INTRODUCTION TO SOFTWARE ENGINEERING

6. SOFTWARE PROJECT MANAGEMENT

Bui Thi Mai Anh
anhbtm@soict.hust.edu.vn

Content

1.1. What is a project?

- Project: The (business) plan to realize a sort of goal.
- Could the followings be projects or not?
  - 2018 model Electric car development.
  - Accounting Business in company ABC.
  - The National Library operation.
  - New swimming pool construction for the University.

And, what about “Course Registration System Development for the University”?

→Project versus Day-to-day business/operation

1.1. What is a project? (2)

- The Characteristics of the “Project”
  - To provide a unique product, service or result.
    - that is to say, to define the scope of the project by itself.
    - that means, nobody has exactly the same experiences as the project.
  - To have the specified term:
    - that is to say, to have a definite beginning/end.
    - that means, the project must have appointed date of delivery.

→ The project has to be controlled and managed properly and fully on the assumption that the change would happen.

What is Your Project?

- List up below the projects which you have experienced.

1.2. Project success

- What do you think the rate of IT project success?
  - 90% ?
  - 70% ?
  - 50% ?
  - 30% ?

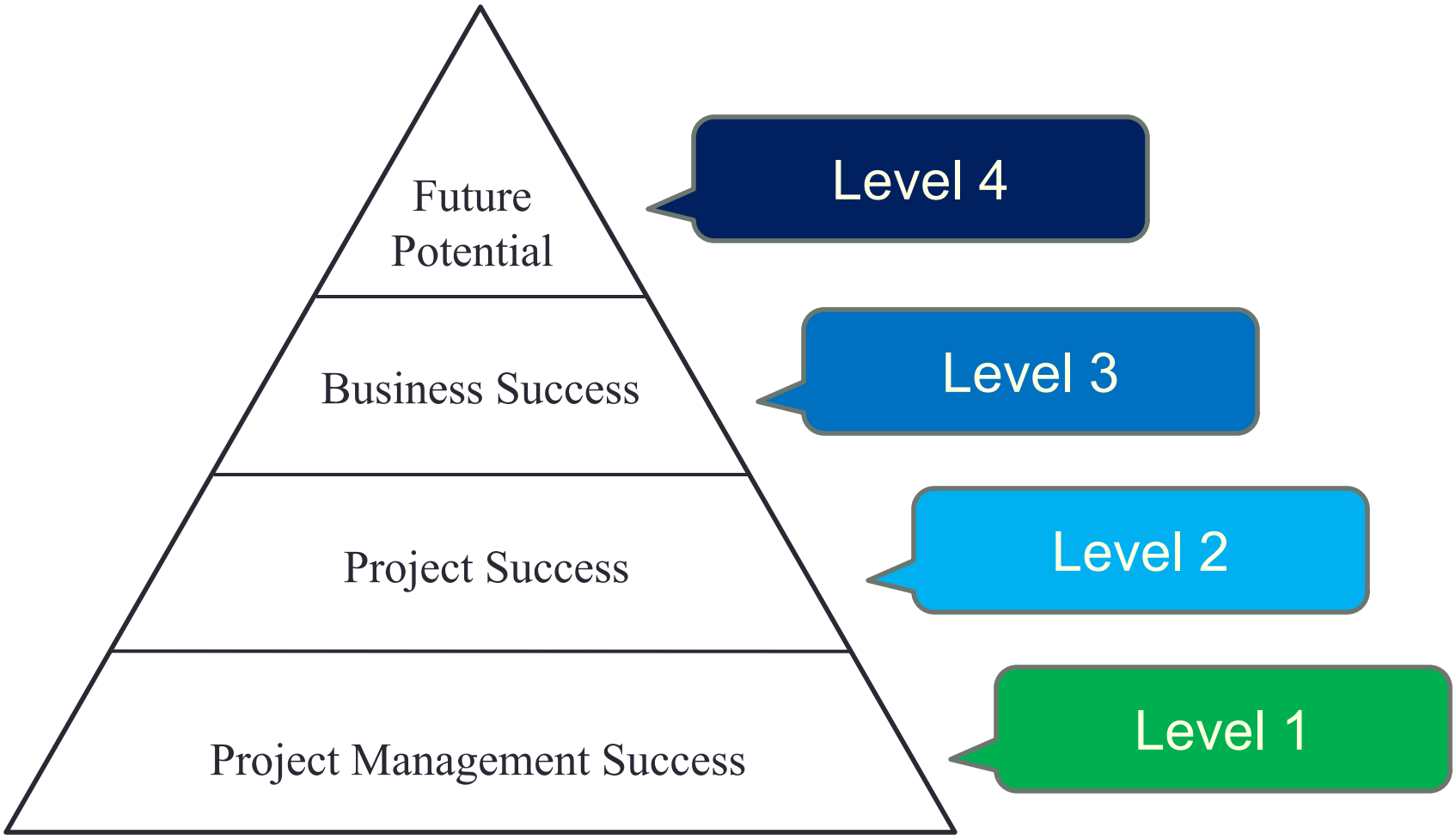
Which is the successful project?

- Project A System
  - Delivered the system by the date agreed on.
  - Completed the project within budget.
  - Almost never used after appreciation.
- Project B System
  - Missed the deadline.
  - Completed the project over budget.
  - Has been used over 10 years.

- Which is the better project for you?

Dimensions of project success

The Layer of Project Success



1.3. Project Lifecycle

- Project Lifecycle: From the beginning to the end of the project.
  - Project is divided into phases/processes and planed/managed
  - Based on the phases/processes considering the related stakeholders.
- In case of Application Software Development,
  - Project Lifecycle may correspond approximately to Software Development processes, however, usually includes Software Installation Process/ Software Acceptance Process.
- Version up or function improvement project of the software is another project.

  →It is said that the scope and the end date of the project are decided when the project is initiated.

1.4. Project and Organization

- A project is established in one or more than one parents organizations such as companies, universities, governmental organizations.

- The project is infected if the parents organizations have the followings;
  - “Project Management System”: Collection of tools, methods, methodologies, resources, procedures for project management.
  - “Project Management Office”: Organization for intensively controlled each project.

1.5. What is project management?

- **What** will be performed?
- **How** will it be performed?
- **Who** will perform the work?
- In **what** sequence?
- **When** will the work be performed?

Planning vs. Scheduling

1.5. What is project management? (2)

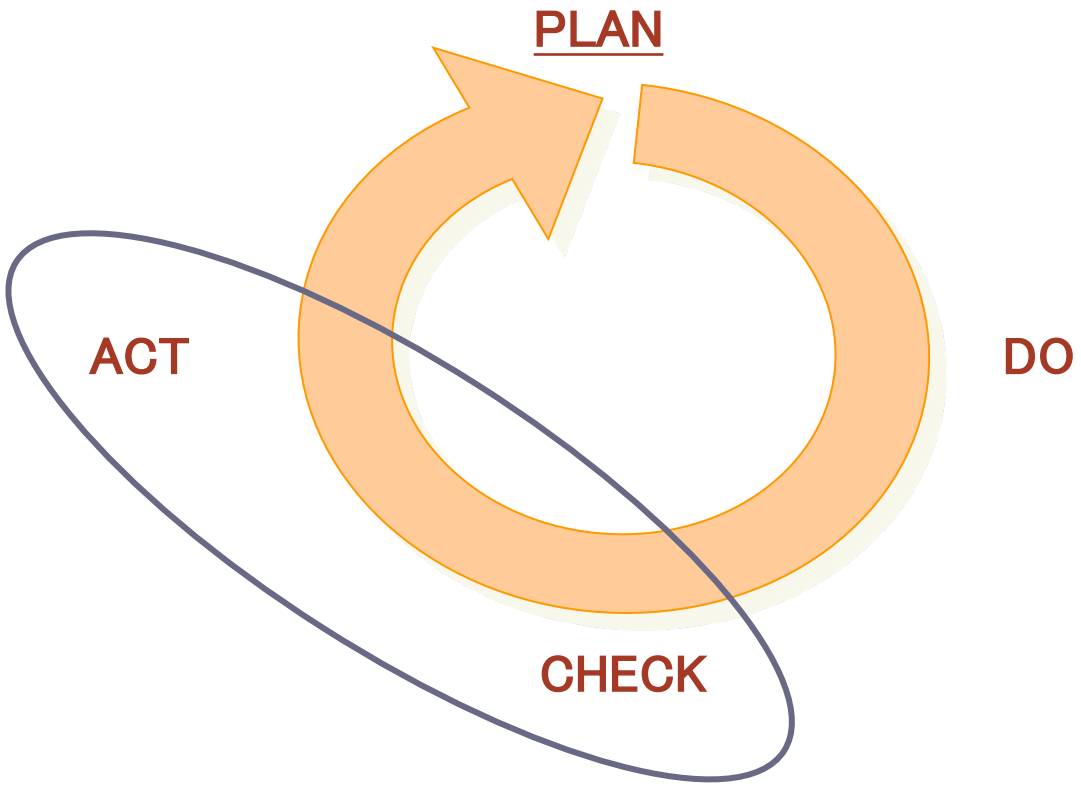
- How long will the entire project take to complete?
- Which activities determine total project time?
- Which activity times should be shortened, if possible, or in other words, how many resources should be allocated to each activity?

1.5. What is project management? (3)

- What is a Project Management?
  - The management activities to realize project goal
- The project management is carried out
  - in order to accomplish the project requirements.
  - using knowledge, skill, tools, methodologies.
  - under the responsibility of Project Manager
- Management focus on the diversity of team members and complexity of tasks
- Management use the process of **"Plan – Do – Check – Act"** which is called "PDCA cycle"

PDCA cycle

- The key to manage well is to run the basic management cycle which is called “PDCA” as follows

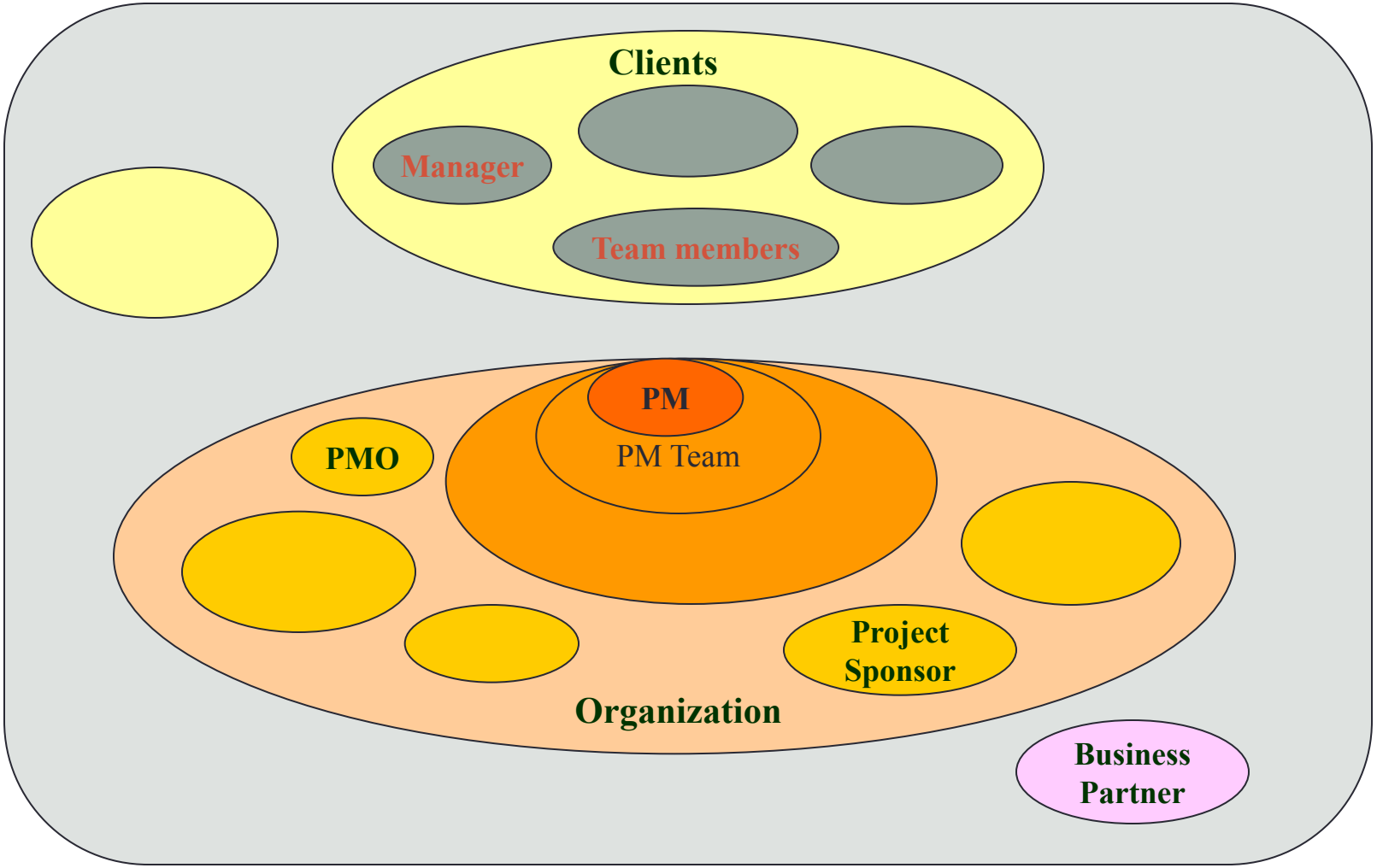


1.5. What is project management? (5)

- What points of the project should be managed by the project manager?
  - Scope of the project: What scope has the project?
  - Schedule and delivery date: When do we need to complete and deliver them?
  - Cost: How many man-hours or cost are required?
  - Quality: What kind of qualities and what level of quality are required to realized?
  - Risk: Forecast possible risks and give the solutions for risks.

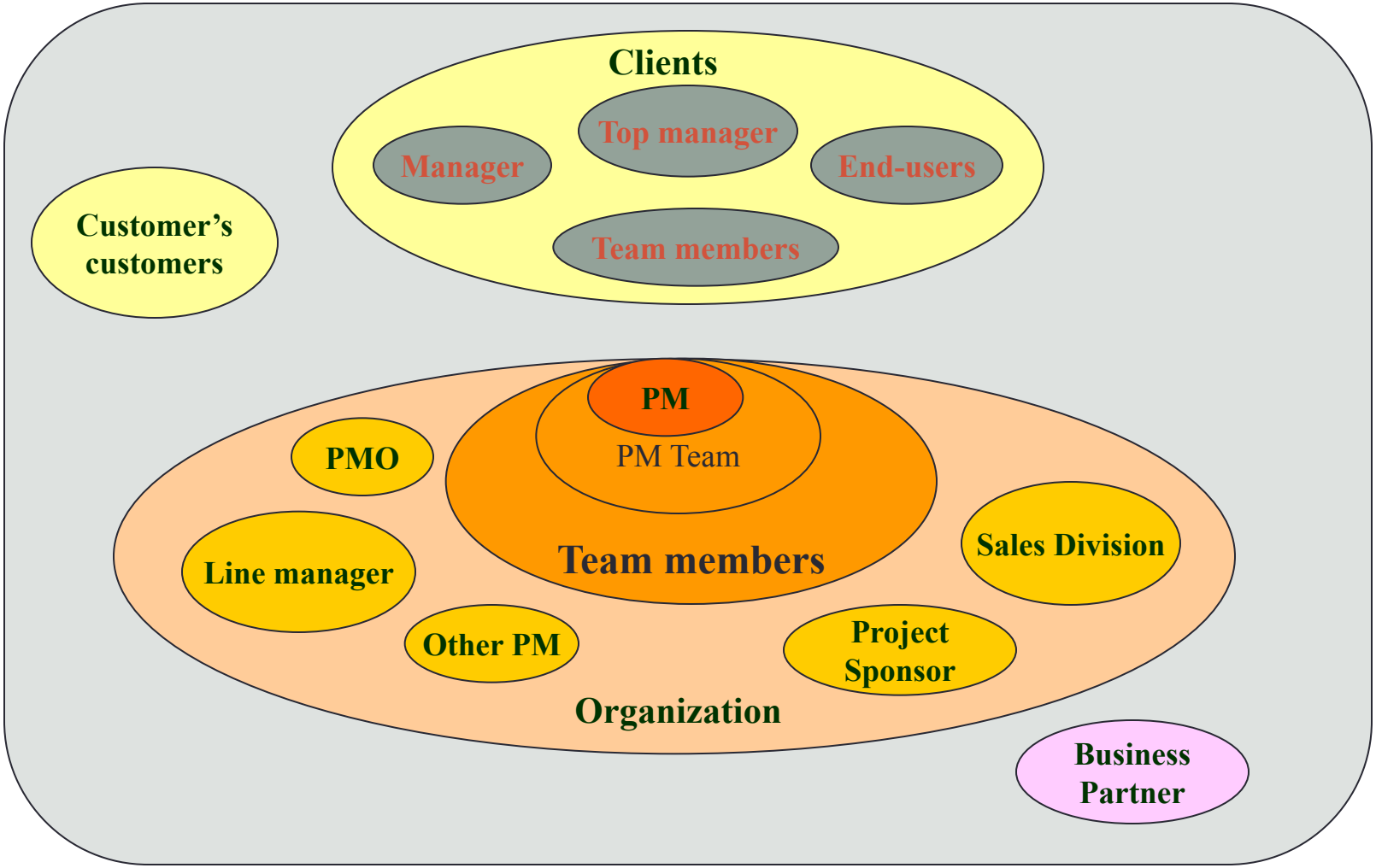
1.6. Project Stakeholders

- Fill stakeholder name in the blank circles



1.6. Project Stakeholders

- Fill stakeholder name in the blank circles



Content

1. Introduction to Project Management
2. PM Body Of Knowledge
3. Scope Management
4. Time Management
5. Cost Management
6. Risk Management

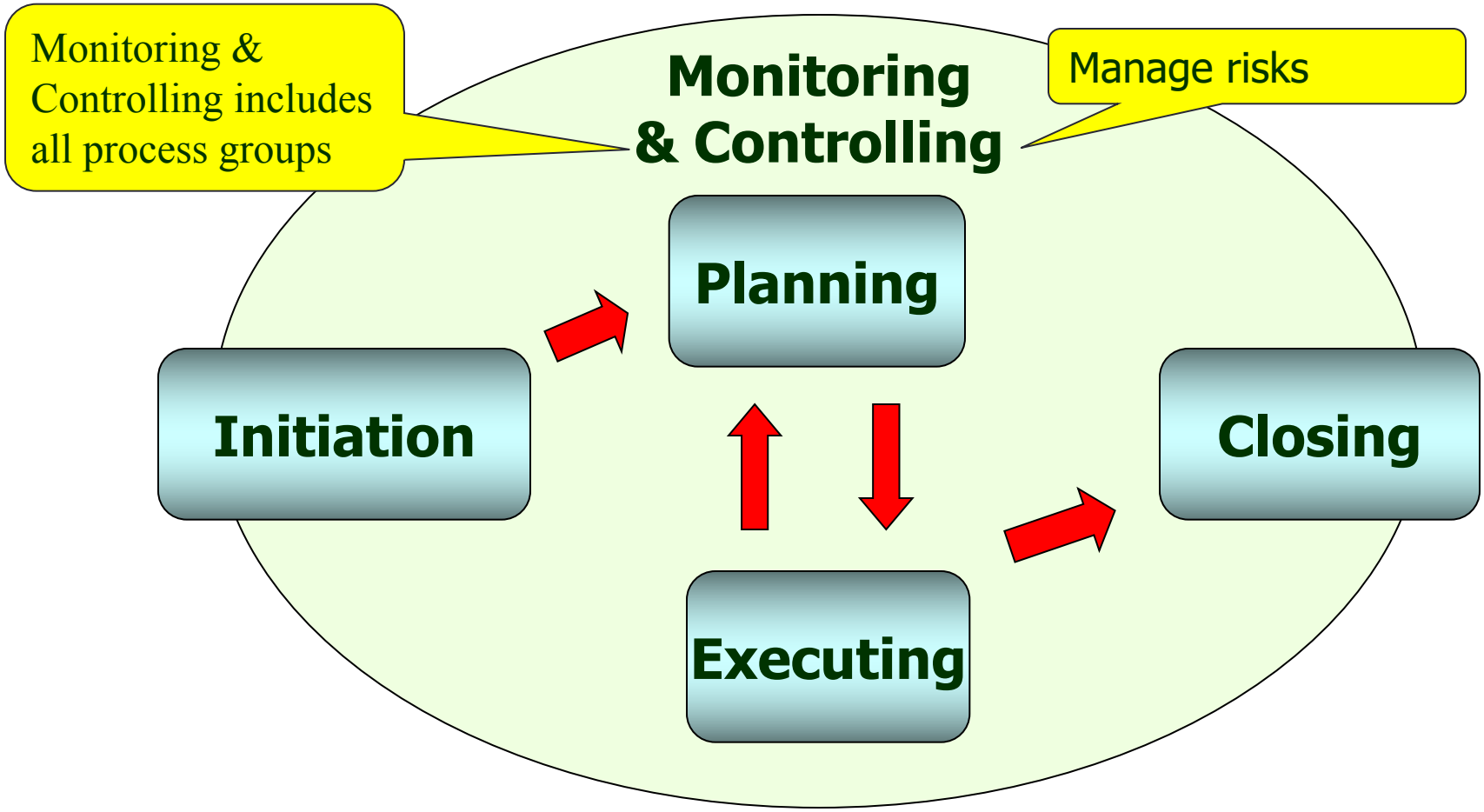
2. Project Management Body Of Knowledge

- Project Management have to
  - be done logically and systematically.
  - consider the past experiences as the best practice.
- Based on the field experiences and researches, PMI* develops the "Project Management Body Of Knowledge (PMBOK)", which is best practice knowledge for project management.
  - The projects dealt with under PMBOK covers wide range.
  - PMBOK is effective for the Software Development Project.
- PMBOK provides the knowledge system beyond the application field.

*: PMI: Project Management Institute

2.1. Five Process Groups

- PMBOK(R) grouped many project processes into five categories,
- Project Management Process Groups (or Process Groups):



2.2. Nine Knowledge Areas

- The knowledge system has 9 knowledge areas, in which the management items, processes, how to deal with, input/output, tools/techniques are explained

1. *Project Integration Management:* To integrate/control various management processes/activities for Integrated Project (explained later).
2. *Scope Management:* To define and control the scope, which means the works should be achieved in the project.
3. *Time Management:* To define and control the schedule, with a goal of timely completion of the project.
4. *Cost Management:* To define and control the cost, with a goal of completion of the project within approved budget.

2.2. Nine Knowledge Areas (2)

5. *Quality Management*: To define and control the quality, which the results of the project are required to satisfy.
6. *Human Resource Management:* To manage human resource of the project to participate in the project with a strong desire to work, and to promote the project effectively.
7. *Communication Management:* To generate, distribute and control the project information to realize timely, appropriate, certain communications in the project members and stakeholders
8. *Risk Management:* To identify, analyze and control the risk items of the project.
9. *Procurement Management:* To manage the procurement process to acquire products, services and results from outside of project team.

2.3. Project Manager

- The Project manager is a person in charge of project management.
- A good Project Manager find out the specifics of each members and make full use of these talent

2.3. Project Manager (2)

- Project Manager should manage the project with balance and integration
  - Project management has various aspects such as Scope, Time, Cost, Quality, Human recourse, Communication, Risk, Procurement.
  - One of the most important points of the project management is to balance with various aspects and to be achieved Integrated management.
  - Project Integration Management means to achieve integrating the various aspects management in the project. The aspects have dependencies with each other

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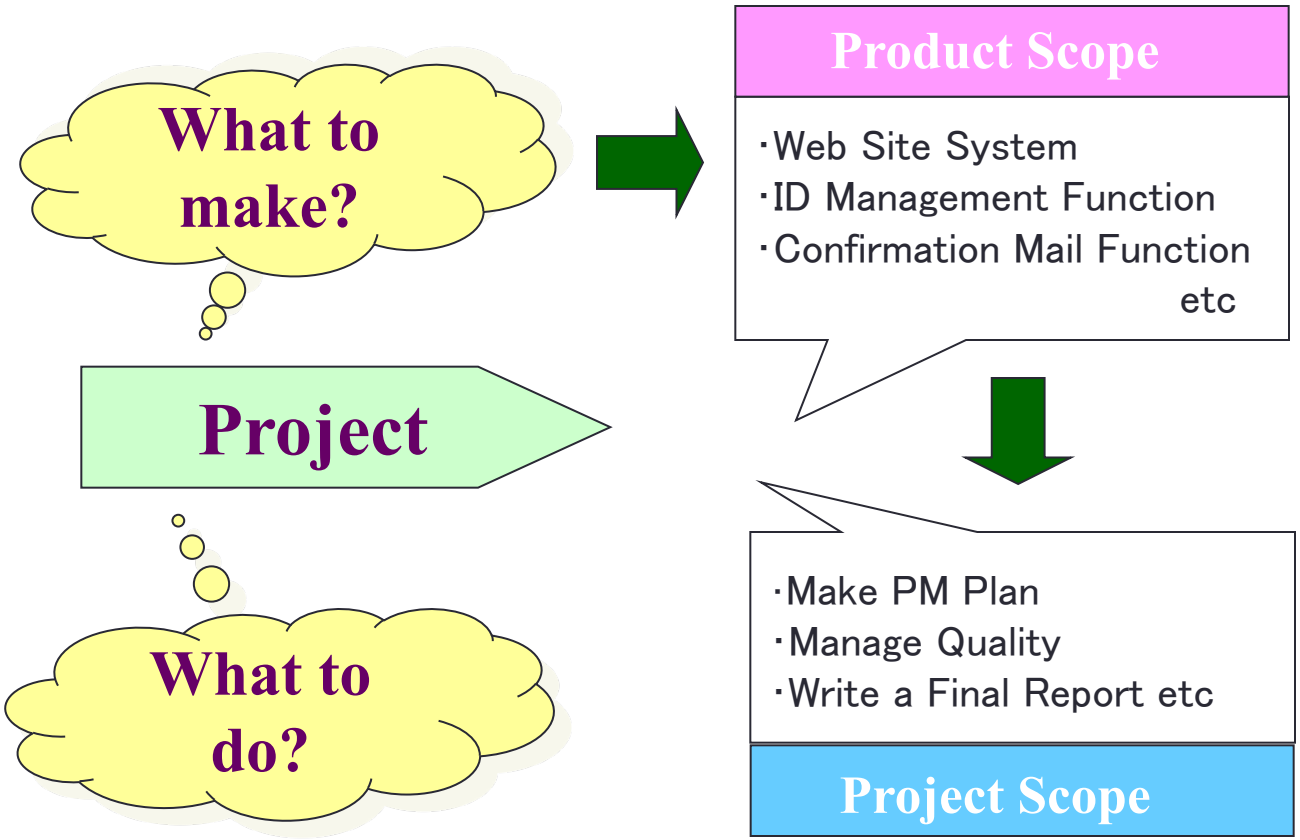
3.1. What is Scope?

- Scope means “range" of the products or services in a project



3.2. Scope Management

- Development scope of the software should be defined in Software Requirements Analysis Process.
  - In this process, the agreement among stakeholders should be done.
- Work Breakdown Structure (WBS) is an effective management tool for
  - analyzing the deliverables produced by the project
  - estimating quantity of work for creating the deliverables.
- Scope change control should be done in the project recognizing the causes of changing scope and managing
  - In the case of change request from the stakeholders, analysis and management based on WBS is effective.

3.3. Work Breakdown Structure

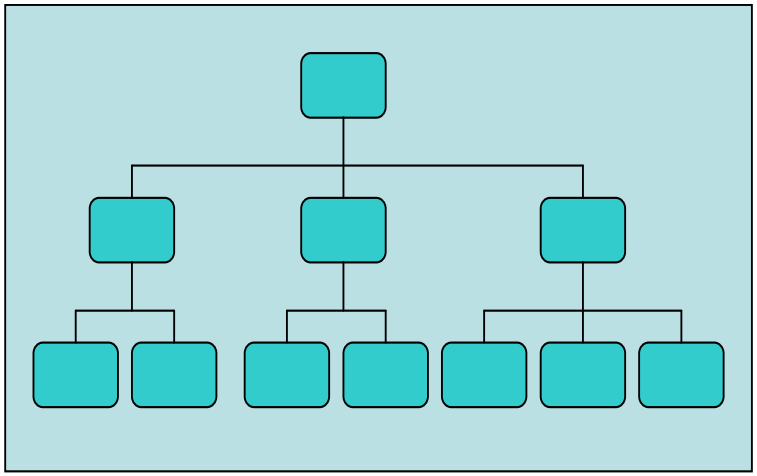
- In the Work Breakdown Structure,
  - To describe major deliverables based on project plan.
  - To divide the deliverables into manageable small deliverables, which are named “Work Package”.
- “Work Package”:
  - It is possible to determine one individual person or team in charge of each work package and also to estimate the quantity of work to create each work package.

→That means “manageable small”

WBS – Chart Form and Tabular Form

- Two forms of WBS

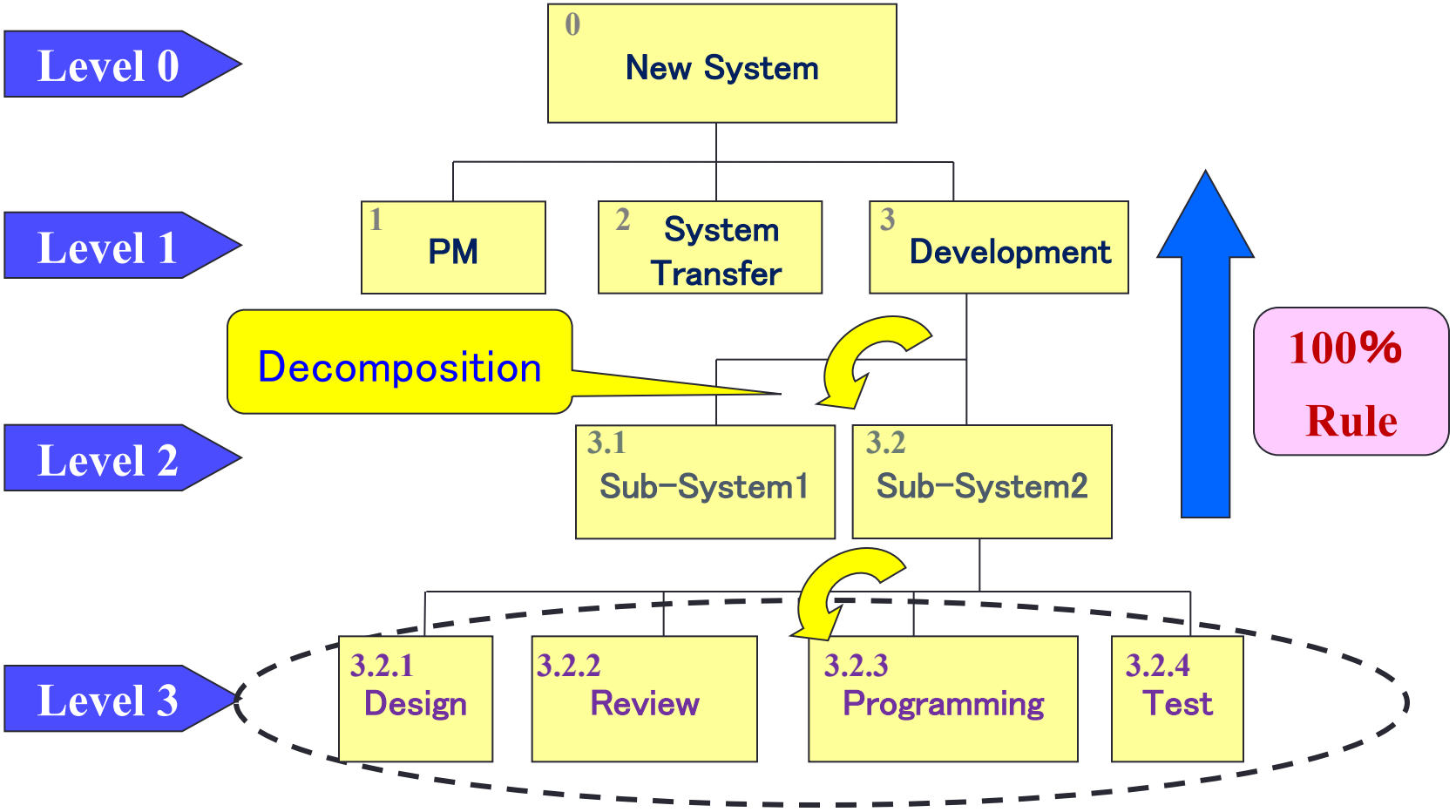
<Chart Form WBS>



<Tabular Form WBS>

1 Project Management		
	1.1 Planning	
		1.1.1 Scope Statement
		1.1.2 Activity List
		1.1.3 Resource Plan
		1.1.4 Time Estimate
		1.1.5 Cost Estimate
		1.1.6 Risk Analysis
		1.1.7 Schedule
		1.1.8 Project Management Plan
	1.2 Executing	
2 Design		

Create WBS


Level 0
Level 1
Level 2
Level 3
0
New System
1
PM
2
System
Transfer
3
Development
Decomposition
3.1
Sub-System1
3.2
Sub-System2
100%
Rule
3.2.1
Design
3.2.2
Review
3.2.3
Programming
3.2.4
Test
Work Package (WP)

Exercise

- Give some basic information and create WBS for the project:

"Wedding Preparation"

Homework 1

- Create WBS for your project by groups.

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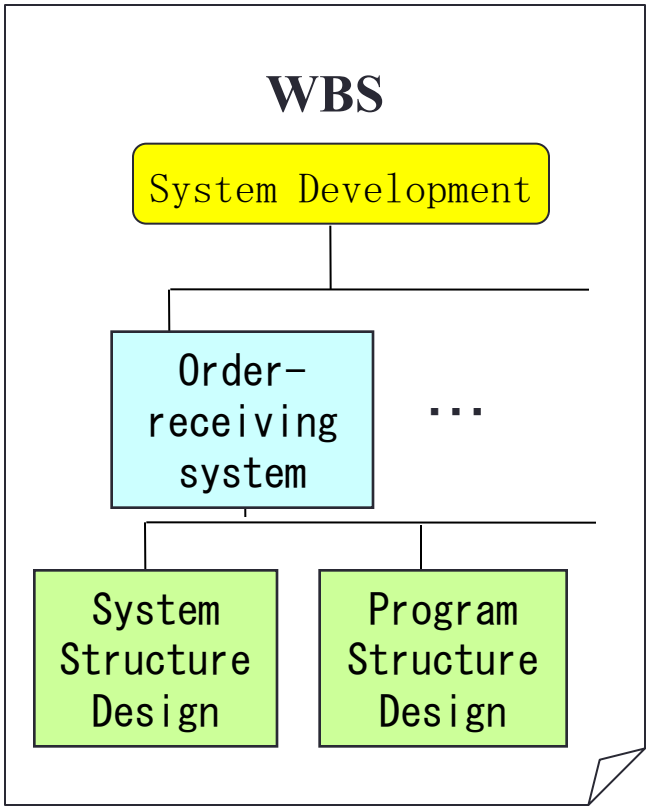
4.1. Define activities

- To define “Schedule Activities” dividing each “Work Package” into “Schedule Activity”: means an individual scheduled component.

4.1. Define activities (2)



Sub-system	Activity 1	Activity 2
Order-receiving system	System Structure Design	Analysis
		Design
		Review
	User Interface Design	Analysis
		Design
		Review

Feedback the change to WBS

4.2. Sequence activities

- Identify and document relationships among the project activities.
- Every project activities except the first and last are connected to at least one predecessor and successor
  - Using Precedence Diagramming Method (PDM)

Precedence Diagramming Method (PDM)

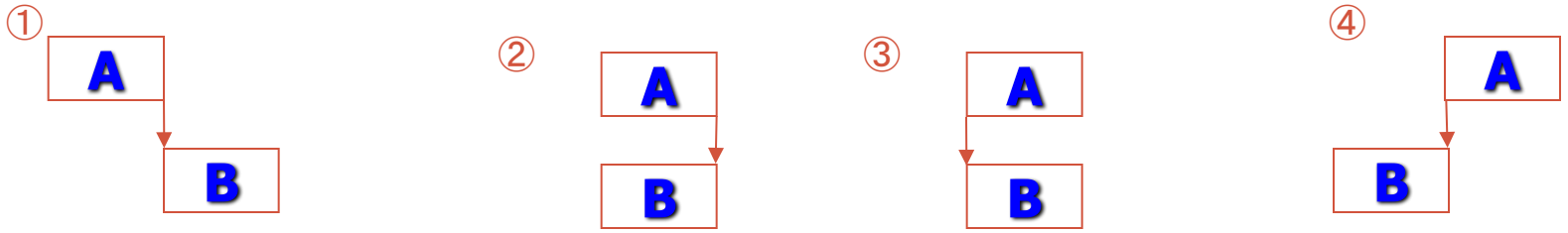
- Describe the activity as a node and connect it with the other using allow to express sequence relationship. PDM can describe four dependent relationships.

① Finish to Start (FS) : The initiation of the successor activity depends on the completion of the predecessor activity.

② Finish to Finish (FF) : The completion of the successor activity depends on the completion of the predecessor activity.

③ Start to Start (SS) : The initiation of the successor activity depends on the initiation of the predecessor activity.

④ Start to Finish (SF) : The completion of the successor activity depends on the initiation of the predecessor activity.



4.3. Time management for activities

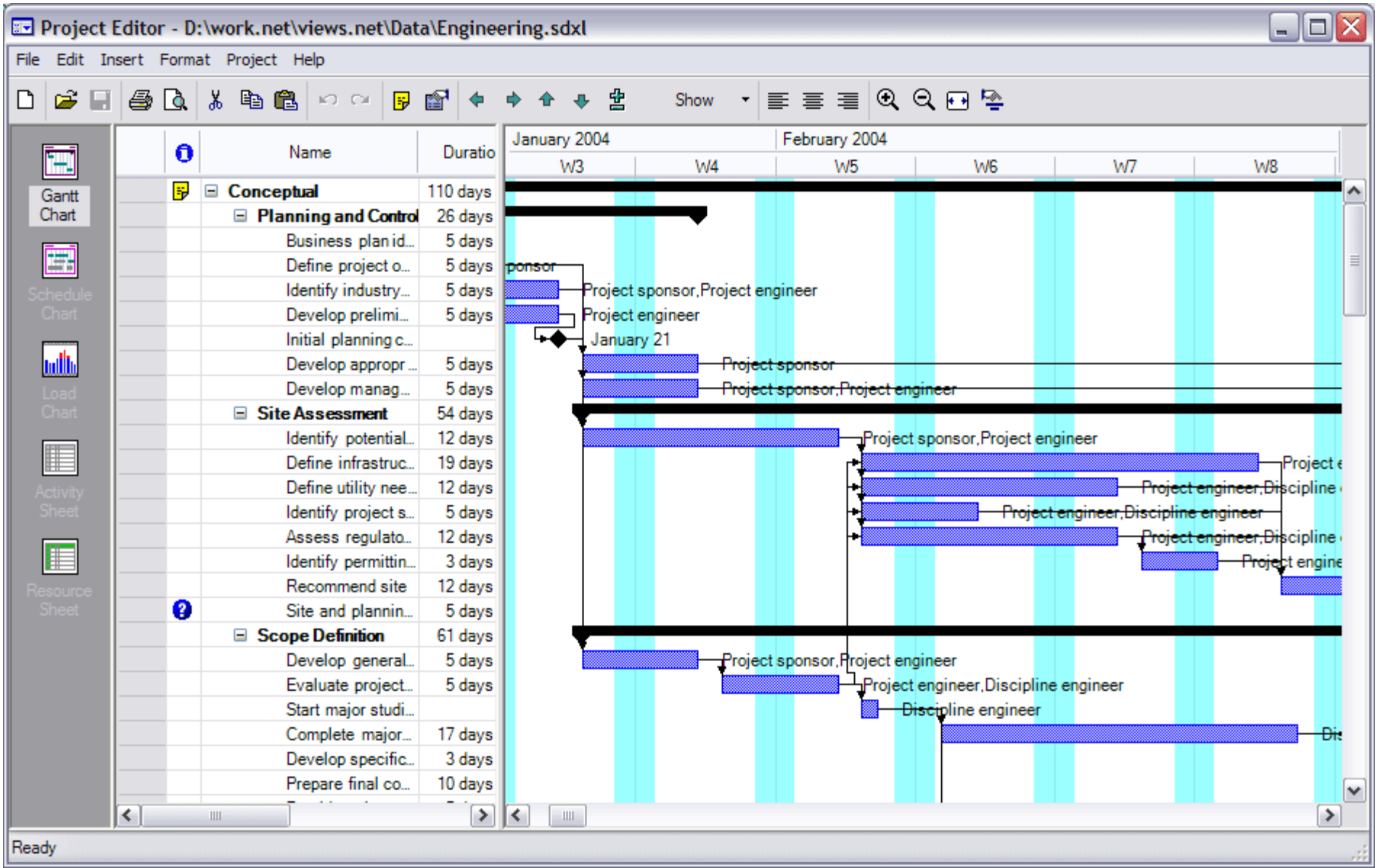
- Using lead and lag time between activities
- To estimate the duration of each activity and to develop schedule; considering milestones, dependencies described in previous phase, and resource requirements

→ Gantt Chart is an effective management tool for time schedule.

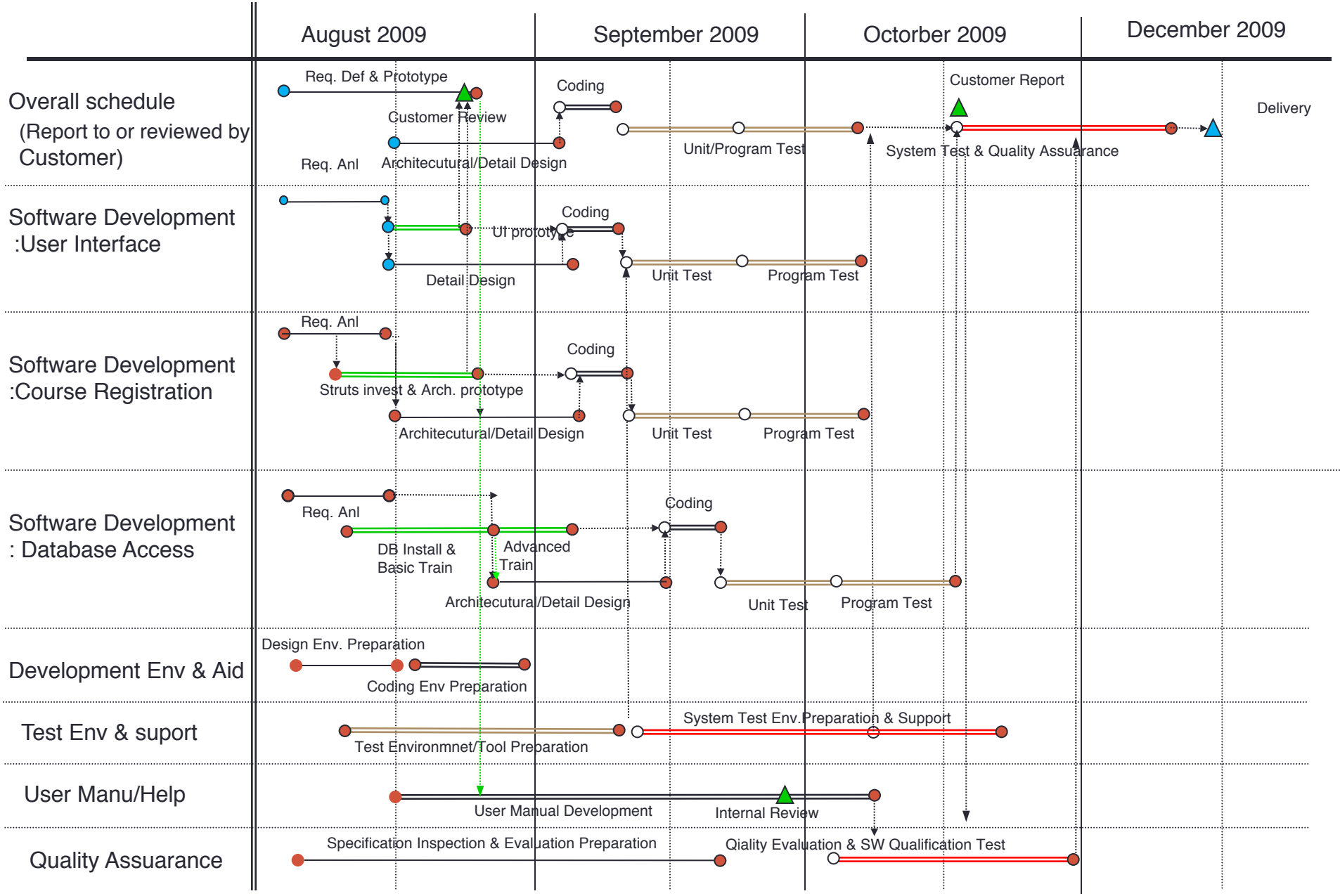
Gantt chart

- Provides easily understandable diagrams in which the schedule of each work section is indicated with a horizontal line (bar).
- Scheduled start and finish timing of each work section and present status the work are shown clearly.
- Priorities of work sections are not shown.
- Degrees in which delay in each work section affects other works are not shown.

Example: Gantt chart in MP

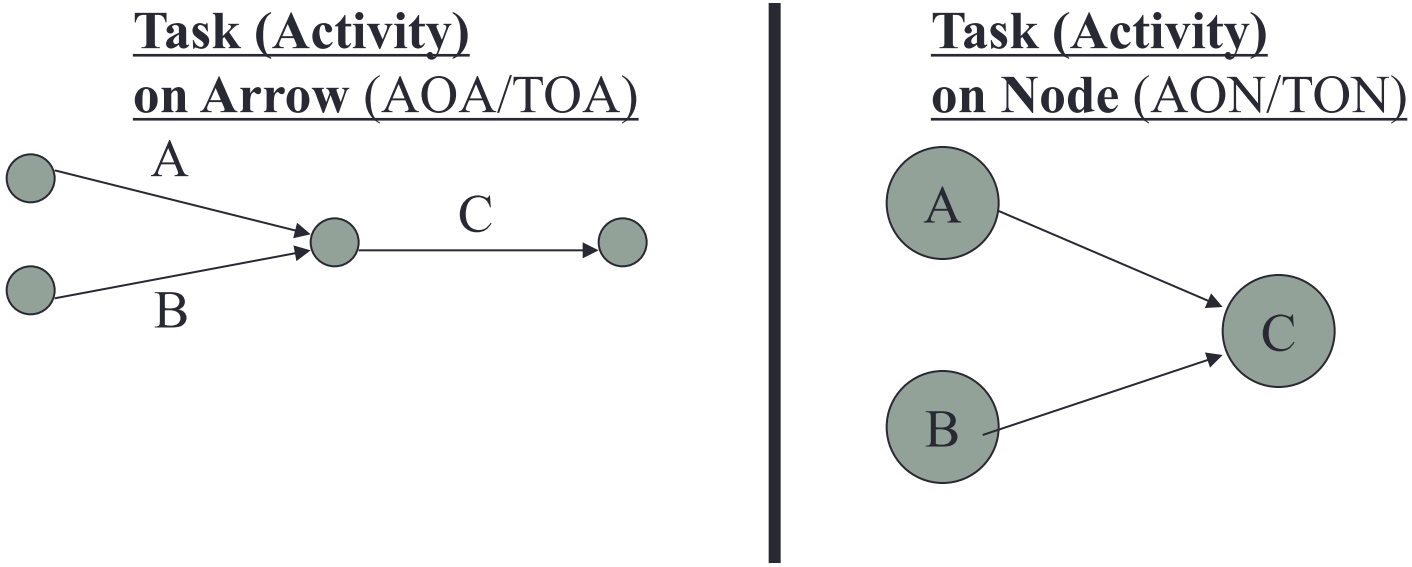


Gantt chart for Course Registration System (1st Version)



4.4. Project Network Diagram

- Any schematic display of the logical relationships of project activities.
- Two graphical representations



Example: Building a house

- Project activities:
  - install landscaping
  - pour foundations
  - frame walls
  - install plumbing systems
  - get permits
  - install electrical systems
  - move in

Example: Building a house

- Activities in order, Durations, Labels, Dependencies

Project tasks	Durations	Labels	Preds.	Post

Example: Building a house

- Activities in order:

Project tasks	Durations	Labels	Preds.	Post
Get permits				
Pour foundations				
Frame walls				
Install plumbing systems				
Install electrical systems				
Install landscaping				
Move in				

Example: Building a house

- Durations:

Project tasks	Durations	Labels	Preds.	Post
Get permits	2			
Pour foundations	6			
Frame walls	5			
Install plumbing systems	4			
Install electrical systems	6			
Install landscaping	9			
Move in	3			

Example: Building a house

- Label activities:

Project tasks	Durations	Labels	Preds.	Post
Get permits	2	A		
Pour foundations	6	B		
Frame walls	5	C		
Install plumbing systems	4	D		
Install electrical systems	6	E		
Install landscaping	9	F		
Move in	3	G		

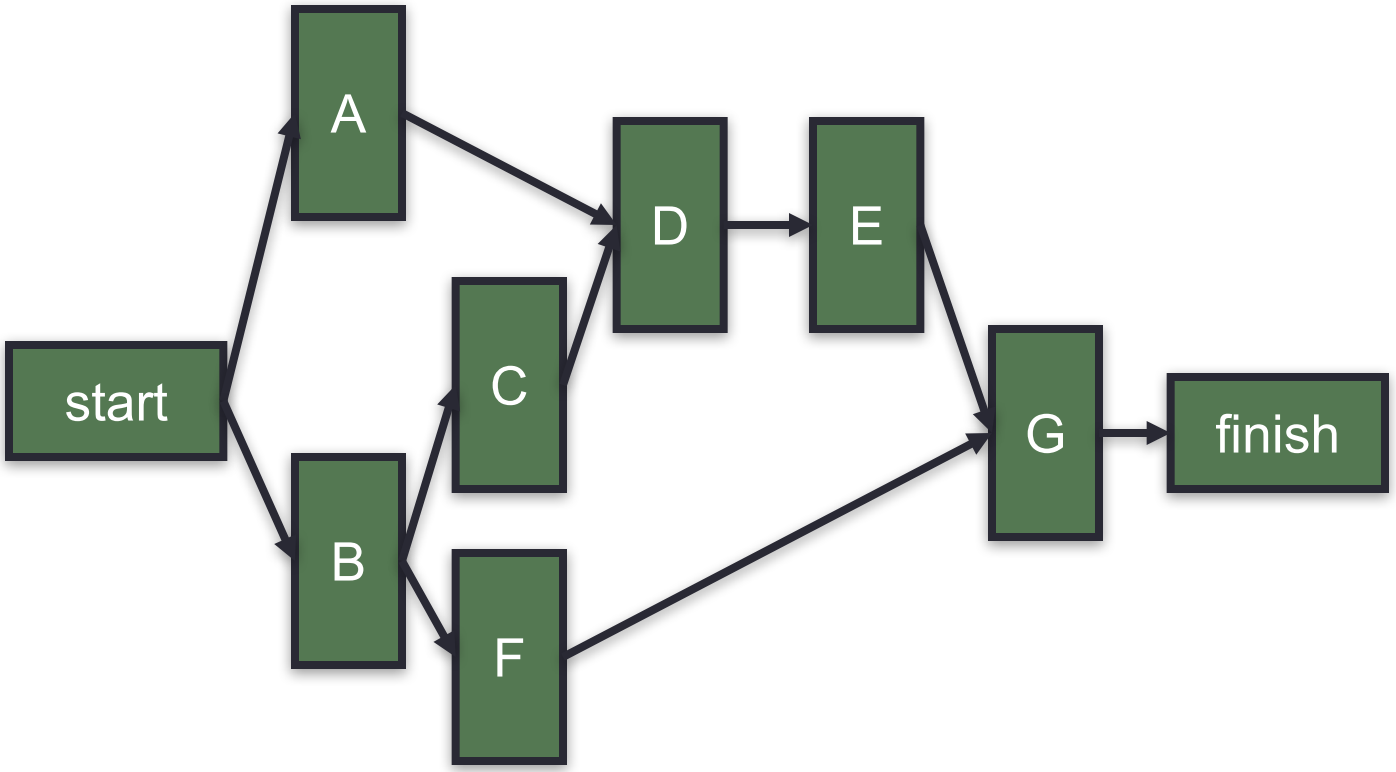
Example: Building a house

- Dependencies:

Project tasks	Durations	Labels	Preds.	Post
Get permits	2	A	--	B
Pour foundations	6	B	--	C, F
Frame walls	5	C	B	D
Install plumbing systems	4	D	A, C	E
Install electrical systems	6	E	D	G
Install landscaping	9	F	B	G
Move in	3	G	E, F	--

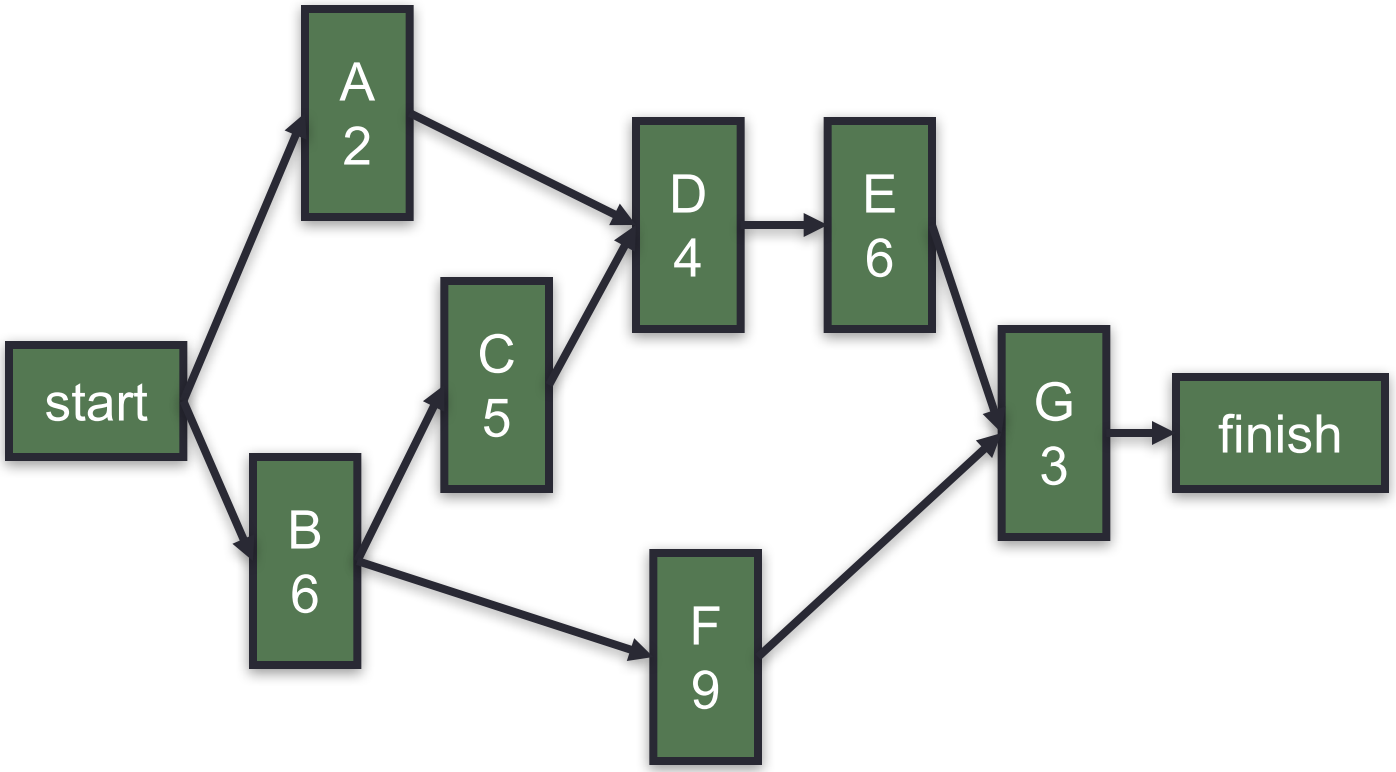
Example: Building a house

- Create precedence diagram:



Example: Building a house

- Add in durations :



4.5. Critical Path Method

- Based on the estimated duration, calculate the theoretical Early Start , Early Finish, Late Start and Late Finish for each activity.
- The critical path is the longest path throughout the project. The float of critical path should be zero.
- Project manager have to focus on the critical path to manage
- Critical path can change to the other path in a project. So, project manager need to monitor near-critical path as well.

4.5.1. Why Critical Path Method?

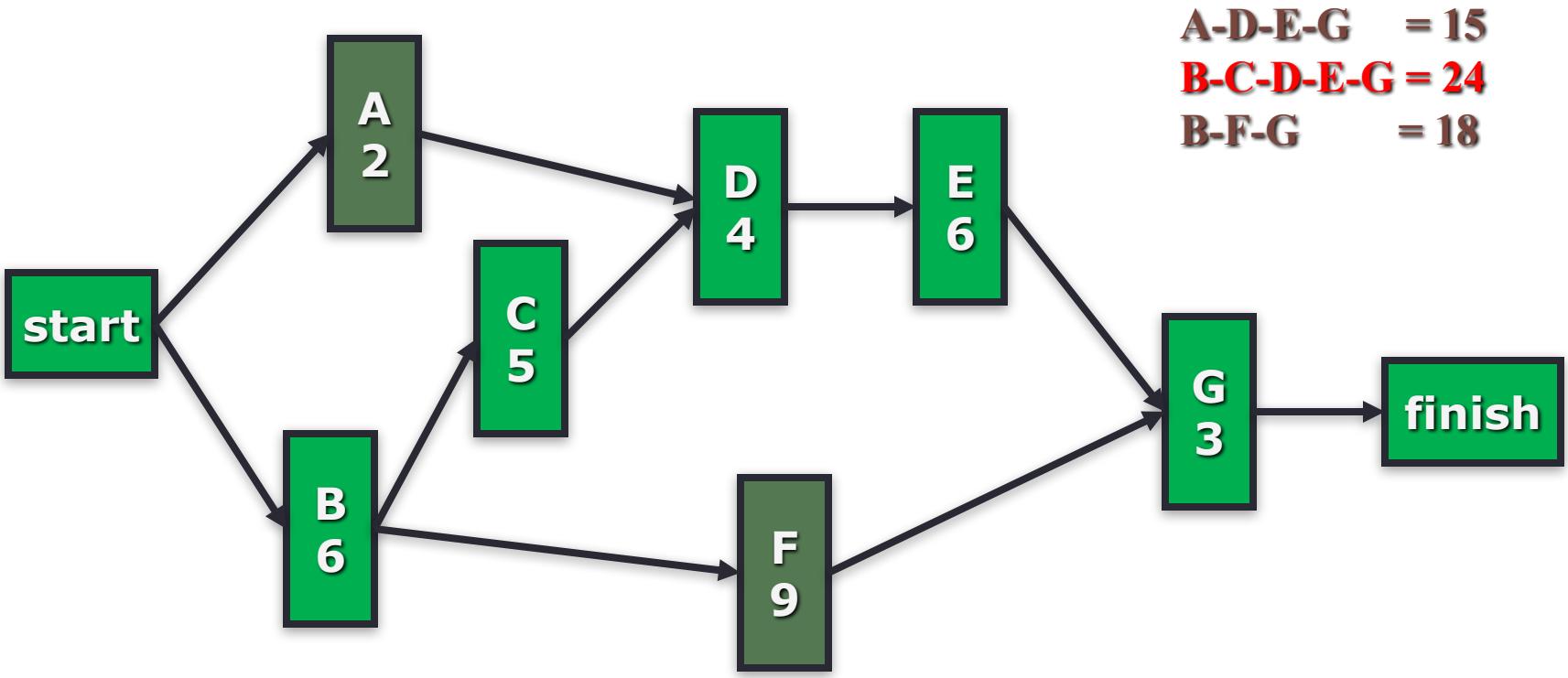
- The **CPM** formally identifies tasks which must be completed on time for the whole project to be completed on time
- Identifies which tasks can be delayed for a while if resource needs to be reallocated to catch up on missed tasks
- It helps you to identify the **minimum length** of time needed to complete a project
- The CPM determines both the **early start** and the **late start** for each activity in the schedule.

4.5.2. Identify the Critical Path

- The critical path is the longest-duration path through the network
- Determining the following four parameters for each activity:
  - ES - earliest start time
  - EF - earliest finish time
  - LF - latest finish time
  - LS - latest start time
- Slack time (float time): how much extra time you have available for a particular activity.

Example: Building a house

- Add up all the paths possible; see what path is the longest. That path is the critical path.



Calculating slack, ES, EF, LS, LF

- For each activity:

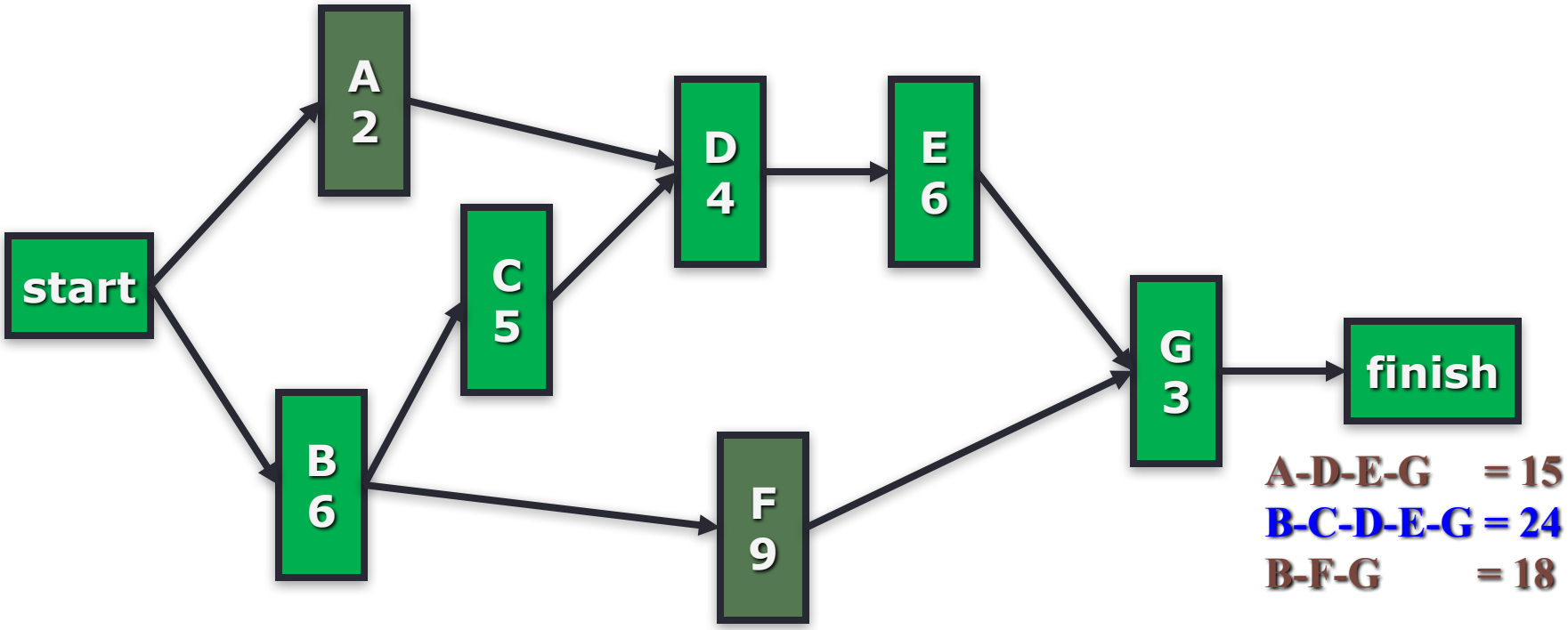
ES	Duration	EF
Activity		
LS	Slack	LF

Calculating Slack time

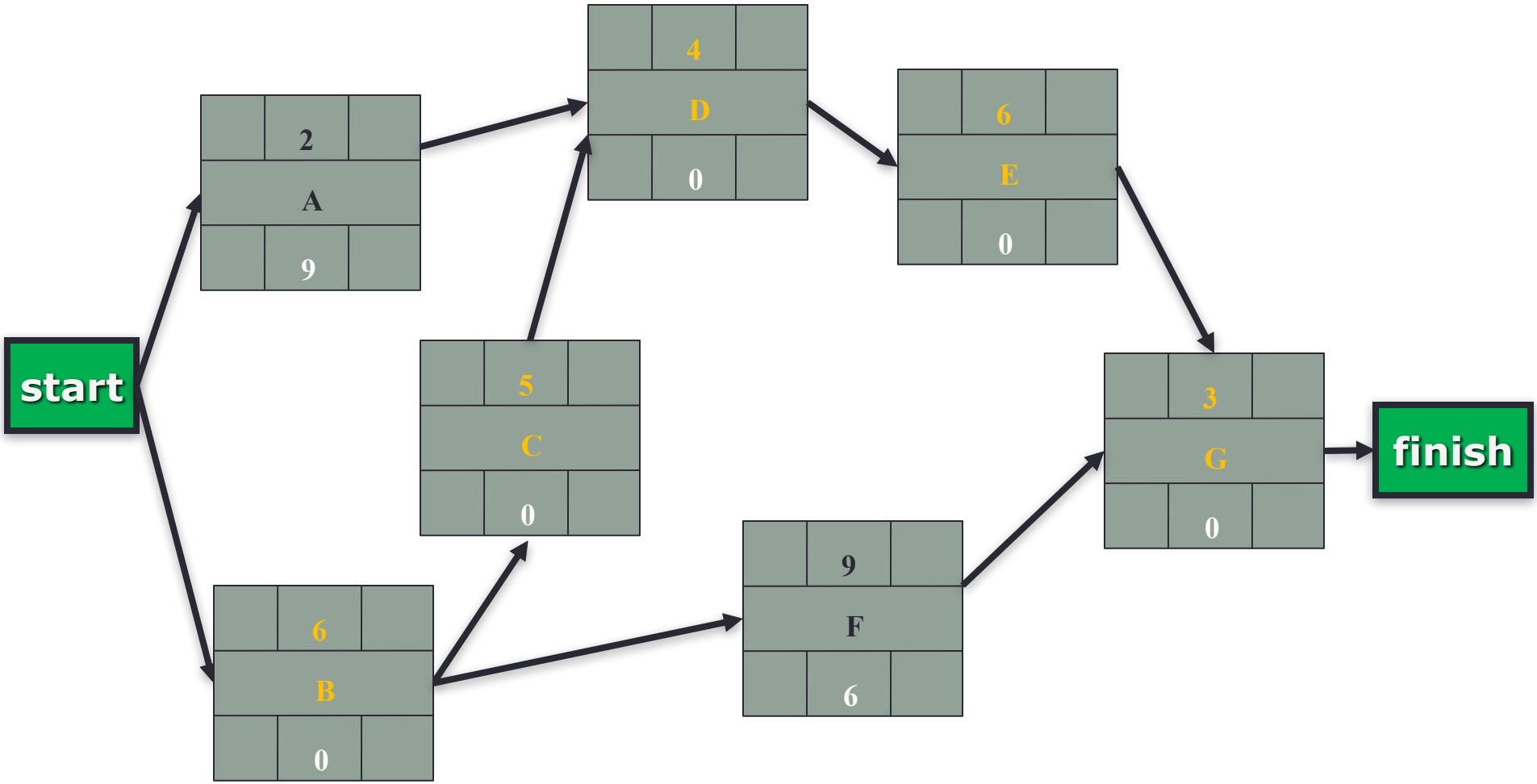
- The float is how long an activity's duration can extend before it lengthens the project duration.
- The float for any activity on the critical path is zero.
- The float for **non-critical activities** is the critical path duration *minus* the duration of the activity's path.
- If **an activity** is on multiple paths, its float is the one that is least.

Calculating Slack time

- The critical path has a duration of 24
- The Slack time of activities B, C, D, E, G are all 0.
- With path B-F-G has a duration of 18, the Slack time of F (non-critical path activities) is 24–18 = 6
- Same with activity A



Calculating Slack time



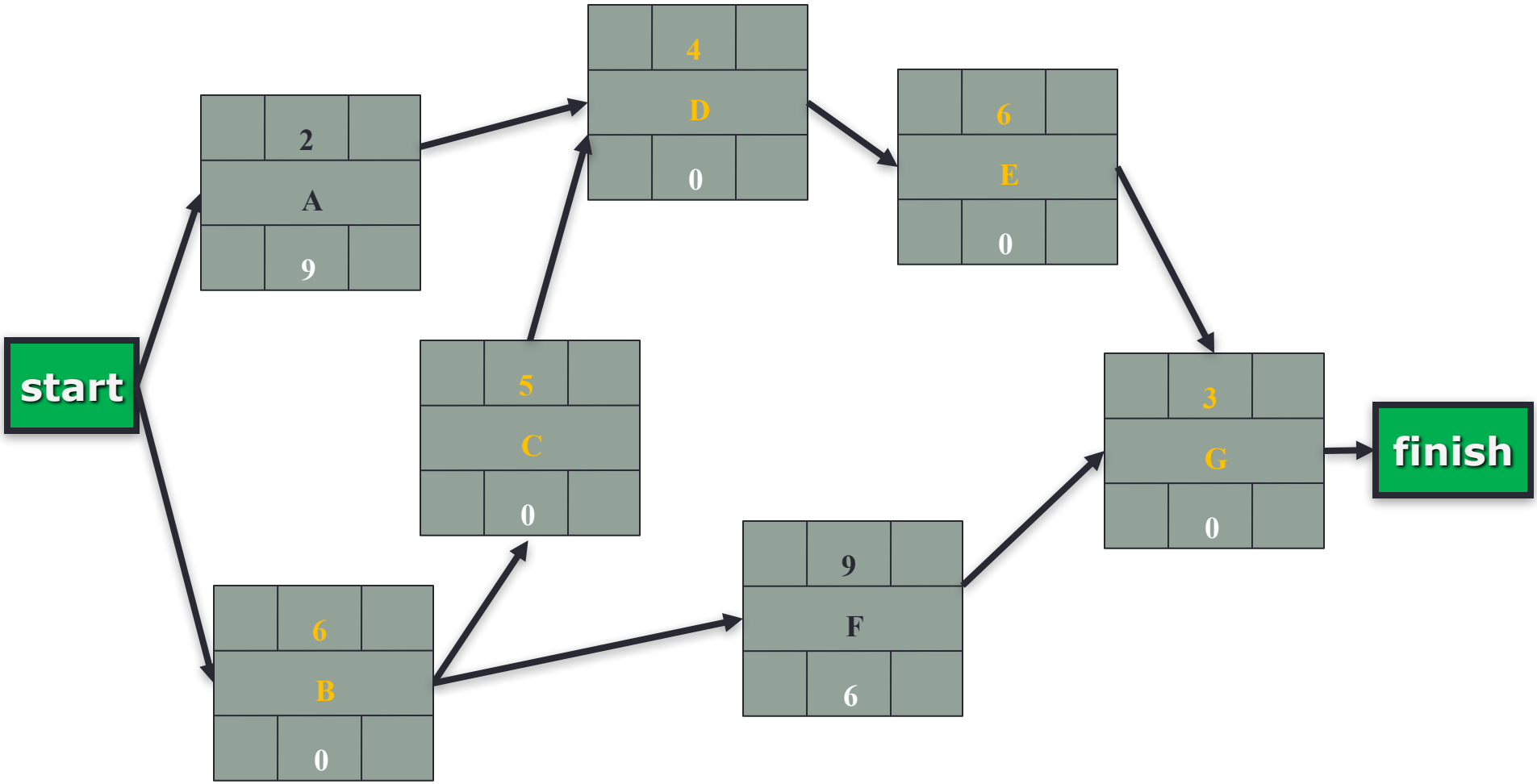
Calculating ES and EF

- Early start is the earliest time that an activity can start.
  - An activity near the end of the path will only start early if all of the previous activities in the path also started early.
- Early finish is the earliest time that an activity can finish.
  - It's the date that an activity will finish if all of the previous activities started early and none of them slipped.

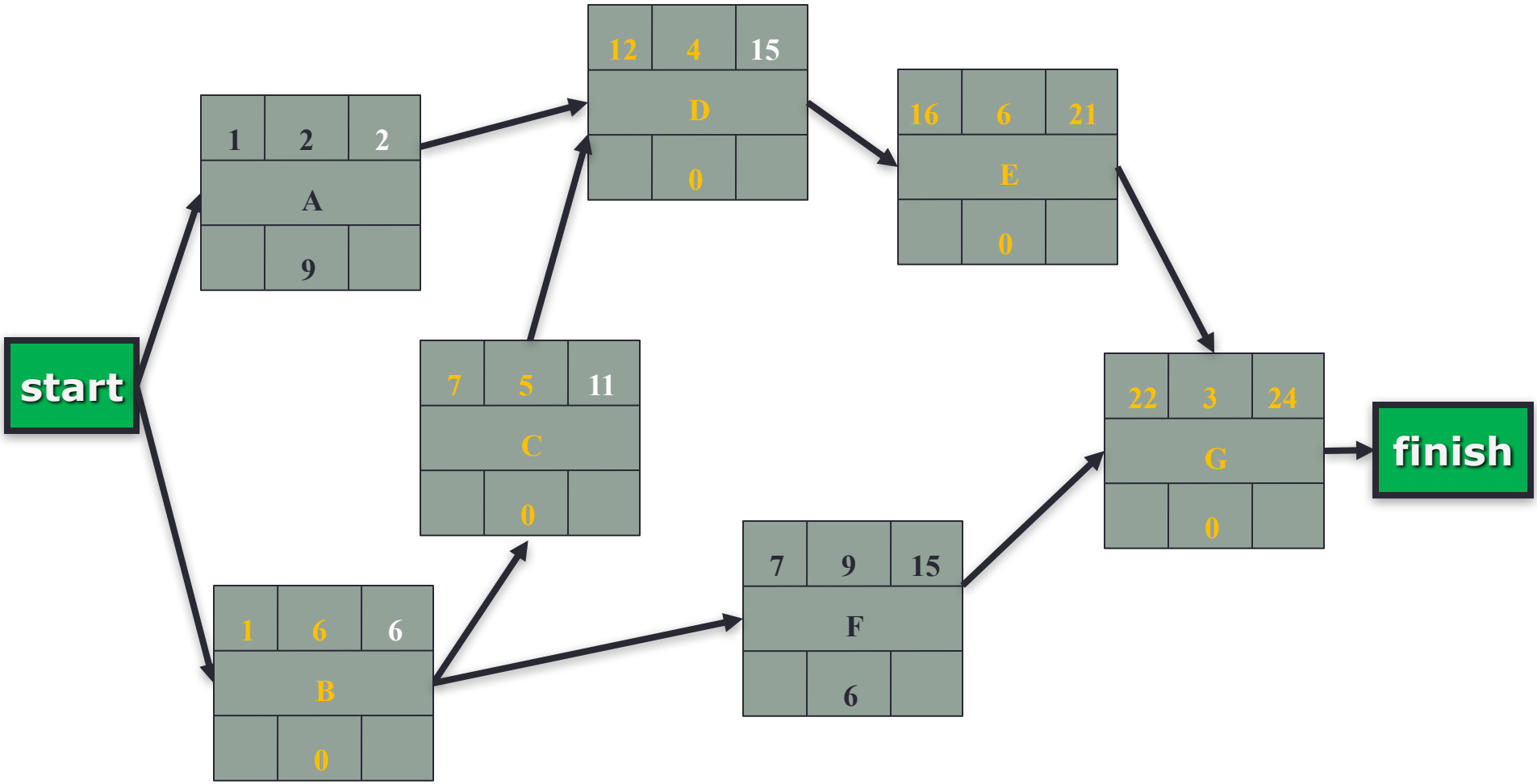
Calculating ES and EF

- ES and EF are calculated by doing a **forward** pass through the diagram.
- The **ES** of *activities after the start node* is 1.
- The **EF** of an activity is its **ES** *plus* **its duration** *minus* **1**.
- The **ES** is the **EF** of the predecessor activity *plus* **1**.
- If there are multiple predecessor activities, use the *greatest EF*.

Calculating Slack time



Calculating ES and EF



Calculating LS and LF

- Late start is the latest time that an activity can start.
  - If an activity is on a path that's much shorter than the critical path, then it can start very late without delaying the project.
- Late finish is the latest time that an activity can finish.
  - If an activity is on a short path and all of the other activities on that path start and finish early, then it can finish very late without causing the project to be late.

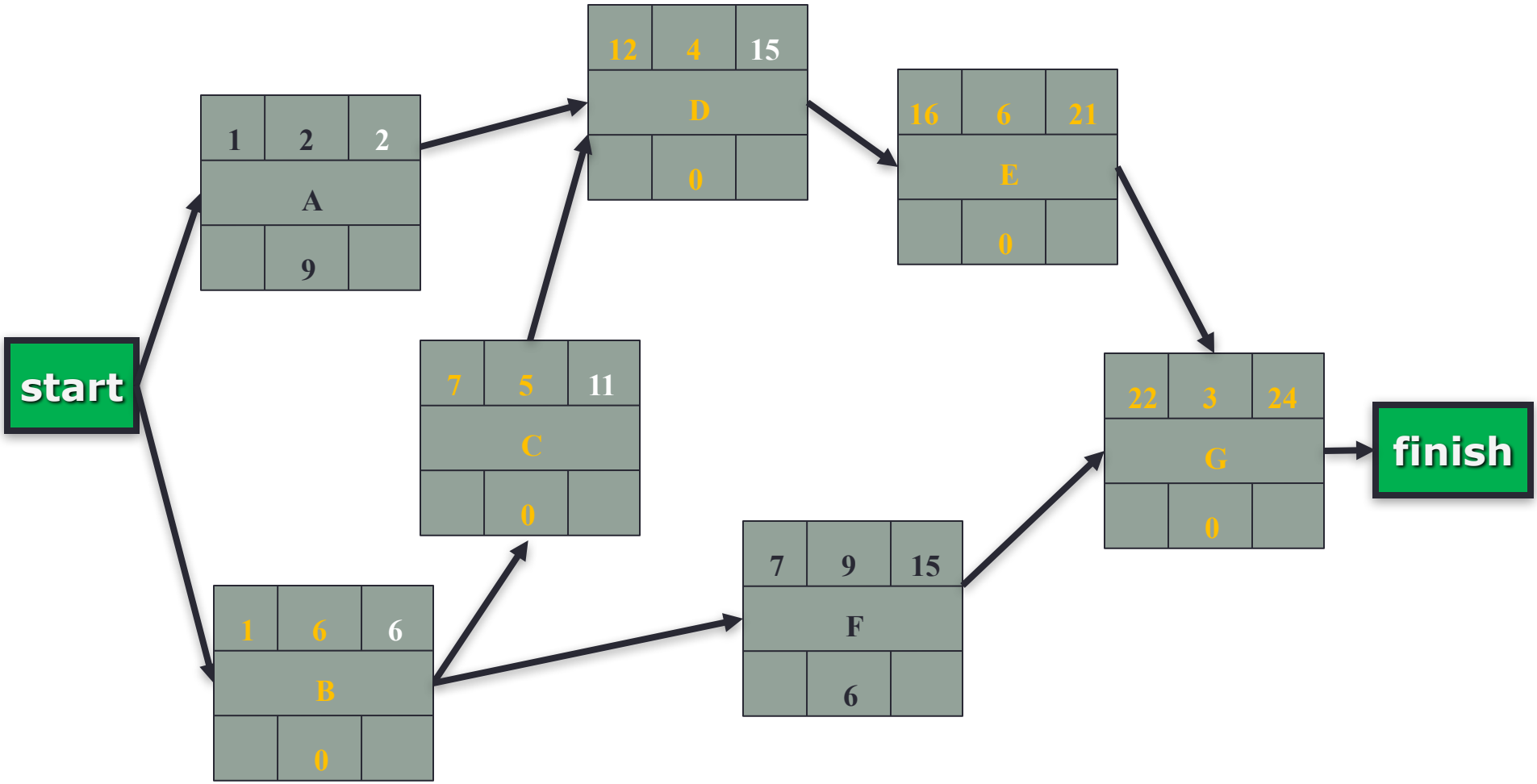
Calculating LS and LF

- LS and LF are calculated by doing a backward pass through the diagram.
- Start with the longest path and work your way from the end node to the start node.
  - Do the same thing for the next longest path, and so on.
  - Don’t recalculate the LS or LF for an activity that’s already been calculated on a prior backward pass.

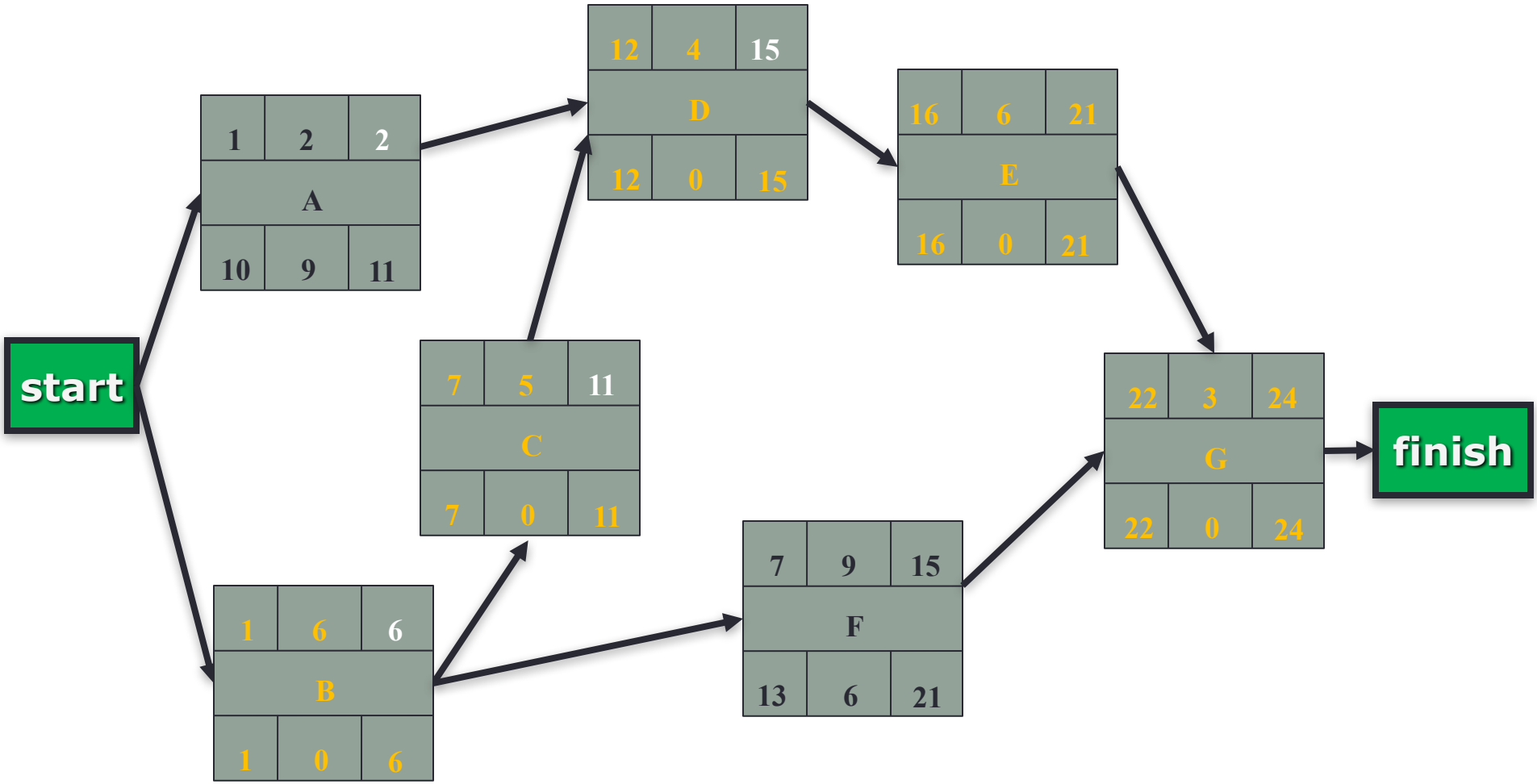
Calculating LS and LF

- The **LS** and **LF** of the **last activity** in the **critical path** will be *the same as its ES and EF*.
- The **LF** of **non-critical activities** with the end node as their successor will be the **LF** of the last critical path activity.
- The **LF** of an activity is the **LS** of its successor *minus* **1**.
  - If there are multiple successor activities, use the *least LS*.
- The **LS** is the **LF** of the activity *minus* its **duration** *plus* **1**.

Calculating ES and EF



Calculating LS and LF



Some questions

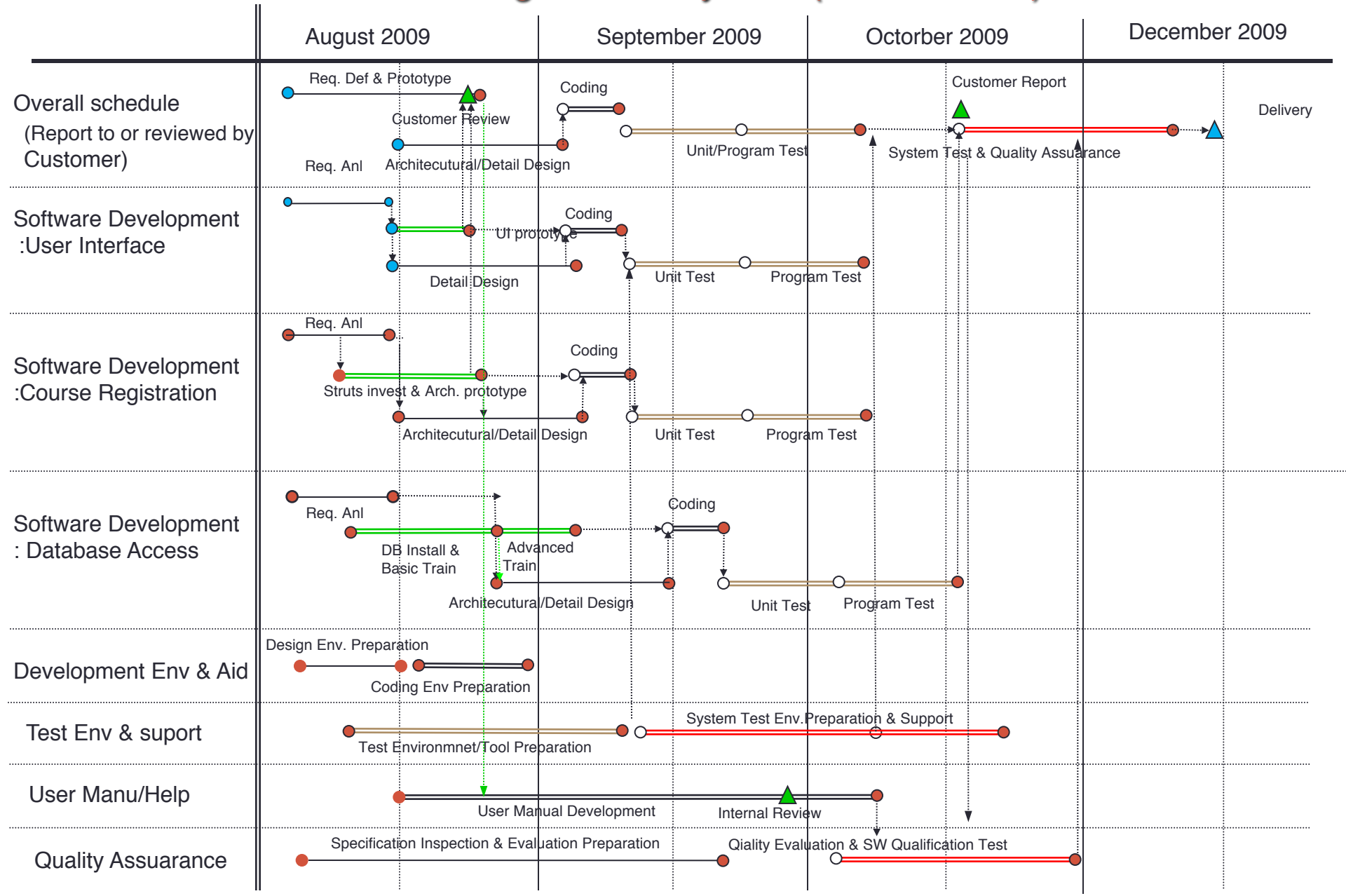
- What are the critical activities?
- How long will it take to complete this project? = What is the expected project completion time?
- Can activity D be delayed without delaying the entire project? If so, how many weeks?
- Can activity F be delayed without delaying the entire project? If so, how many weeks
- What is the schedule for activity C?

4.6. Schedule adjust and control

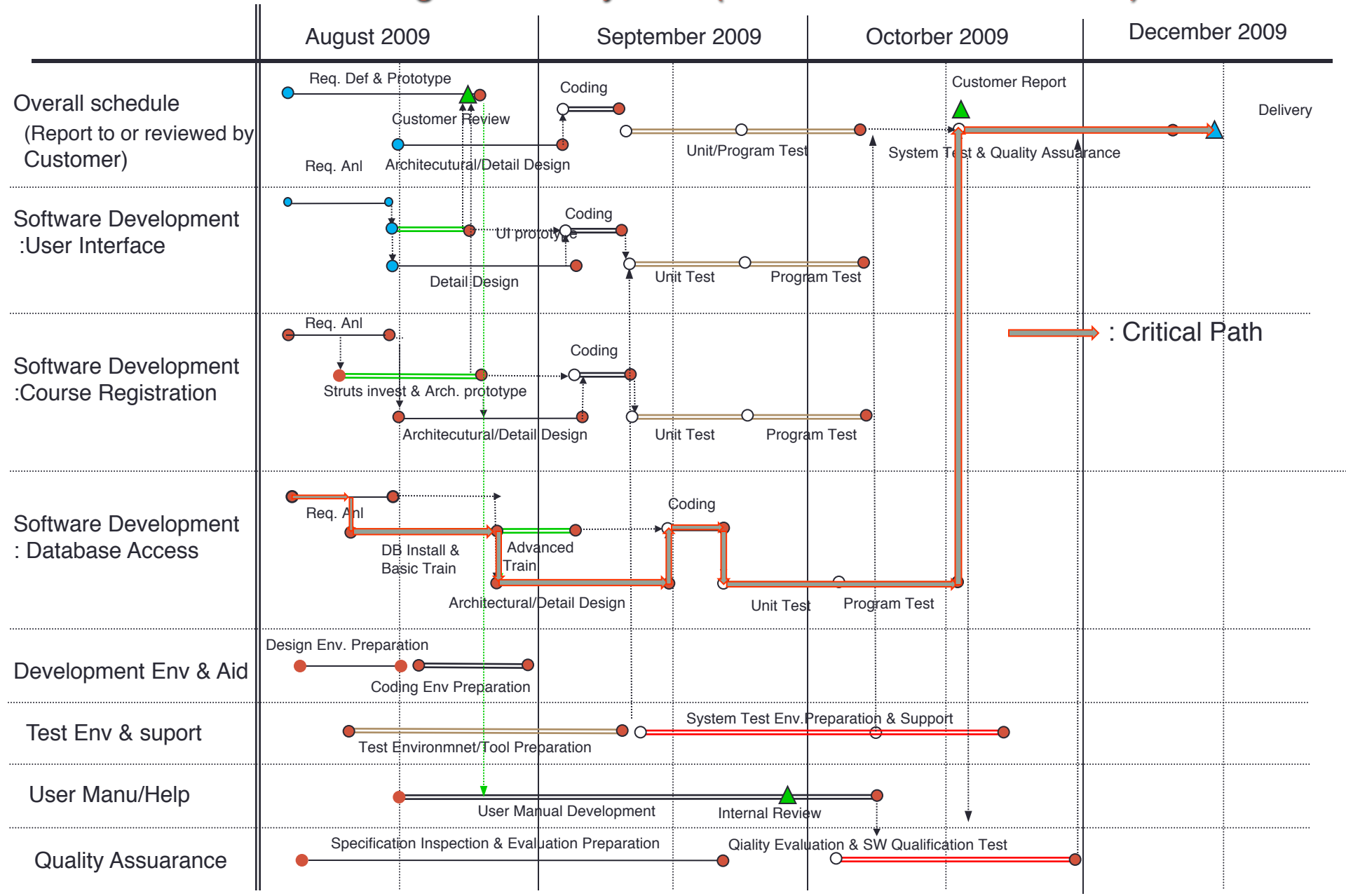
- If needed, to adjust and compress the schedule considering deliverable date and other conditions considering critical path and fast tracking.
- Schedule control should be done identifying the difference between planned and real work and the reasons of them.

→ Gantt Chart is also an effective management tool here!

Course Registration System (First Version)



Course Registration System (Where are Critical Paths)

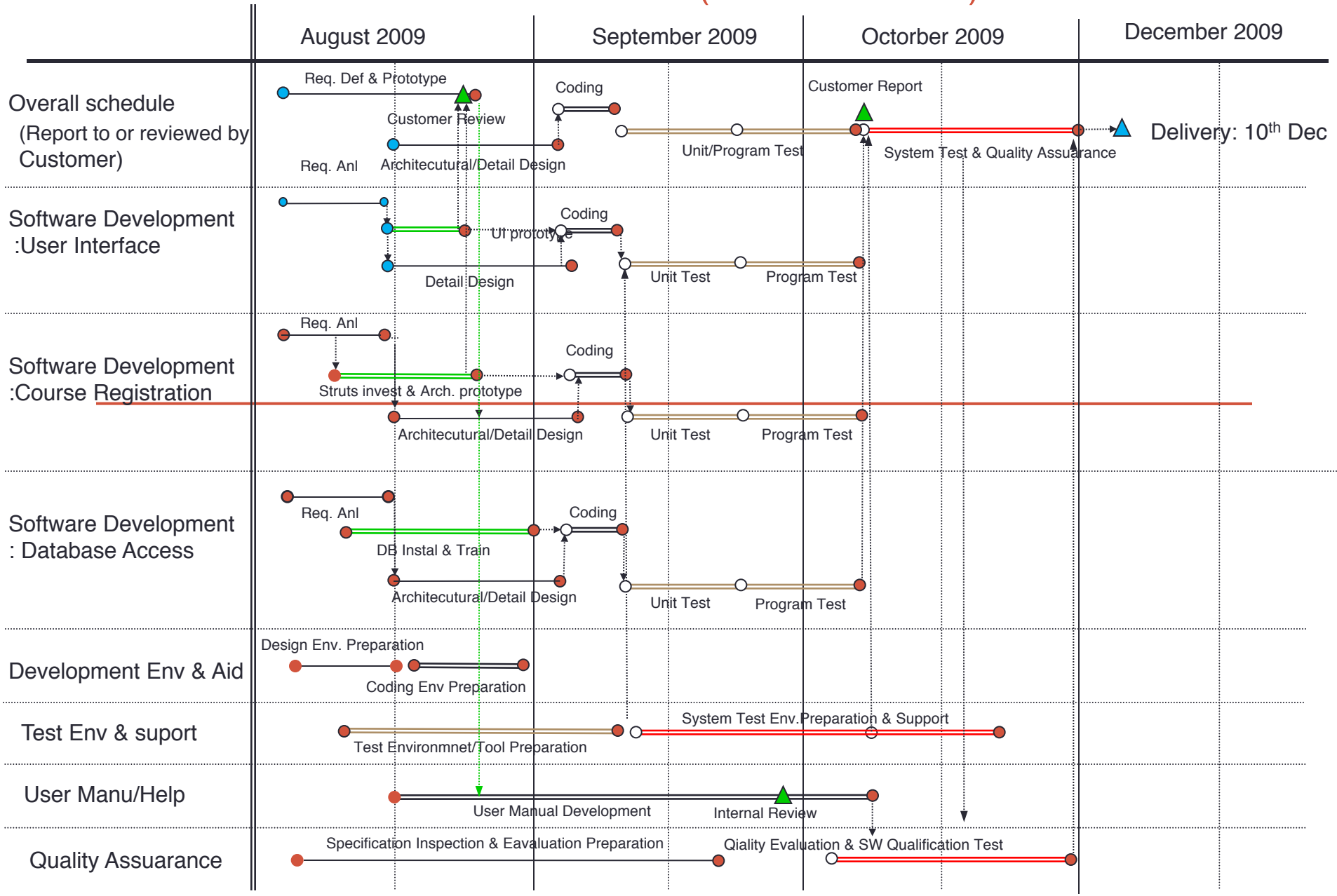


How to adhere closely to due date of delivery

- Due date of delivery is 10th Dec
- On first Version of the schedule, delivery day is 15th Dec.
- Where is critical path?
  - Software Development: Database Access
- What happens in the “Database Access” development
  - They use new database, no experience yet!
  - So, install and training period is set up long and serial

  → Project Manager decided to put experienced engineer into the “Database Access” development team
- And ”Install and training period” is compressed (Crashing), “Architectural/Detail Design Period” starts earlier (Fast Tracking)

COURSE REGISTRATION SYSTEM (FINAL VERSION)



Content

1. Introduction to Project Management
2. PM Body Of Knowledge
3. Scope Management
4. Time Management
5. Cost Management
6. Risk Management

5.1. Cost Estimation

- To estimate cost for Software Development using the following techniques:
  - *Analogous Estimating:* To estimate based on the results of past experienced similar projects by experts.
  - *Parametric Estimating:* To estimate using the relationships between past cost data and Parameters such as developed code lines number of the software.
  - *Bottom-up Estimating:* To estimate summating the costs of each activity.
- Combination of the above techniques
  - To budget summated each activity cost and set up cost baseline considering risk/backup and environment for software development

5.2. Cost control

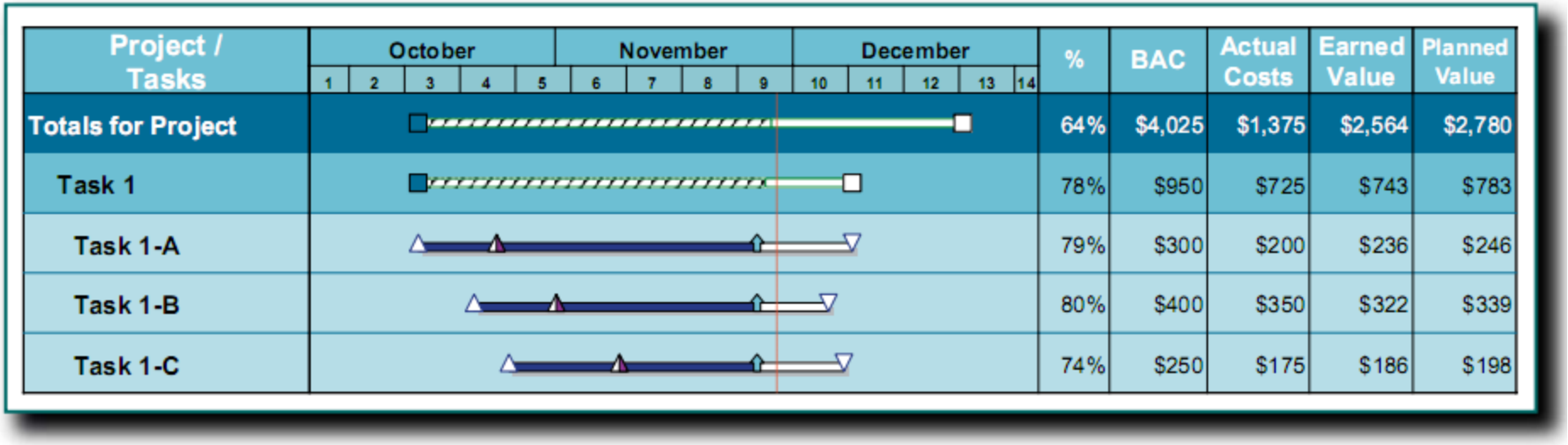
- Monitor the status of the project to update the project budget and managing changes to the cost baseline.
- PM will use the inputs as follows:
  - Project funding requirements
  - Work performance information
- To control cost Software Development using techniques such as Earned Value Management (EVM).

5.3. Earned Value Management (EVM)

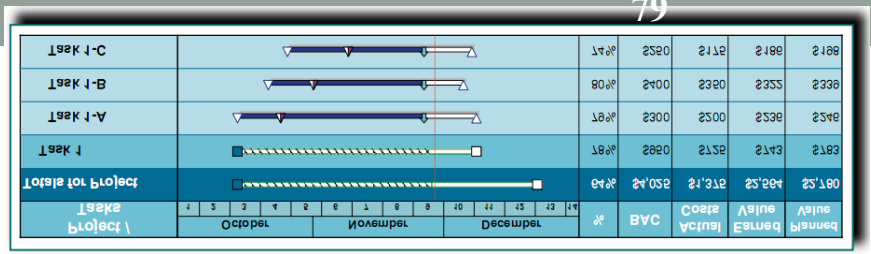
- The EVM is a valuable tool in the management of all projects, software projects in particular.
- The Earned Value (EV) can then be compared to actual costs and planned costs to determine project performance and predict future performance trends.
- Can be used to
  - Analyse schedule performance and cost performance
  - Forecast future performance trends

5.3. Earned Value Management (2)

- Can do the two-dimensional analysis
  - Has this project spent more or less money than planned?
  - What did we get for the money we spent?



EV Analysis

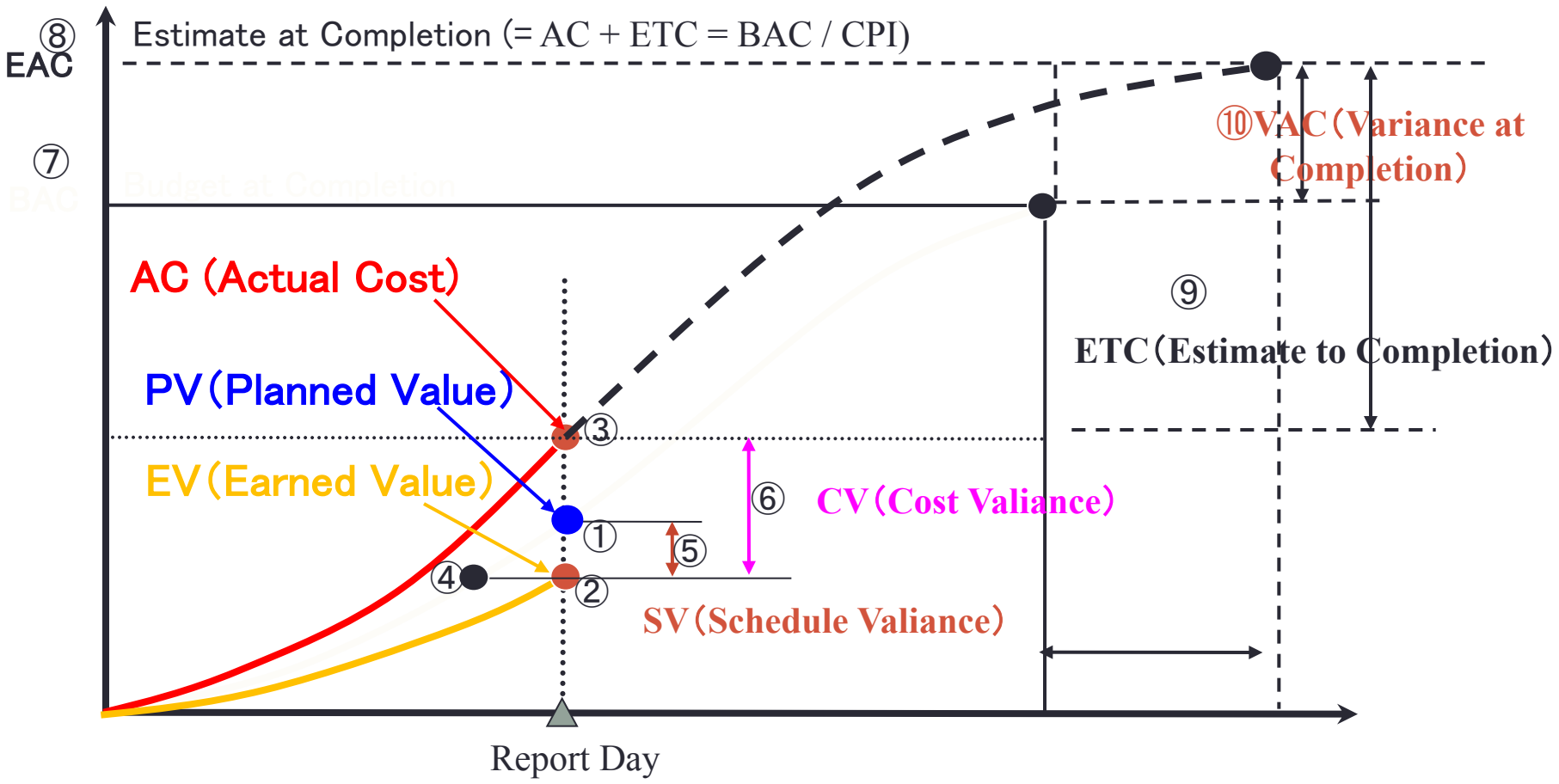


- Basis measurements
  - Budget at Completion (BAC) = Overall approved budget for a task.
  - Actual Costs (AC) = Total amount spent on a task up to the current date.
  - Percent Complete (PC) = Task progress
  - Planned Value (PV) = What is the value of the task expected to be done?
- Calculation based on the above three measurements
  - Earned Value (EV) = What is the value of the task already performed? (BAC x Percent Complete)

Other measurements

SV	Schedule Variance	**EV-PV**
SPI	Schedule Performance Index	**EV/PV**
CV	Cost Variance	**EV-AC**
CPI	Cost Performance Index	**EV/AC**
EAC	Estimate at Completion -if no variance has occurred or expect to continue at the same rate as currently: **BAC/CPI** -if current variances won't be continued into the future: **AC + (BAC-EV)**	**AC+(BAC-EV)/CPI**
ETC	Estimate to Complete	**EAC-AC**
VAC	Variance at Completion	**BAC-EAC**

Data graph for EVM



Example

- In a certain 4-week project, total budget is 3,000$.
- At the end of the 3rd week, 2/3 of the scheduled work has been completed, actual cost from cost ledger is 1,600$, planned value is 1,500$
  - Earned value is BAC x PC = 2,000$
  - Schedule variance is EV – PV = 500$
  - Cost variance is EV – AC = 400$
- If this project continues at present cost efficiency rate of CPI = EV/AC = 125%

→ Estimated cost at completion is EAC = BAC/CPI = 3,000/1.25 = 2400$

Exercise – Building a shed

- The floor is budgeted at $200 while each side is budgeted at $100 and the roof is budgeted for $300.
- The plan is as follows: the floor will take 2 days to complete, each side will take 1 day to complete while the roof is expected to come in at 2 days. The floor gets done first, followed by each side and then the roof.
- Actual work is done as follows: the floor takes 3 days to build and costs $300, and the first side takes 2 days and costs $150. Then you get on a roll. The next side comes in according to project estimate – 1 day and costs only $50.
- We are at the end of day 6, how does our project look?

Answer – Basis

- At the end of 6th day:
  - BAC = 200 + 100 x 4 + 300 = 900
  - AC = 300 + 150 + 50 = 500
  - PV = 200 + 4 x 100 = 600
  - EV = 200 + 2 x 100 = 400
  - Percent Completion = EV/BAC = 4/9

Answer – Analysis & Forecast

- BAC = 900; AC = 500; PV = 600; EV = 400; PC = 4/9

Measurement	Calculation	Result
SV	EV-PV = 400 – 600	-200
SPI	EV/PV = 400/600	2/3 (1/3 behind)
CV	EV-AC = 400 – 500	-100
CPI	EV/AC = 400/500	80% (25% overrun)
EAC	AC+(BAC-EV)/CPI	500 + (900-400)/0.8 = 1125
ETC	EAC-AC = 1125 – 500	625
VAC	BAC-EAC = 900 – 1125	-225

Content

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6. Risk Management

6.1. What is a risk

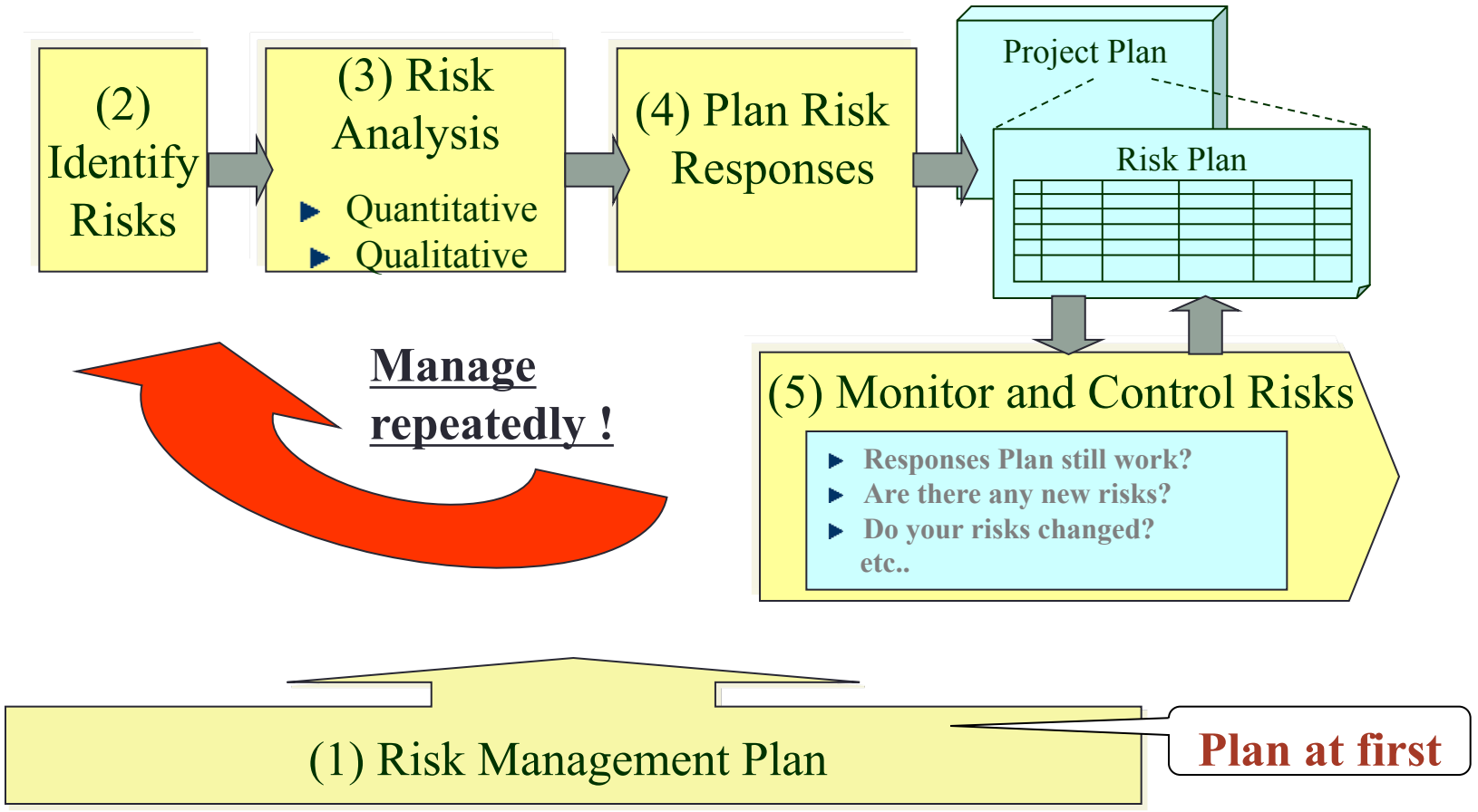
- What is a risk?
  - Uncertainty which will be able to make a good or bad impact on the project.
  - Project includes a lot of risk.
  - You need to proceed almost all process in the project considering risk.

Mini Exercise

- How to deal with the risk as follows:
  - You plan to have a home party next weekend.
  - But you don’t know how many people will come.
  - Now, you consider to prepare drink and food for 10 people.
  - It will be too much if you have only 5 people.
  - It will be too small if you have 15 people.
  - But you can’t confirm how many people will come in advance (uncertainty will be kept).
- Please find out the best way to avoid the risk under uncertainty.

6.2. Whole process of Risk Management

- Purpose: To avoid/alleviate the effect of risks for the customer.



6.2.1. Identify Risks

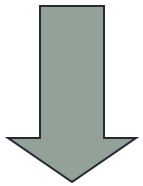
- Determining the risks which may affect the project and document their characteristics

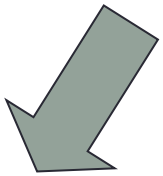
Category	Risk Driver	Risk
System	・Request is unclear.	・It may be delay to fix requirement.
	・Size of system is big.	・Estimation may be difficult.
	・Quality requirement is high.	・It may be schedule delay.
Technical	・Use new technology.	・It may take many time for trouble shooting.
	・Use package software.	・It can be difficult to customize it.
Organization	・End use can't join the project.	・It can be difficult to cover all users needs.
	・There are not enough system engineer in the project.	・The project can be delayed.
Project-management	・Risk in Management method/policy	
External	・Risk in supplier, Risk in Business environment	

6.2.2. Risk analysis

Probability	
High	Many times occurred in the past
Middle	Several times occurred in the past
Low	Never or few times occurred in the past

Impact Level	
High	Company have to deal with it. (Lose all profit, Bring law suit, Have a press conference for appology etc..)
Middle	Other project team or division need to help the project to solve the problem.
Low	Project team or members can solve pbblems using their own baffer.

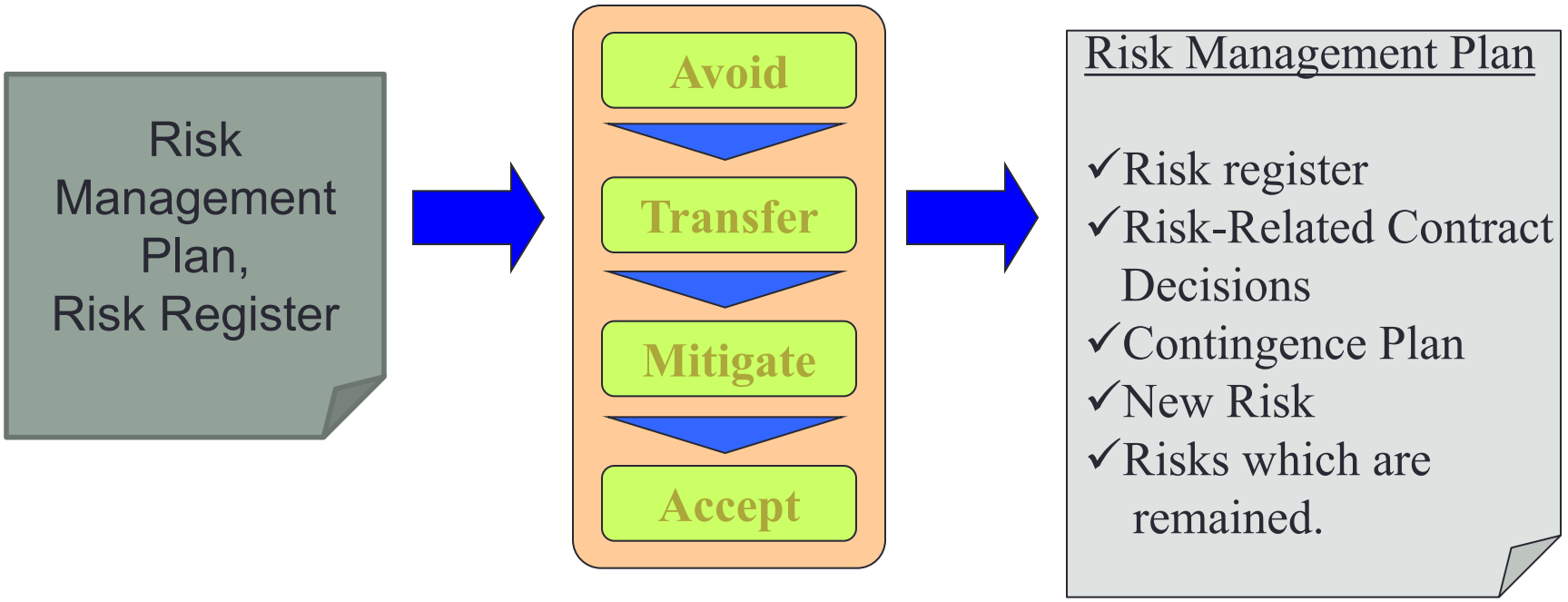




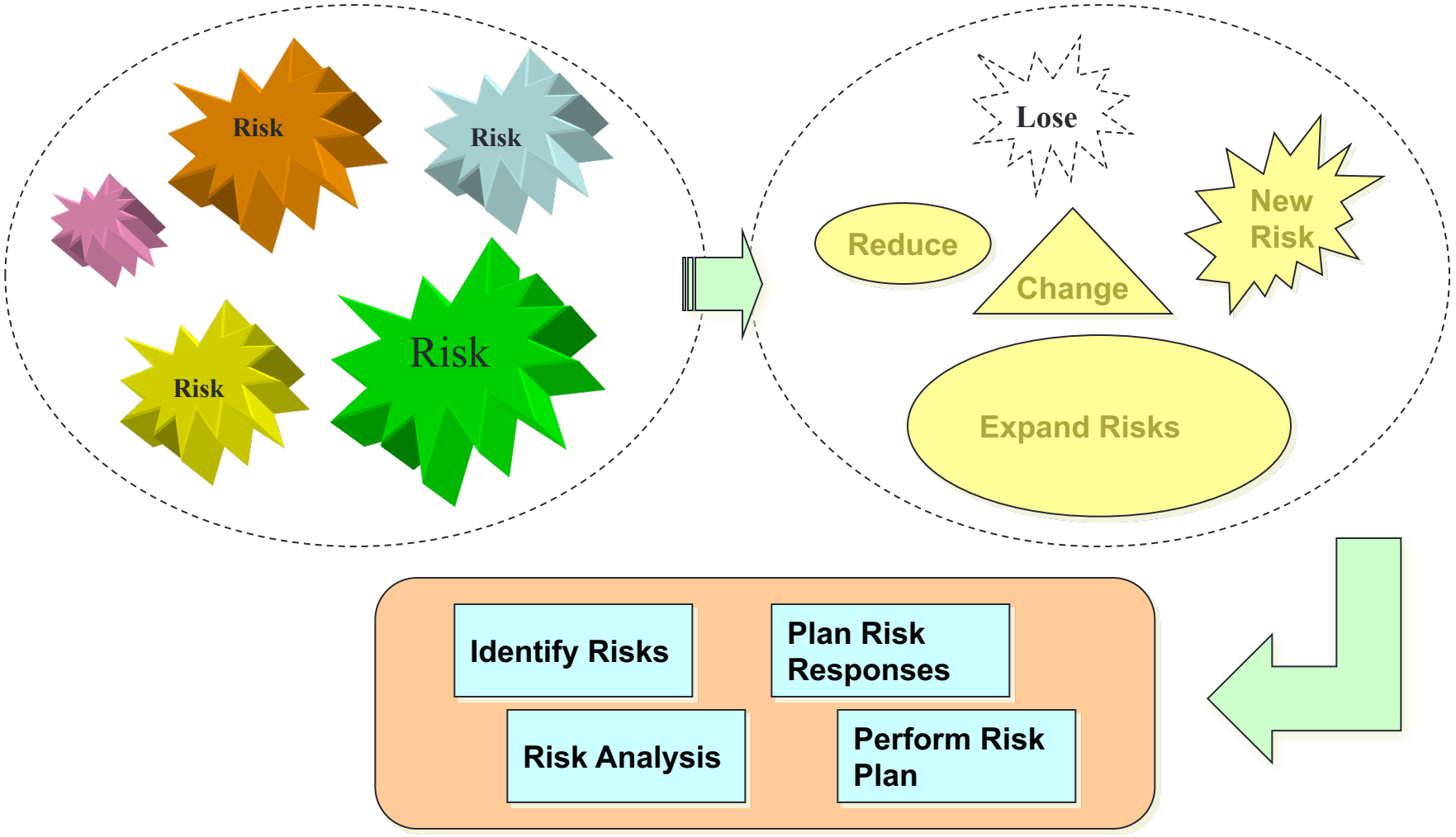
Impact / Probability	Big	Middle	Small
High	A	A	B
Middle	A	B	C
Low	B	C	C

6.2.3. Plan Risk Responses

- Plan Risk Responses is the process of developing options and actions to enhance opportunities and to reduce threats to project objectives.



6.2.4. Monitor and control risks



Question?