Cost Estimation and Budgeting

Course Structure

- Introduction
- Projects and Strategy
- Project Selection and Portfolio Management
- **Project Cost Estimation and Budgeting**
- **Project Scheduling: Lagging, Crashing and Activity Networks**
- **Project Scheduling: Networks, Duration estimation, and Critical Path**
- **Risk Management**
- **Resource Management**
- **Project Evaluation and Control**
- **Agile Project Management**
- **Critical Chain Project Scheduling**

Common Sources of Project Cost

- Labor
- Materials
- Subcontractors
- Equipment & facilities
- Travel
- …

Types of Costs

- Direct Vs. Indirect
  - Direct: clearly assigned
  - Indirect: overhead, administration, marketing
- Recurring Vs. Nonrecurring
- Fixed Vs. Variable
- Normal Vs. Expedited ➡ Expedited cost = cost of an activity when it is speeded up

Direct vs. Indirect Costs

- The formula for determining total direct labor costs for a project is straightforward:

(direct labor rate)(total labor hours) =
total direct labor costs

- **Indirect costs** generally are linked to two features: overhead, and selling and general administration.

Total direct labor cost =

(hourly rate) x (hours needed) x (overhead charge) x (personal time)

Direct vs. Indirect Costs

The programmer is paid an annual salary of $75,000, which translates to an hourly rate of approximately $37.50/hour. The programmer's involvement in the new project is expected to be 80 hours over the project's life. Remember, however, that we also need to consider overhead charges. The firm uses an overhead multiplier of 65%.

Hourly rate		Hours needed		Overhead charge		Total direct labor cost
($37.50)	*	(80)	*	(1.65)	=	$4,950

Direct vs. Indirect Costs

- Meredith and Mantel (2003) have argued that if such personal time is not included in the original total labor cost estimate, a multiplier of 1.12 should be used to reflect this charge, increasing the direct labor cost of our senior programmer to

Hourly rate		Hours needed		Overhead charge		Personal Time		Total direct labor cost
($37.50)	×	(80)	×	(1.65)	×	(1.12)	=	$5,544

- The use of overhead (indirect costs) involves the manner in which overhead may be differentially applied across job categories.

Recurring Vs. Nonrecurring Costs

- Nonrecurring costs might be those associated with charges applied once at the beginning or end of the project, such as preliminary marketing analysis, personnel training, or outplacement services.

- Recurring costs are those that typically continue to operate over the project's life cycle. Most labor, material, logistics, and sales costs are considered recurring because some budgetary charge is applied against them throughout significant portions of the project development cycle.

Fixed Vs. Variable Costs

- Fixed costs, For example, when leasing capital equipment or other project hardware, the leasing price is likely not to go up or down with the amount of usage the equipment receives. Whether a machine is used for 5 hours or 50, the cost of its rental is the same. When entering fixed-rate contracts for equipment, a common decision point for managers is whether the equipment will be used sufficiently to justify its cost.

- Variable costs are those that accelerate or increase through usage; that is, the cost is in direct proportion to the usage level. Suppose, for example, we used an expensive piece of drilling equipment for a mining operation.

Normal Vs. Expedited Costs

- Normal costs refer to those incurred in the routine process of working to complete the project according to the original, planned schedule agreed to by all project stakeholders at the beginning of the project (based on the baseline project plan).

- Expedited costs are unplanned costs incurred when steps are taken to speed up the project's completion.

Cost estimation

- Clear definition of project costs at the beginning decreases the possibility of estimation errors.
- With greater initial accuracy the likelihood of completing within budget estimates is greater.
- To be able to create good estimations the project must be broken down by deliverables, work packages and tasks.

Cost Estimation Methods

1. **Ballpark estimates**— used when either information or time is scarce.
2. **Comparative estimates**—based on the assumption that historical data can be used as a frame of reference for current estimates on similar projects.
3. **Feasibility estimates**—based as a guideline on real numbers, or figures derived after the completion of the preliminary project design work.
4. **Definitive estimates**—given only upon the completion of most design work, at a point when the scope and capabilities of the project are quite well understood.

Learning Curves

- Experience and common sense teach us that repetition of activities often leads to reduction in the time necessary to complete the activity over time.

$$Y_x = aX^b$$

Where:

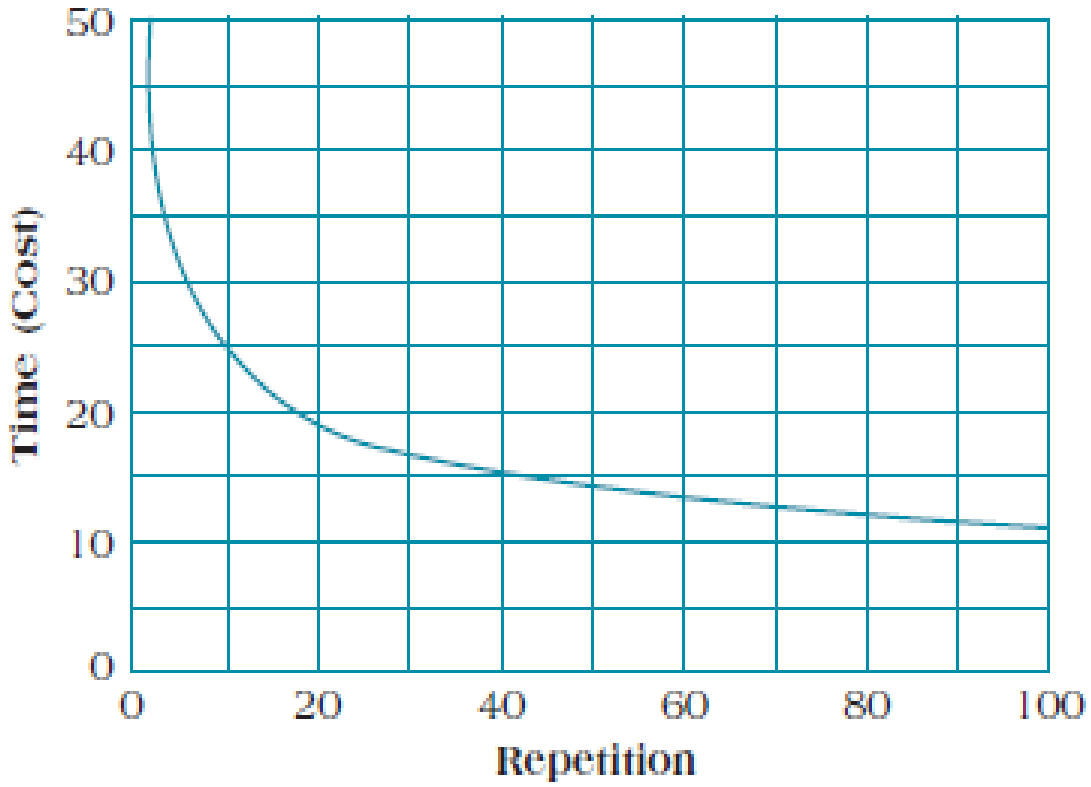
Y_x = time required for the x unit of output

a = time required for the initial unit of output

X = the number of units to be produced

b = learning curve slope = log(learning %)/log(2)

Learning Curves

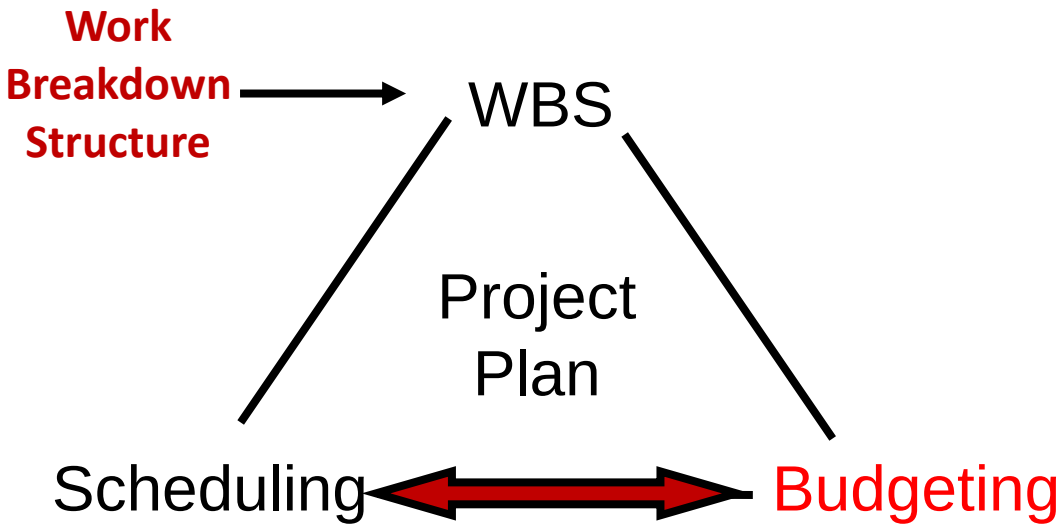


Problems with Cost Estimation

- ✓ Low initial estimates
- ✓ Unexpected technical difficulties
- ✓ Lack of definition
- ✓ Specification changes
- ✓ External factors

Budgeting

Creating a Project Budget



The *budget is a plan* that identifies the resources, goals and schedule that allows a firm to achieve those goals

- Top-down: from overall project costs to major wp-s
- Bottom-up: from work packages to overall project cost
- Activity-based costing (ABC)

Budget Contingencies

The allocation of extra funds to cover uncertainties and improve the chance of finishing on time.

Contingencies are needed because

- Project scope may change
- Cost estimation must anticipate interaction costs
- Normal conditions are rarely encountered

Planned and actual costs

- Planned cost – Committed cost = Cost variance
- Variance can be positive or negative
- Negative variance is always bad, but the positive is not necessarily good.

Examples

- What is the variance if the budgeted cost is 200 and the actual cost is 250?

200 – 250 = variance thus
Variance = -50

- What is the actual cost if the budgeted cost is 2000 and the variance is 500?

2000 – actual cost = 500 thus
Actual cost = 1500

- What is the planned cost, if the actual cost is 120 and the variance is -30?

Planned cost – 120 = -30 thus
Planned cost = 90

Example

- There is a project with three activites planned for a year
  - ‘a’ with a planned cost of 1000,
  - ‘b’ with a planned cost of 500 and
  - ‘c’ with a planned cost of 1500.
- ‘a’ activity turned out to be more expensive (with an additional 200).
- ‘b’ was done as budgeted.
- ‘c’ is not finished in the year, and only 1000 was spent on it.
- An additional ‘d’ activity was needed and performed with a cost of 300.

- What is the cost variance for the given year?

(1000+500+1500) – (1200+500+1000+300) = 0

Cost & schedule variances

- For any instant we can calculate:
  - BCWS: budgeted cost of work scheduled
  - BCWP: budgeted cost of work performed
  - ACWP: actual cost of work performed
- From these, two variances can be derived:
  - Schedule variance in cost terms = BCWP – BCWS
  - Cost variance = BCWP – ACWP

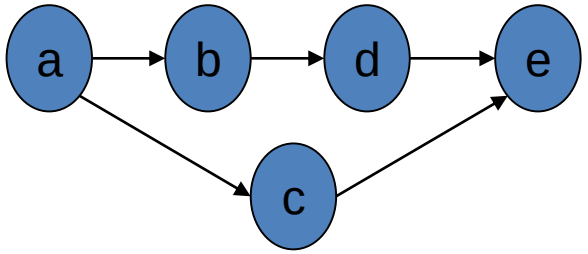
Cost & schedule variances

"Test hardware" estimated to run from 1 January to 10 January and to cost $1000, and that this is a simple effort with no overhead or allocated costs. However on 5 January, halfway through the time allowed, the work is 30% complete and has spent $250.

1. BCWP is $1000 (budgeted cost) times 30% = $300
2. BCWS is $1000 (budgeted cost) times 50% = $500
3. ACWP is $250

Problem solving

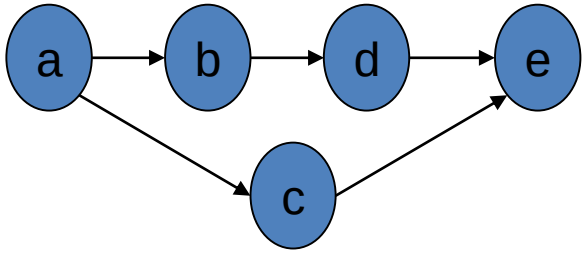
- There is a small project with the following network diagram:



- The following table contains the information on the activity durations and costs:

Activity label	Duration (day)	Cost of the activity
a	1	100
b	1	50
c	2	60
d	3	90
e	2	40

- Plot a Gantt chart from the information above and calculate the BCWS for every day of the project.



Solution

Task	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
A	100						
B		50					
C		30	30				
D			30	30	30		
E						20	20
BCWS	**100**	**180**	**240**	**270**	**300**	**320**	**340**

Problem solving

- In the previous project, the project manager receives a progress report of the first 4 days, with the following information:
  - Activity ‘a’ is completed
  - Activity ‘b’ is completed
  - Activity ‘c’ is 50% completed
  - Activity ‘d’ is 33.33% completed
  - Costs are calculated with completition ratio
- ***Calculate BCWP for the first 4 days***

Solution

BCWP = 100 + 50 + 0.5(60) + 0.33(90) = 210