

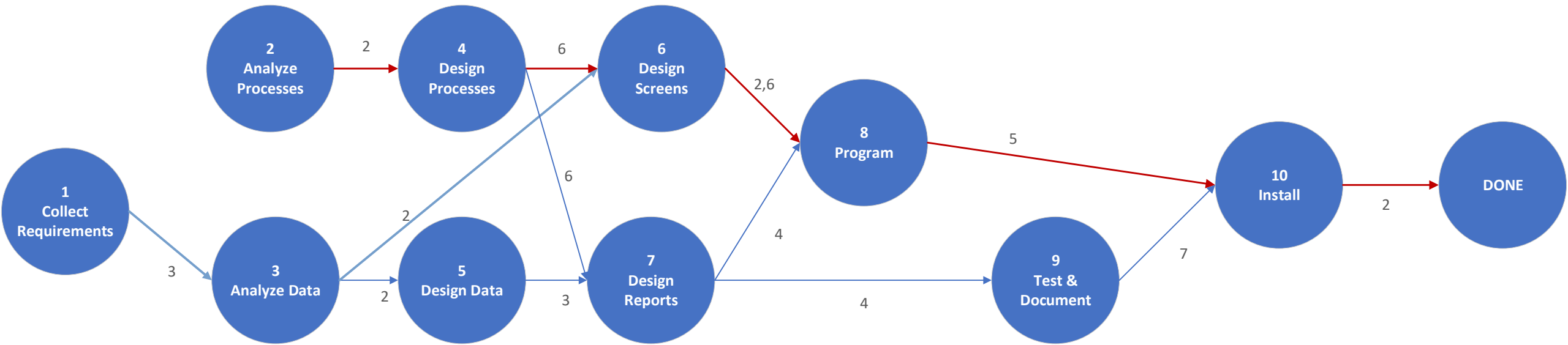
# Project Planning and Management

## - Unit 4 -

# Agenda

- Homework assignment Question 3
- Project management knowledge areas
- Project roles
- Project manager's role
- Project planning
- Work breakdown structure, tasks, cost and labor estimates
- Critical path analysis
- Project management triangle
- Quiz

# Homework Question 3



3A. Graph above

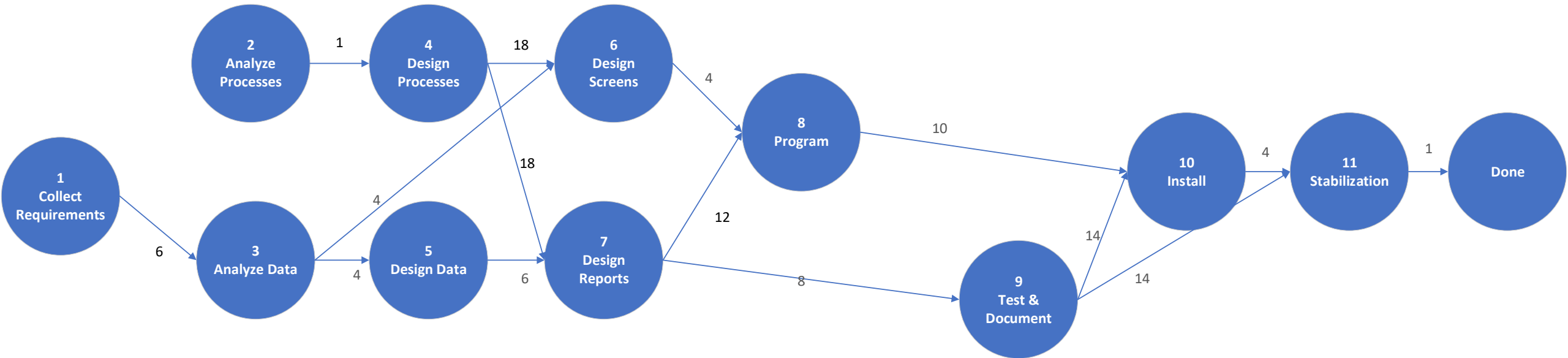
3B. 17 weeks

3C. see red

3D. 2,4,6,8,10,Done = 21 (no longer critical path), Both 19 become critical path

1,3,5,7,9,10,Done = 21  
 2,4,6,8,10,Done = 17 (21)  
 1,3,6,8,10,Done = 19 (23)  
 1,3,5,7,8,10,Done = 19  
 2,4,7,9,10,Done = 21  
 2,4,7,8,10,Done = 19

# Homework Question 3



- 1,3,5,7,9,11,Done=39
- 1,3,5,7,9,10,11,Done=43
- 1,3,6,8,10,11,Done=29**
- 1,3,5,7,8,10,11,Done=43
- 2,4,6,8,10,11,Done=38
- 2,4,7,8,10,11,Done=46
- 2,4,7,9,11,Done=42
- 2,4,7,9,10,,11,Done=46

# What are knowledge areas for Project Management?

Project Management Institute's (PMI) 5 lifecycle domains for Project Management Professional (PMP) certification:

1. Initiating the project
2. Planning the project
3. Executing the project
4. Monitoring and controlling the project
5. Closing the project

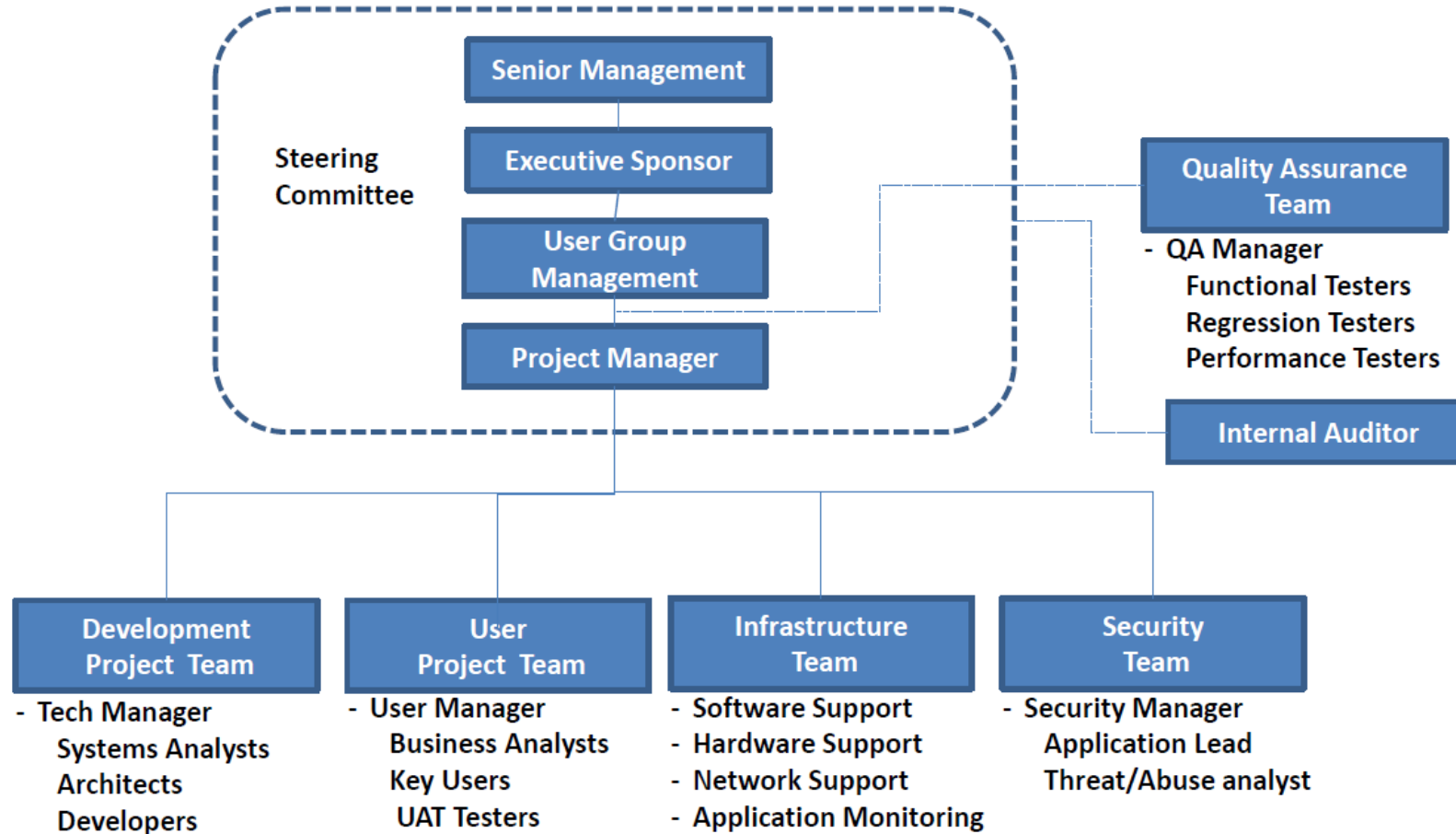
These map to 10 knowledge areas:

1. Project Integration Management
2. Project Scope Management
3. Project Schedule Management
4. Project Cost Management
5. Project Quality Management
6. Project Resource Management
7. Project Communications Management
8. Project Risk Management
9. Project Procurement Management
10. Project Stakeholder Management

[https://en.wikipedia.org/wiki/Project\\_Management\\_Professional](https://en.wikipedia.org/wiki/Project_Management_Professional)

# Project roles

## Typical Project Management Organization Chart



# Project Manager juggles many activities



## Phases of Project Management Process

- Phase 1: Initiation
- Phase 2: Planning
- Phase 3: Execution
- Phase 4: Closedown

# Project Plan

Should define clear, discrete activities and the work needed to complete each activity. Tasks include:

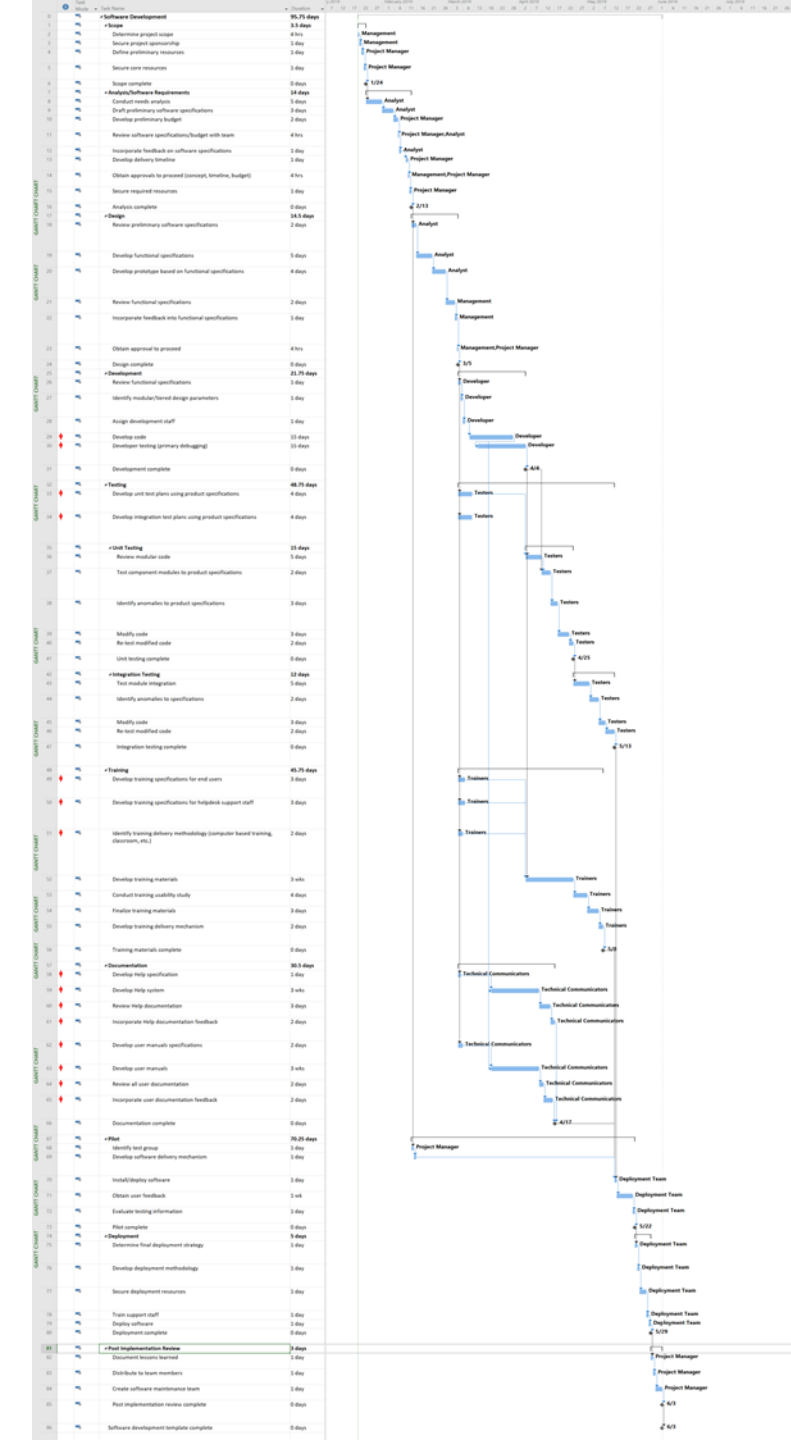
1. Describing Project Scope
2. Dividing the Project into Manageable Tasks
3. Estimating Resources and Creating a Resource Plan
4. Developing a Preliminary Schedule
5. Developing a Communication Plan
6. Determining Project Standards and Procedures
7. Identifying and Assessing Risk
8. Creating a Preliminary Budget
9. Setting a Baseline Project Plan



# Project Planning

Answers the following questions:

- What tasks must be done to complete the project?
- What are the dependencies among tasks?
- Who is responsible for each task?
- What resources are required to complete the tasks?
- How long will it take to complete the project?
- Is the project possible, given the known parameters?
- Where is the project most at risk?



# Project Planning

- **Phase 1: Initiation**
- **Phase 2: Planning**
- Phase 3: Execution
- Phase 4: Closedown

Is a 5-step process that defines a “road map” for successful project completion:

1. Define the work
  - What problem or opportunity does the project address?
  - What are the quantifiable results to be achieved?
  - What needs to be done?
  - How will success be measured?
  - How will we know when we are finished?
2. Develop initial project schedule
3. Refine project plans
4. Assess project risk
5. Set fixed delivery date and publish plans

# Project Planning – Define the work

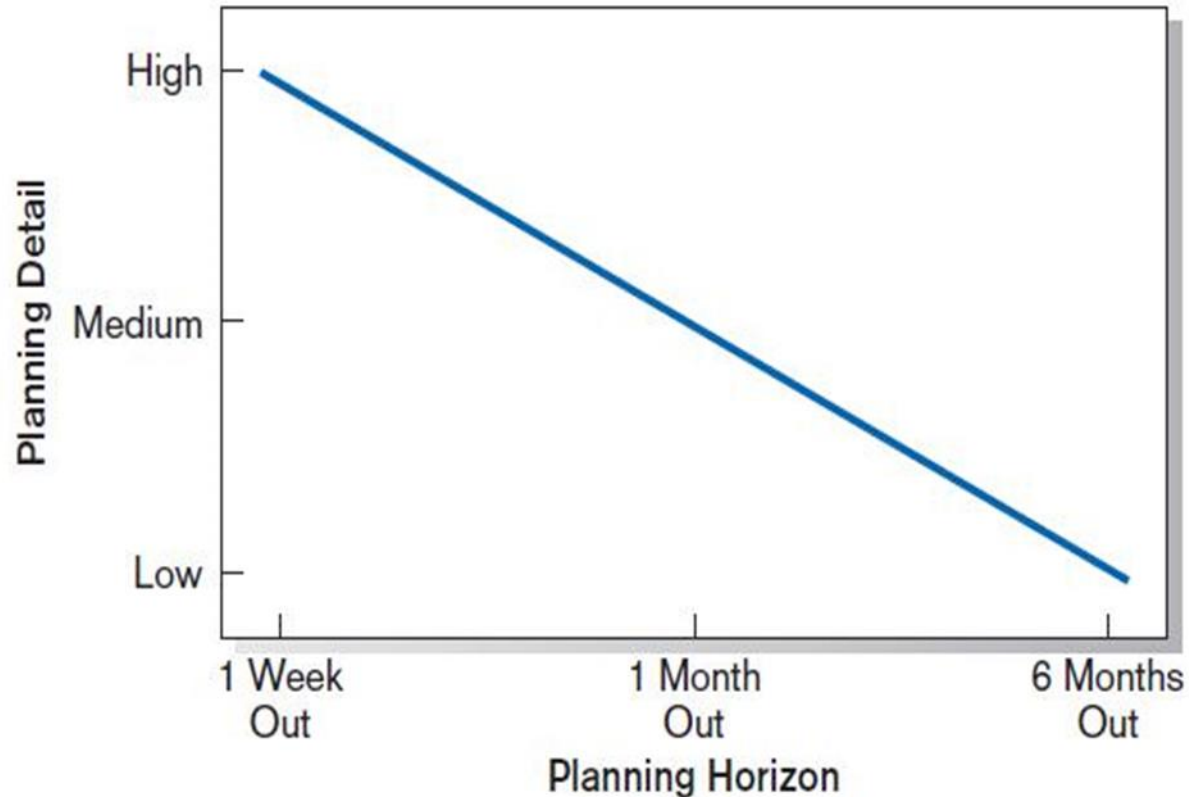
Project Manager does the following:

- Reviews historical project information
- Identifies major project activities
- Decomposes major activities and identifies individual tasks
- Establishes task ownership
- Identifies skills and resources needed

Outputs of this step:

- Work Breakdown Structure (WBS)
- Clearly defined tasks and deliverables
- Tasks assigned to the Functional Leads
- Specify resources by task

# Planning Detail



Level of project planning detail should be high in the short term, with less detail as time goes on

- The general principal is that we need to accept the fact of uncertainty, and that things will change over time
- Although we want a detailed idea of what we're going to do in the immediate future, we allow for more flexibility as time goes on
- This implies that planning is always going on
- Plans are revisited and evolve over time

# Agenda

- ✓ Homework Question 3
- ✓ Project management knowledge areas
- ✓ Project roles
- ✓ Project manager's role
- ✓ Project planning
  - Work breakdown structure, tasks, cost and labor estimates
  - Critical path analysis
  - Project management triangle
  - Quiz

# Project Planning – Work Breakdown Structure (WBS)

Is a “top down” logical structuring of project work

At the highest level, the WBS may be broken down into major work packages that reflect phases of the SDLC, for example:

1. Planning
2. Analysis
3. Design
4. Implementation

Each work package is further broken down into tasks of greater detail, for example:

2. Analysis
  - A. Workflow requirement analysis
  - B. Functional requirements analysis
  - C. Data requirements analysis
  - D. Information security requirements analysis
3. Design
  - A. User interface design
  - B. Database design
  - C. Applications processing design

Task Name
▾ Software Development
▸ Scope
▸ Analysis/Software Requirements
▸ Design
▸ Development
▸ Testing
▸ Training
▸ Documentation
▸ Pilot
▸ Deployment
▸ Post Implementation Review

Task Name
▾ Software Development
▸ Scope
▸ Analysis/Software Requirements
▾ Design
Review preliminary software specifications
Develop functional specifications
Develop prototype based on functional specifications
Review functional specifications
Incorporate feedback into functional specifications
Obtain approval to proceed
Design complete

# Work Breakdown Structure (WBS) – RAD example

	Task Name
1	▲ EWS Project
2	▸ Planning
38	▸ System Development
159	▸ Implementation

*Notice RAD Development Iterations...*

	Task Name
1	▲ EWS Project
2	▲ Planning
3	Plan and Schedule Project
4	▸ Requirements Analysis and Specifications
15	▸ Prepare Development Team
21	▸ Setup Development Environment
38	▸ System Development
159	▸ Implementation

	Task Name
1	▲ EWS Project
2	▲ Planning
3	Plan and Schedule Project
4	▲ Requirements Analysis and Specifications
5	User Requirements Finalize
6	Functional Requirements
7	System Architecture
8	Data Model
9	User Interface and Interaction
10	Data Sources, Formats, and Data Flow
11	Flow of Control
12	Maps
13	Test Cases
14	Specifications Complete
15	▸ Prepare Development Team
21	▸ Setup Development Environment
38	▸ System Development
159	▸ Implementation

	Task Name
1	▲ EWS Project
2	▲ Planning
3	Plan and Schedule Project
4	▲ Requirements Analysis and Specifications
5	User Requirements Finalize
6	Functional Requirements
7	System Architecture
8	Data Model
9	User Interface and Interaction
10	Data Sources, Formats, and Data Flow
11	Flow of Control
12	Maps
13	Test Cases
14	Specifications Complete
15	▸ Prepare Development Team
21	▸ Setup Development Environment
38	▲ System Development
39	▸ Develop Application - V 0.1 Incident
70	▸ Develop Application - V0.1.1 Incident Analysis
93	▸ Develop Application V0.2 Background Water Quality
132	▸ Develop Application V0.3 Historical Incidents
159	▸ Implementation

*Which kind of requirements would an IT Auditor find missing here?*



# Work Breakdown Structure (WBS) – RAD example...

	Task Name
1	▲ EWS Project
2	▲ Planning
3	Plan and Schedule Project
4	▲ Requirements Analysis and Specifications
5	User Requirements Finalize
6	Functional Requirements
7	System Architecture
8	Data Model
9	User Interface and Interaction
10	Data Sources, Formats, and Data Flow
11	Flow of Control
12	Maps
13	Test Cases
14	Specifications Complete
15	▷ Prepare Development Team
21	▷ Setup Development Environment
38	▲ System Development
39	▷ Develop Application - V 0.1 Incident
70	▷ Develop Application - V0.1.1 Incident Analysis
93	▷ Develop Application V0.2 Background Water Quality
132	▷ Develop Application V0.3 Historical Incidents
159	▷ Implementation

	Task Name
38	▲ System Development
39	▲ Develop Application - V 0.1 Incident
40	▲ Develop Business Logic Layer
41	Incident Schemas
42	Incident New Workflow Capabilities
43	Incident Workflow Rules
44	▲ Develop Database
45	Incident Entities Database Schema
46	Incident Entities Table Definitions and Views
47	Incident XML Mapping Schemas
48	▲ Setup ArcSDE
49	Setup Spatial Tables and Layers
50	Index Spatial Layers
51	▲ Views and Stored Procedures
52	Incident Entities
53	▲ Develop Data Integration Layer
54	Base Map Integration Service
55	GeoCoding Integration Service
56	Telephony Data Integration Service
57	▲ Develop UI Layer
58	▲ Develop UI SubSystem (ArcIMS - CAPIT) Interface
59	Coordinate Map and non-Map Pages
60	Login and Main Pages
61	New Widgets and UI Capabilities
62	Improve Validation Error Feedback
63	▲ Incident Pages
64	Task Bars
65	Menus
66	Forms
67	Pages
68	Integration and Testing
69	Milestone 1 - V0.1 Complete

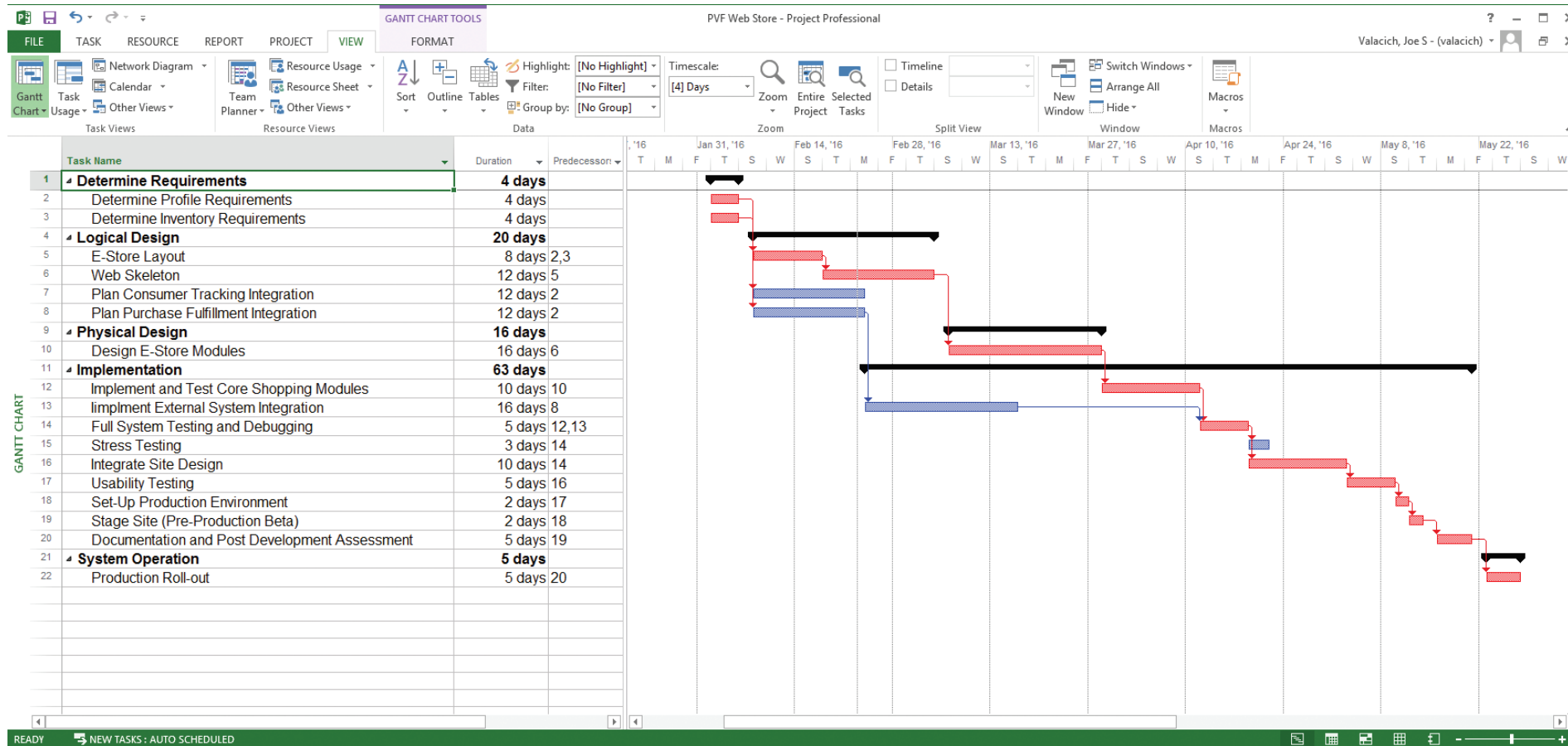
*1<sup>st</sup> Development Iteration*



# WBS is an integral part of the Gantt chart

You can see this WBS is similar to a waterfall approach

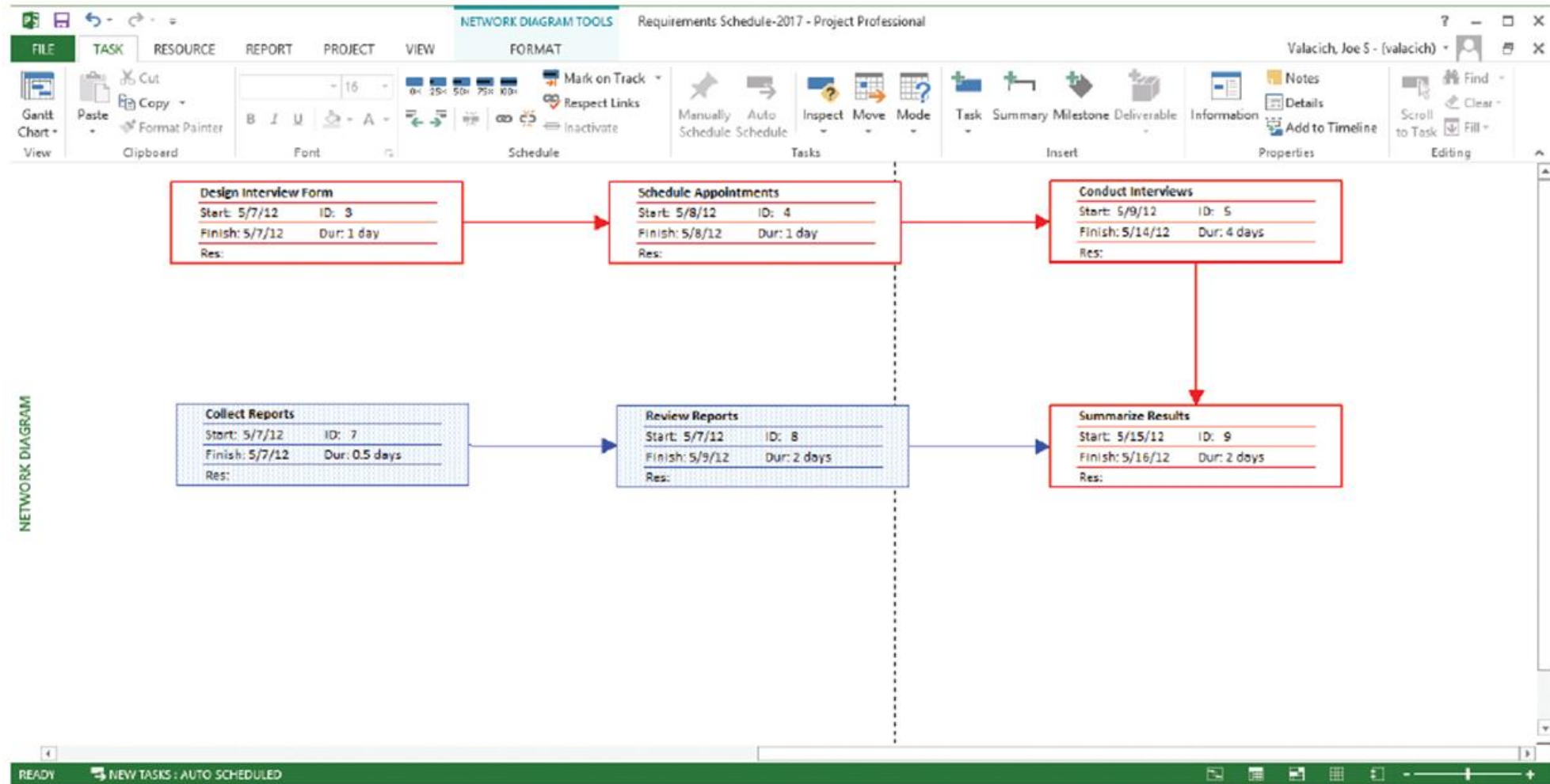
## E-Commerce project plan for Pine Valley Furniture webstore



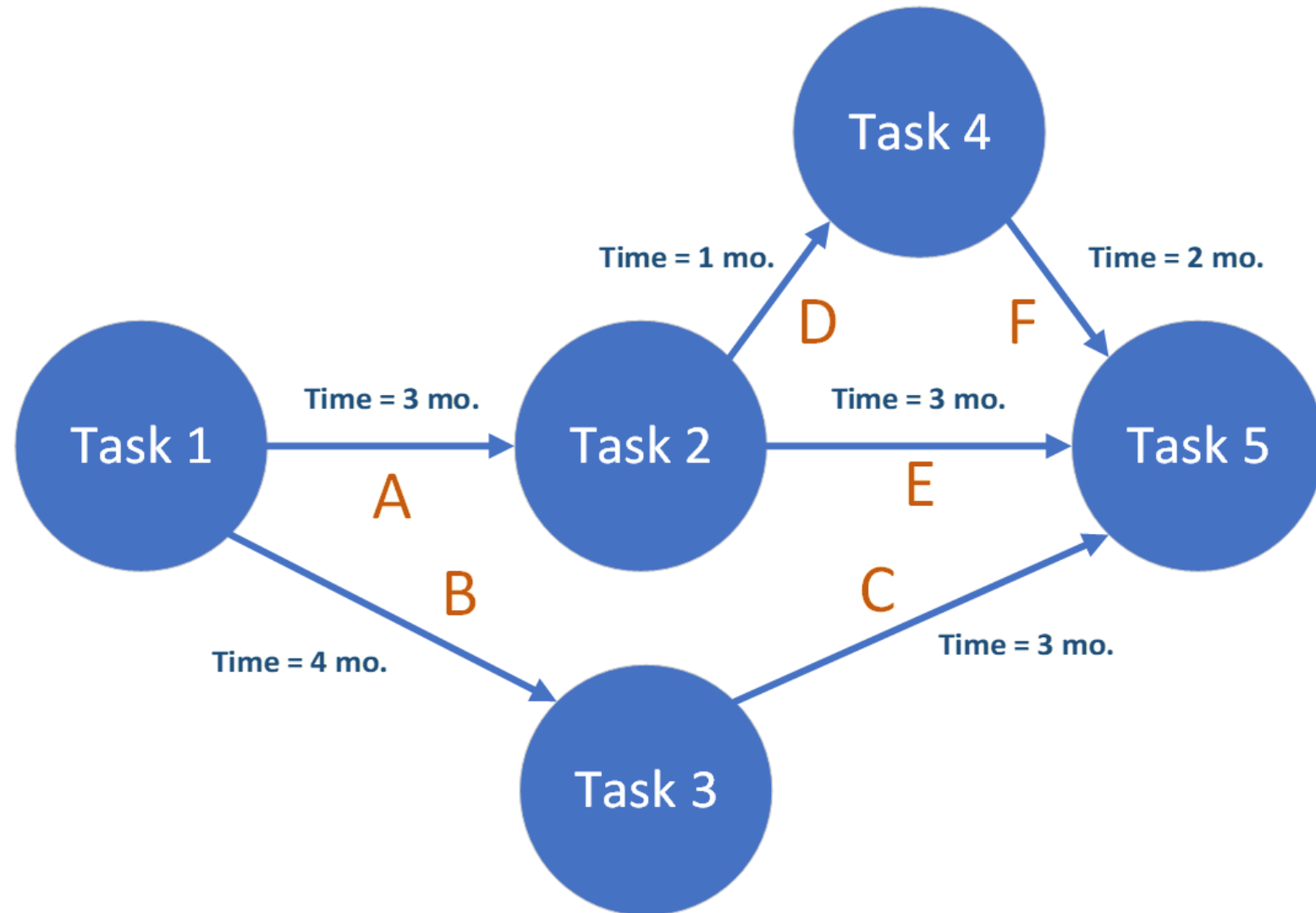
Note:

- Overlap between logical and physical design
- Overlap between design and implementation
- Critical path shown with red bars in the Gantt chart (more on this later in this lecture)

# WBS can also be illustrated using network diagrams

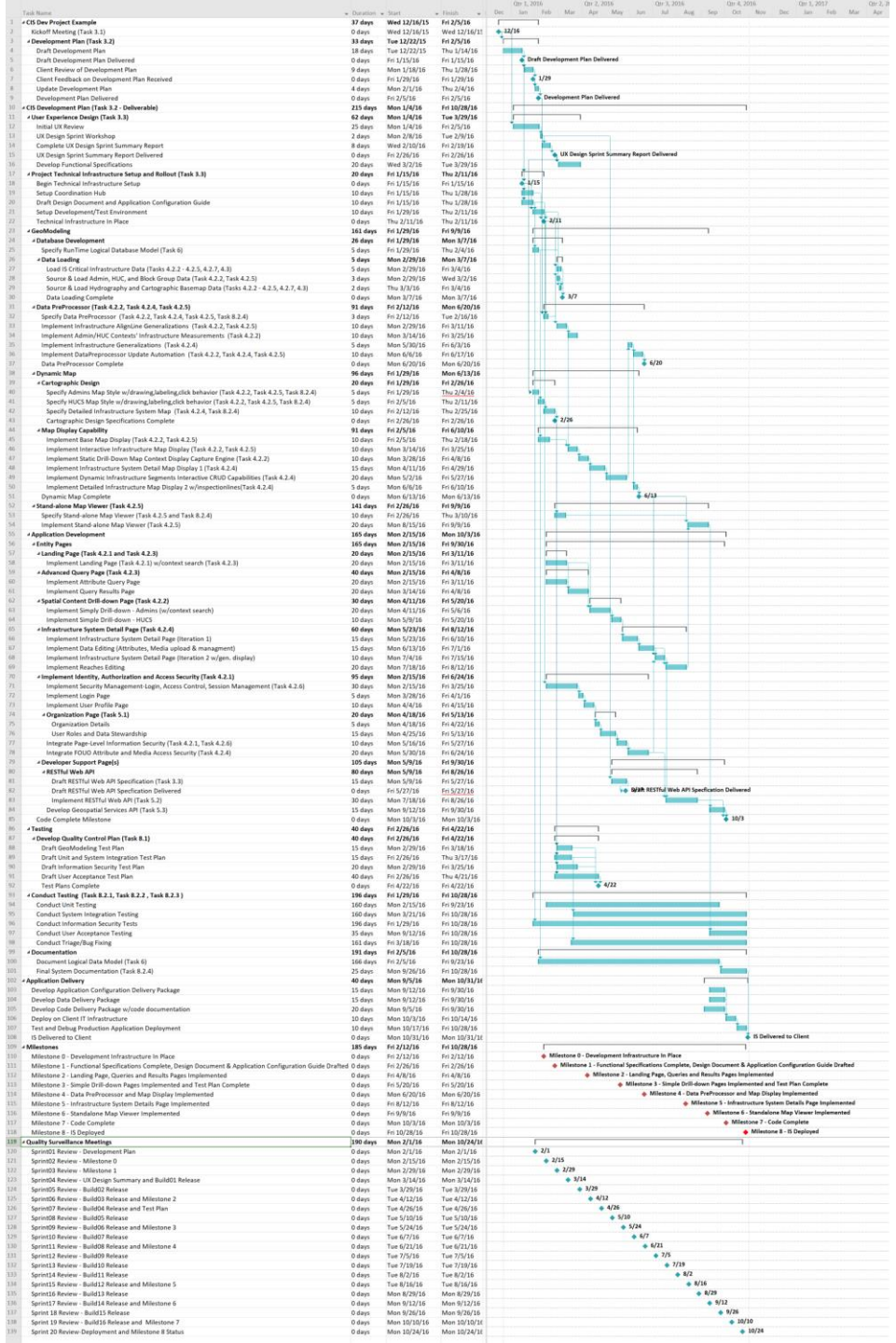


# WBS can also be illustrated using network diagrams



# Exercise

- Open up MS Project on IS-Dev Project Gantt Example (find zip file in Unit 04 Wrap Up)
- Analyze and explain what this project about?



# Cost Estimation

Can be based on:

- Analogous estimating – using experience from prior projects
- Parametric estimating – extending cost models from similar prior projects
- Bottom-up estimating – building up costs from detailed Work Breakdown Structure
- Actual costs – leveraging actual historic costs from identical prior project

Software Size Estimation Techniques:

- Source Lines of Code (SLOC)
- COnstructive COst Model (COCOMO)
- Function Point Analysis (FPA)
- FPA With Feature Points

# COCOMO – COConstructive COst MOdel

## Models for estimating effort, cost, and schedule

Boehm, B. (1981) Software Engineering Economics

- Derived from fitting regression formulas to historical project data
- Applies to 3 classes of software development projects
  - **Organic projects** - small teams with "good" experience working with flexible requirements
  - **Semi-detached projects** - "medium" teams with mixed experience working with a mix of rigid and less than rigid requirements
  - **Embedded projects** - developed within a set of "tight" constraints
- A hierarchy of three increasingly detailed models:
  1. **Basic COCOMO** for quick, early, rough order of magnitude estimates of software costs
  2. **Intermediate COCOMO** added "Cost Drivers"
  3. **Detailed COCOMO** added influence of individual project phases

Intermediate COCOMO
Cost Drivers
<b>Product attributes</b>
Required software reliability
Size of application database
Complexity of the product
<b>Hardware attributes</b>
Run-time performance constraints
Memory constraints
Volatility of the virtual machine environment
Required turnabout time
<b>Personnel attributes</b>
Analyst capability
Applications experience
Software engineer capability
Virtual machine experience
Programming language experience
<b>Project attributes</b>
Application of software engineering methods
Use of software tools
Required development schedule

# Cost Estimation – Function Point Analysis (FPA)

A technique used to determine size of a development task, based on the number of function points

Function points are factors such as inputs, outputs, queries, and logical processing units

Parameter	Simple	Average	Complex
# of Screens	5	10	5
# of Services	0	2	2
# of Database Tables	4	2	0
# of Data Files	0	4	0
# of Reports	0	2	3
# of External Interfaces	1	1	1
# of Environment Variables	3	4	0
<b>Total:</b>	<b>13</b>	<b>25</b>	<b>11</b>

# Cost Estimation – Function Point Analysis (FPA)

A technique used to determine size of a development task, based on the number of function points

Function points are factors such as inputs, outputs, queries, and logical processing units

Parameter	Simple	Simple Weight	Average	Average Weight	Complex	Complex Weight	Function Points
# of Screens	5	5	10	10	5	15	200
# of Services	0	10	2	20	2	40	120
# of Database Tables	4	10	2	15	0	20	70
# of Data Files	0	5	4	10	0	15	40
# of Reports	0	20	2	30	3	40	180
# of External Interfaces	1	20	1	40	1	60	120
# of Environment Variables	3	20	4	30	0	40	180
<b>Total:</b>	<b>13</b>	<b>90</b>	<b>25</b>	<b>155</b>	<b>11</b>	<b>230</b>	<b>910</b>



# Cost Estimation – Function Point Analysis

Parameter	Simple	Simple Weight	Average	Average Weight	Complex	Complex Weight	Function Points	Labor Hours	Labor Costs
# of Screens	5	5	10	10	5	15	200	2,000	200,000
# of Services	0	10	2	20	2	40	120	1,200	120,000
# of Database Tables	4	10	2	15	0	20	70	700	70,000
# of Data Files	0	5	4	10	0	15	40	400	40,000
# of Reports	0	20	2	30	3	40	180	1,800	180,000
# of External Interfaces	1	20	1	40	1	60	120	1,200	120,000
# of Environment Variables	3	20	4	30	0	40	180	1,800	180,000
<b>Total:</b>	13	90	25	155	11	230	910	9,100	910,000
Labor Hours/Function Point:	10								
Cost/Function Point:	1,000								

# Example of a complex project's WBS and labor estimate

	A	E	O
1			<b>Task Hours</b>
2	<b>Intermodal Transportation Model</b>		
3	<b>Task 1 - Evaluate existing data sets</b>		<b>1,284</b>
31	<b>Task 2 - Integration Strategy</b>		<b>2,974</b>
88	<b>Task 3 - Intermodal Transportation Model</b>		<b>4,244</b>
129	<b>Task 4 - Intermodal Visualization Tool</b>		<b>1,496</b>
139	<b>Total Hours:</b>		<b>9,998</b>

# WBS and labor estimate

	A	O
1		<b>Task Hours</b>
2	<b>Intermodal Transportation Model</b>	
3	<b>Task 1 - Evaluate existing data sets</b>	<b>1,284</b>
31	<b>Task 2 - Integration Strategy</b>	<b>2,974</b>
88	<b>Task 3 - Intermodal Transportation Model</b>	<b>4,244</b>
129	<b>Task 4 - Intermodal Visualization Tool</b>	<b>1,496</b>
139	<b>Total Hours:</b>	<b>9,998</b>

	A	N	O
1		<b>Activity Hours</b>	<b>Task Hours</b>
2	<b>Intermodal Transportation Model</b>		
3	<b>Task 1 - Evaluate existing data sets</b>		<b>1,284</b>
4	<b>Data sourcing</b>	<b>156</b>	
9	<b>Develop data quality assurance and finishing tool</b>	<b>236</b>	
13	<b>Visual proof reading and data repair tool</b>	<b>420</b>	
20	<b>Analyze existing datasets' content, format, organization, integrity and routability</b>	<b>320</b>	
29	<b>Integrate dataset models</b>	<b>152</b>	

# WBS and labor estimate

	A
1	
2	<b>Intermodal Transportation Model</b>
3	<b>Task 1 - Evaluate existing data sets</b>
4	<b>Data sourcing</b>
5	Research and acquire data sources and QA proofing materials
6	Acquire and manage existing OSM and DOT datasets and documentation
7	Identify Open Source transportation datasets
8	Proofing support imagery
9	<b>Develop data quality assurance and finishing tool</b>
10	Setup development environment
11	Holistic transportation feature extraction and network gap identification
12	Holistic dataset attribute value tester
13	<b>Visual proof reading and data repair tool</b>
14	Gap reviewer
15	Intermodal connection evaluation
16	Random NavUnit sampler and road/rail connection reviewer
17	Random road/rail connection sampler and reviewer
18	Route runner and reviewer (for visually proof reading while surfing route)
19	Geospatial bug creation, tracking - reproduction, assignment and resolution
20	<b>Analyze existing datasets' content, format, organization, integrity and routability</b>
21	Model waterborne datasets UML
22	Model roadway datasets UML
23	Model railway datasets UML
24	Model Opensource transportation datasets UML
25	Model aviation datasets UML
26	Model Census datasets UML
27	Model Administrative, populated places, and other stakeholder reporting area datasets UML
28	<b>Integrate dataset models</b>



# WBS and labor estimate

	Project Manager	UX-Designer	Database Dev.	Developer 1	Developer 2	Developer 3	Developer 4	Data Dev	Testing	Hours		
<b>Intermodal Transportation Model</b>												
<b>Task 1 - Evaluate existing data sets</b>												
<b>Data sourcing</b>												
Research and acquire data sources and QA proofing materials									24	24		24
Acquire and manage existing UML and datasets and documentation		24						40		64		64
Identify Open Source transportation datasets	4	4						24		32		32
Proofing support imagery		4						16	16	36		36
<b>Develop data quality assurance and finishing tool</b>												
Setup development environment		16						16		32		32
<b>Intermodal Transportation Model</b>												
<b>Task 1 - Evaluate existing data sets</b>												
<b>Data sourcing</b>												
Research and acquire data sources and QA proofing materials									24	24		24
Acquire and manage existing UML and datasets and documentation		24						40		64		64
Identify Open Source transportation datasets	4	4						24		32		32
Proofing support imagery		4						16	16	36		36
<b>Develop data quality assurance and finishing tool</b>												
Setup development environment		16					16			32		32
Holistic transportation feature extraction and network gap identification	24	40					80			144		144
Holistic dataset attribute value tester	4		40						16	60		60
<b>Visual proof reading and data repair tool</b>												
Gap review	4	16		40			16			76		76
Intermodal connection evaluation	4											
Random NavUnit sampler and road/trail connection reviewer	4	16		40			16			76		76
Random road/trail connection sampler and reviewer	4	16		40			16			76		76
Route runner and reviewer (for visually proof reading while surfing route)	4	16		40			16			76		76
Geospatial bug creation, tracking - reproduction, assignment and resolution	4	16		80			16			116		116
<b>Analyze existing datasets' content, format, organization, integrity and routability</b>												
Model waterborne datasets UML	8		40	8	8					64		64
Model roadway datasets UML	8		4				40			52		52
Model railway datasets UML	8		4					40		52		52
Model Opensource transportation datasets UML	8		4				40			52		52
Model aviation datasets UML	8		4					40		52		52
Model Census datasets UML	8		4	24						36		36
Model Administrative, populated places, and other stakeholder reporting area datasets UML	8		4							12		12
<b>Integrate dataset models</b>												
	40	24	8					40	40	152		152

# WBS and labor estimate

30	<b>Task 2 - Integration Strategy</b>
31	<b>Document results of Task 1 dataset view integration and evaluation</b>
32	<b>Identify case studies and develop data, functional and user requirements for Intermodal Transportation Model and Viewer</b>
33	Validate need for Router 1, Router 2, Router 3, and Router 4
34	Specify the data, functional, and user requirements for Intermodal Transportation Model and Viewer
35	<b>Design Intermodal Transportation Model - Data models</b>
36	Design intermodal transportation infrastructure data model
37	Design routing network data model
38	Design agency freight movement statistics data model
39	Design geographic context data model (Census, Admins, Risk zones...)
40	<b>Develop Data Model Intergration Plan</b>
41	<b>Router 1 Integration Plan</b>
42	Identify transportation network datasets for integration within Router 1
43	Detail source to data model mappings and integration steps for Router 1
44	Develop test plan for Router 1
45	<b>Router 2 Integration Plan</b>
46	Identify transport carrier (vessel, container, car ?) movement datasets for integration with Router 2
47	Detail source to data model mappings and dataset integration steps for Router 2
48	Develop test plan for Router 2
49	<b>Router 3 Integration Plan</b>
50	Identify freight movement datasets for integration with Router 3
51	Detail source to data model mappings and dataset integration steps for Router 3
52	Develop test plan for Router 3
53	<b>Router 4 Integration Plan</b>
54	Identify community impact datasets for integration with Router 4
55	Detail source to data model mappings and dataset integration steps for Router 4
56	Develop test plan for Router 4
57	
58	<b>Design Intermodal Transportation Model - Router V1</b>
59	Design routing criteria options (all modes, > 1 modes, shortest/least-cost/quickest...)
60	Design map GUI for viewing and analyzing routing network results
61	Design route description report
62	Develop data integration strategy for Router 1
63	<b>Design Intermodal Transportation Model - Router V2</b>
64	Design traffic measurement and congestion detection algorithm
65	Design feeding traffic and congestion for use by router to reroute for quickest/least-cost/...
66	Design traffic and congestion summary map and report
67	Develop integration strategy for Router 2
68	<b>Design Intermodal Transportation Model - Router V3</b>
69	Design freight movement and conflation model
70	Design freight movement statistical summary map and report
71	Develop integration strategy for Router 3
72	<b>Design Intermodal Transportation Model - Router V4</b>
73	Design community impact model
74	Design community impact summary map and report
75	Design environmental vulnerability model
76	Design environmental vulnerability summary map and report
77	Develop integration strategy for Router 4
78	<b>Develop Intergration Strategy Report</b>

# WBS and labor estimate

	A	C	D	E	F	G	H	I	J	K	L	N	O
		Project Manager	UX-Designer	Database Dev.	Developer 1	Developer 2	Developer 3	Developer 4	Data Dev	Testing	Hours	Activity Hours	Task Hours
1													
30	<b>Task 2 - Integration Strategy</b>												<b>2,974</b>
31	Document results of Task 1 dataset view integration and evaluation	16							40		56		56
32	<b>Identify case studies and develop data, functional and user requirements for Intermodal Transportation Model and Viewer</b>	32	80								112		112
33	Validate need for Router 1, Router 2, Router 3, and Router 4	4	4								8		
34	Specify the data, functional, and user requirements for Intermodal Transportation Model and Viewer	32	40								72		
35	<b>Design Intermodal Transportation Model - Data models</b>												<b>480</b>
36	Design intermodal transportation infrastructure data model	24	24	32				16	40	40	176		
37	Design routing network data model	8	40					40	16	40	144		
38	Design agency freight movement statistics data model	32	24	32				24			112		
39	Design geographic context data model (Census, Admins, Risk zones...)	16	8					8	8	8	48		
40	<b>Develop Data Model Intergration Plan</b>												
41	<b>Router 1 Integration Plan</b>												<b>260</b>
42	Identify transportation network datasets for integration within Router 1	4		4					8	8	24		
43	Detail source to data model mappings and integration steps for Router 1	16	8	32				24	40	40	160		
44	Develop test plan for Router 1	4	24					8	16	24	76		
45	<b>Router 2 Integration Plan</b>												<b>256</b>
46	Identify transport carrier (vessel, container, car ?) movement datasets for integration with Router 2	4		4		4			8	8	28		
47	Detail source to data model mappings and dataset integration steps for Router 2	16	8	32				24	40	40	160		
48	Develop test plan for Router 2	4	16					8	16	24	68		
49	<b>Router 3 Integration Plan</b>												<b>244</b>
50	Identify freight movement datasets for integration with Router 3	4		4					8	8	24		
51	Detail source to data model mappings and dataset integration steps for Router 3	16	8	32				24	40	40	160		
52	Develop test plan for Router 3	4	16						16	24	60		
53	<b>Router 4 Integration Plan</b>												<b>256</b>
54	Identify community impact datasets for integration with Router 4	4				16		8	4	4	36		
55	Detail source to data model mappings and dataset integration steps for Router 4	16	8	32				24	40	40	160		
56	Develop test plan for Router 4	4	16						16	24	60		
57													
58	<b>Design Intermodal Transportation Model - Router V1</b>												<b>210</b>
59	Design routing criteria options (all modes, > 1 modes, shortest/least-cost/quickest...)	2	16					16	8	16	58		
60	Design map GUI for viewing and analyzing routing network results	8	40								48		
61	Design route description report	4	24								28		
62	Develop data integration strategy for Router 1	4	8	24				16	8	16	76		
63	<b>Design Intermodal Transportation Model - Router V2</b>												<b>508</b>
64	Design traffic measurement and congestion detection algorithm	16	24		40	40		80			200		
65	Design feeding traffic and congestion for use by router to reroute for quickest/least-cost/...	16	24		40	40		80			200		
66	Design traffic and congestion summary map and report	8	32								40		
67	Develop integration strategy for Router 2	4	8	24				16	8	8	68		
68	<b>Design Intermodal Transportation Model - Router V3</b>												<b>292</b>
69	Design freight movement and conflation model	16	8		40	40		80			184		
70	Design freight movement statistical summary map and report	8	32								40		
71	Develop integration strategy for Router 3	4	8	24				16	8	8	68		
72	<b>Design Intermodal Transportation Model - Router V4</b>												<b>260</b>
73	Design community impact model	16									16		
74	Design community impact summary map and report	16									16		
75	Design environmental vulnerability model	8	8		40	40		24			120		
76	Design environmental vulnerability summary map and report	8	32								40		
77	Develop integration strategy for Router 4	4	8	24				16	8	8	68		
78	<b>Develop Intergration Strategy Report</b>	40									40		<b>40</b>



# WBS and labor estimate

<b>Task 3 - Intermodal Transportation Model</b>
<b>Setup N-Tier Geospatial Application System Development Environment</b>
<b>Develop Intermodal Transportation Model - Routing</b>
<b>Router 1 - Basic</b>
Implement freight router 1 for basic routing test environment
Implement Router 1 geodatabase data model and integrate data
Find and fix intermodal network connection gaps
Test and improve intermodal network connections using router 1
Implement intramode and intermodal freight movement integrity rules in router 1
Test and improve freight movement integrity rules in router 1
<b>Router 2 - Traffic and Congestion</b>
Evolve Router 1 to Router 2 for traffic and congestion test environment
Implement Router 2 geodatabase data model changes and integrate additional data
Find and fix routing and traffic and congestion modeling errors
Test and improve intermodal routing of transport movements (no freight)
<b>Router 3 - Traffic and Congestion and Freight Movement</b>
Evolve Router 2 to Router 3 for freight movement test environment
Implement Router 3 geodatabase data model changes and integrate additional data
Find and fix routing, traffic and congestion modeling, and freight movement modeling
Test and improve intermodal routing of freight movements (no freight)
<b>Router 4 - Traffic and Congestion, Freight Movement, and Community Impact and Environmental Vulnerability</b>
Evolve Router 3 to Router 4 for community impact and environmental vulnerability test environment
Implement Router 4 geodatabase data model changes and integrate additional data
Find and fix routing, traffic and congestion, freight movement and community impact and environmental vulnerability modeling
Test and improve intermodal routing of freight movements (no freight)
<b>Publishing Tool</b>
Data Generalization Processing
Determine cartographic generalization requirements for Intermodal Intermodal Transportation Model and Visualization Tool
Implement generalization processing of intermodal transportation network for multiscale map displays in ArcGIS ModelBuilder
Remove non-routing intermodal transportation network infrastructure feature classes and attributes for high-performance routing
Data reformatting and organizing for production (create file geodatabases) and target production databases
Data Copying
<b>Develop Intermodal Transportation Model Documentation</b>
<b>Prepare and Package Intermodal Transportation Model for delivery</b>

# WBS and labor estimate

	A	C	D	E	F	G	H	I	J	K	L	N	O
		Project Manager	UX-Designer	Database Dev.	Developer 1	Developer 2	Developer 3	Developer 4	Data Dev	Testing	Hours	Activity Hours	Task Hours
1													
30	<b>Task 2 - Integration Strategy</b>												2,974
31	Document results of Task 1 dataset view integration and evaluation	16							40		56		56
32	<b>Identify case studies and develop data, functional and user requirements for Intermodal Transportation Model and Viewer</b>	32	80								112		112
33	Validate need for Router 1, Router 2, Router 3, and Router 4	4	4								8		
34	Specify the data, functional, and user requirements for Intermodal Transportation Model and Viewer	32	40								72		
35	<b>Design Intermodal Transportation Model - Data models</b>												480
36	Design intermodal transportation infrastructure data model	24	24	32				16	40	40	176		
37	Design routing network data model	8	40					40	16	40	144		
38	Design agency freight movement statistics data model	32	24	32				24			112		
39	Design geographic context data model (Census, Admins, Risk zones...)	16	8					8	8	8	48		
40	<b>Develop Data Model Intergration Plan</b>												
41	<b>Router 1 Integration Plan</b>												260
42	Identify transportation network datasets for integration within Router 1	4		4					8	8	24		
43	Detail source to data model mappings and integration steps for Router 1	16	8	32				24	40	40	160		
44	Develop test plan for Router 1	4	24					8	16	24	76		
45	<b>Router 2 Integration Plan</b>												256
46	Identify transport carrier (vessel, container, car ?) movement datasets for integration with Router 2	4		4		4			8	8	28		
47	Detail source to data model mappings and dataset integration steps for Router 2	16	8	32				24	40	40	160		
48	Develop test plan for Router 2	4	16					8	16	24	68		
49	<b>Router 3 Integration Plan</b>												244
50	Identify freight movement datasets for integration with Router 3	4		4					8	8	24		
51	Detail source to data model mappings and dataset integration steps for Router 3	16	8	32				24	40	40	160		
52	Develop test plan for Router 3	4	16						16	24	60		
53	<b>Router 4 Integration Plan</b>												256
54	Identify community impact datasets for integration with Router 4	4				16		8	4	4	36		
55	Detail source to data model mappings and dataset integration steps for Router 4	16	8	32				24	40	40	160		
56	Develop test plan for Router 4	4	16						16	24	60		
57													
58	<b>Design Intermodal Transportation Model - Router V1</b>												210
59	Design routing criteria options (all modes, > 1 modes, shortest/least-cost/quickest...)	2	16					16	8	16	58		
60	Design map GUI for viewing and analyzing routing network results	8	40								48		
61	Design route description report	4	24								28		
62	Develop data integration strategy for Router 1	4	8	24				16	8	16	76		
63	<b>Design Intermodal Transportation Model - Router V2</b>												508
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66	Design traffic and congestion summary map and report	8	32								40		
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76	Design environmental vulnerability summary map and report	8	32								40		
77	Develop integration strategy for Router 4	4	8	24				16	8	8	68		
78	<b>Develop Intergration Strategy Report</b>	40									40		40

# WBS and labor estimate

## **Task 4 - Intermodal Visualization Tool**

**Develop User Experience (UX) Design Specification based on case requirements**

**Evolve geospatial application system development environment to support web application development**

**Develop and test Intermodal Visualization Tool**

**Prototype 1 development, testing and bug fixing**

**Prototype 2 development, testing and bug fixing**

**Prototype 3 development, testing and bug fixing**

**Develop Intermodal Visualization Tool Documentation**

**Prepare and package Intermodal Visualization Tool for delivery**

# WBS and labor estimate

	Project Manager	UX-Designer	Database Dev.	Developer 1	Developer 2	Developer 3	Developer 4	Data Dev	Testing	Hours	Activity Hours	Task Hours
1												
121	<b>Task 4 - Intermodal Visualization Tool</b>											<b>1,496</b>
122		24	80							104		<b>104</b>
123			32	32		32	32			160		<b>160</b>
124						120				120		<b>1,032</b>
125		8	40			16	120	120		304		
126		8	40			16	120	120		304		
127		8	40			16	120	120		304		
128			40							40		<b>40</b>
129			40	40		40	40			160		<b>160</b>

<b>Task 4 - Intermodal Visualization Tool</b>
<b>Develop User Experience (UX) Design Specification based on case requirements</b>
<b>Evolve geospatial application system development environment to support web application development</b>
<b>Develop and test Intermodal Visualization Tool</b>
<b>    Prototype 1 development, testing and bug fixing</b>
<b>    Prototype 2 development, testing and bug fixing</b>
<b>    Prototype 3 development, testing and bug fixing</b>
<b>Develop Intermodal Visualization Tool Documentation</b>
<b>Prepare and package Intermodal Visualization Tool for delivery</b>

# IT Auditor should evaluate the WBS and check validity of labor and cost estimates

Task	Project Manager	UX-Designer	Database Dev.	Developer 1	Developer 2	Developer 3	Developer 4	Data Dev	Testing	Hours	Task %	Activity Hours	Task Hours
<b>Total Hours:</b>	734	1,812	876	528	532	552	2,544	1,300	1,204	10,082		9,998	9,998
Cost										10,078			
												0.84%	84

Project Manager	UX-Designer	Database Dev.	Developer 1	Developer 2	Developer 3	Developer 4	Data Dev	Testing	Hours	Task %	Activity Hours	Task Hours

Activity Hours and Task Hours have lost 84 hours somewhere?

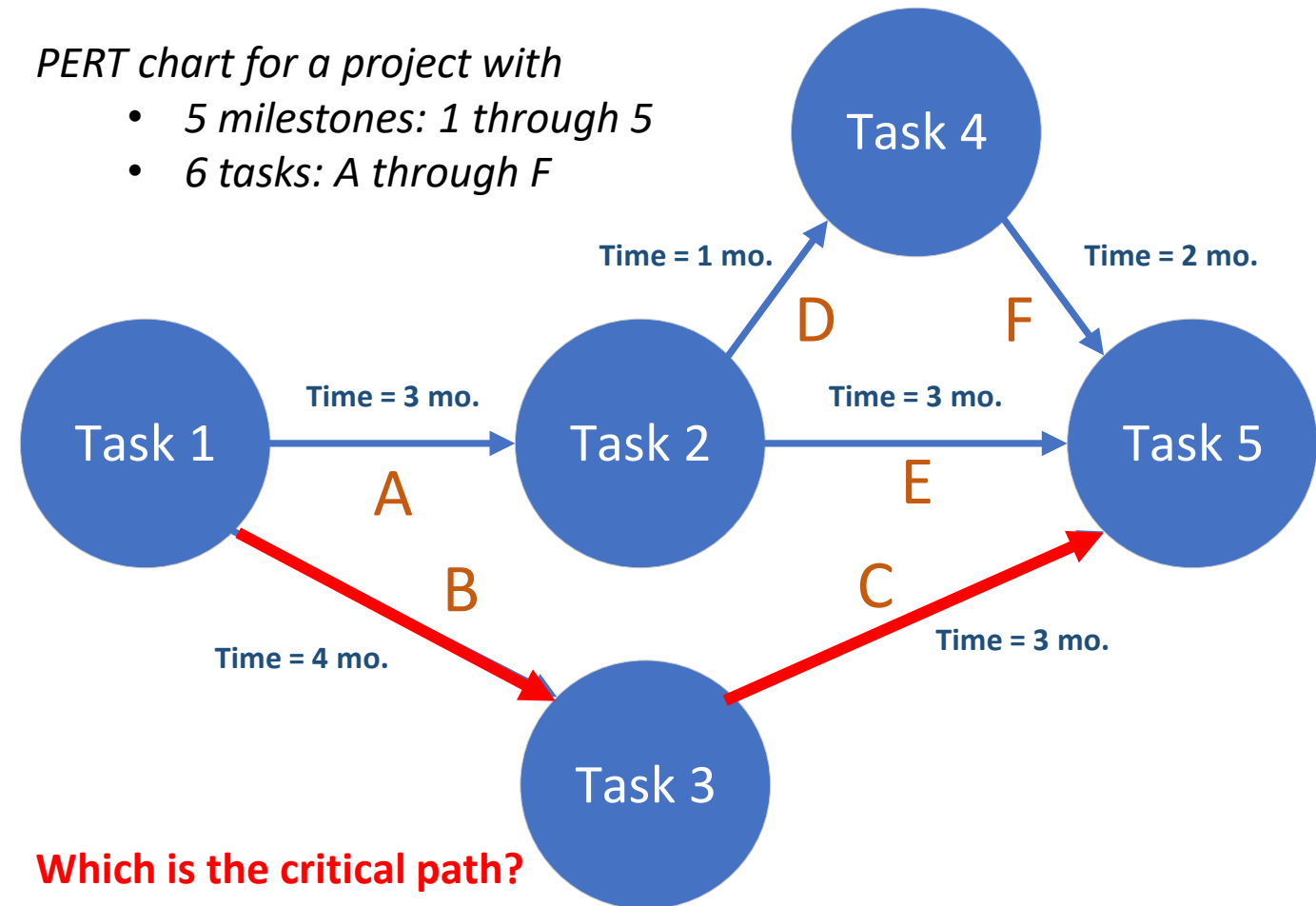
# Critical Path Analysis

An algorithm for scheduling a set of project activities

- Used with Program Evaluation and Review Technique (PERT) network diagram
- Determines
  1. Critical path by identifying and measuring the time required to complete the longest path of dependent activities (i.e. tasks) from start to finish
  2. Earliest and latest that each task can start and finish without making the project longer
    - Slack time is the amount of time a task can be delayed without making the project longer
      - **Critical path has 0 slack**

PERT chart for a project with

- 5 milestones: 1 through 5
- 6 tasks: A through F



**Which is the critical path?**

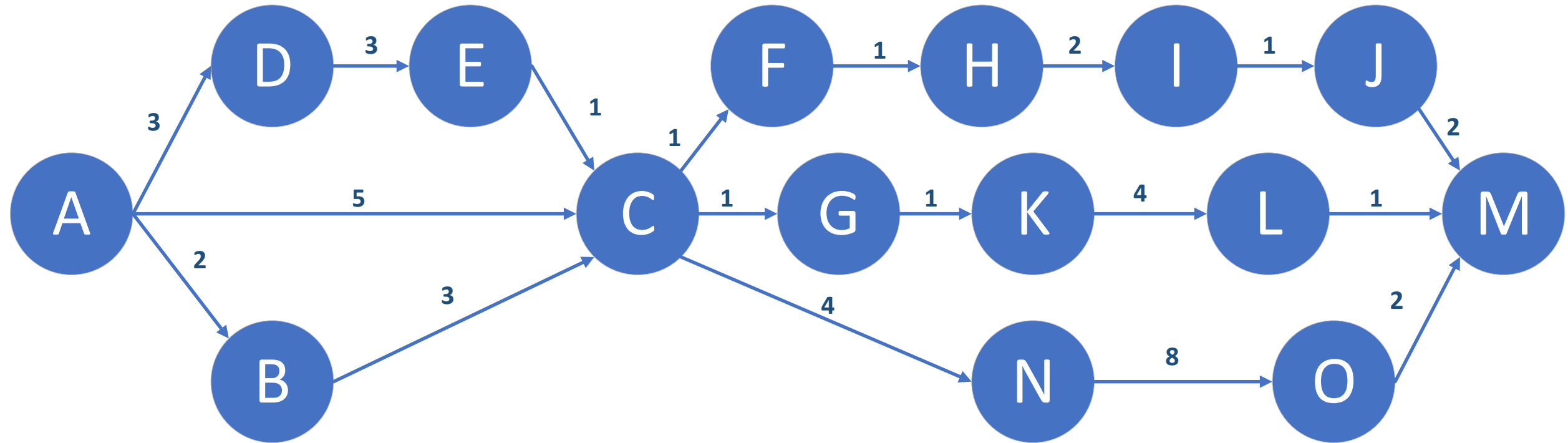
3 Paths through the tasks:

A, D, F = 3 + 1 + 2 = 6 mo. Slack time = 1 mo.

A, E = 3 + 3 = 6 mo. Slack time = 1 mo.

**→** B, C = 4 + 3 = 7 mo. **Slack time = 0 mo.**

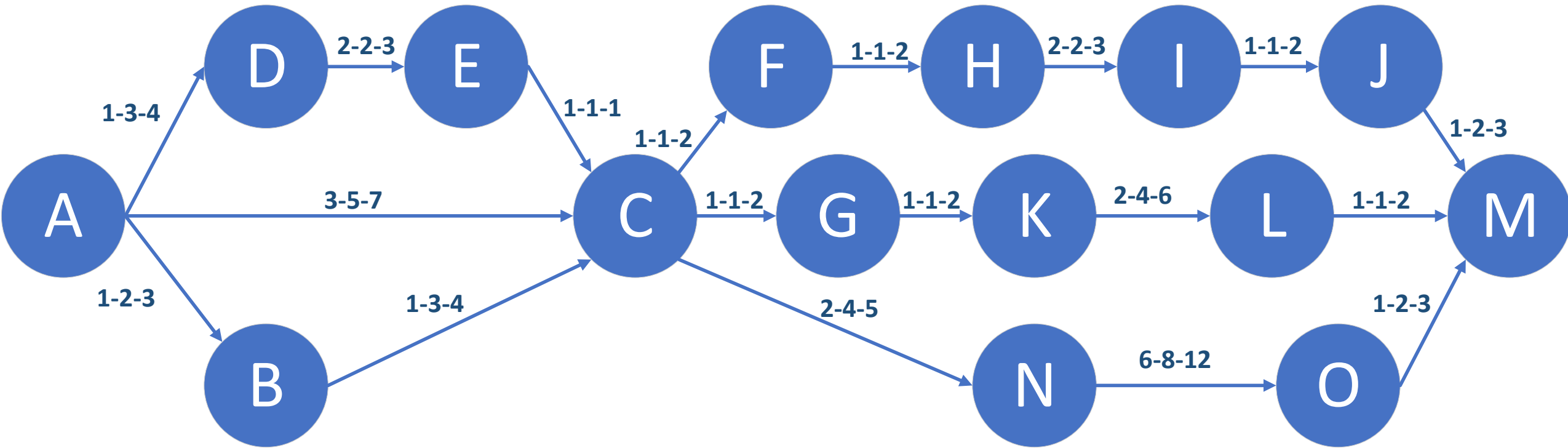
# Critical Path Exercise



What is the critical path?

What is the slack time?

# Calculate Expected Time Duration of Activities (Tasks)



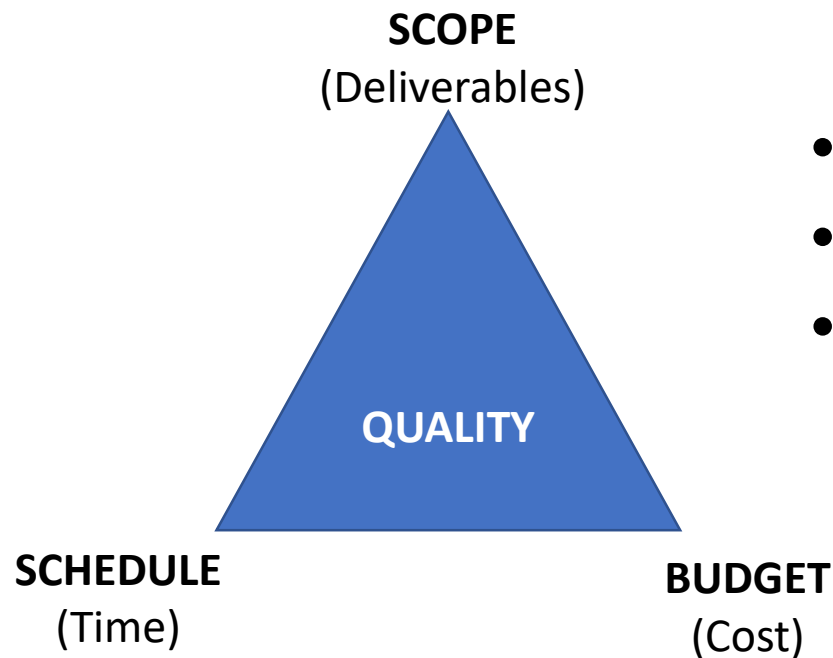
PERT Time Estimate = 
$$\frac{\text{Optimistic} + (4 \times \text{Most Likely}) + \text{Pessimistic}}{6}$$



# Project Planning - Project Management Triangle

Projects are planned and managed in the context of 3 constraints: Scope, Schedule and Budget

- Project Managers can trade among these 3 constraints
- Changes in one constraint necessitate changes in others or quality will suffer

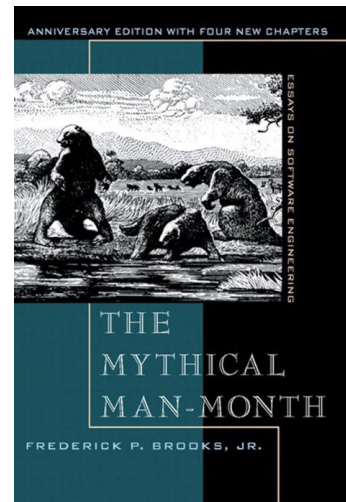


- **Good**
- **Cheap**
- **Fast**

*Pick 2*

*Do not overlook implications of the*

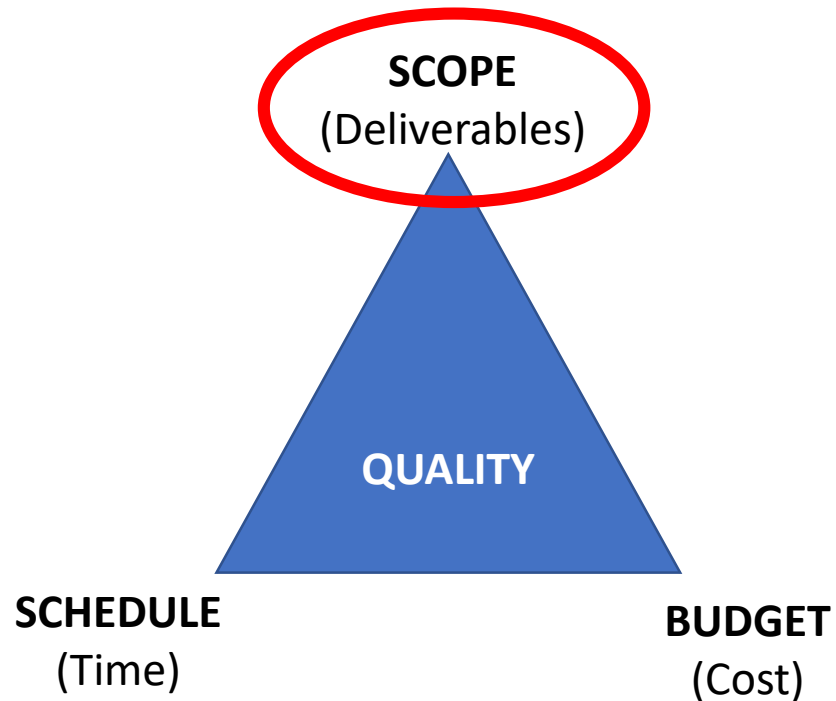
- *“Mythical Man-Month”*
  - *More budget/resources can increase schedule*
- *Good is a function of:*
  - *Need to meet/exceed stakeholder expectations*
  - *Need to pass User Acceptance Testing*



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# Project Planning - Project Management Triangle

Project planning and management accomplished in context of 3 constraints:  
Scope, Schedule and Budget



**Scope** involves getting information required to start a project, and the features the product would have that would meet its stakeholders requirements

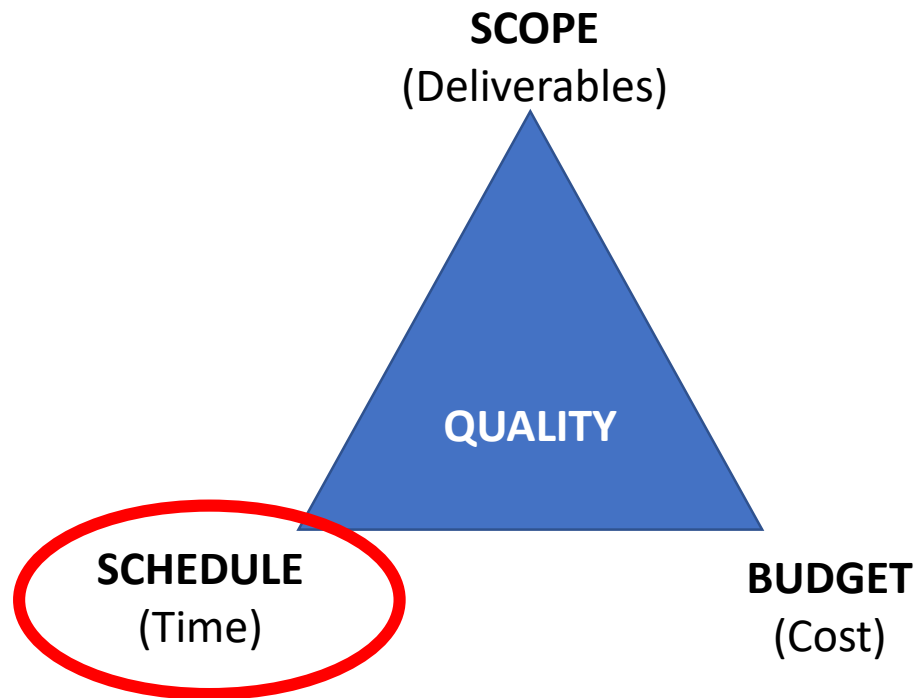
- **Project Scope:** "The work that needs to be accomplished to deliver a product, service, or result with the specified features and functions"
- **Product Scope:** "The features and functions that characterize a product, service, or result."

***Scope Risks: If requirements are not completely defined and described and if there is no effective change control in a project, scope creep or requirements creep may result***

A Guide to the Project Management Body of Knowledge (PMBOK Guide) - Fourth Edition. Project Management Institute, 2008. ISBN 978-1-933890-51-7

# Project Planning - Project Management Triangle

Project planning and management accomplished in context of 3 constraints:  
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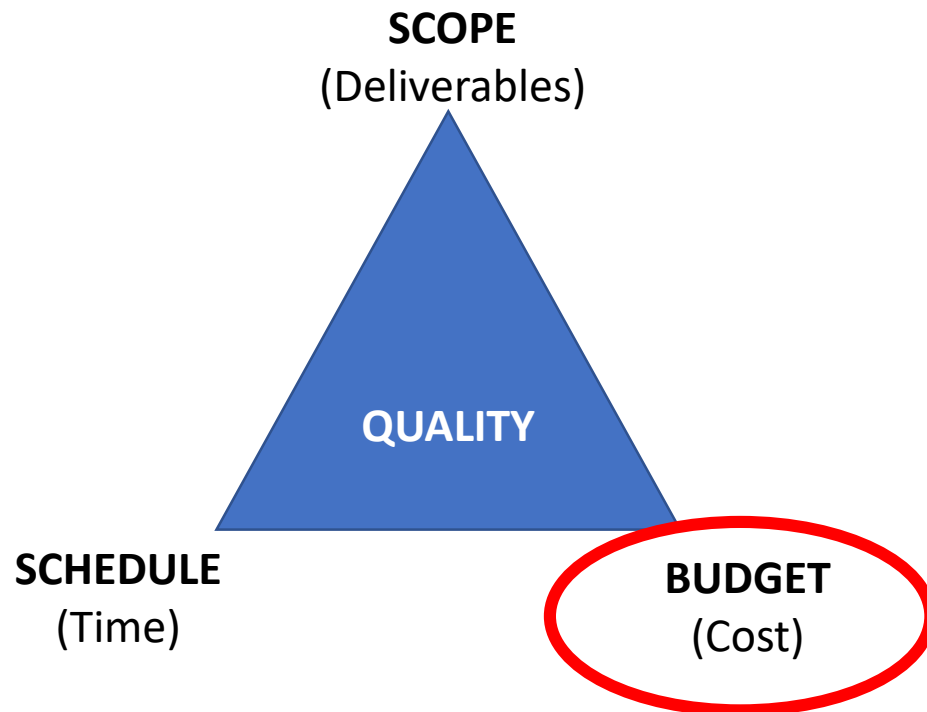


## Schedule Risks:

- Tasks which are exceptionally complicated
- Tasks with durations longer than two weeks
- Tasks on the critical path
- Tasks which have several predecessors or dependencies
- Tasks that have minimal slack
- Optimistically estimated tasks
- Tasks reliant on external resources
- Start-to-Start and Finish-to-Finish dependencies
- Dependencies with lags
- Major milestones
- Unforeseen issues (e.g., sicknesses, relocations, reorganizations)
- Unstated assumptions

# Project Planning - Project Management Triangle

Project planning and management accomplished in context of 3 constraints:  
Scope, Schedule and Budget



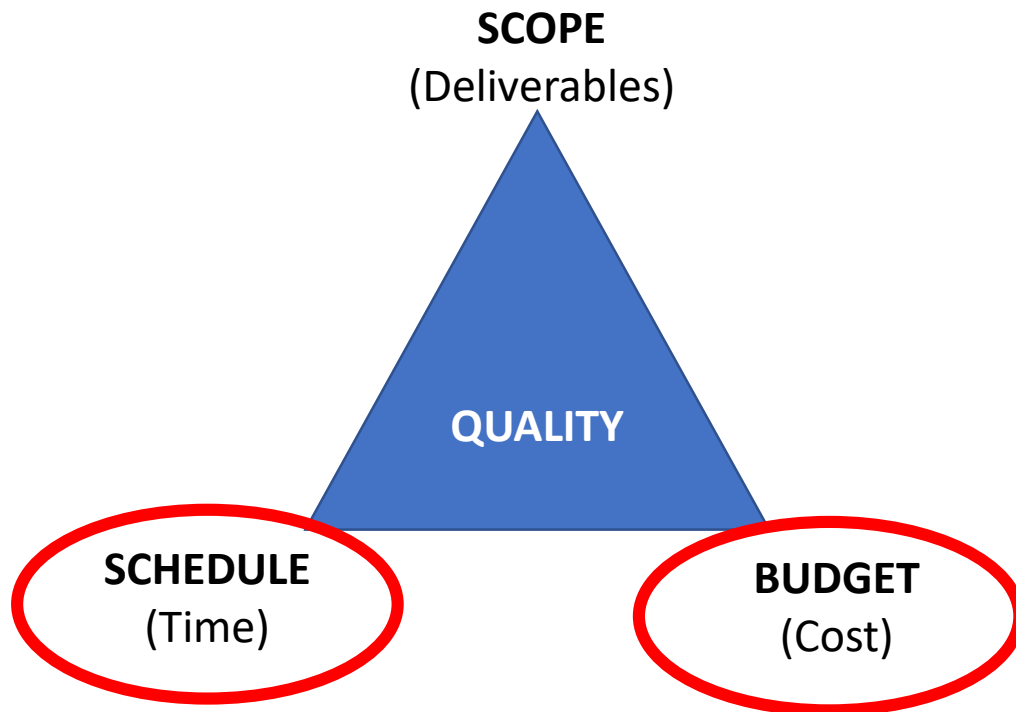
## Budget Risks:

Under-budgeted or unbudgeted

- Development tasks
- Testing and bug fixing tasks
- Documentation tasks
- Hardware, software, other equipment, or datasets
- Meetings
- Training of clients

# Project Planning - Project Management Triangle

Project planning and management accomplished in context of 3 constraints:  
Scope, Schedule and Budget

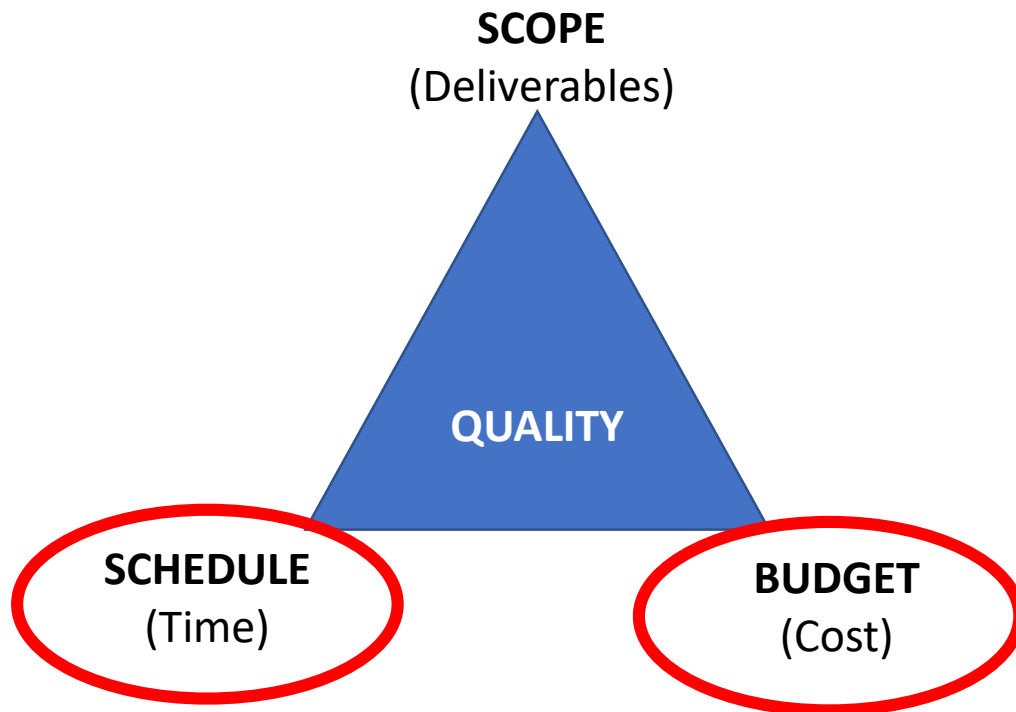


## Resource Risks:

- Tasks with one key individual assigned
- Tasks using scarce resources
- Tasks which are mismatched with the people assigned
- Tasks which require large amounts of resources
- Availability of tools and/or techniques
- Tasks which rely on sub-consultants or third party vendors for their completion
- Tasks which rely on resources within another organizational division or group for their completion

# Project Planning - Project Management Triangle

Project planning and management accomplished in context of 3 constraints:  
Scope, Schedule and Budget



## Preventative Tasks to Mitigate Risk

- Schedule high risk tasks earlier in the development cycle
- Shift more experienced people to tasks
- Add prototyping tasks to prove concepts
- Add review tasks
- Change the approach to eliminate high risk tasks
- Add resources to tasks for cross-training, if budget can support it
- Establish independent parallel efforts
- Reduce project scope
- Design in redundancy

# Agenda

- ✓ Homework Question 3
- ✓ Project management knowledge areas
- ✓ Project roles
- ✓ Project manager's role
- ✓ Project planning
- ✓ Work breakdown structure, tasks, cost and labor estimates
- ✓ Critical path analysis
- ✓ Project management triangle
- Quiz

# Quiz:

What is MOST important to consider as part of planning an IT project?

- a) Deliverables and functionality
- b) Timeline
- c) Costs for labor, hardware and software
- d) All of the above

Who is responsible for providing direction to the team and ensuring project is completed on-time, on-budget, and meets business needs?

- a) Executive sponsor
- b) User management
- c) Steering committee
- d) Project Manager



# Quiz:

The quality assurance (QA) manager on a \$10 million ERP migration project for PetNow pet supply company reports to the Project Manager (PM). The PM believes this will expedite the delivery of the project using the agile SDLC methodology.

What should the Internal Auditor, who recently joined the project team, do?

- a) Nothing, as it makes sense to expedite project delivery
- b) Demand changes to the project team right away, as the project is likely to fail
- c) Understand the project's goal, current state of the project, and then advise Steering Committee to possibly make changes so the QA manager is independent from both the PM and user manager
- d) Wait for a problem to surface before making the case for a change

# Quiz:

Which of the following would BEST help to prioritize project activities and determine the timeline for a project?

- a) Gantt chart
- b) Earned value analysis (EVA)
- c) Program evaluation review technique (PERT)
- d) Function point analysis (FPA)

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What is MOST important to consider as part of planning an IT project?

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