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UoG / UESTC Joint School of Engineering

Engineering Project Management & Finance

Project Management Tools and Techniques

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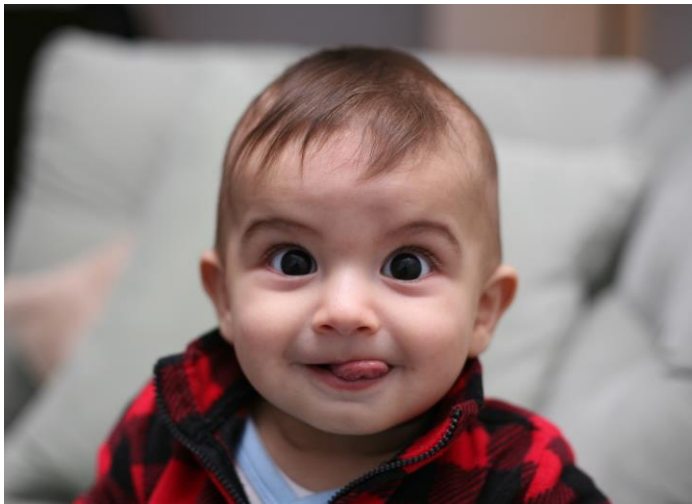
Class Discussion Questions ?

1. If it takes 1 person 1 day to dig one hole, how many people and how long will it take to dig 10 holes?

2. If one programmer can write 100 lines of code in 1 day, how long will it take to write 1,000,000 lines of code?

3. If it takes one woman 9 months to deliver a child, how long will it take 10 men?



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This lecture will…

- Introduce you to project planning techniques
- Demonstrate how you should consider engaging with project planning
- Provide you with some overview and tools to perform project planning

- ..and if we have time, prepare a nice dinner…

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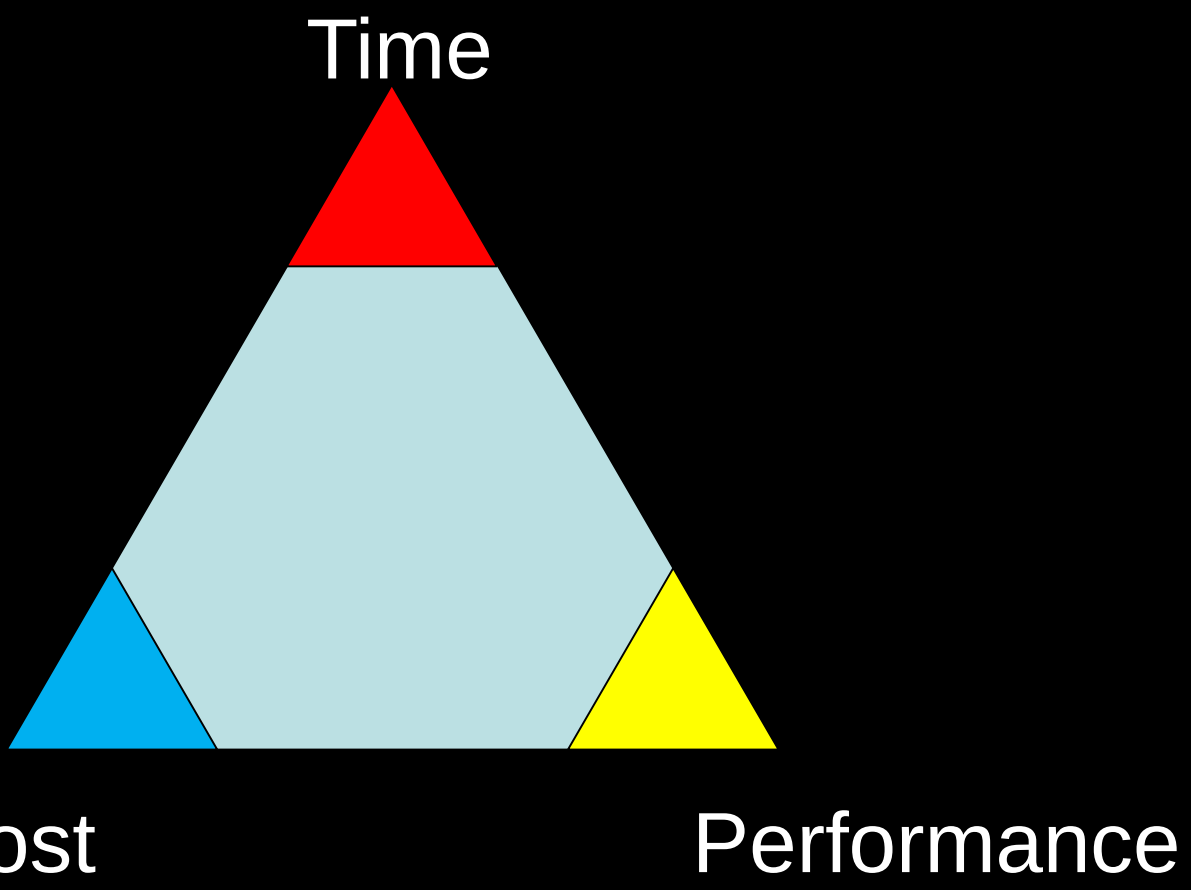
It is a balancing act!!



You can ONLY fix two of these variables; the third MUST be a dependent variable (Cost & Time), (Cost & Performance), (Time & Performance)

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In other words…Pick Any Two !!

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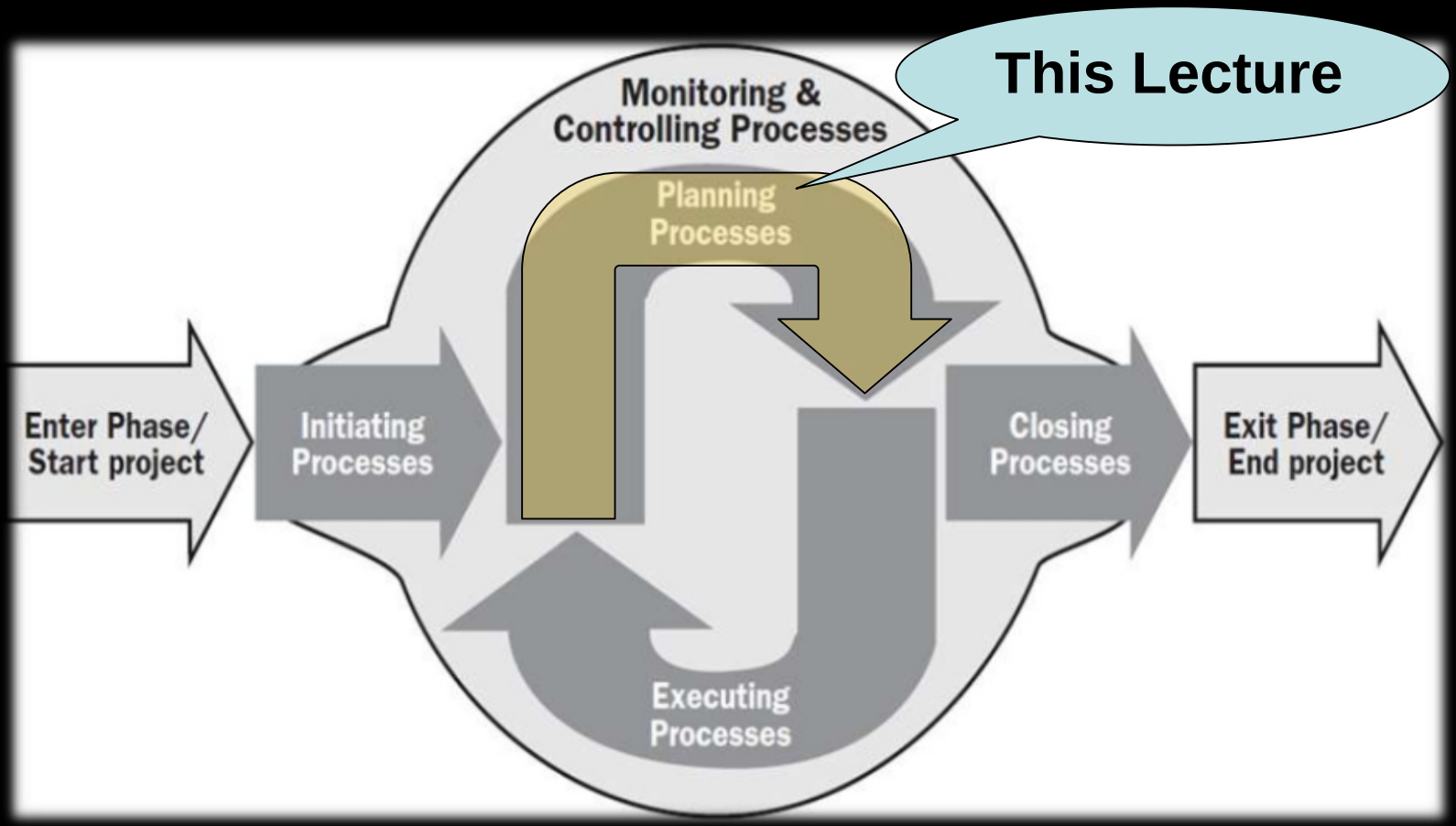
Project Management Process



Roadmap to Project Management Success

Form Project Team

Statement of Work

Work Breakdown Structure

Responsibility Matrix

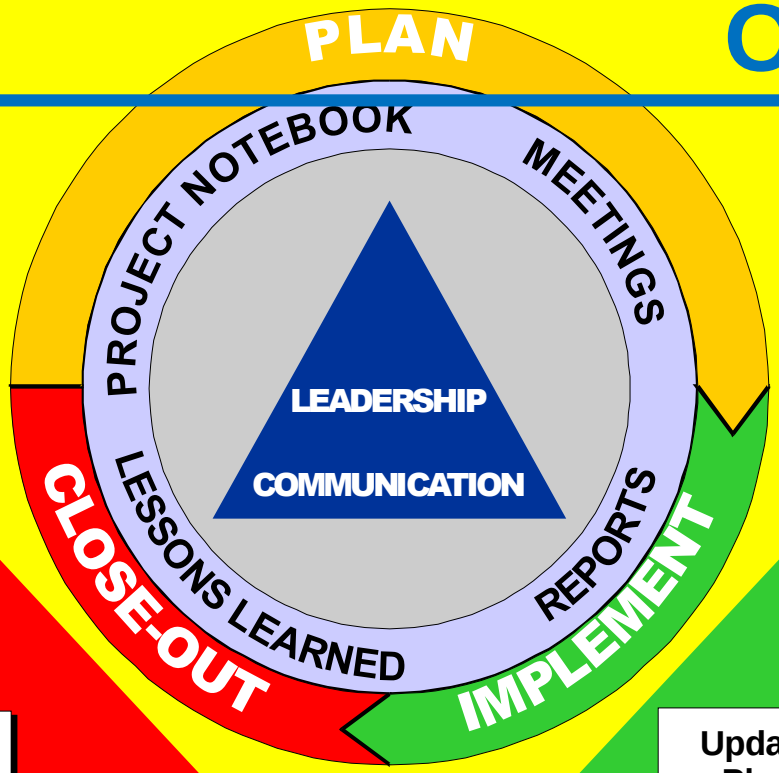
Network

Gantt

Resource Plan

Budget

Our focus



Perform Tasks

Track Progress

Manage Change

Resolve Issues

Update Plan

Evaluate Success

Share Lessons Learned

Conduct Close-Out Meeting

Project Team Members Responsibilities

- Identify work tasks
- Estimate the duration of work tasks
- Help prepare the project network diagram
- **Honestly** report work status
- Keep the project manager informed on project issues
- Attend scheduled progress review meetings
- Raise issues important to the project's success
- Keep their functional managers updated
- Participate in the project close-out

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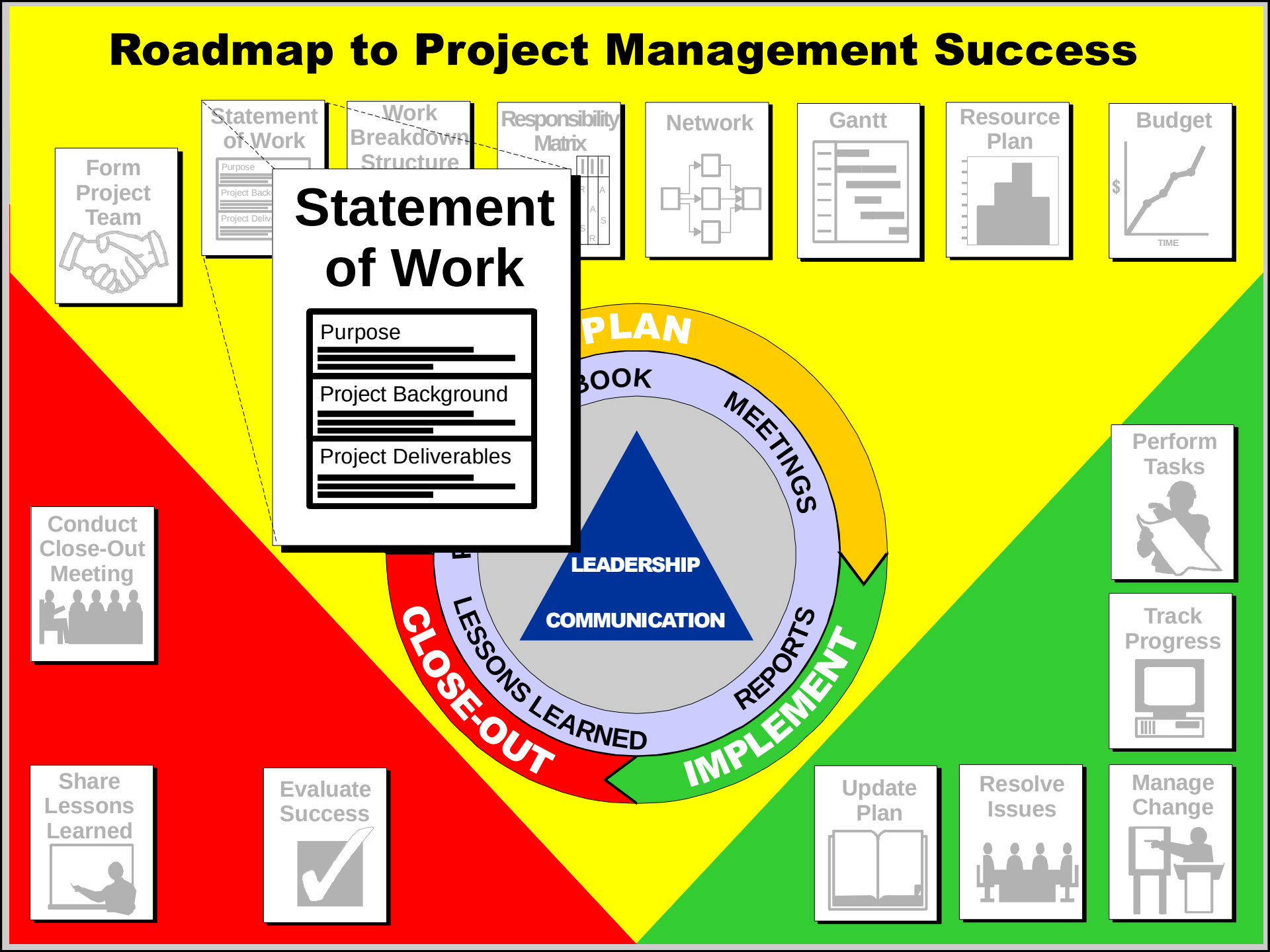

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Statement of Work — Purpose

- The Statement of Work (SoW) converts the project charter (vision) into a realistic, achievable project goals
- Define the scope of the project
- Establish customer expectations
- Serve as a “contract” if necessary
  - The PM will refer to this document if there are disputes on what the project will deliver.
  - Example: Write an application for managing a music library
    - **Does it need to run on Apple, Android, or both?**
    - **This would /should be defined in the SoW**

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A Good SOW will answer …

1. What is the purpose or goal of the project?
2. Why is the project being done?
3. Who is the customer?
4. What are the customer deliverables?
5. What is the budget?
6. What is the date for the deliverables?
7. What are the measurable success indicators (metrics)?

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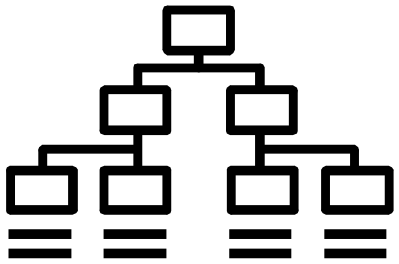
$

TIME

Work Breakdown Structure



PLAN

IMPLEMENT

CLOSE-OUT

PROJECT NOTEBOOK

MEETINGS

REPORTS

LESSONS LEARNED

LEADERSHIP

COMMUNICATION

Conduct Close-Out Meeting

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Work Breakdown Structure (WBS)—Purpose

- Identify **all** of the work that needs to be done to complete the project.
- Structure the work into logical components and subcomponents.
- Define the work to a level of detail so individual responsibilities can be assigned.
- Usually presented in a hierarchical format for ease of reading
- Note: **EVERYTHING** needed to deliver a project is contained in the WBS.
  - Requests for changes / additions may come along during the project
  - These are **either** accepted into the WBS **or** rejected from the project

Pitfalls to avoid when using WBS

- Keep descriptions to work package level; just enough detail
- Focus on deliverables NOT activities of tasks 9these will fall out of the deliverables)
- WBS is NOT a plan or a schedule
- Any project changes must update the WBS
- WBS is NOT an organisational hierarchy

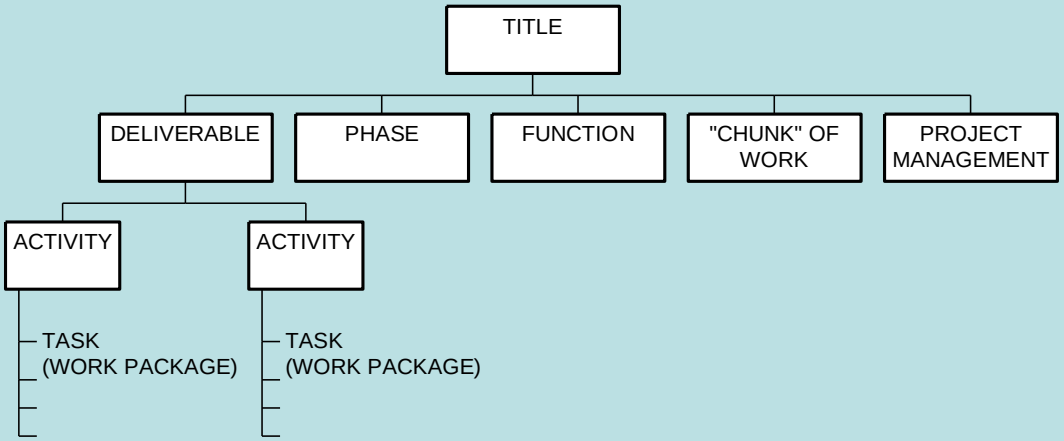
Exemplar WBS

Level I
(Noun)

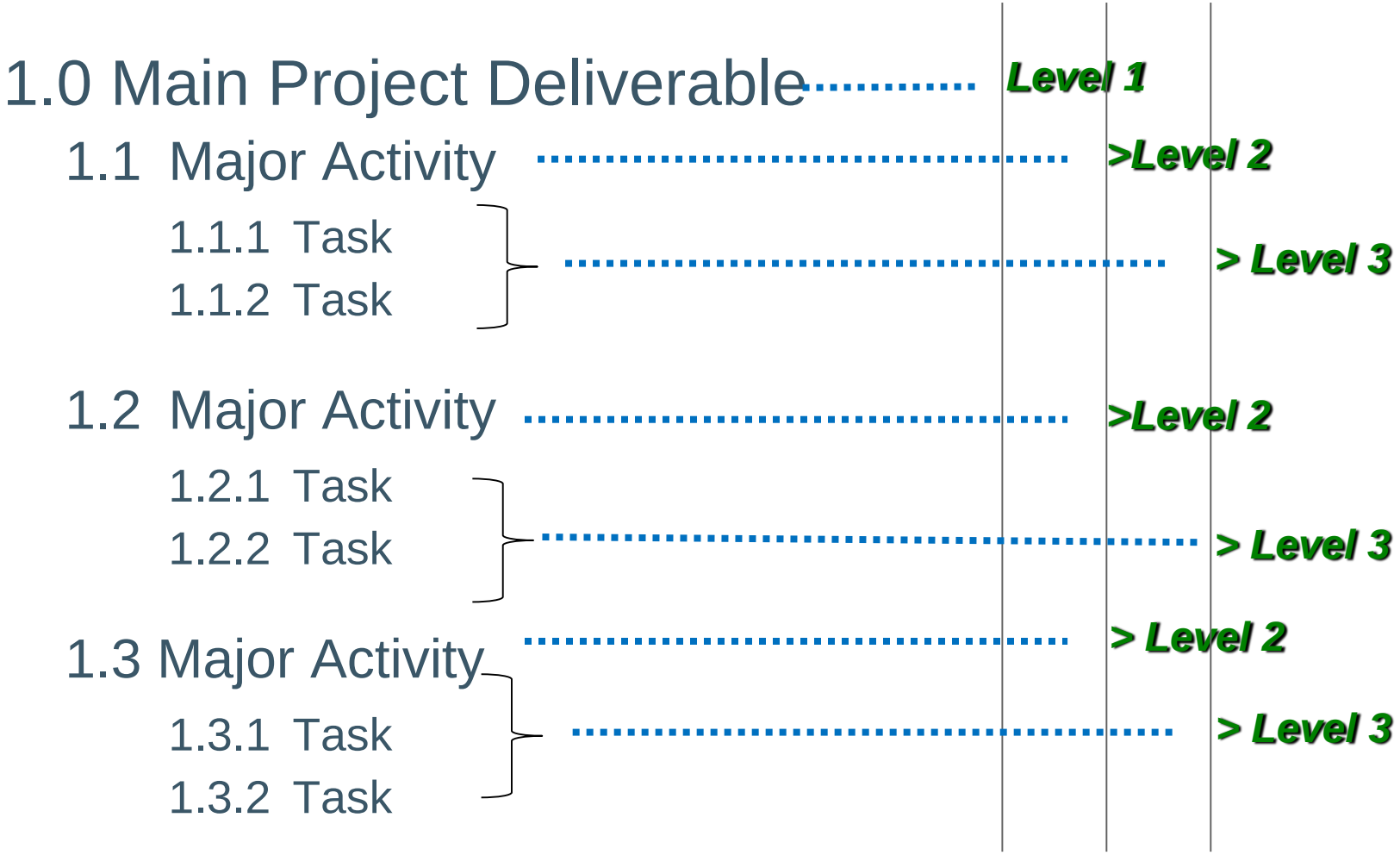
Level II
(Noun)

Level III
(Action Verbs)

Level IV
(Action Verbs)



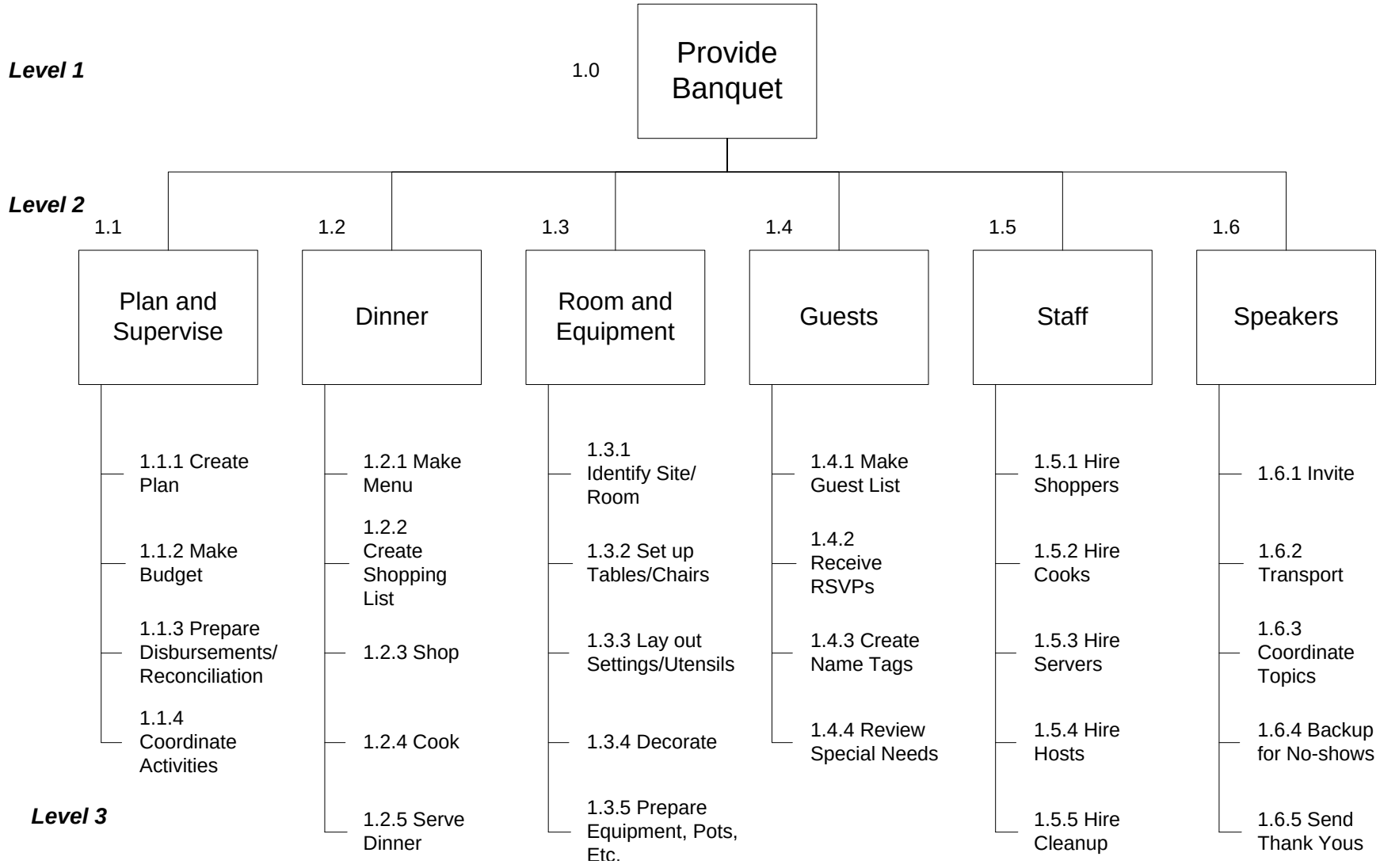
WBS — Outlining Approach



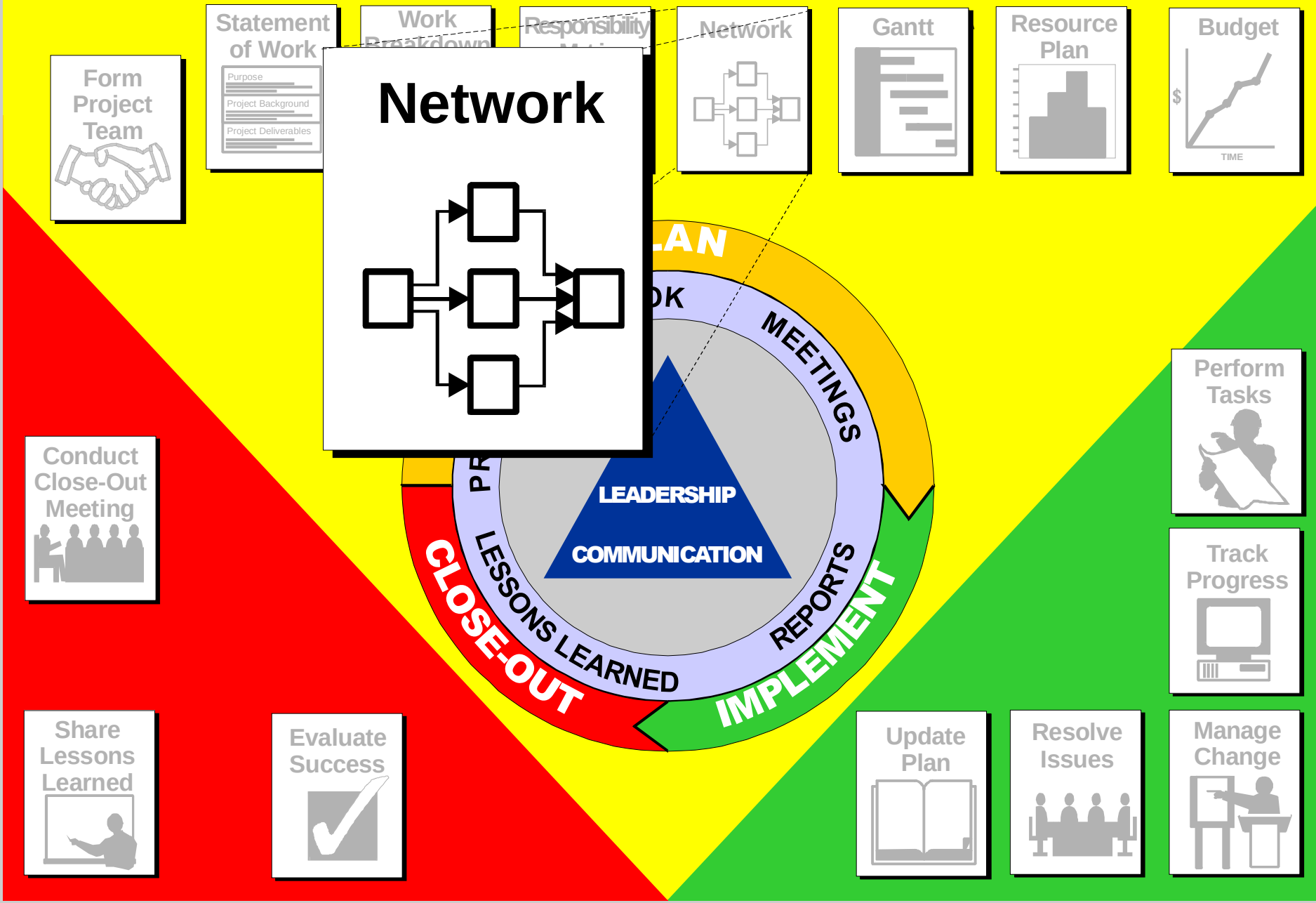
The WBS groups activities by major element deliverable

WBS Example – Arrange Banquet Dinner

WBS Example - Banquet



Roadmap to Project Management Success



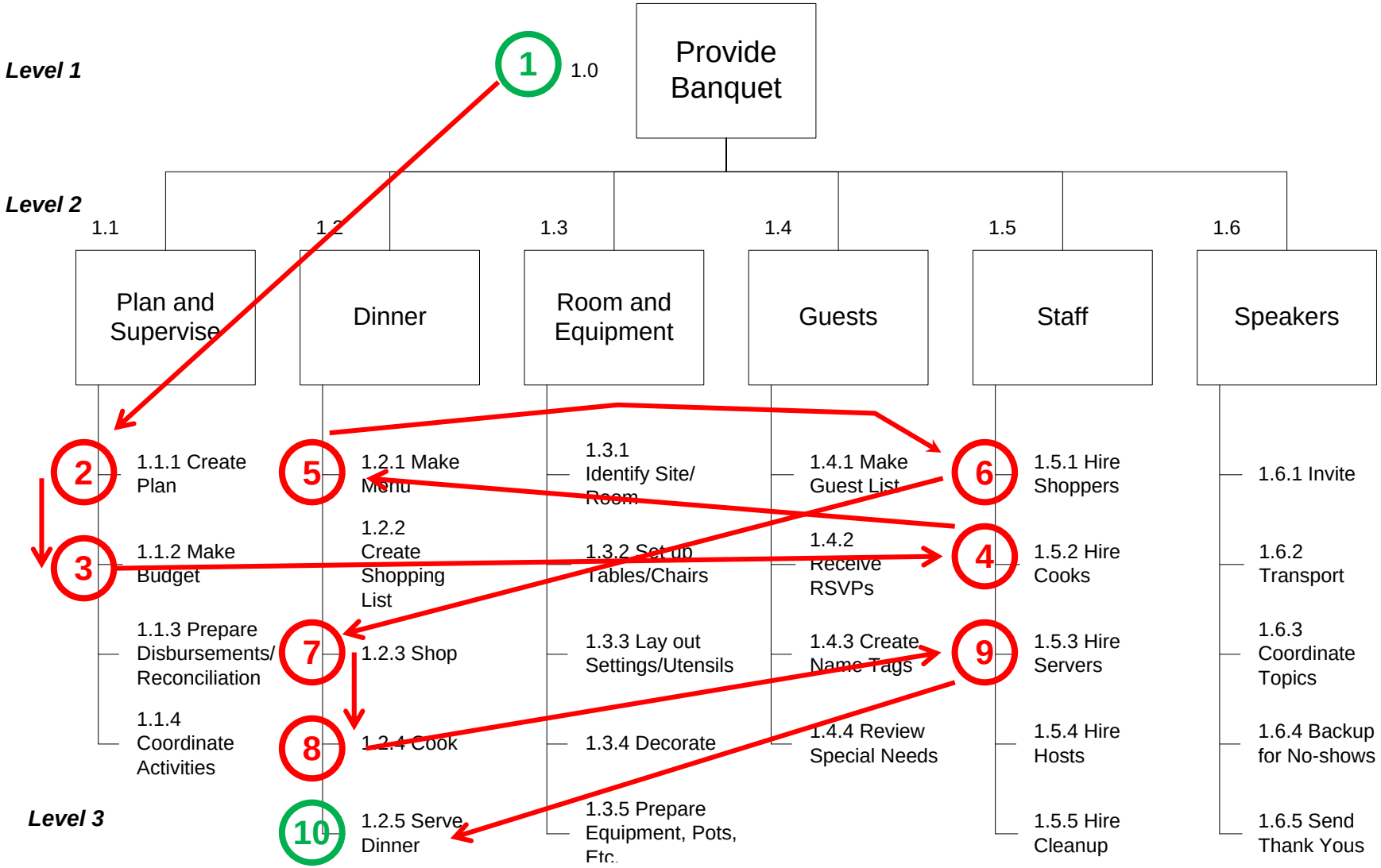
Project Network Diagram

- Network diagram shows how the tasks interlink and their interdependencies
  - means… what order tasks are undertaken
  - means… the project managers cannot start task **'d'** until task **'c'** is completed
- A network diagram will contain all the tasks in the WBS **BUT** will show their interdependencies

- Let's look at the Banquet example again
  - Let's look at the work sequence of dealing with the menu planning and actually getting food onto the tables. (Note this is simplified).
- You can think of the network diagram representing the way tasks are linked up

WBS Example – the network of planning/preparing/serving food

WBS Example - Banquet



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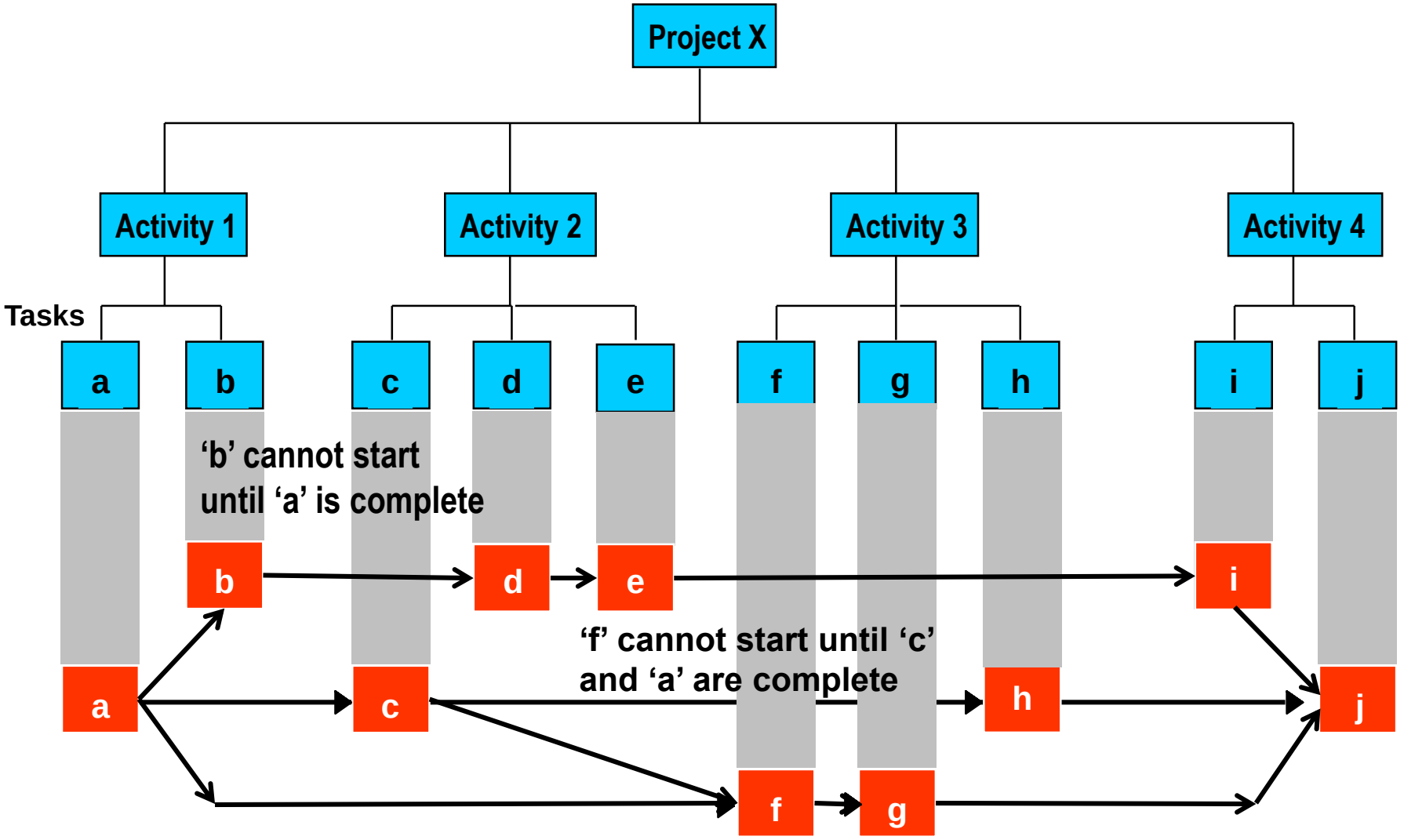
WBS /Network Diagram Linkage - Project X



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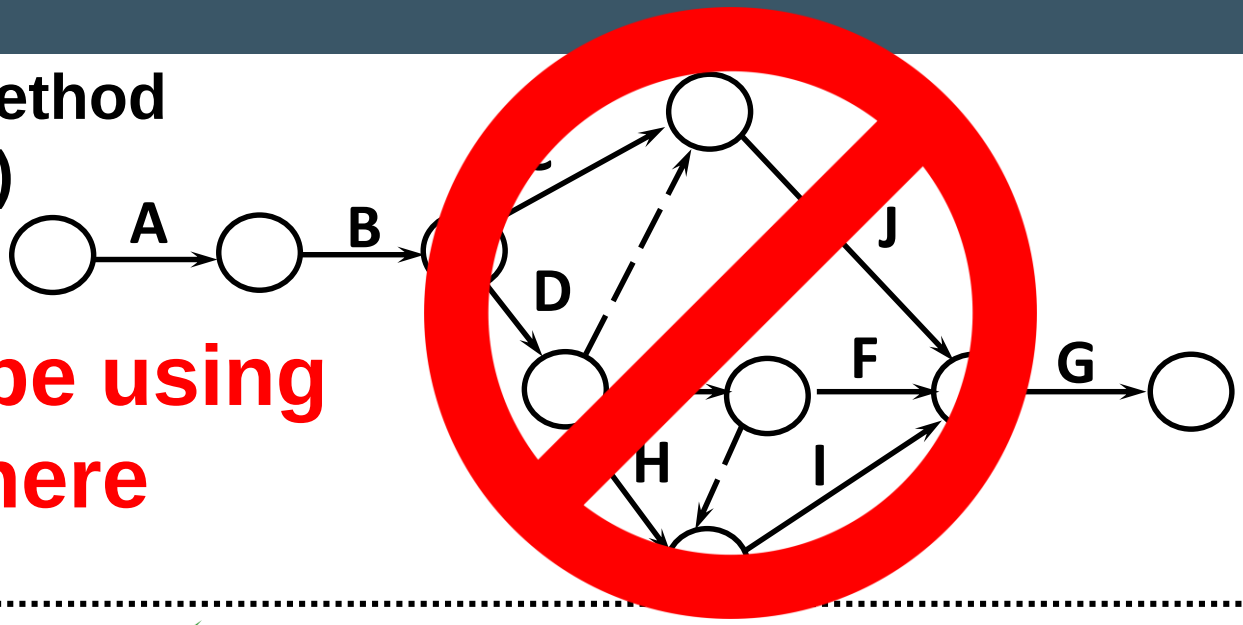
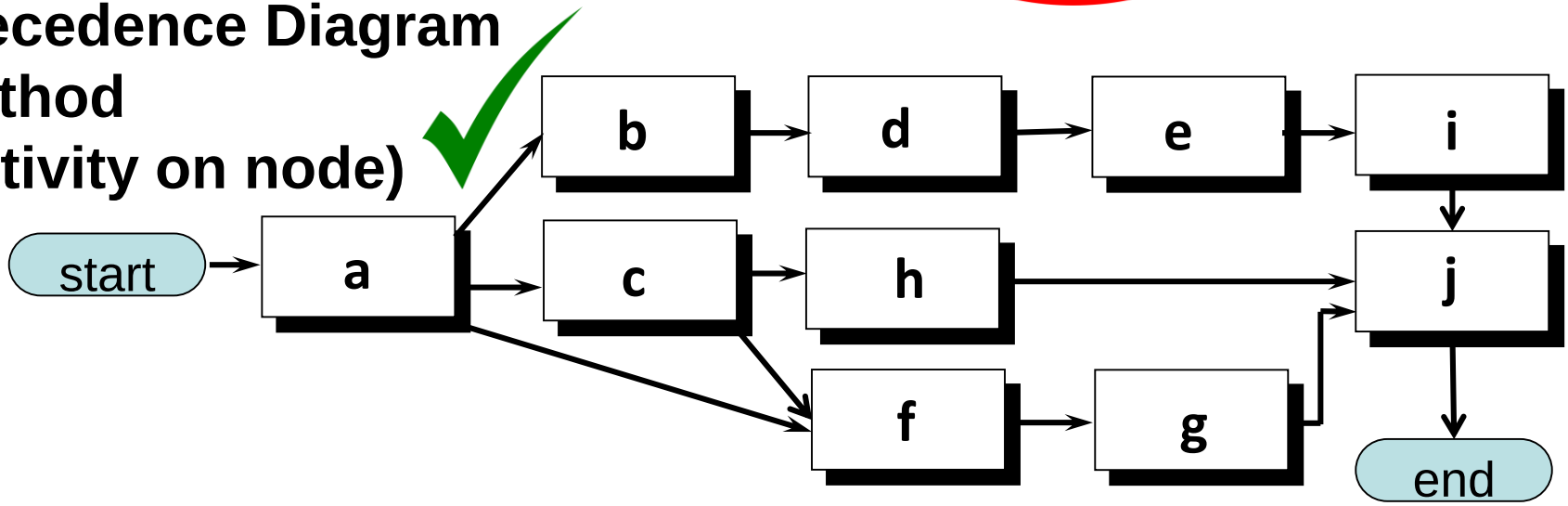
Network Diagram Methods - Project X

Arrow Diagram Method (activity on arrow)



We will NOT be using this method here

Precedence Diagram Method (activity on node)



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Using Network diagram to assist in project scheduling

- **What is scheduling?**
- The calculation or estimation of total project duration
- Allows the PM to provide management with a completion date
- Can be used to calculate the project **CRITICAL PATH** (the shortest time to complete a project)

- **To do this we need to insert estimates of each task duration on the network diagram**
  - Task duration estimation is notoriously difficult, it comes with experience (I am particularly **bad** at it!!!)

- Consider each task in isolation and think how long it will take with the available resources…

What's is the Critical Path?

- Path with longest duration
- ***Critical Path Method*** *is* a project management technique that analyzes what activities have the least amount of scheduling flexibility (i.e., are the most mission-critical) and then predicts project duration schedule based on the activities that fall along the "critical path."
  - Activities that lie along the critical path cannot be delayed without delaying the finish time for the entire project.
  - It is the path that the PM spends most time managing

Critical Path Solution - Project X

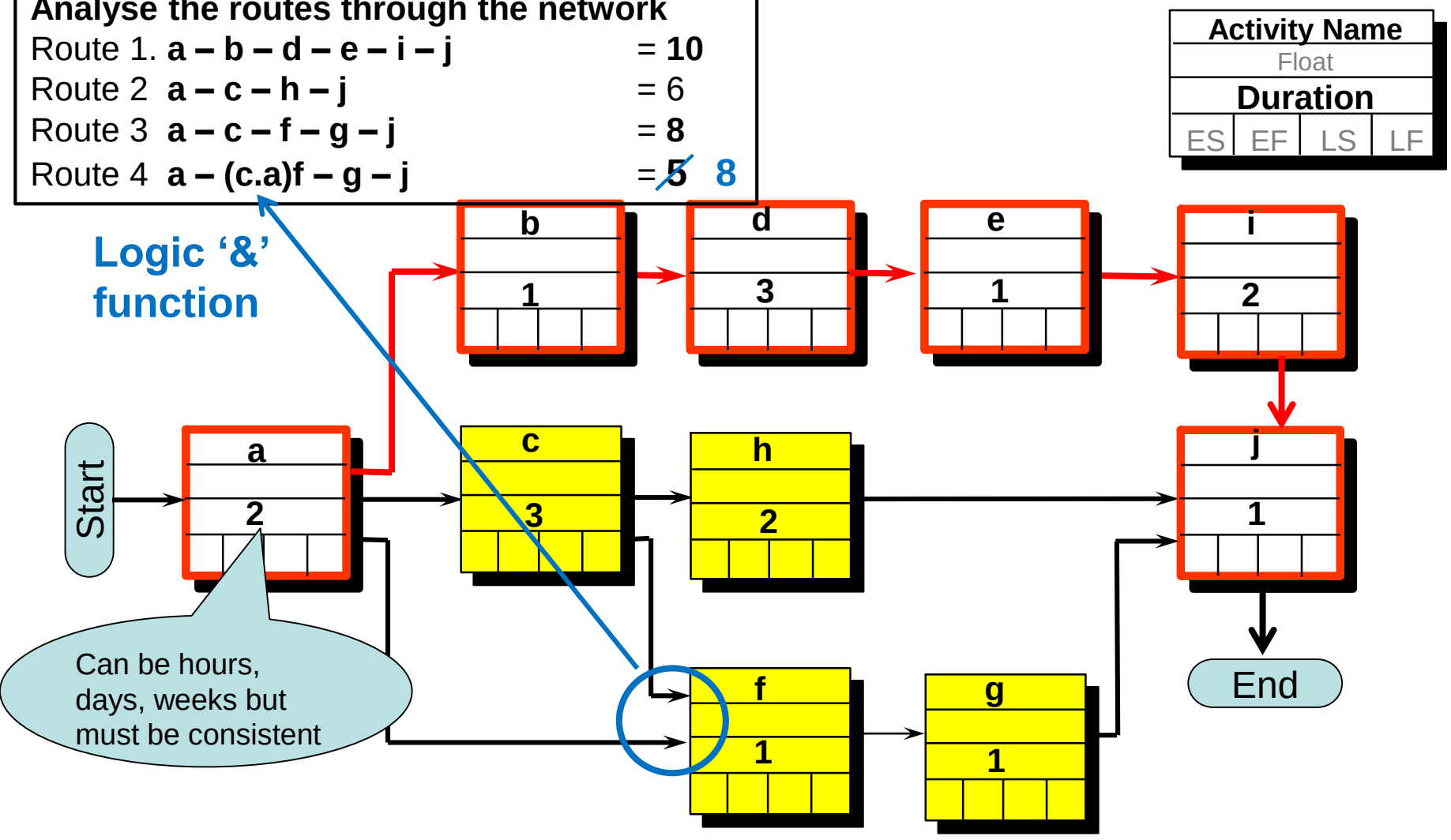
Analyse the routes through the network

Route 1. **a – b – d – e – i – j** = **10**

Route 2 **a – c – h – j** = 6

Route 3 **a – c – f – g – j** = **8**

Route 4 **a – (c.a)f – g – j** = ~~5~~ **8**



Critical Path Summary

- Based on the previous network diagram the following conclusions can be drawn:
  - The critical path flows through Tasks **a -> b -> d -> e -> i -> j**
  - The Critical Path duration is **10** units of time (hours/days/weeks)
  - The other routes are not critical and have **slack time**

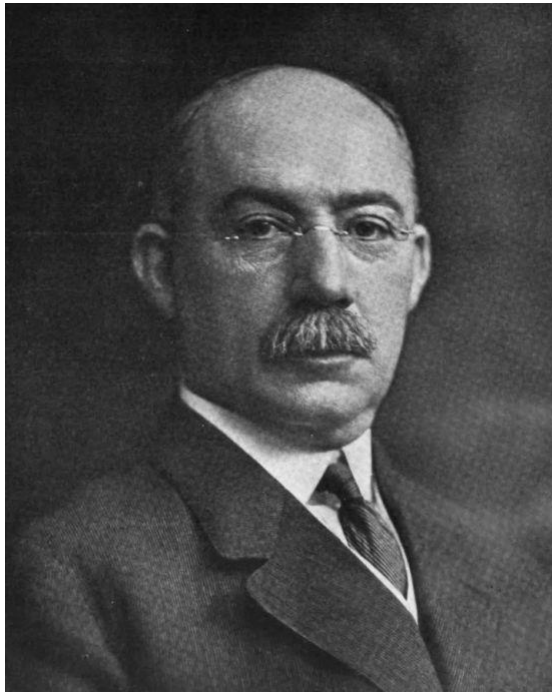
Analyse the routes through the network

Route 1. **a – b – d – e – i – j**	= **10**		**Slack = 0**
Route 2 **a – c – h – j**	= **6**		Slack = **4**
Route 3 **a – c – f – g – j**	= **8**		Slack = **2**
Route 4 **a – (c.a)f – g – j**	= **5**	**8**	Slack = **2**

Be Careful of predecessors into activities

The Gannt Chart

- Invented by Henry Gannt in 1910s to manage large projects e.g. Hoover Dam
- A graphical representation of a project and most common tool used to show project schedule
- Can align easily with the WBS approach
- You have the GanttProject.org software available to download (which can also produce Network Diagrams (PERT) charts
- This is most common scheduling tool you will use or see



Information required to generate a Gannt Chart

ID	WBS Level	Description	Duration	Predecessors
1.0	1	**Project Title**		
1.1	2	**Activity '1'**		
1.1.1	3	- Task 'a'	2	
1.1.2	3	- Task 'b'	1	a
1.2	2	**Activity B**		
1.2.1	3	- Task 'c'	3	a
1.2.2	3	- Task 'd'	3	b
1.2.3	3	- Task 'e'	1	d
1.3	2	**Activity C**		
1.3.1	3	- Task 'f'	1	a,c
1.3.2	3	- Task 'g'	1	f
1.3.3	3	- Task 'h'	2	c
1.4	2	**Activity 4**		
1.4.1	3	- Task 'i'	2	e
1.4.2	3	- Task 'j'	1	i,h,g

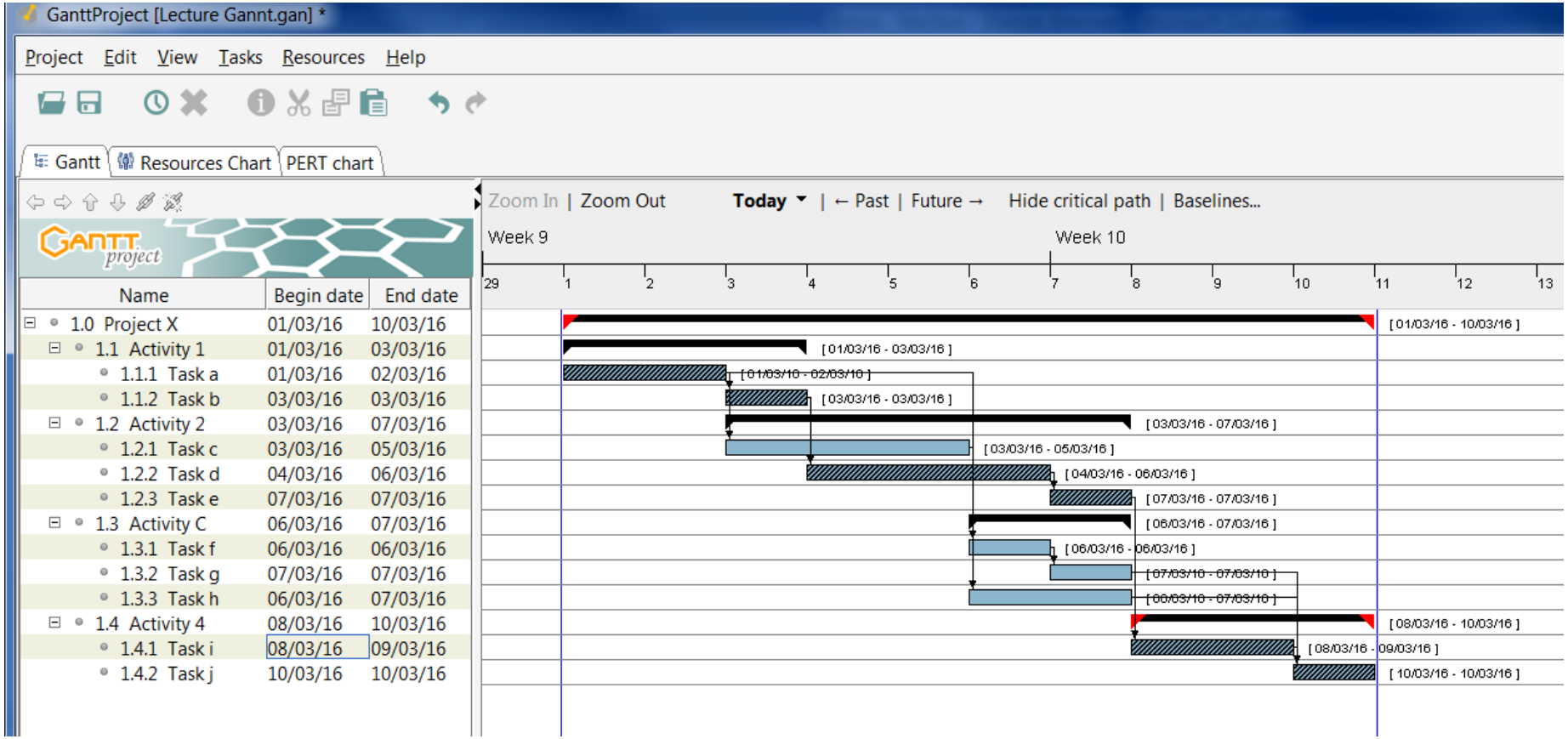
These are the tasks that must complete before starting

Project X — Gantt Chart Solution

Time		1	2	3	4	5	6	7	8	9	10
Task	**Duration**										
a	2										
b	1										
c	3										
d	3										
e	1										
f	1										
g	1										
h	2										
i	2										
j	1										

Gannt charts can be simply constructed on square paper or MS excel (you don't need software!!)

Entering the Data into Gannt Project



For simple projects, a manual version is equally good

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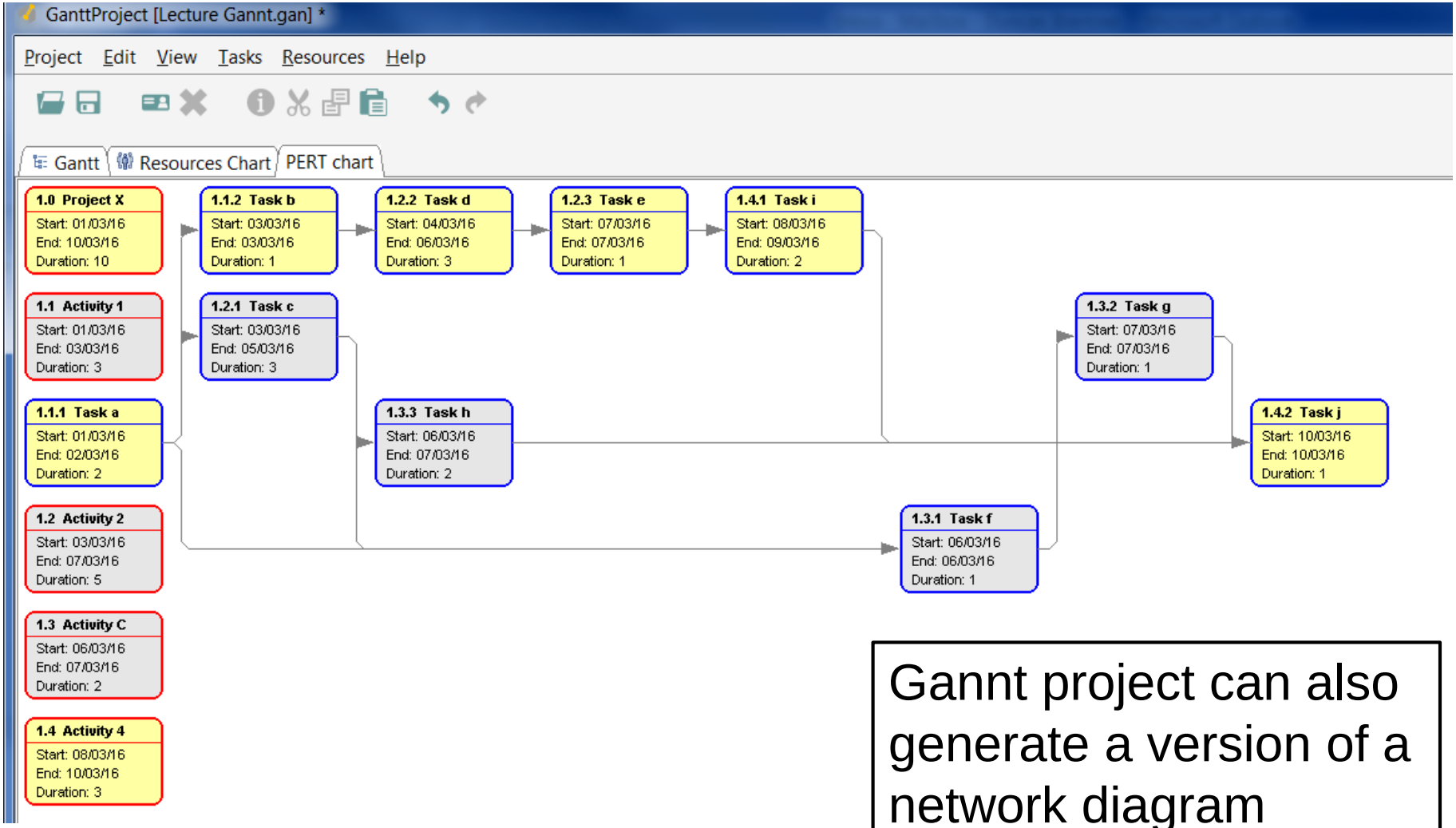

Gannt project can also generate a version of a network diagram

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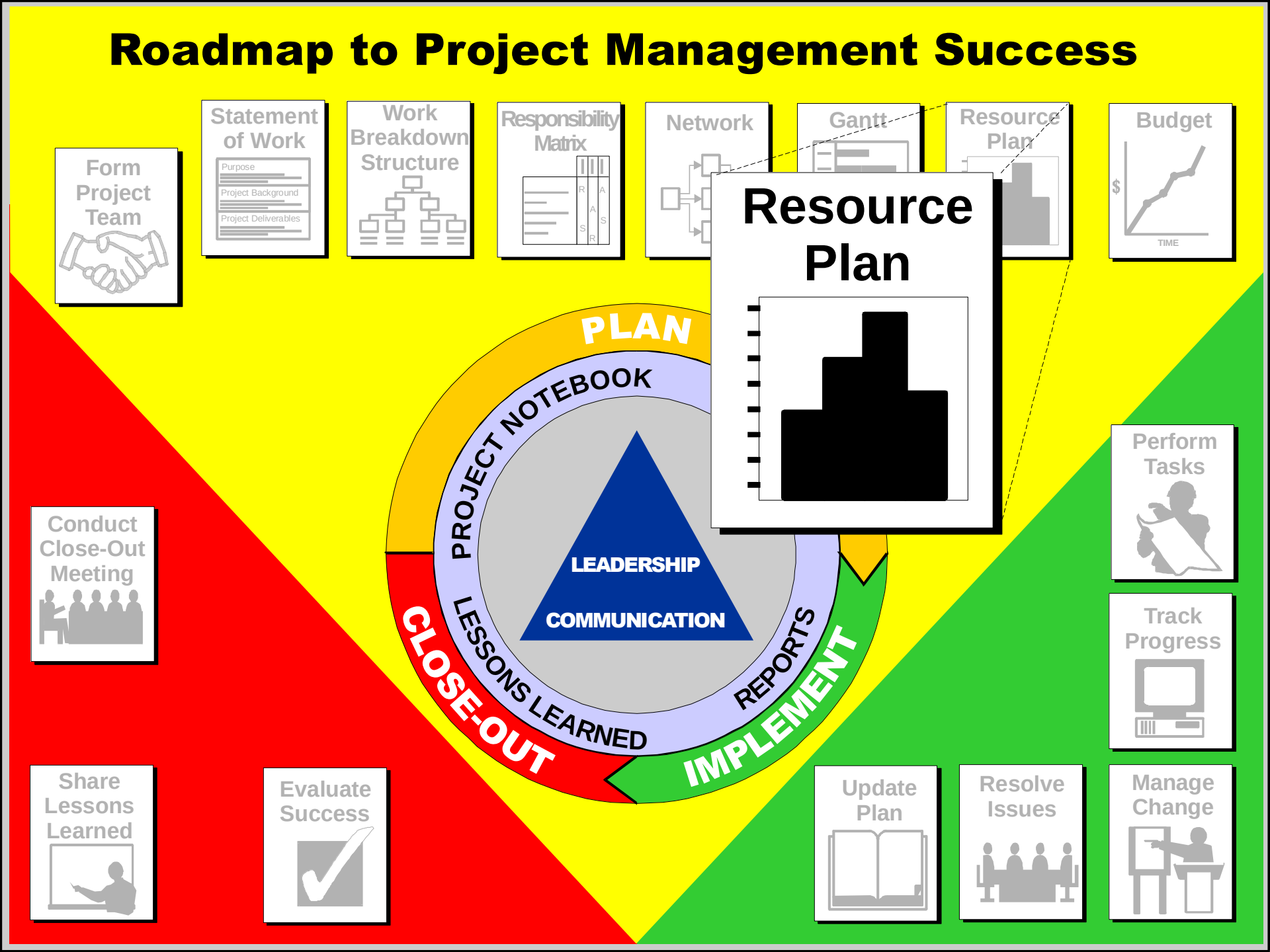
Some practice plans

Morning Routine	Making Tea	Exam Preparation
Get Washed	Serve	Revise notes
Wake up	Clean cup	Sit exam
Eat Breakfast	Boil Water	Check notes complete
Get Dressed	Select Tea	Attend lectures
Find Tooth Brush	Prepare table	Set Alarm
Set Alarm	Find kettle	Sign-up for class
Get out of bed	Draw Water	Find out exam time/place

Roadmap to Project Management Success



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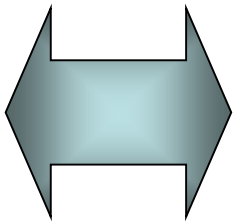
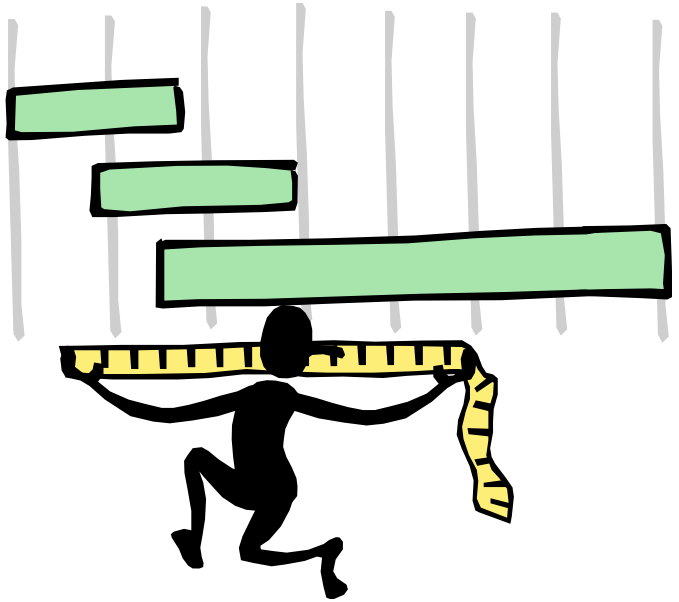
Resource Planning

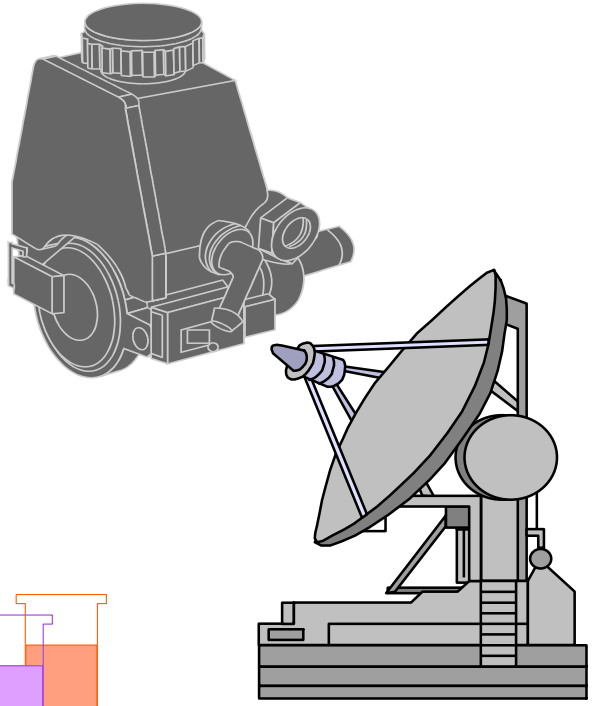


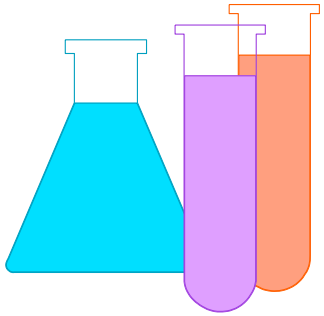


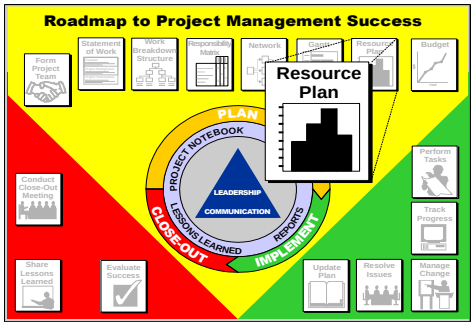
Resources can be human, equipment, or consumable resources

Non-Labour Resources

- Lab time
- Facilities
- Prototype parts/systems
- Equipment
- Materials







A resource plan must contain all the resources needed for every task; task – by- task

Why is resources important to a project plan ?

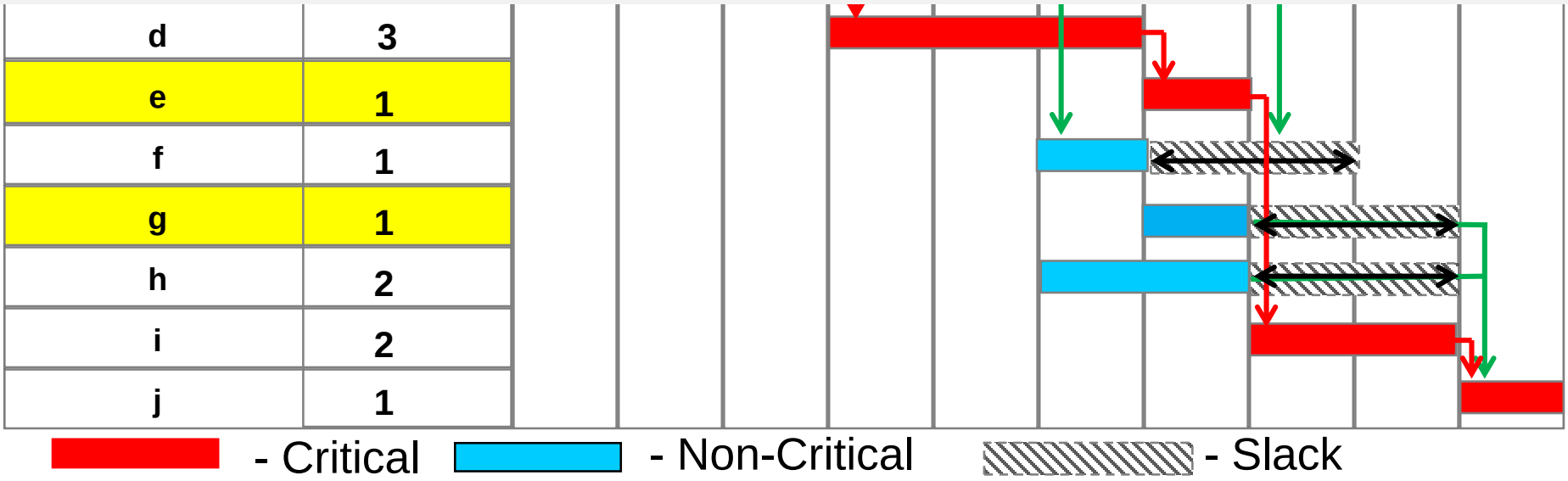
Consider the Gannt chart again

What happens if we need to share resources across different tasks?

Assume task ‘e’ and Task ‘g’ require the same resource.

What can the project manager do ?

d	3
e	1
f	1
g	1
h	2
i	2
j	1



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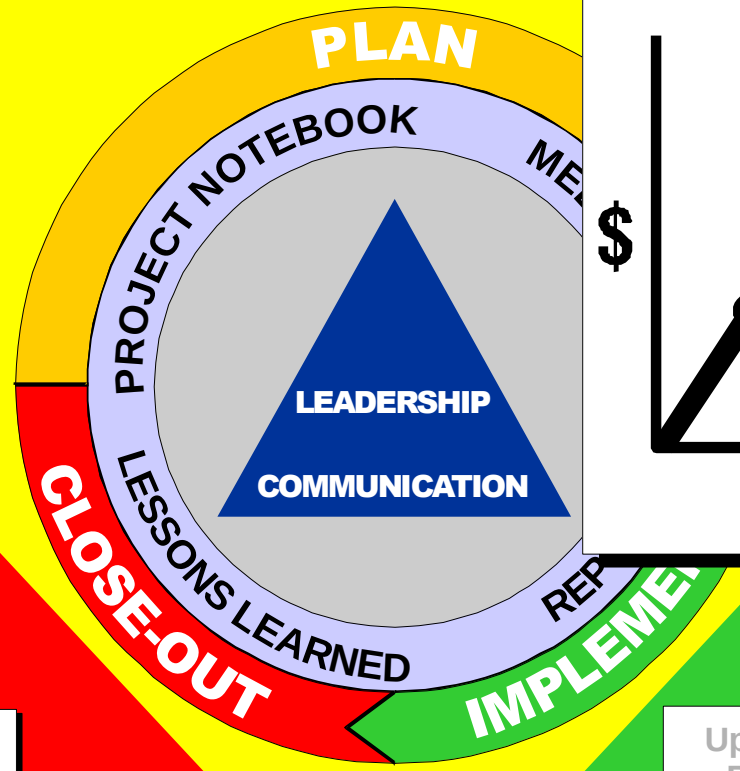

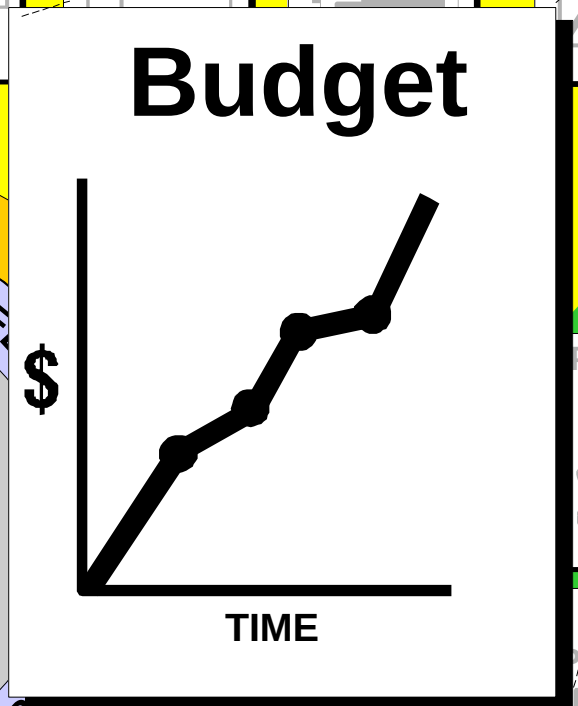

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Cost Budgeting

- Cost Budgeting involves allocating overall cost estimates to individual work items in order to establish a cost baseline.
- Using cost estimates, the WBS, the project schedule, **the project team** develops a time-phased budget. This budget will be used to measure and monitor **cost performance** on the project."

- Remember: Cost is only **ONE** of the measures of a project

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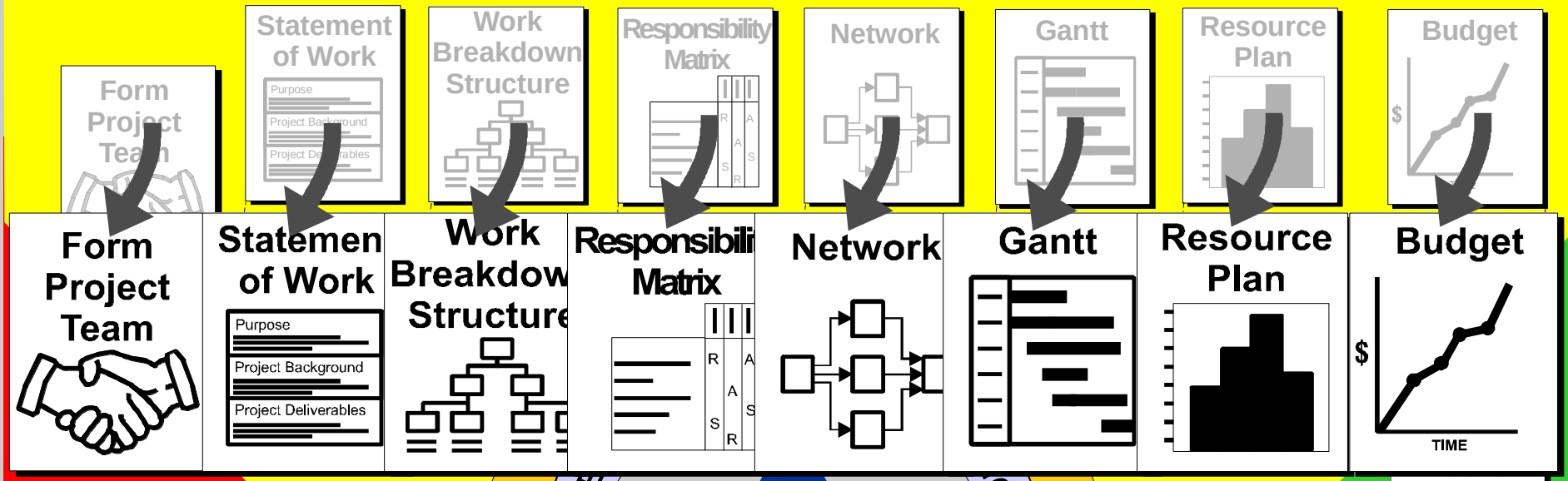
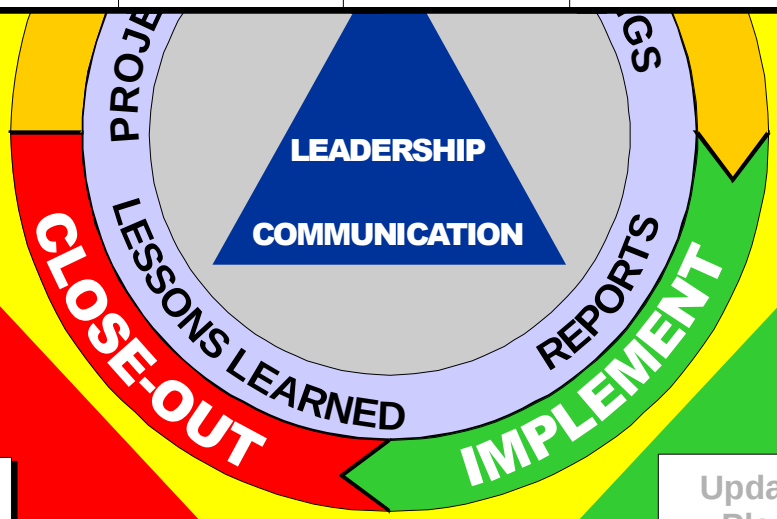
Summary

- Project planning is a vital part of projects
- Planning a project is a team effort, not just left to the project manager
  - More brains have more ideas
  - Team member responsibilities and interactions are important
  - Everyone needs to know the end goal and how to get there
- Project planning can sometimes take 25% of the project time
- A good project plan will get you out of trouble when things go wring (and they will)

Roadmap to Project Management Success





Conduct Close-Out Meeting

Share Lessons Learned

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Manage Change

Post Lecture Reading Material

- There are many project management articles. I will provide more later.
- Read the following:

– Why Projects Fail; PM Today; Algar, J; Carver, S; Johnson, W. (2014)

– Download and Install Gannt Project. https://www.ganttproject.biz/download

– Test the software is working; try out

Skim | Read | Understand | Critique