



PROJECT MANAGEMENT

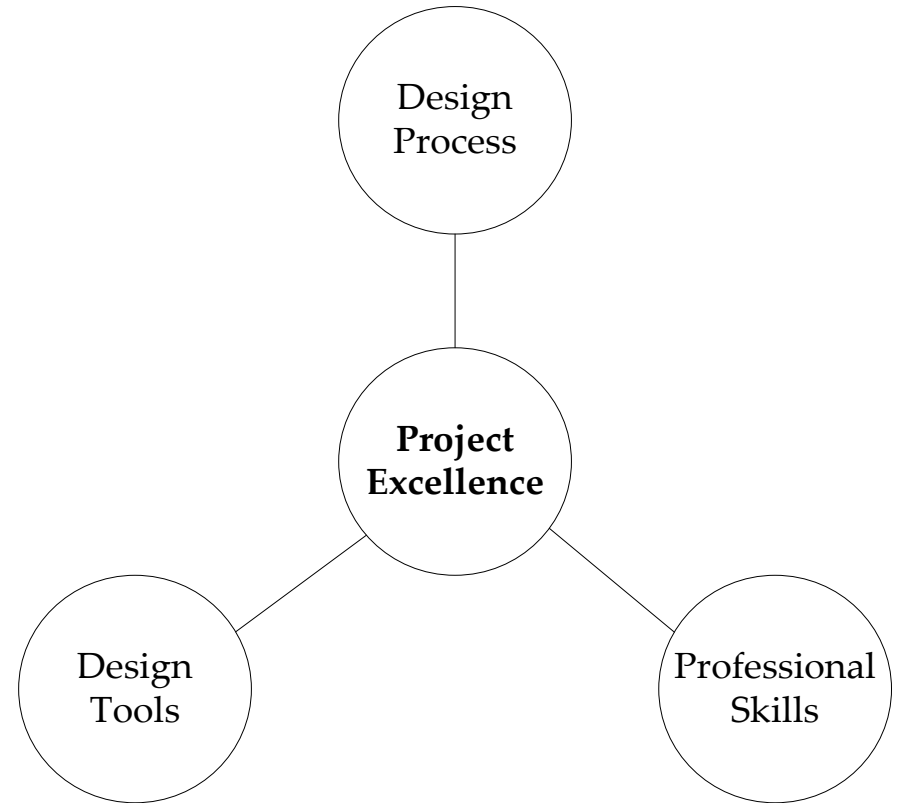


MOTIVATION

Engineers are regularly engaged in projects in their careers!

Middle management continues to shrink

Industry now organizes more around projects than functions.



MOTIVATION, CONT'D

Engineers have led the way on project management, it is now “hot and trendy”.

#1 Area of Continuing Education reported by Penn State Behrend ECE alumni.

Penn State Behrend School of Engineering Survey 2003 of Fortune 500 companies- #1 required skill for new engineers = PROJECT MANAGEMENT SKILLS

THE HOLY GRAIL!

To complete the project

- On-time
- Within budget
- So that it meets the **requirements**

LEARNING OUTCOMES

By the end of this chapter, you should

- ▶ Be able to create a work breakdown structure.
- ▶ Be able to create network diagrams and Gantt charts.
- ▶ Be able to determine the critical path for completing a project and the float time for each activity in the plan.
- ▶ Be able to conduct break-even analysis and understand some basic methods of cost estimation.
- ▶ **APPLY THIS TO YOUR PROJECT – YOU MUST LEARN BY DOING!**

WORK BREAKDOWN STRUCTURE

Work Breakdown Structure (WBS)

Activity



WBS

Tasks

Deliverables

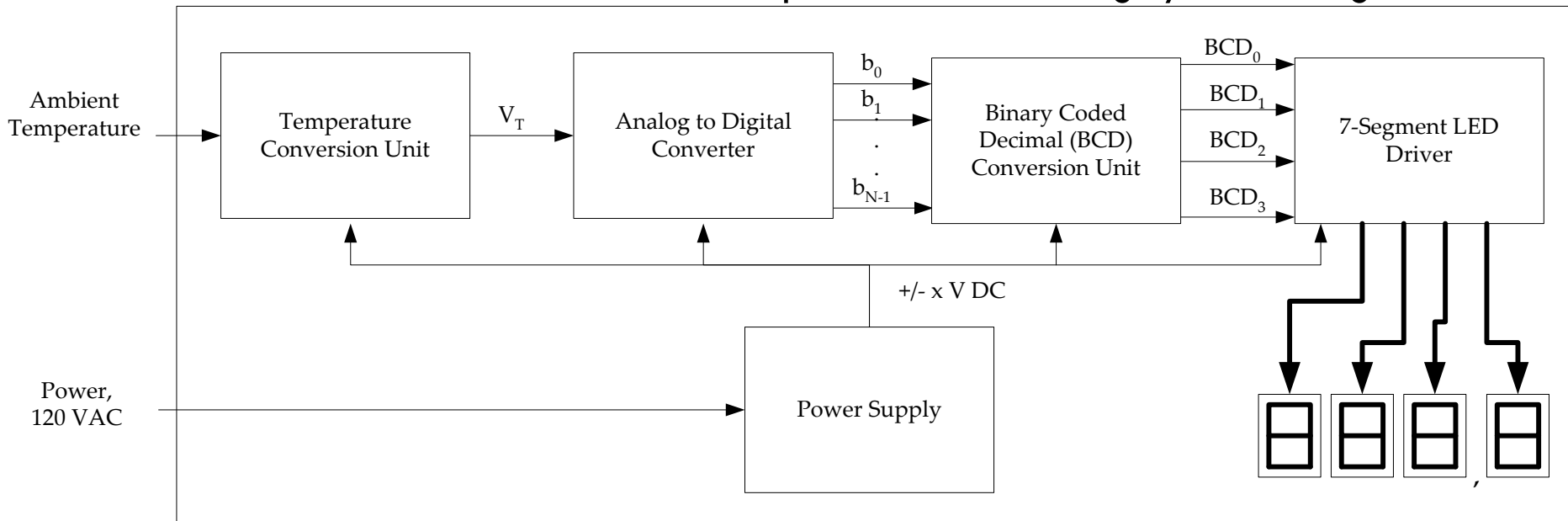
WBS - DEFINITION

From MIL-HDBK 881

- ▶ A product-oriented family tree composed of hardware, software, services, data, and facilities. The family tree results from systems engineering efforts.
- ▶ A WBS displays and defines the product, or products, to be developed and/or produced. It relates the elements of work to be accomplished to each other and to the end product.
- ▶ A WBS can be expressed down to any level of interest. However the top three levels are as far as any program or contract need go unless

EXAMPLE — THERMOMETER DESIGN

Problem: Create the WBS for a temperature monitoring system design



EXAMPLE — THERMOMETER, CONT'D

There are three main tasks

1. The analog interface circuitry.
2. The LED & digital circuitry.
3. Integrate & Test.

EXAMPLE — THERMOMETER, CONT'D

- ▶ **Activity:** Design Circuitry
- ▶ **Description:** Complete the detailed design and verify it.
- ▶ **Deliverables/Checkpoints:** 1) Circuit schematic, and 2) Verify in simulation.
- ▶ **Duration:** 14 days.
- ▶ **People:** Jana (1), Rob (1)
- ▶ **Resources:** PC, SPICE Simulator
- ▶ **Predecessors:** none

EXAMPLE — THERMOMETER DESIGN

ID	Activity	Description	Deliverables / Checkpoints	Duration (days)	People	Resources	Predecessors
1	Interface Circuitry						
1.1	Design Circuitry	Complete the detailed design and verify it in simulation.	<ul style="list-style-type: none"> • Circuit schematic • Simulation verification 	14	Rob (1) Jana (1)	<ul style="list-style-type: none"> • PC • SPICE simulator 	
1.2	Purchase Components		<ul style="list-style-type: none"> • Identify parts • Place order • Receive parts 	10	Rob		1.1
1.3	Construct & Test Circuits	Build and test.					
1.3.1	Current Driver Circuitry	Test of circuit with sensing device.	<ul style="list-style-type: none"> • Test data • Measurement of linearity 	2	Jana (1) Rob (2)	<ul style="list-style-type: none"> • Test bench • Thermometer 	1.2
1.3.2	Level Offset & Gain Circuitry	Test of circuit with voltage inputs.	<ul style="list-style-type: none"> • Test data • Measurement of linearity 	3	Rob (1) Jana (2)	<ul style="list-style-type: none"> • Test bench 	1.2
1.3.3	Integrate Components	Integrate the current driver and offset circuits.	<ul style="list-style-type: none"> • Test data verifying functionality and linearity requirement 	5	Rob (1) Jana (1)	<ul style="list-style-type: none"> • Test bench • Thermometer 	1.3.1 1.3.2

ACTIVITY DURATION ESTIMATES

PERT: Project Evaluation and Review Technique

Statistical methods to estimate project completion time.

Based on earlier studies that show that project task completion follows a Beta probability distribution.

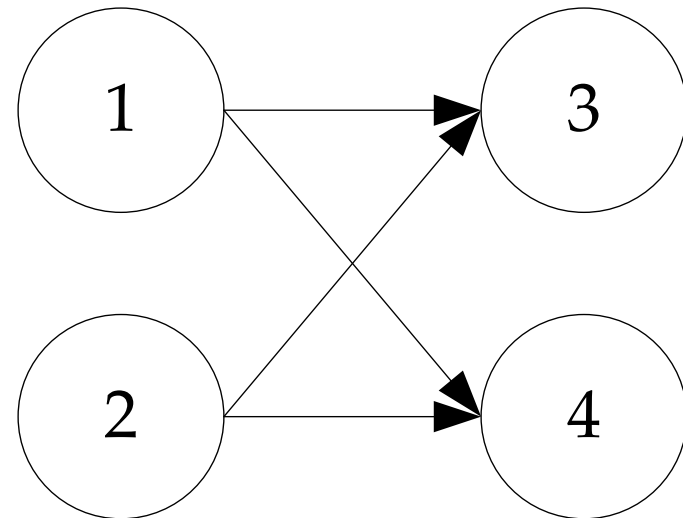
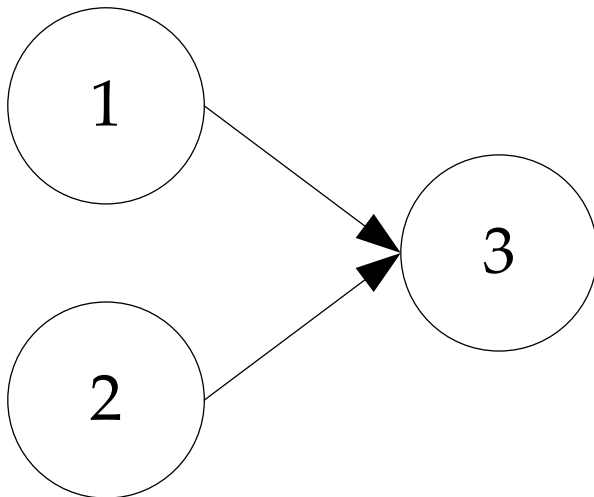
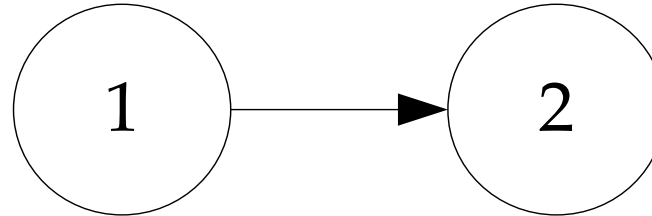
$$t_e = \frac{t_a + 4t_m + t_b}{6}$$

NETWORK DIAGRAMS

A *network diagram* is a ???

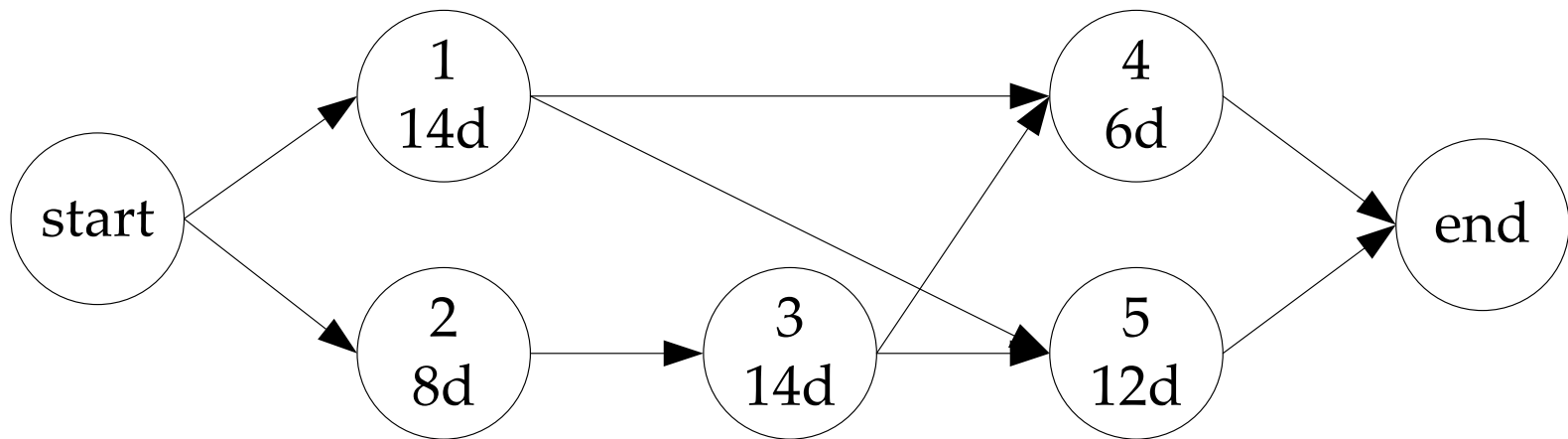
We will use AON (Activity on Node)

AON BASICS



EXAMPLE: NETWORK DIAGRAM

Problem: identify the paths to completion.



NETWORK DIAGRAM DEFINITIONS

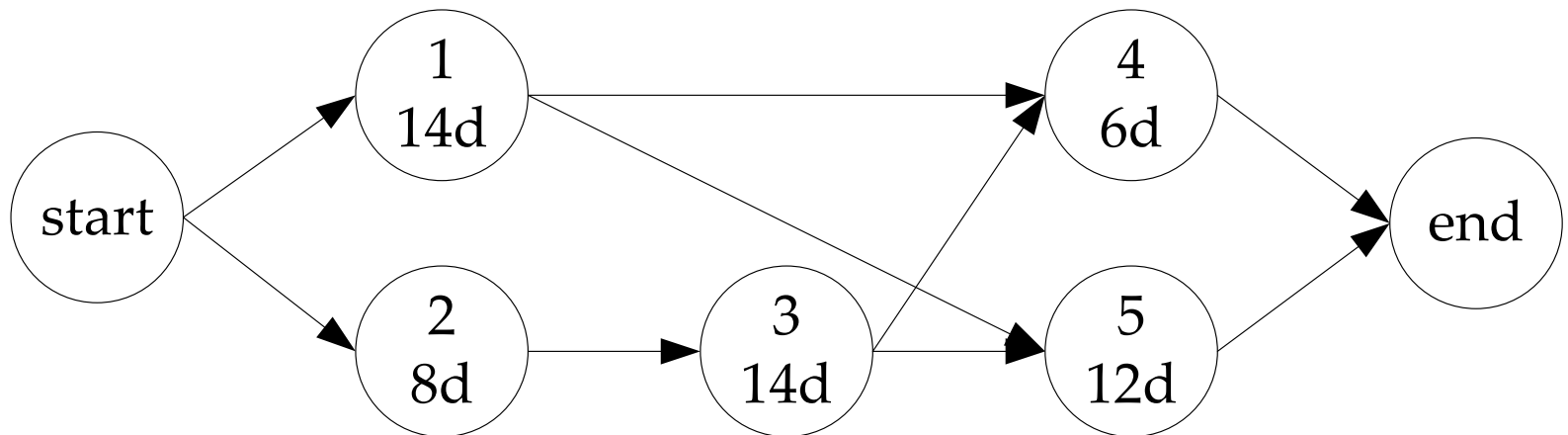
Critical Path =

Slippage =

Float =

EXAMPLE

Problem: Calculate the float for all activities in network.



Task Name	Start	Finish	Duration	Jan 2005		Feb 2005			
				1/16	1/23	1/30	2/6	2/13	2/20
1: Interface Circuitry	1/10/2005	2/22/2005	32d						
1.1: Design Circuitry	1/10/2005	1/27/2005	14d						
1.2: Purchase Components	1/28/2005	2/10/2005	10d						
1.3: Construct & Test Circuits	2/11/2005	2/22/2005	8d						
1.3.1: Current Driver Circuitry	2/11/2005	2/14/2005	2d						
1.3.2: Level Offset & Gain Circuitry	2/11/2005	2/15/2005	3d						
1.3.3: Integrate Components	2/16/2005	2/22/2005	5d						
2: LED & Driver Circuitry	1/10/2005	2/9/2005	23d						
2.1 Research A/D Converters	1/10/2005	1/10/2005	1d						
2.2 Complete Hardware Design	1/11/2005	1/19/2005	7d						
2.3 Purchase LED & Driver Components	1/20/2005	2/2/2005	10d						
2.4: Construct & Test	2/3/2005	2/9/2005	5d						
3: System Integration & Test	2/23/2005	3/3/2005	7d						

COST ESTIMATION

How do you complete projects within cost?

Need to be able to estimate costs for

- System design
- Development
- Manufacture

Basics presented here – complex problem that requires experience.

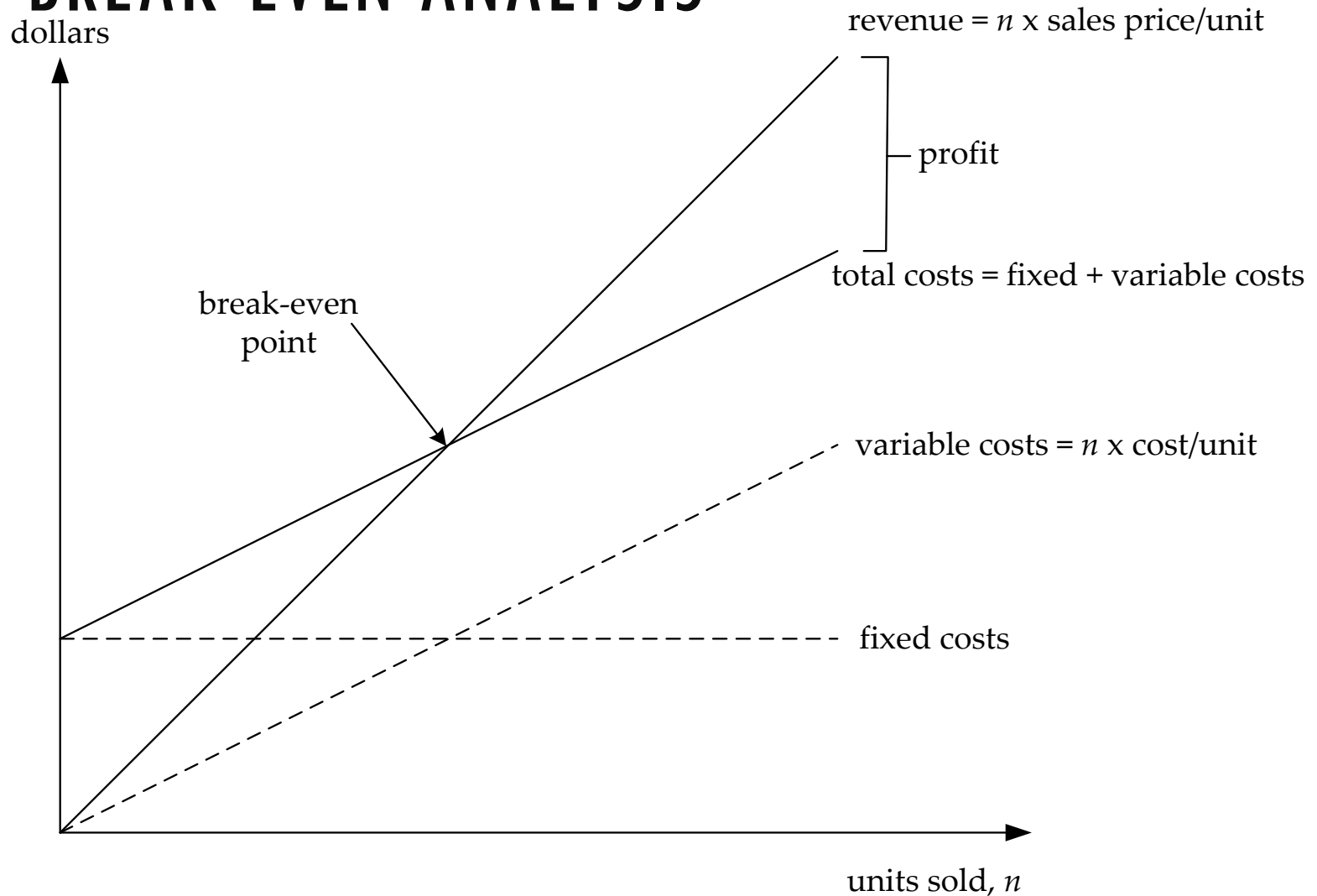
BREAK-EVEN ANALYSIS

Fixed costs

Variable Costs

Break-Even Point

BREAK-EVEN ANALYSIS



COST MODELS

$$\text{cost} = \frac{\text{cost}_a + 4\text{cost}_m + \text{cost}_b}{6}$$

$$\text{effort} = a \times KLOC + b$$

$$\text{effort} = a(KLOC)^b$$

GUIDANCE

- ▶ Take the initial time estimates for activities and double them!
- ▶ Assign a lot of time for testing and integration.
- ▶ Factor in lead times for part ordering.
- ▶ Assign a project manager(s).
- ▶ Do not assign all team members to all tasks.
- ▶ Track the progress versus the plan.
- ▶ Don't become a slave to the plan.
- ▶ Experience counts.

PROJECT APPLICATION

A Project Plan should contain

Work Breakdown Structure. Identify the activities, deliverables, responsibilities, duration, resources, and dependencies.

Gantt Chart and/or Network Diagram. Provide a graphical representation of the project plan.

Costs. Develop a tabulated list of costs and for the equipment, materials, and labor necessary to carry out the project.

SUMMARY

- ▶ Three important objectives of project management are to complete the project
 - On-time
 - Within budget
 - To meet the needs of the user.
- ▶ WBS – hierarchical breakdown of activities needed to complete a project.
- ▶ Network diagram – graphical representation of activities for project – can use for quantitative analysis of project.
- ▶ Cost estimates
 - Break-even analysis
 - Cost estimation models