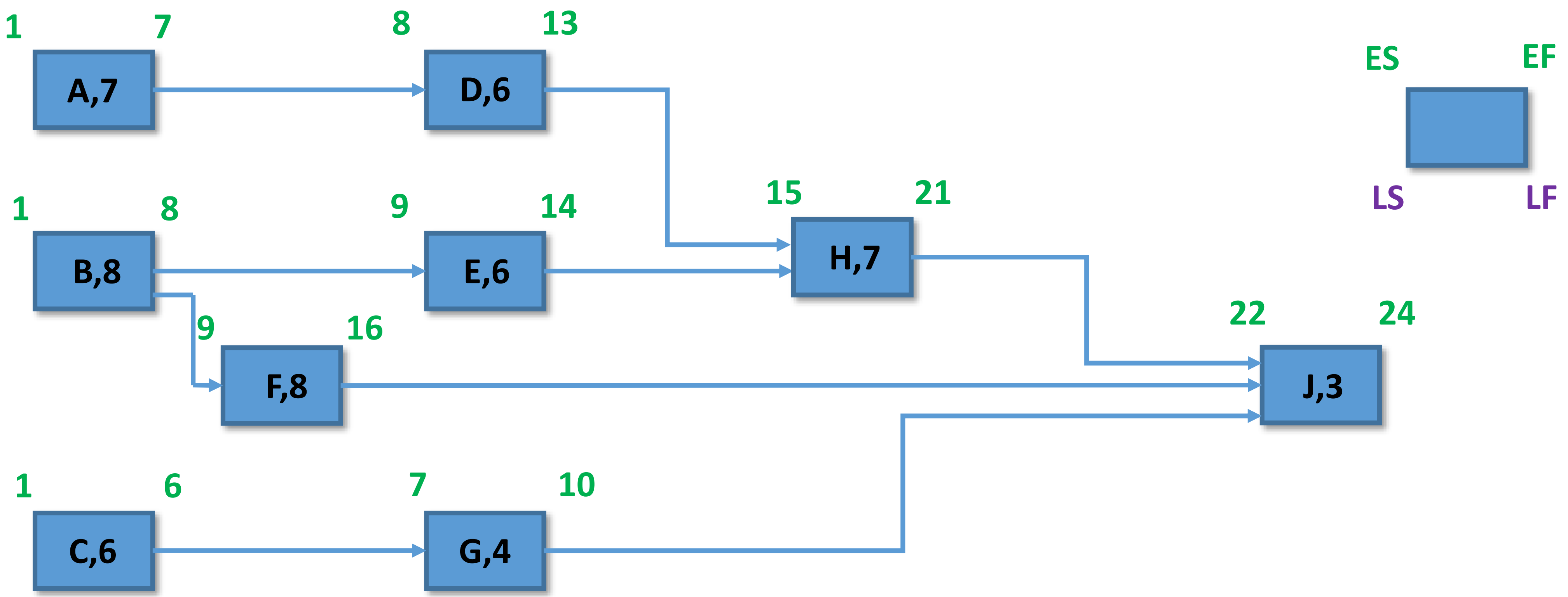
- First step : calculating the Forward Pass → Identifying the early start and early finish for each activity



3.2 Planning Building

- **Critical Path Method : exercise**

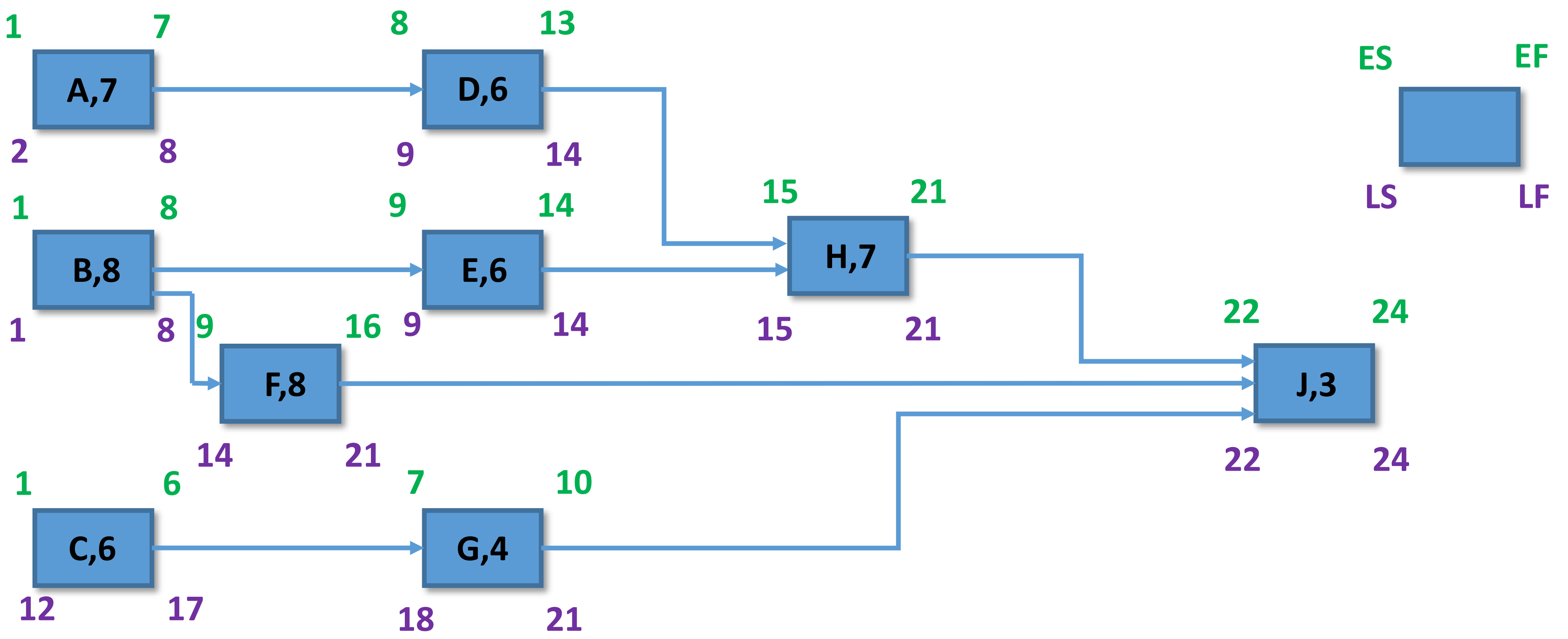
- **First step : calculating the Forward Pass** → Identifying the early start and early finish for each activity



- Second step : **calculating the Backward Pass** → Identifying the late start and late finish for each activity (it is performed starting from right to left)

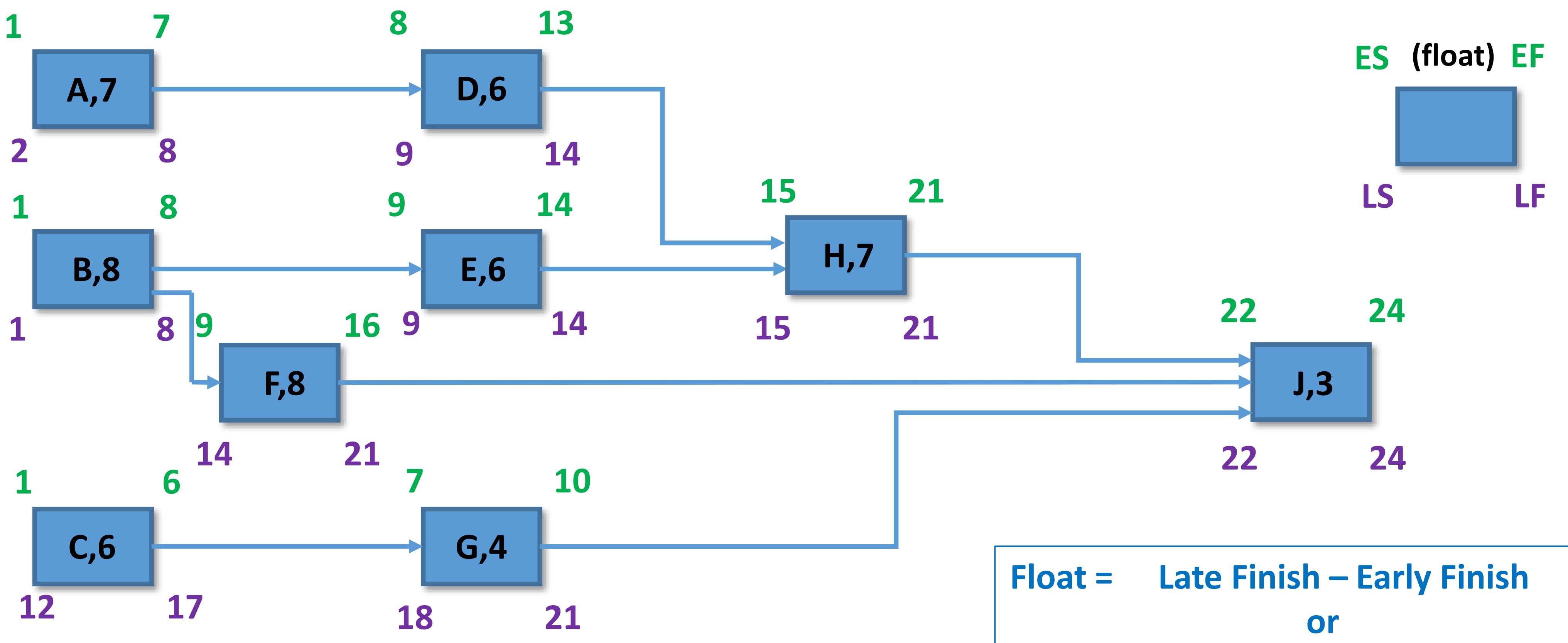
3.2 Planning Building

- **Critical Path Method : exercise**
  - Second step : **calculating the Backward Pass** → Identifying the late start and late finish for each activity (it is performed starting from right to left)



3.2 Planning Building

- Critical Path Method : exercise
  - Calculating the Critical Path : calculate the float (in parenthesis) → it is the amount of time you can delay a task without affecting the project end date.

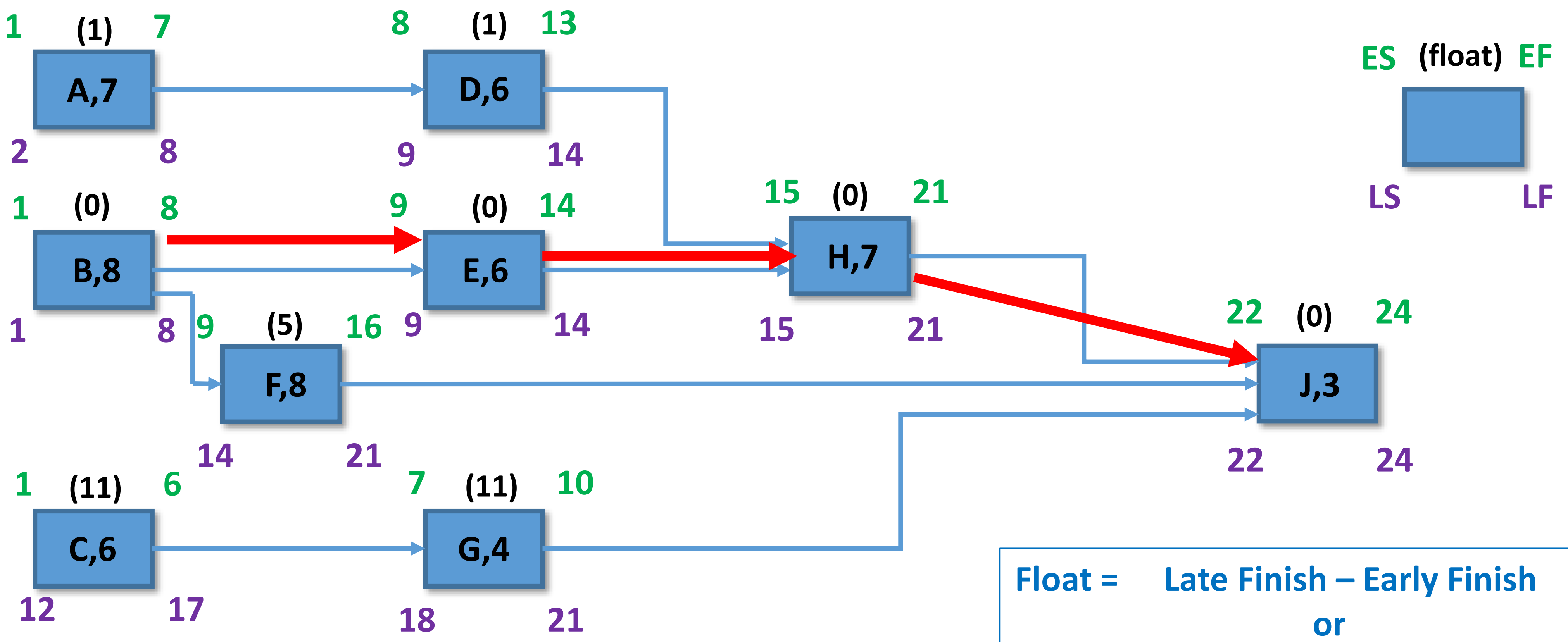


Float = Late Finish – Early Finish
or
Late Start – Early Start

3.2 Planning Building

- ❑ Critical Path Method : exercise

- Calculating the Critical Path : calculate the float (in parenthesis) → it is the amount of time you can delay a task without affecting the project end date.



Float = Late Finish – Early Finish
or
Late Start – Early Start

3.2 Planning Building

- **Critical Chain Method :**

- Critical Chain Method, developed by Dr. Eliyahu M. Goldratt (1997), is **a schedule network analysis technique that takes account of task dependencies, limited resource availability & buffers**.

- This method is based on the **Theory of Constraints (TOC)**, a management philosophy

- CCM or TOC differs from the traditional CPM by focusing on the series of activities in a project schedule that becomes the critical chain after all resources issues have been addressed.
- This method allows the project team to place buffers :
  - ⇨ To account for limited resources
  - ⇨ To manage uncertainty
  - ⇨ Buffers are placed :
    - on the end of the Critical chain → to protect the target finish date – **Project Buffer**
    - on each point where a chain of dependent activities feeds into the critical chain – **Feeding Buffer**

- The TOC addresses two major goals of Project management :
  - Completing projects more quickly
  - Funneling more projects through the organization without adding resources

3.2 Planning Building

- **Schedule Compression :**

- To reduce the duration of a project, you have to reduce the duration of activities on the Critical path.

- Two ways of Schedule compression :

  - **Fast Tracking** : Doing activities in parallel
    Cons :
    - Often results in Rework
    - Usually increases risk

  - **Crashing Technique** : costs and schedules trade-offs are analysed to add more resources by increasing Project cost.

3.2 Planning Building

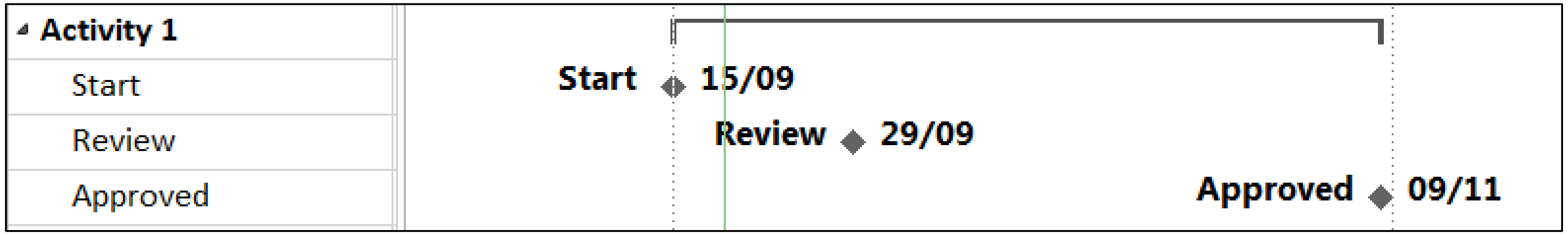
- **"What if " Scenario**

- Evaluate scenarios to predict effect on project objectives :
    - Assess feasibility of the project schedule under adverse conditions
    - Prepare contingency and response plans
    - Mitigate impact of unexpected situations

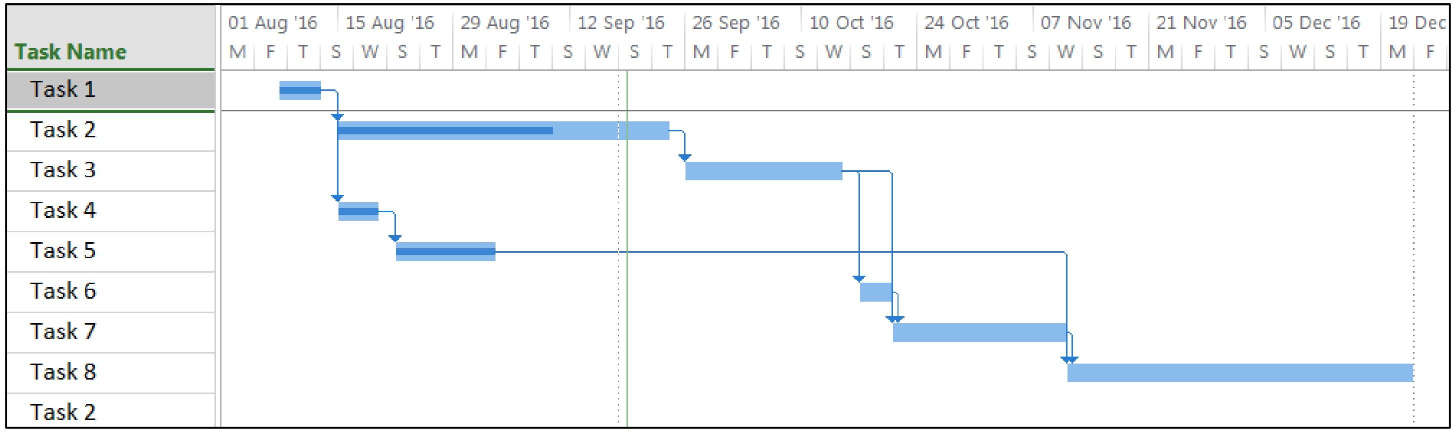
3.2 Planning Building

❑ Different views according level of details

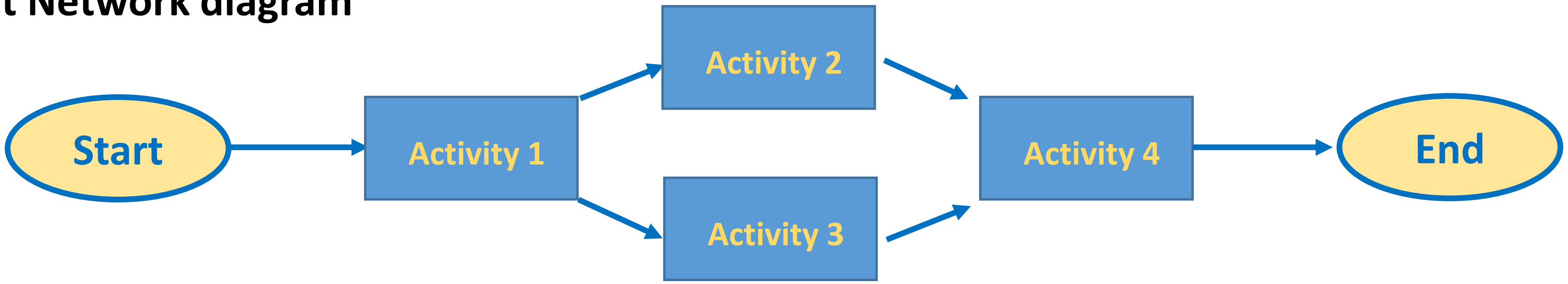
- Milestones Chart



- Gantt Chart



- Project Network diagram



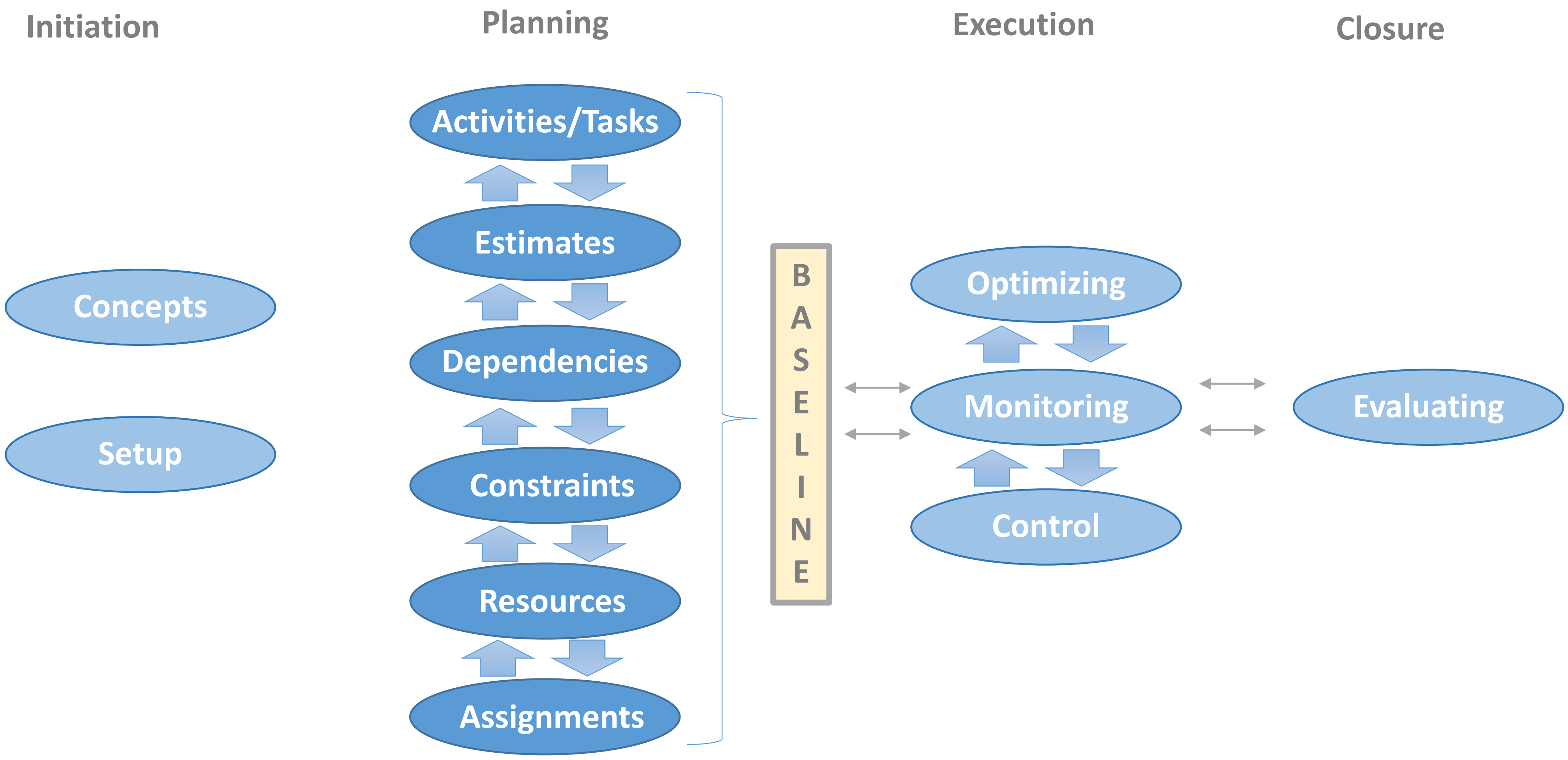
3.2 Planning Building

- During the Planning Phase, the PM builds the planning of the work to be done
  - He has created **a Baseline of his planning / schedule**

  - **SCHEDULE BASELINE →** Schedule baseline is the **approved version of a schedule** that can be changed only through formal change control procedures and is used as a basis for comparison to actual results

- **Difference between Project Schedule (as addressed in 3. Planning Monitoring and Control) and Schedule Baseline:**
  - Project Schedule is a "living" document, whereas Schedule Baseline is "frozen".
  - Project Schedule is the "actual", whereas Schedule Baseline is the "plan".
  - Project Schedule is updated as the project is being executed, whereas Schedule Baseline is revised only as a result of an approved change request (by management or customer).
  - Schedule performance is measured by comparing the actual (Project Schedule) vs the baseline (Schedule Baseline).
  - **At the beginning of project execution, the Project Schedule is the same as the Schedule Baseline.**

3.1 Planning Definition



Chapter 3 : Time

1. Planning definition
2. Planning building
3. **Planning Monitoring and Control**

3.2 Planning Monitoring and Control

- During the Planning Phase, the PM builds the planning of the work to be done
  - He has created **a Baseline of his planning / schedule**

- During the Execution Phase the PM monitors the work done on the planned activities

- The PM should consider the difference between:
  - *Elapsed time / effort spent / % complete (it can be a measure of the progress)*
  - *Time-to-complete / effort remaining / % to go → to allow to tell us how much effort or time is still needed*

  ⇘ Logically the planned time for the activity should be the elapsed time + the time remaining. When the this sum is greater than the planned time then the activity is running late

- **How to control schedule : Techniques and Tools**
  - **Performance reviews** :
    They measure, compare and analyze schedule performance → Project Metrics can be developed to compare the plan versus the actual.
    Using the planned versus actual information and analyzing the critical path provides a good way to track the performances.
    - **Trend Analysis** : Project performance over time is examined to determine if performance is improving or deteriorating. Graphical Analysis techniques are used.

3.2 Planning Monitoring and Control

- **How to control schedule : Techniques and Tools**
  - **Performance reviews** :
    - **Critical Path Method** : Comparing **the progress along the critical path** can help to understand schedule status

    - **Critical Chain Method** : Comparing the **amount of buffers remaining versus the amount of buffers needed** to reach the end date.

    - **Control of schedule by Earn Value Management (PMBOK Guide)** :
      - EVM came into the limelight in the sixties when the US Air Force started using it in their programs.
      - EVM has many advantages over traditional project management :
        - The traditional method focuses on planned and actual expenditure
        - The EVM makes you aware of actual accomplishments and gives you a clear insight into the project.
        ➔ This methodology combines scope of project / schedule / resources measurements to assess Project performances and progress.
    - Earned Value Management has **three basic elements**:
      - **Planned Value (PV)** : Planned Value is the scheduled cost of work planned in a given time. Planned Value is also known as Budgeted Cost of Work Scheduled (BCWS) or in French **Coût budgété du travail planifié** (CBTP).
      - **Earned Value (EV)** : Earned Value is the budgeted cost of the work performed in a given time. Earned Value is also known as Budgeted Cost of Work Performed (BCWP) or **Coût budgété du travail effectué** (CBTE).
      - **Actual Cost (AC)** : Actual Cost is the actual amount of money spent to date. Actual Cost is also known as Actual Cost of Work Performed (ACWP) or coût réel du travail effectué (CRTE).

3.2 Planning Monitoring and Control

- **Earned Value Management**

PLANNED VALUE

What are the budgeted costs of the work scheduled ?
→ authorized budget
→ Baseline

ACTUAL COSTS

What is the actual cost of the work performed?
→ Actual costs for reported work

EARNED VALUE

What are the budgeted costs of the work performed
→ Baseline vaule of the reported work

3.2 Planning Monitoring and Control

- **Earned Value Management :**

With the help of these three elements, you can calculate the following variances and performance index:

- **Schedule Variance (SV)**= Earned Value – Planned Value

SV = EV – PV

- **Cost Variance (CV)** = Earned Value – Actual Cost

CV = EV – AC

- **Schedule Performance Index (SPI)** = (Earned Value) / (Planned Value)

SPI = EV/PV

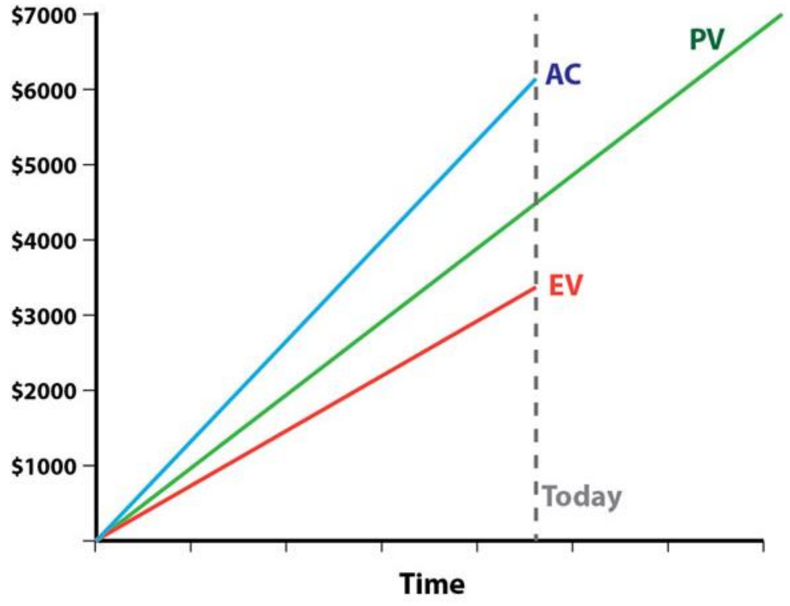
- **Cost Performance Index (CPI)** = (Earned Value) / (Actual Cost)

CPI = EV/AC

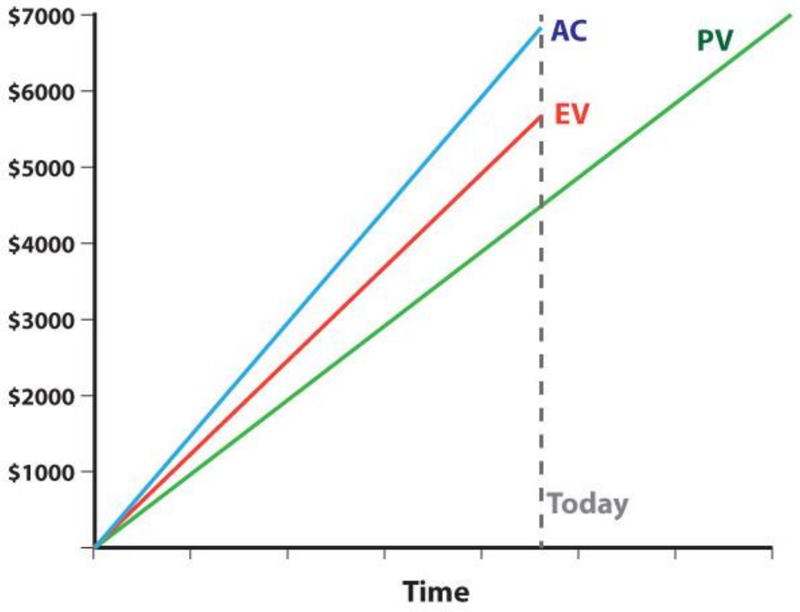
3.2 Planning Monitoring and Control

- How to control schedule : Techniques and Tools
  - Earned Value Management

SV = schedule variance = EV – PV



SV = EV-PV = 3500-4500
=-1000
→ Negative variance
so behind schedule



SV = EV-PV = 5500-4500
= 1000
→ Positive variance
so ahead of schedule

3.2 Planning Monitoring and Control

- **How to control schedule : Techniques and Tools**
  - **Earned Value Management**

SPI (Schedule performance index) = EV / PV

Examples :

1 - A project with a Schedule Performance Index (SPI) of 0.80. The project is currently:

a. ahead of schedule
b. behind schedule

SPI = EV / PV	>1 (ahead of Schedule)	<1 (behind schedule)

2 - You are the project manager of a road paving project. A total of 10km of road is to be paved over a 5-month period. The total budget for the project is $10,000. The project is now at the end of the 3rd month with 8km of road paved and $8,000 spent. The Schedule Performance Index (SPI) for the project is:

A. 0.78
B. 0.98
C. 1.20
D. 1.33

Solution: D

Since the road is assumed to be paved linearly, i.e. 2km of road per month. At the end of 3rd month, the PV should be $6,000 (for 6km of road). The formula to be used to calculate SPI is:

SPI = EV / PV

SPI = $8,000 / $6,000 = 1.33

3.2 Planning Monitoring and Control

- **Monitoring and control helps us to see if our product starts to be on the critical path :**
  - Why can we observe it ?
    - Slippage of activities
    - Changes to activities (new activities / new dependencies …)
    - Reduction of time allocated
    - Problems of resources availability :
      - Issue to find some special competencies
      - Inexperienced personnel …

  - To allow to respect initial commitment (BASELINE) , the PM has to :
    - Control the resource allocation
    - Control the duration :
      - Change the scope of the task
      - Change activities relationship
      - Break-down further
      - Change end date
    - Control the end date
      - Redefine the scope (remove features for ex)
      - Add resources by accepting cost increase
      - Use floats

If any change of the initial commitment :
→ **new BASELINE is defined**
→ **New BASELINE has to be approved by Customer (internal or external)**

Time Management – Summary