

Software Project Management

CENG 323 – Project Management

7 December 2022, @IZTECH



What is a Project?

A project is
a **temporary** endeavor
undertaken to create a **unique product**, **service**,
or **result**.

Recall from
Week 1

Example Projects



building a house



developing a medicine



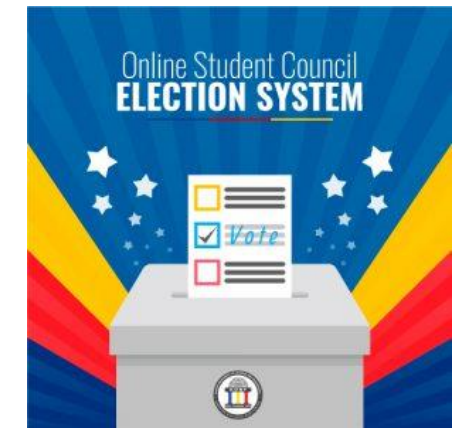
*developing a new
transportation vehicle*



running a campaign



*developing a messenger
application (like
WhatsApp)*



*developing an online student
council election system*

Image credits:

House: https://www.freepik.com/free-vector/house-construction-phases-isometric-poster-with-team-workers-working-unfinished-building-vector-illustration_7201660.htm

Medicine: <https://www.drugtargetreview.com/article/58060/laboratory-automation-in-early-drug-discovery/>

Transportation vehicle: <https://www.businessinsider.com/tesla-cybertruck-pickup-trucks-coolest-features-2019-11>

Image credits:

Campaign: <https://anceauxmarketing.nl/build-brand-supporting-campaigns/>

Messenger: <https://www.passionatestar.com/whatsapp-system-design/>

Election System: <https://komar.edu.iq/events/onlinestudentcouncilelectionsystem/>



What is Project Management?

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

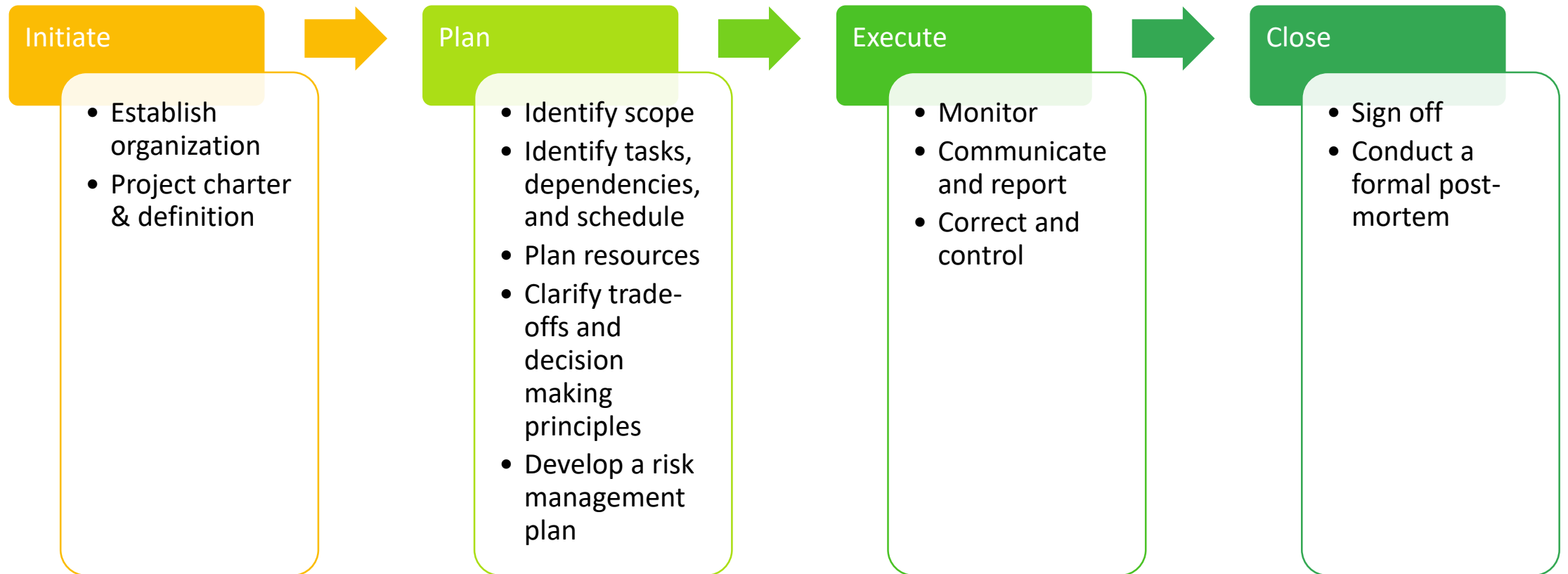
Recall from
Week 1

Constraints / Variables in a Project



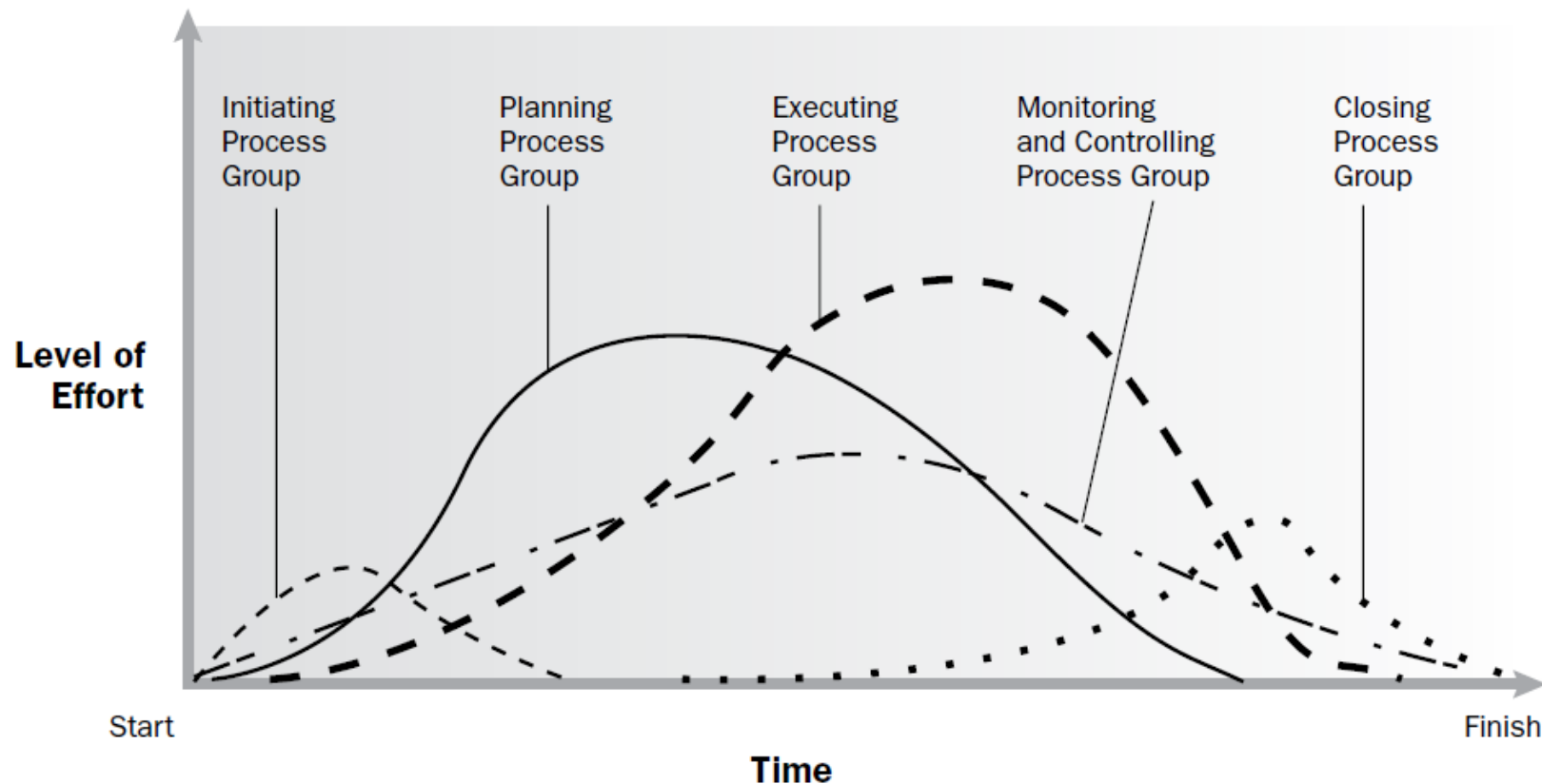
Recall from
Week 1

Project Life-Cycle



Example of Process Group Interactions Within a Project

Process Groups are not project phases!



Fundamental Concepts



Stakeholders



Project Manager



Activities/Tasks
*Work Breakdown
Structure*



Estimation
*Duration, Effort,
Resource*



Scheduling
*Dependency, Network
diagram, Critical path,
Gantt chart, Milestone*



Optimizing a Plan
*Fast tracking, Project
crashing*



Cost
Direct/Indirect, Budget



Resource management
*Roles & Responsibilities,
RACI matrix, Organization
chart*



**Communications
management**



Risk
*Risk matrix, Risk register,
Risk response*

Project Initiation

What to achieve?

- define a new project or a new phase of an existing project

What to do?

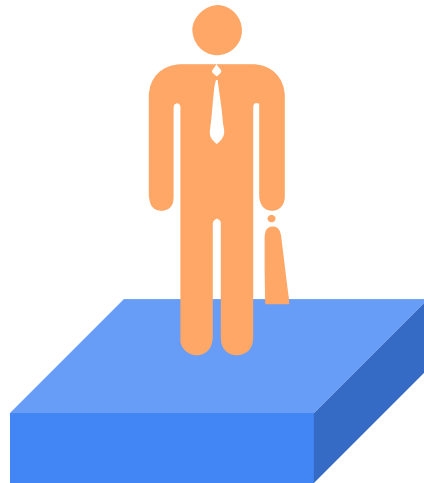
- vision is set
- initial scope is defined
- initial financial resources are committed
- internal and external stakeholders are identified
- project manager assigned

What to
produce?

- project charter
- stakeholder register

Project Manager

the person assigned by the performing organization to lead the team that is responsible for achieving the project objectives

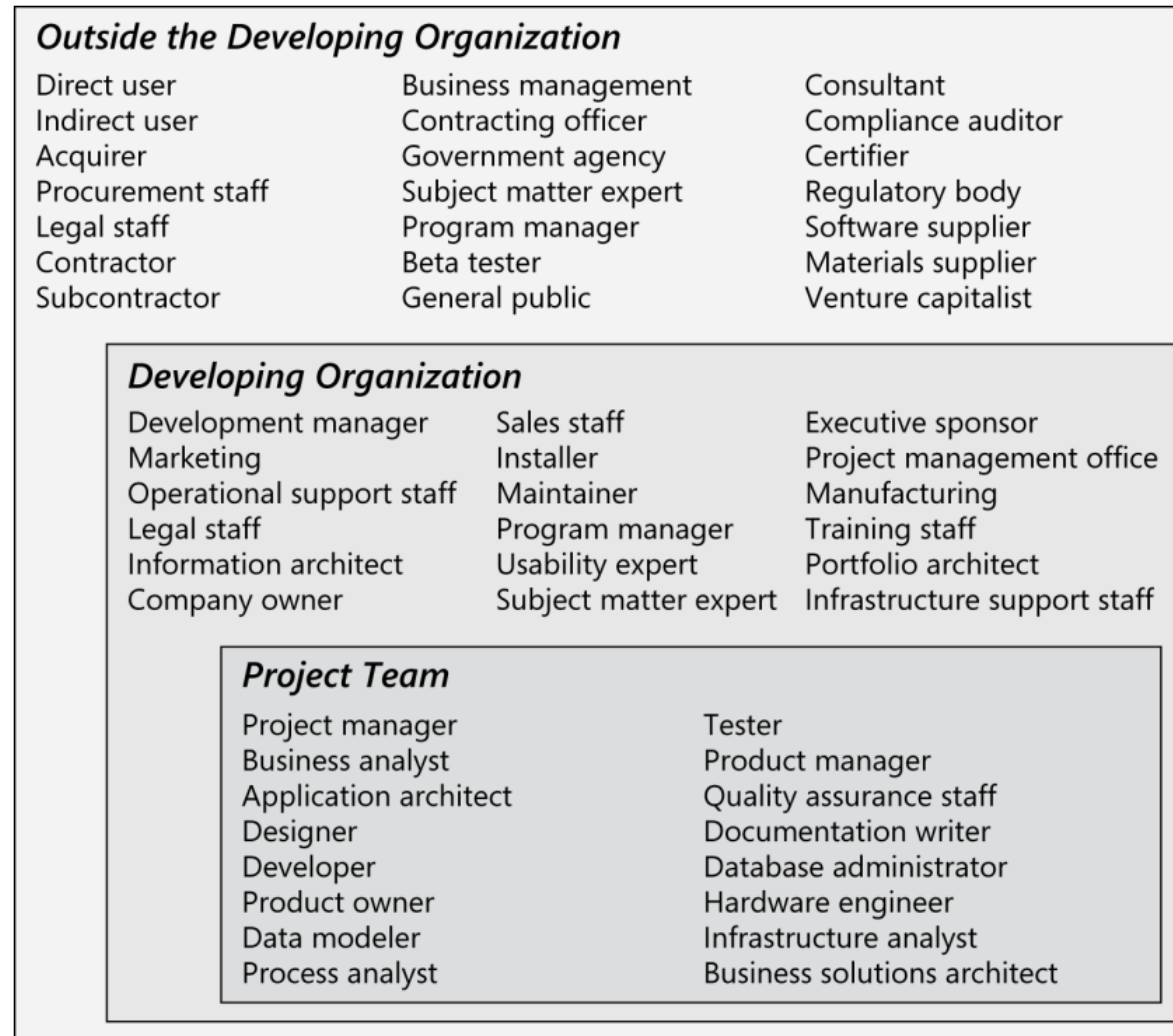


Stakeholders

people, groups, or organizations that could impact or be impacted by a decision, activity, or outcome of the project

- Who will be doing the work?
- Who is the Project Manager?
- Who is paying for the project?
- Who will consume the product or service?
- Who are those effected by the project?

Possible Stakeholders – Software Development



Fundamental Activities in Project Planning

DECIDING THE WORK

- Work Breakdown Structure

ESTIMATING

- Duration
- Effort
- Resource

SCHEDULING

- identify constraints between activities
- when each activity should start and how long should it last

OPTIMIZING THE PLAN

- Project crashing
- Fast tracking



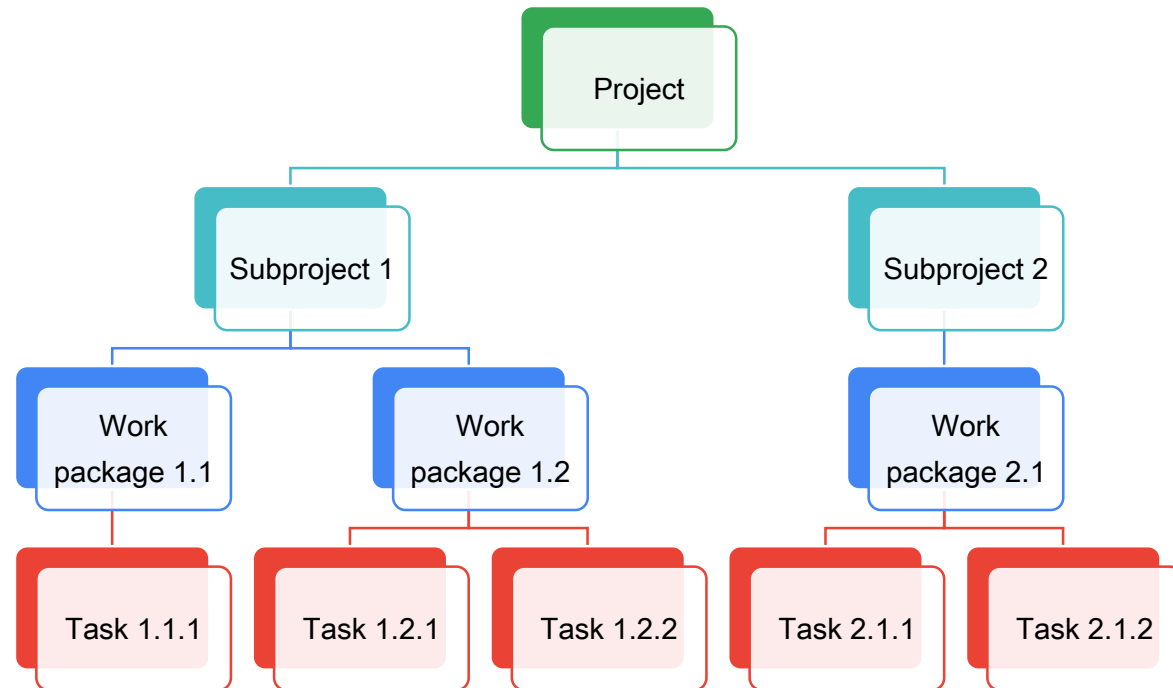
Deciding the Work

After describing the main goals and the boundaries of a project; we can start identifying the activities that we need to carry out in the project

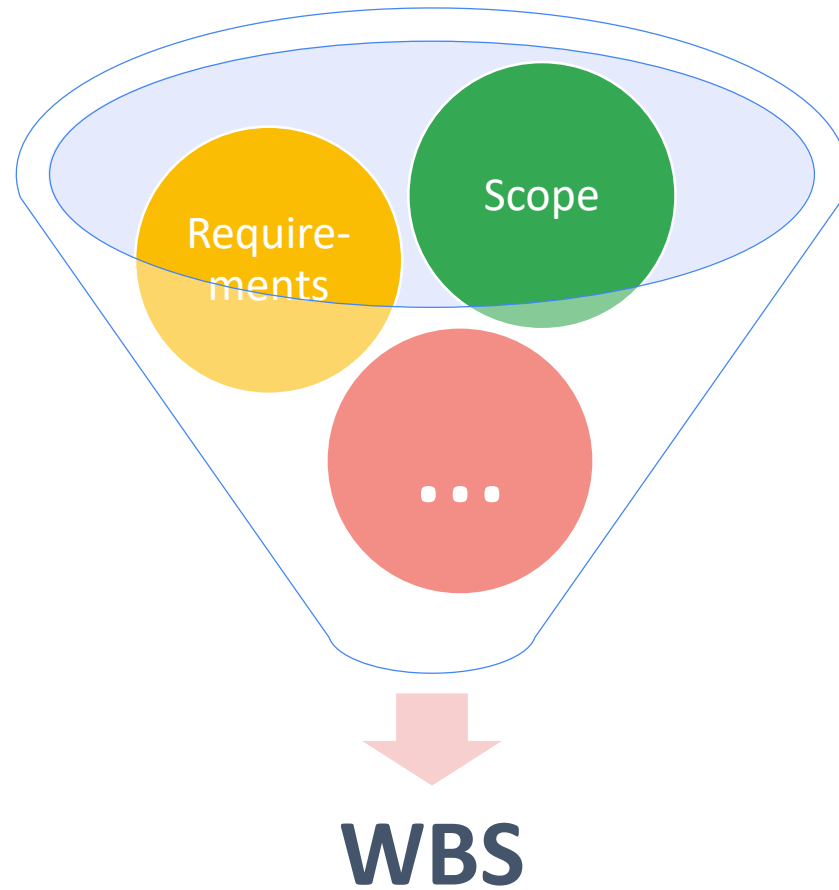
Work Breakdown Structure (WBS)

visually breaks down project scope

- Project
 - Subprojects
 - Work packages
 - Activities/Tasks



Inputs for WBS

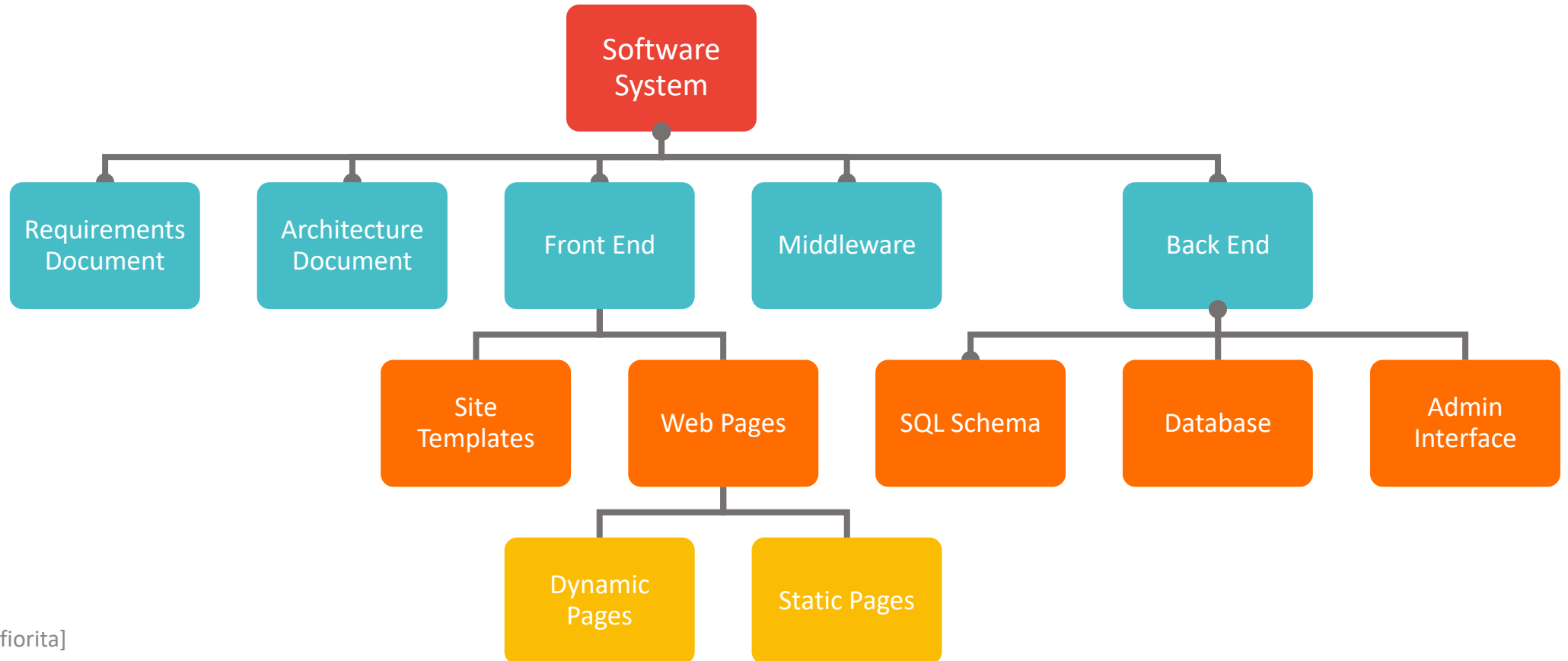


WBS Decomposition Styles



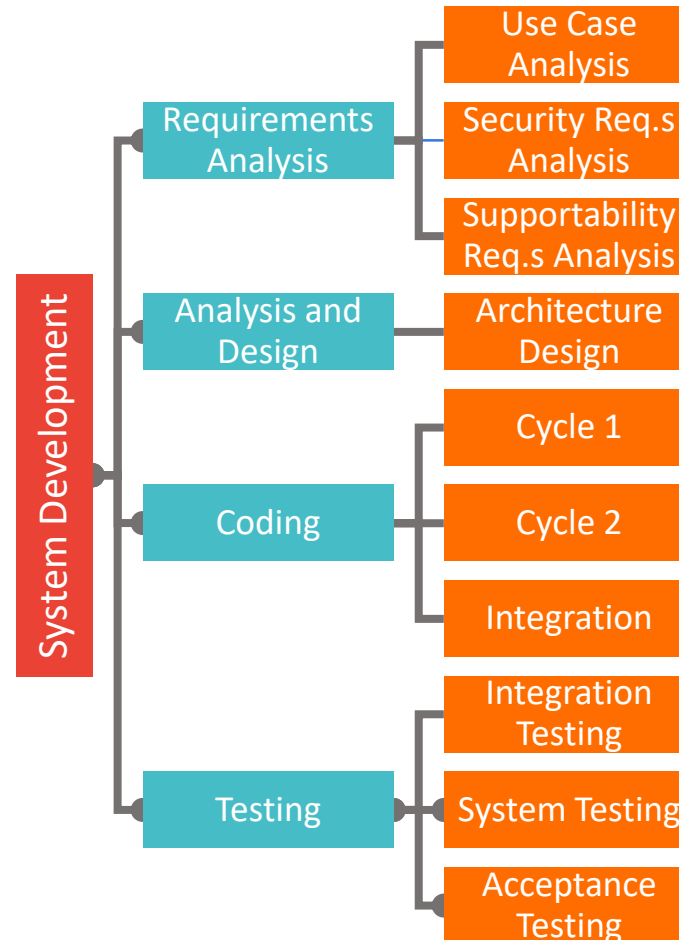
1. Product-oriented WBS

- identify the items that must be developed to build deliverables
- establish a one-to-one correspondence between project activities and project (sub)products



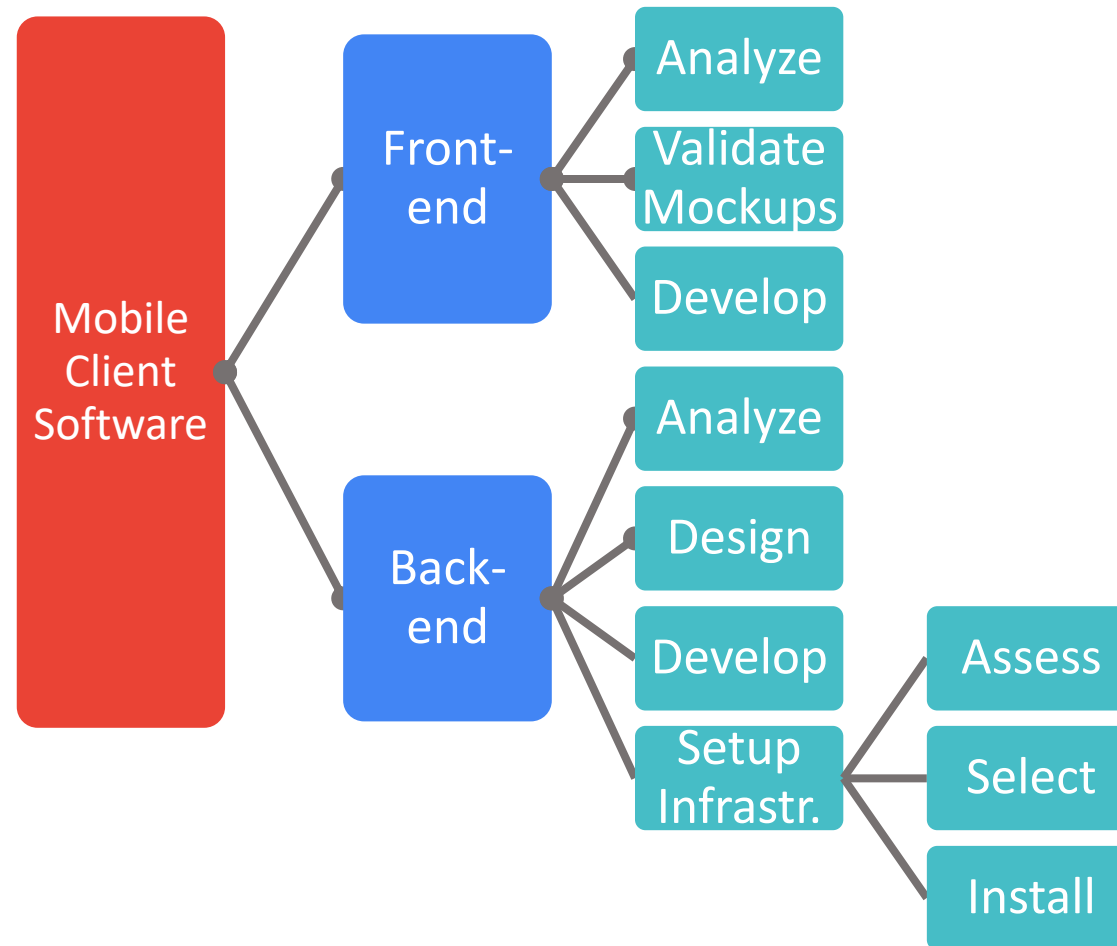
2. Process-oriented WBS

- identify the activities that are necessary to carry out the project



3. Hybrid WBS

- contains both process- and product-oriented nodes



Estimating

determine the requirements to carry out an activity

- **Duration:** how long an activity will last
- **Effort:** the amount of work necessary to complete an activity
- **Resources:** how much effort can be produced

Duration

- How long the activity will last for
- Measured in **hours**, **days**, **months**, ...
- Often:
 - 1 week = 5 days = 40 hours
 - 1 month = 20 days ... why?
- In some countries:
 - 1 week = 36 hours (7.12 hours/day)
- Calendar time differs from duration: calendar time includes non-working days, holidays, ...

Effort

- The **amount of work** an activity requires to be completed.
- Measured in (work-)days, (work-)weeks, (work-)months
- Often the term **man-*** is also used (e.g. 3 man-months = 1 person working for 3 months; 3 people working for one month)
- the work required in a project includes direct and indirect activities (i.e., getting the stuff done, but also email, communication, reports, meetings, ...)

Resource

- The resources needed to carry the work out. Typically a constraint.
- Expressed as **manpower**, that is, number of people and percentage of availability
- For instance: 1 person full time; 2 people at 50%
- Certain tasks might require **material resources** (e.g. bricks & pipes) or **equipment** (e.g. a machine for DNA sequencing)
- Material resources are consumed by the execution of an activity; equipment can be reused
- In software development usually resources = manpower

Relationship among Duration, Effort, and Resource

$$\text{Duration} = \frac{\text{Effort}}{\text{Manpower}}$$

- 1 week = 40 hours
- Effort: 40 man-hours; Resources: 1 @ 100% →
 $D = 40 \text{ man-hours} / 1 \text{ man} = 40 \text{ hours} = 1 \text{ week}$
- Effort: 80 hours; Resources: 2 @ 100% →
 $D = 80 \text{ man-hours} / 2 \text{ man} = 40 \text{ hours} = 1 \text{ week}$
- Effort: 80 hours; Resources: 1 @ 50% →
 $D = 80 / 50\% = 160 \text{ hours} = 4 \text{ weeks}$
(a person at 50% will be able to work 20 hours/week; it takes 4 weeks to get to the 80 hours needed for the activity)

Scheduling

identify constraints between activities;
when each activity should start and how long should it last

- Identify dependencies among activities
- Identify the critical path of the plan
- Allocate resources to tasks and level resources

Types of Dependencies

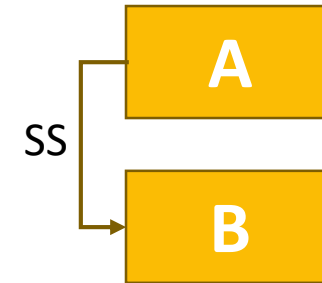
Finish-to-Start (FS)

B cannot start till A finishes
Most commonly used



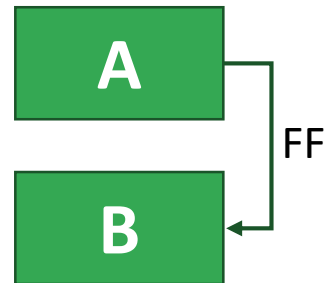
Start-to-Start (SS)

B cannot start till A starts



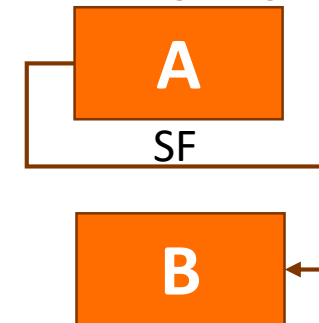
Finish-to-Finish (FF)

B cannot finish till A finishes



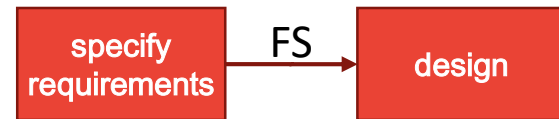
Start-to-Finish (SF)

B cannot finish till A starts (rare)



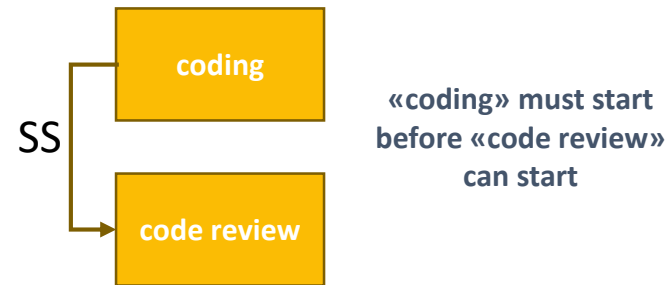
Types of Dependencies

Finish-to-Start (FS)

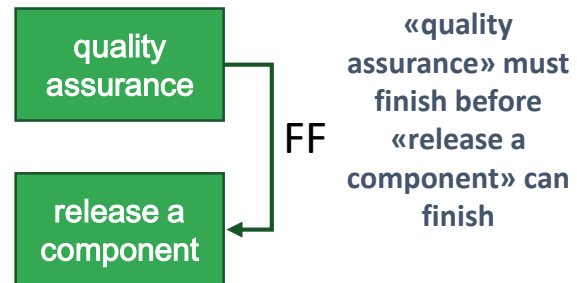


«specify requirements» must finish before
«design» can begin

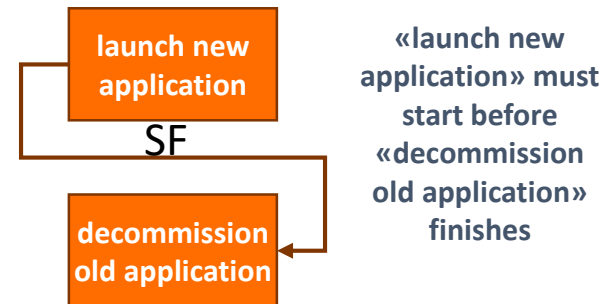
Start-to-Start (SS)



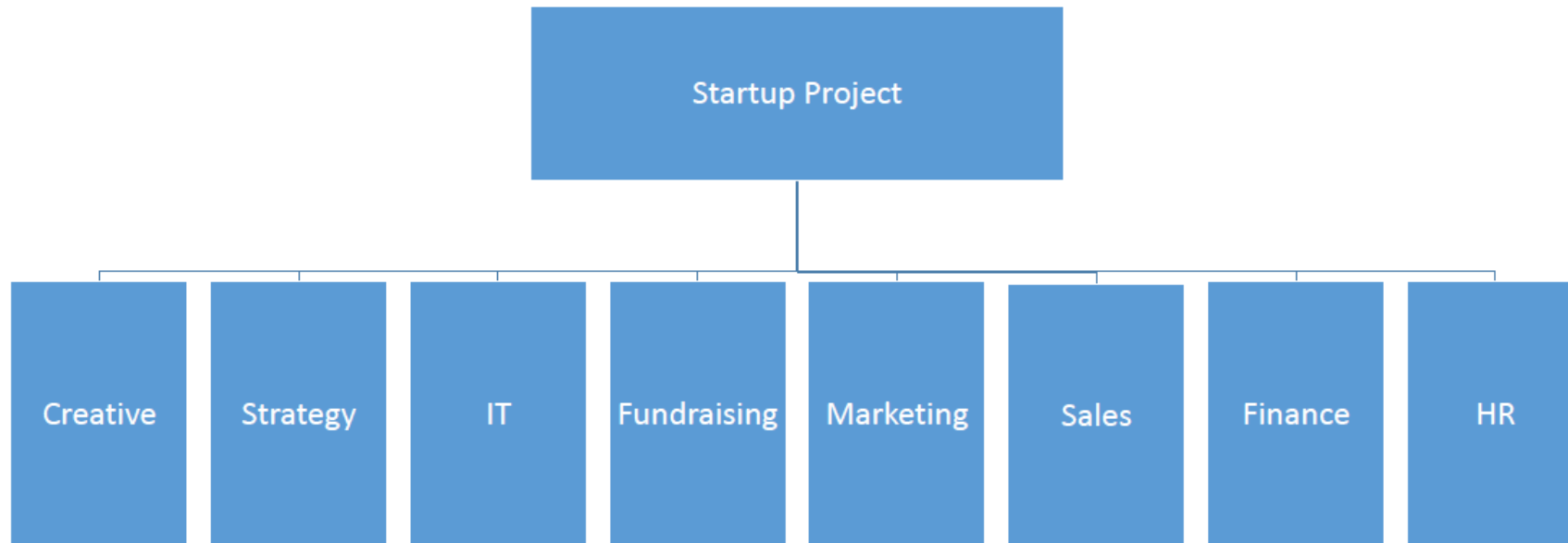
Finish-to-Finish (FF)



Start-to-Finish (SF)



WBS: A Simple Example



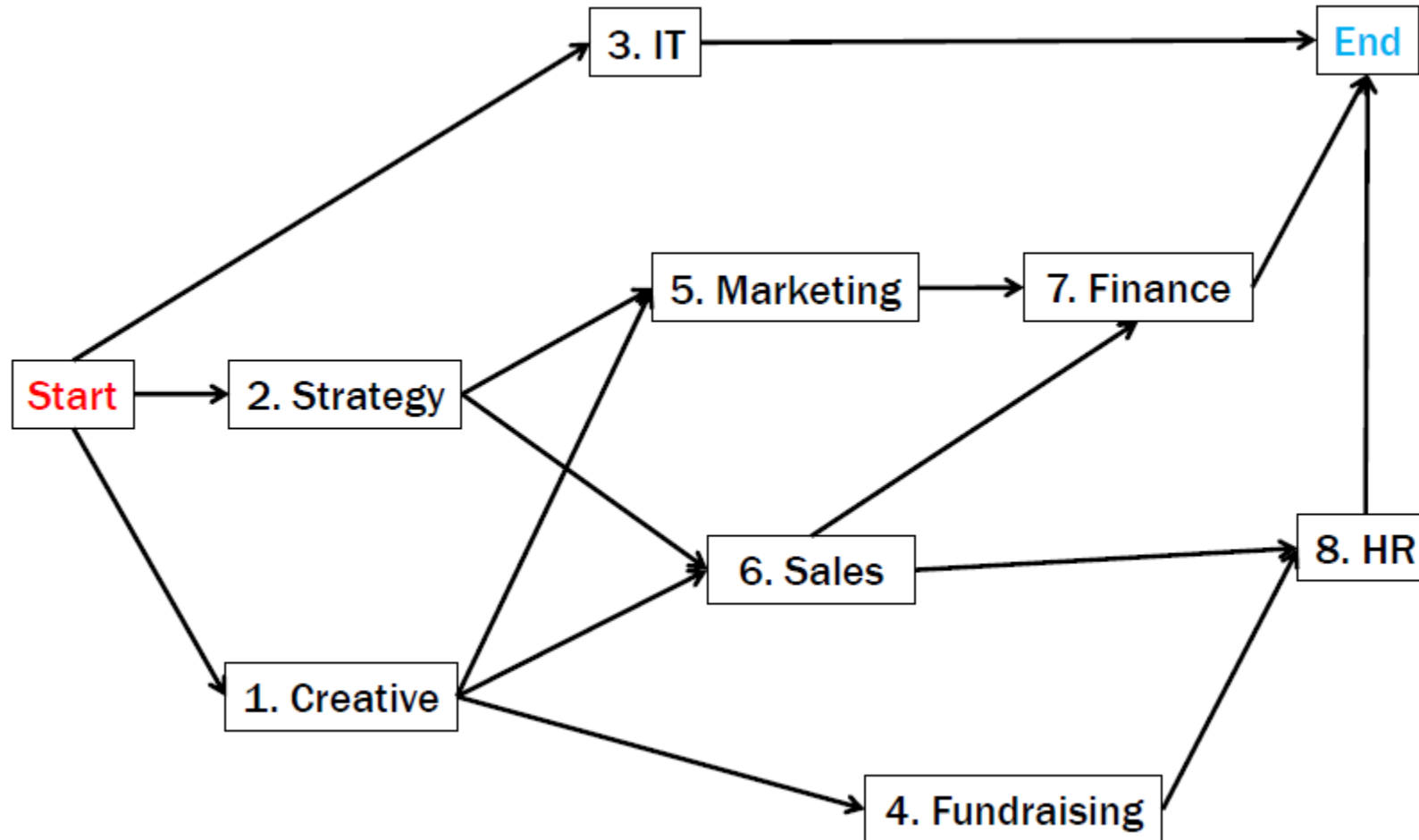
Dependency Matrix

		Creative	Strategy	IT	Fundraising	Marketing	Sales	Finance	HR
		1	2	3	4	5	6	7	8
Creative	1								
Strategy	2								
IT	3								
Fundraising	4								
Marketing	5								
Sales	6								
Finance	7								
HR	8								

Activity Dependencies

Activity #	Description	Predecessors
1	Creative	-
2	Strategy	-
3	IT	-
4	Fundraising	1
5	Marketing	1,2
6	Sales	1,2
7	Finance	5,6
8	HR	4,6

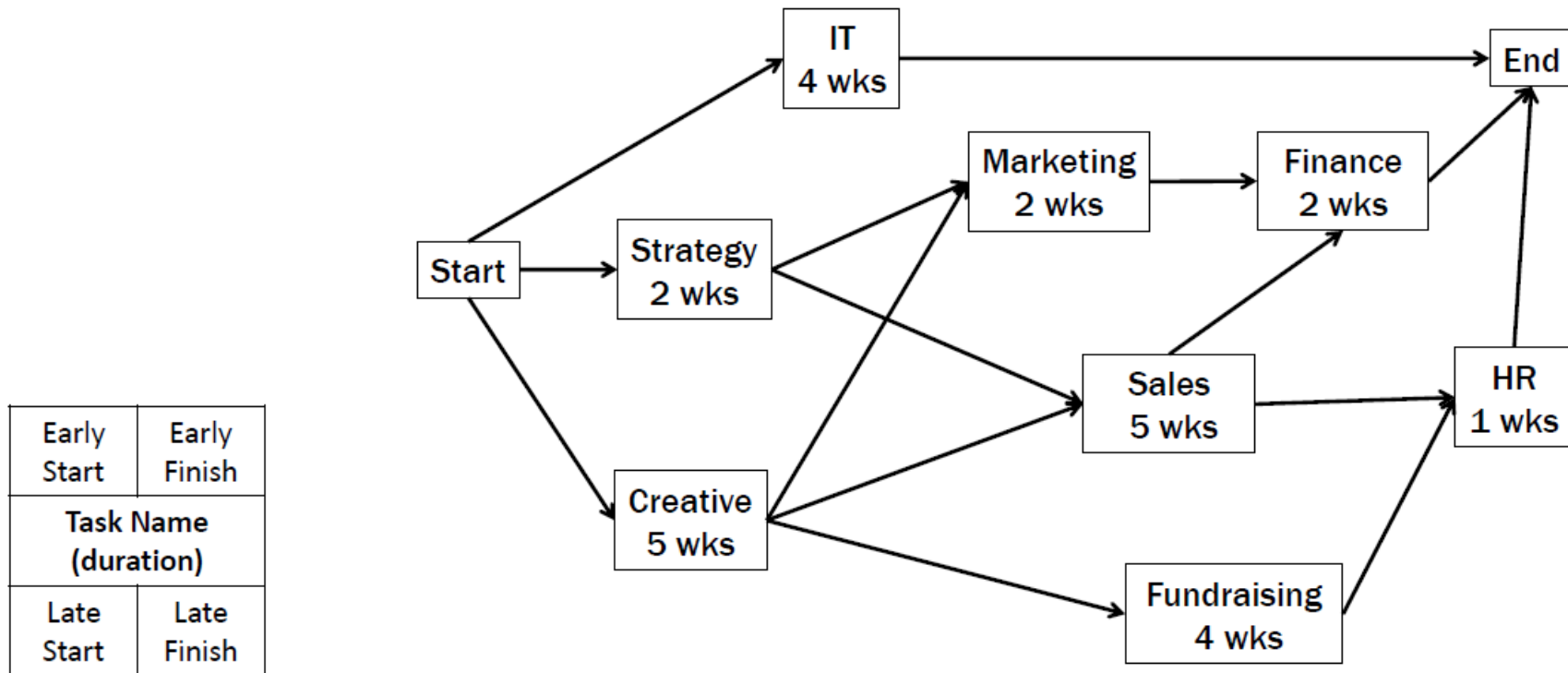
Network Diagram



Durations

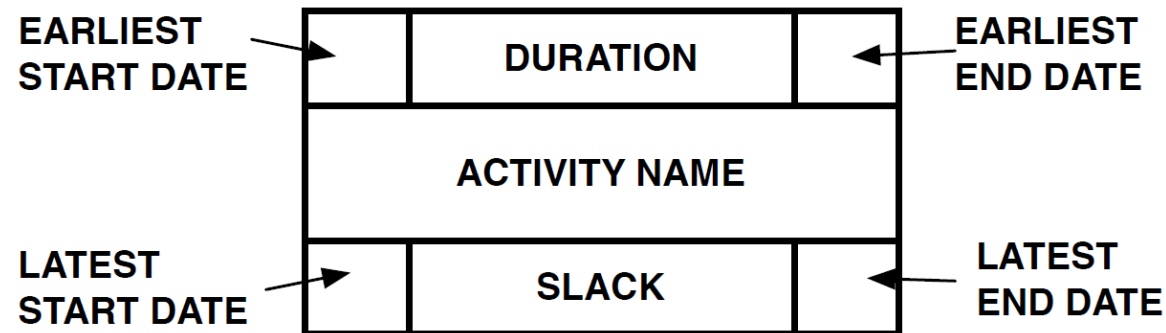
Activity #	Description	Predecessors	Duration (Weeks)
1	Creative	-	5
2	Strategy	-	2
3	IT	-	4
4	Fundraising	1	4
5	Marketing	1,2	2
6	Sales	1,2	5
7	Finance	5,6	2
8	HR	4,6	1

How Long Will the Project Take?



Critical Path Analysis

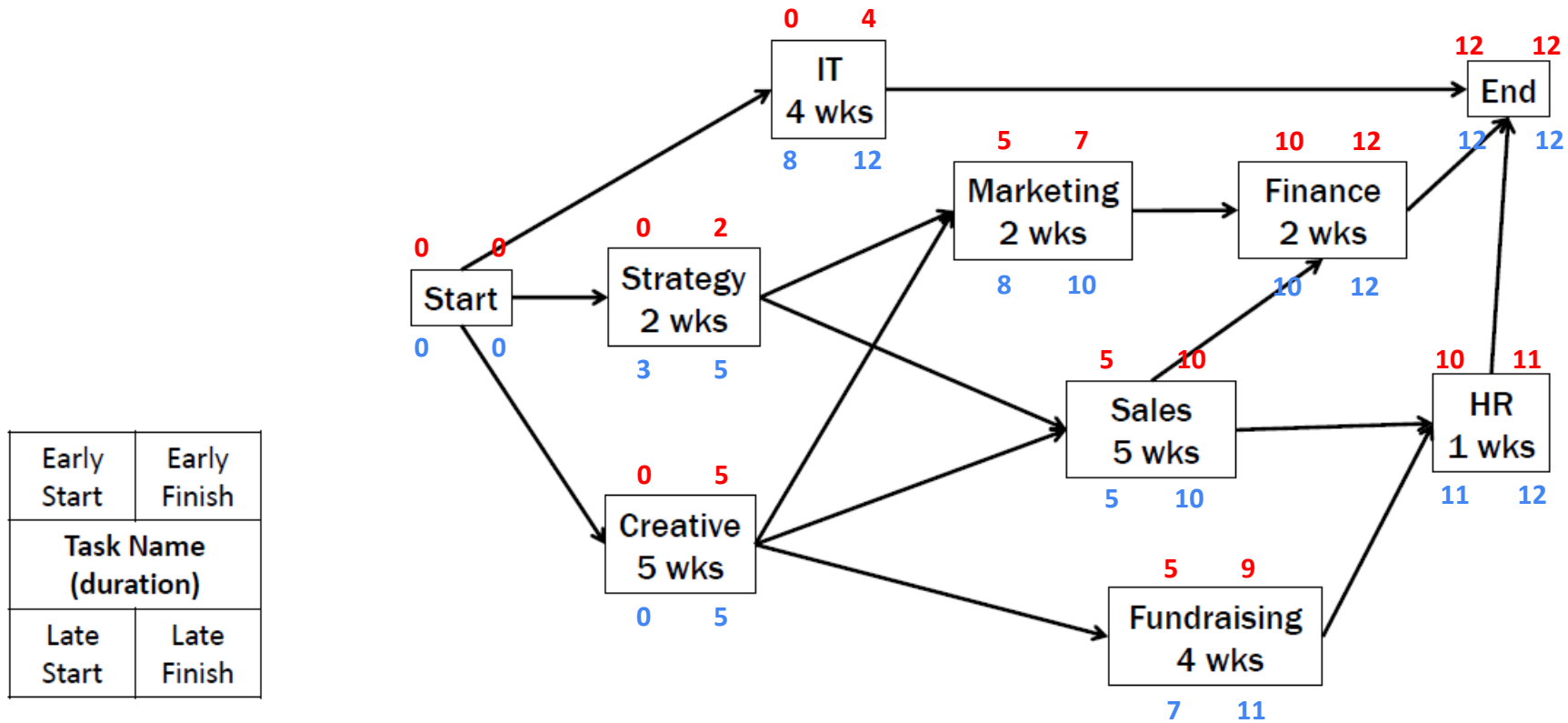
Goal: given a plan (activities, duration, and dependencies), determine **earliest** and **latest** dates of each activity



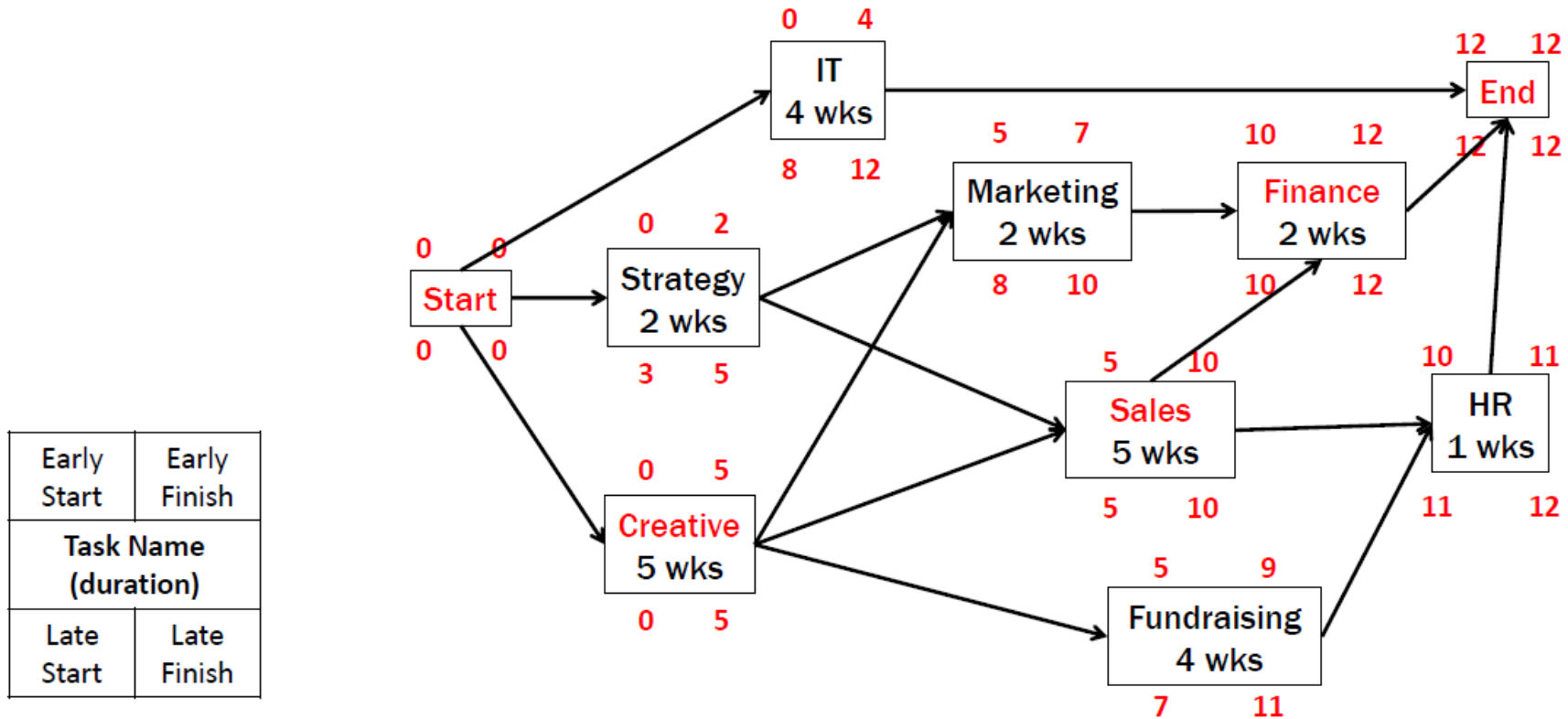
Critical Path Analysis

- A **forward pass** determines the earliest start and end dates of each activity in the plan
- A **backward pass** determines the latest start and end dates of each activity in the plan
- The difference between earliest start (end) and latest start (end) is the slack of an activity
- The **critical path** is the path in which all activities have zero slack
- A plan always has a critical path... changing the plan changes what activities are in the critical path

Critical Path Analysis



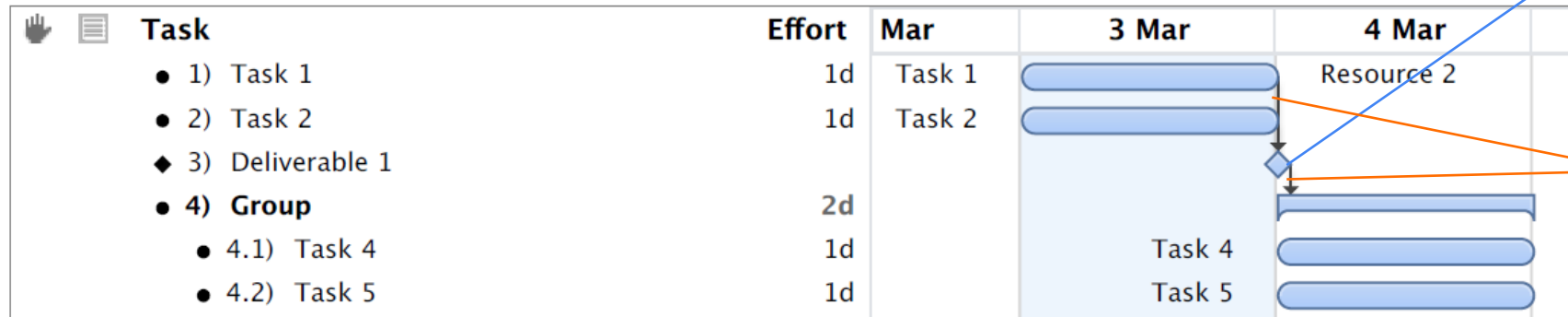
Critical Path Analysis



Critical Path

- The longest path in the project/network.
- The project duration, defined by the length of the critical path, is also known as makespan.
- A delay in any activity along the critical path will cause a delay in the project.
- The method was developed by Engineers at DuPont Corporation in the 1950s.

Gantt Chart



A milestone is a significant point or event in a project. Milestones have zero duration.

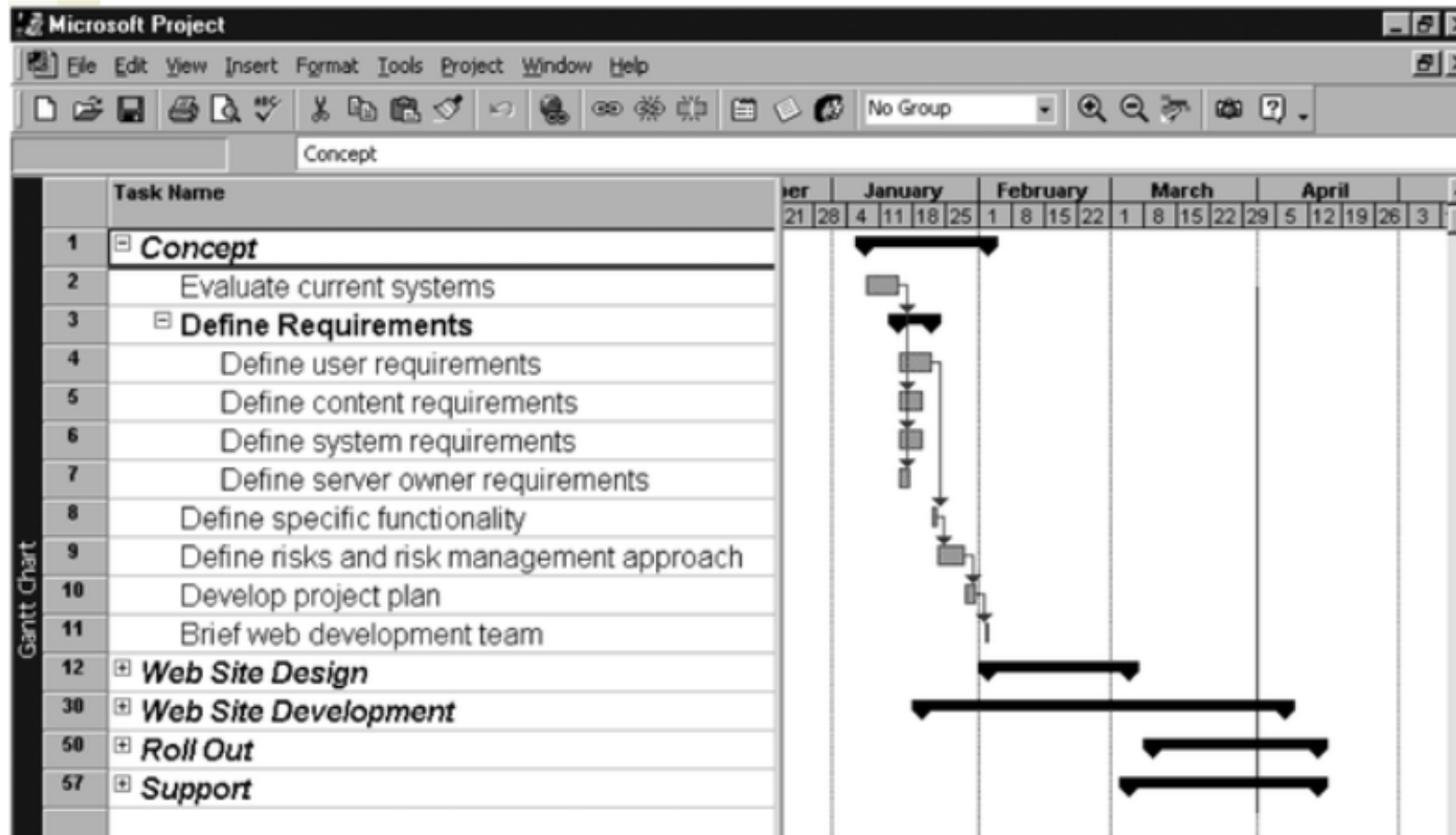
Dependency

- Textual Outline + Calendar Graph
- Activities as bars (possibly annotated with names and resources)
- Deliverable (as diamonds)
- Activities can be grouped (information of group is derived by lower level activities)
- Dependencies among tasks

Project Tasks & Milestones



Outline WBS with Gantt Chart



Optimizing the Plan

What if the project schedule ends up by being too long to respect the constraints set by the stakeholders, by the project goals, or by the environment!

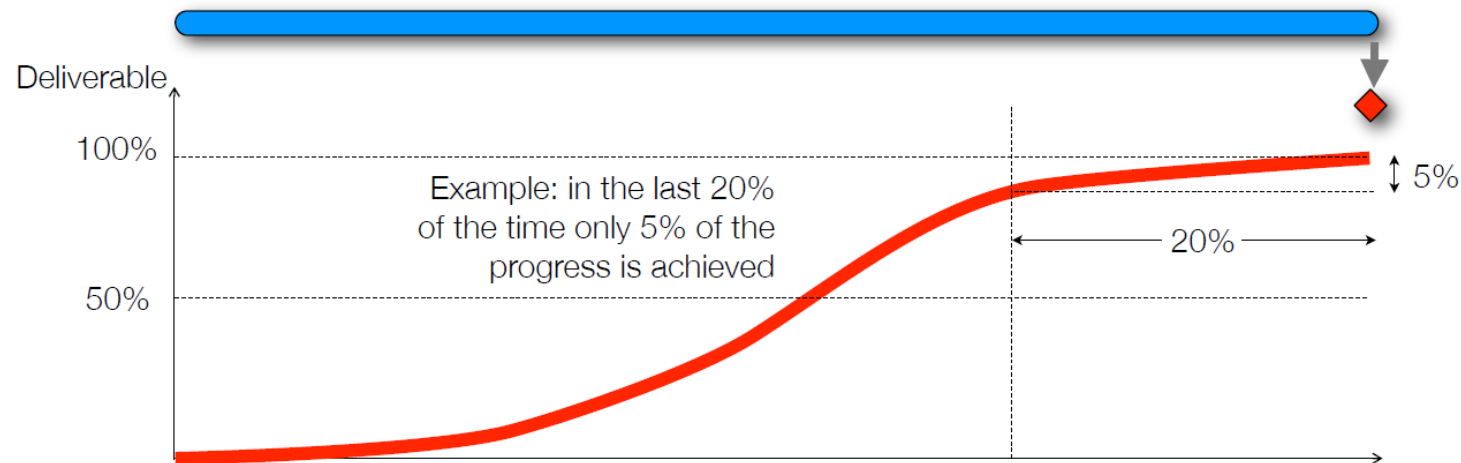
compress the schedule of a plan

Compressing a plan

1. Reduce scope (it makes some activities shorter or useless)
2. Reduce quality (it makes some activities shorter or useless)
3. Outsource some activities (it increases risk and, possibly, costs)
4. Fast tracking
5. Project crashing

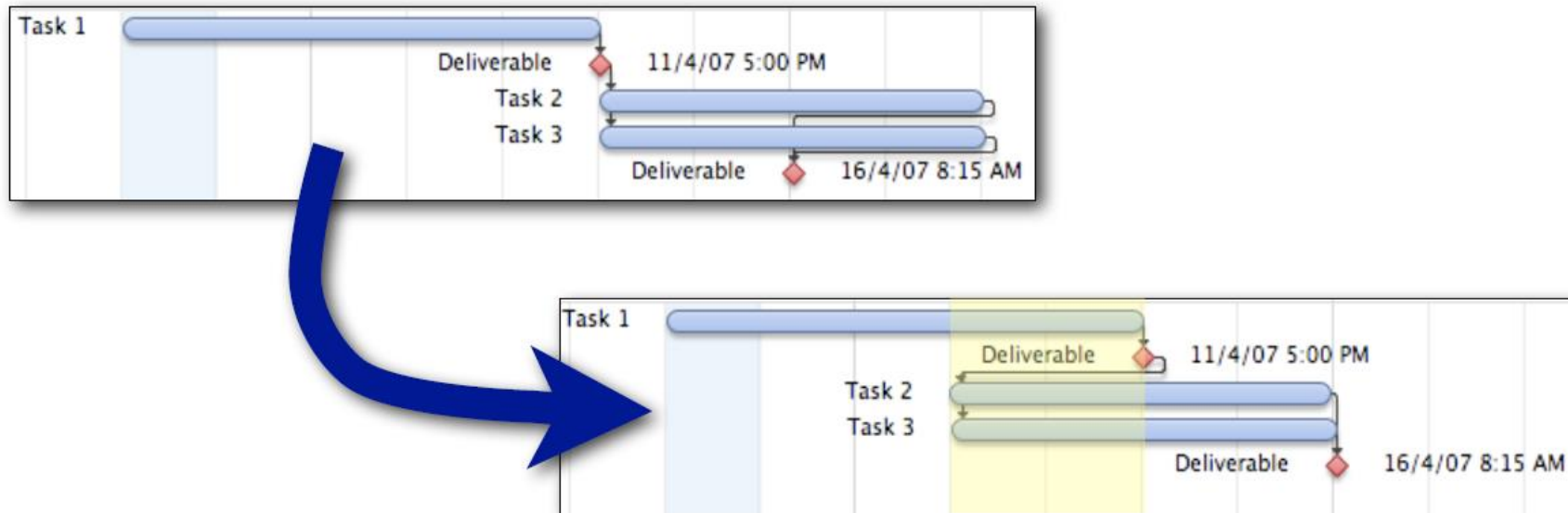
Fast Tracking

- Fast tracking is based on the fact that deliverables of activities are incrementally produced (and refined) during the execution of the activity
- Example: a requirement document is not written on the last day of the “requirement writing” activity. Rather it gets written a bit at a time, when the activity is executed



Fast Tracking

- Fast tracking works by overlapping activities which would otherwise be sequential



Fast Tracking: Issues and Rules of the Thumb

- Fast tracking is risky and it might cause rework
- When deciding what dependencies are better to break, consider the following:
 - How the deliverable production during the activity will progress (**will it produce intermediate outputs?**) and consolidate (**will the intermediate output be stable?**)
 - The risk involved in changes to the output (**what if the consequence of re-work in the subsequent activity; how will it affect the rest of the plan?**)

Project Crashing

- Project duration can be reduced only by shortening critical activities.
- It may be worth spending money to reduce the length of a project.
 - select the least expensive to crash
- New critical paths may emerge.
 - reduce all critical paths!

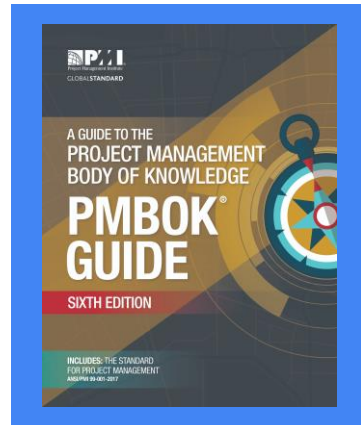
As a Result of Project Crashing

- Critical path
 - shorter
 - may change
 - more activities may become critical
- Higher risk?

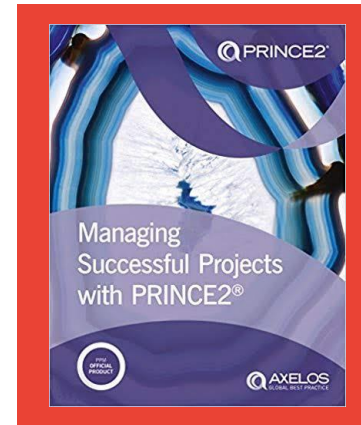


Some Resources for PM

PMBOK



PRINCE2



References

[Google]	"Project Planning: Putting It All Together" course at coursera.org, Google.
[Greene]	Head First PMP, 3rd Edition, Jennifer Greene, Andrew Stellman, O'Reilly Media, 2013.
[Grushka-Cockayne]	"Fundamentals of Project Planning and Management" course at coursera.org, Yael Grushka-Cockayne.
[PRINCE2]	Managing Successful Projects with PRINCE2, 2017 Edition, The Stationery Office, 2017.
[PMI]	A Guide to the Project Management Body of Knowledge: PMBOK® Guide (6th Ed.), Project Management Institute, 2017.
[Valle]	Planning and Managing Software Projects 2014-15, Emanuele Della Valle, Politecnico Di Milano, http://emanueledellavalle.org .
[Villafiorita]	Introduction to Software Project Management, 1st Edition, Adolfo Villafiorita, Auerbach Publications, 2014.
[Wiegers]	Software Requirements, 3rd Ed, Karl Wiegers, Joy Beatty, Microsoft Press, 2013.