Cost Management

What is project cost management?
Estimating costs.
Budgeting.
Control Cost

Objectives of Project's Cost Management

- To guarantee that all expenses will be covered – Budgeting:
  - Itemizing costs
  - Assessing the money needed
  - Define risks and set aside reserves

- Managing Cash-Flow
  - Guarantee that money will be available when needed
  - Generate some additional income

The Importance of Project Cost Management

* IT projects have a poor track record for meeting budget goals
* The CHAOS studies found the average cost **overrun** (the additional percentage or dollar amount by which actual costs exceed estimates) ranged from 180 percent in 1994 to 56 percent in 2004; other studies found overruns to be 33-34 percent

What Went Wrong?

- The U.S. government, especially the Internal Revenue Service (IRS), continues to provide examples of how not to manage costs
  - A series of project failures ... the IRS ... cost taxpayers ...
  - In 2006, th... ... fraudulent refu...
  - A 200... ...eport stated ...cts, worth an es... ...ing... und...
- T... ...Health Service IT modernization program was called the greatest IT disaster in history with an estimated $26 billion overrun

One task for Student Government:

What is the actual cost overrun of the BlackBoud Project?

What is Cost and Project Cost Management?

- **Cost** is a resource sacrificed or foregone to achieve a specific objective or something given up in exchange
- Costs are usually measured in monetary units like dollars
- **Project cost management** includes the processes required to ensure that the project is completed within an approved budget

Project Cost Management Processes

- **Estimating costs**: developing an approximation or estimate of the costs of the resources needed to complete a project
- **Determining the budget**: allocating the overall cost estimate to individual work items to establish a baseline for measuring performance
- **Controlling costs**: controlling changes to the project budget
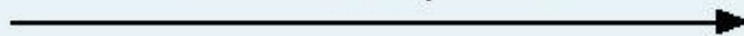
Project Cost Management Summary

Planning
Process: **Estimate costs**
Outputs: Activity cost estimates, basis of estimates, project document updates
Process: **Determine budget**
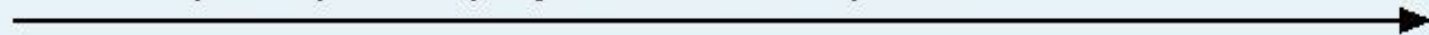Outputs: Cost performance baseline, project funding requirements, product document updates

Monitoring and Controlling
Process: **Control costs**
Outputs: Work performance measurements, budget forecasts , organizational process assets updates, change requests, project management plan updates, project document updates

Project Start   **Project Finish**

Basic Principles of Cost Management

Most members of an executive board better understand and are more interested in financial terms than IT terms, so IT project managers must speak their language

- **Profits** are revenues minus expenditures
- **Profit margin** is the ratio of revenues to profits
- **Life cycle costing** considers the total cost of ownership, or development plus support costs, for a project
- **Cash flow analysis** determines the estimated annual costs and benefits for a project and the resulting annual cash flow

What Went Right?

- Many organizations use IT to reduce operational costs
- Technology has decreased the costs associated with processing an ATM transaction:
  - In 1968, the average cost was $5
  - In 1978, the cost went down to $1.50
  - In 1988, the cost was just a nickel
  - In 1998, it only cost a penny
  - In 2008, the cost was just half a penny!
- Investing in green IT and other initiatives has helped both the environment and companies' bottom lines; Michael Dell, CEO of Dell, reached his goal to make his company "carbon neutral" in 2008

Basic Principles of Cost Management

- **Tangible costs** or **benefits** are those costs or benefits that an organization can easily measure in dollars

- **Intangible costs** or **benefits** are costs or benefits that are difficult to measure in monetary terms

- **Direct costs** are costs that can be directly related to producing the products and services of the project

- **Indirect costs** are costs that are not directly related to the products or services of the project, but are indirectly related to performing the project

- **Sunk cost** is money that has been spent in the past; when deciding what projects to invest in or continue, you should *not* include sunk costs

Basic Principles of Cost Management

- **Learning curve theory** states that when many items are produced repetitively, the unit cost of those items decreases in a regular pattern as more units are produced
- **Reserves** are dollars included in a cost estimate to mitigate cost risk by allowing for future situations that are difficult to predict
  - **Contingency reserves** allow for future situations that may be partially planned for (sometimes called **known unknowns**) and are included in the project cost baseline
  - **Management reserves** allow for future situations that are unpredictable (sometimes called **unknown unknowns**)

Estimating Costs

- Project managers must take cost estimates seriously if they want to complete projects within budget constraints

- It's important to know the types of cost estimates, how to prepare cost estimates, and typical problems associated with IT cost estimates

Types of Cost Estimates

TYPE OF ESTIMATE	WHEN DONE	WHY DONE	HOW ACCURATE
Rough Order of Magnitude (ROM)	Very early in the project life cycle, often 3–5 years before project completion	Provides estimate of cost for selection decisions	−50% to +100%
Budgetary	Early, 1–2 years out	Puts dollars in the budget plans	−10% to +25%
Definitive	Later in the project, less than 1 year out	Provides details for purchases, estimates actual costs	−5% to +10%

Cost Management Plan

- A **cost management plan** is a document that describes how the organization will manage cost variances on the project

- A large percentage of total project costs are often labor costs, so project managers must develop and track estimates for labor

efforts estimation * cost per hour

Consider risks and uncertainty!

Cost Estimation Tools and Techniques

Basic tools and techniques for cost estimates:

- **Analogous** or **top-down estimates**: use the actual cost of a previous, similar project as the basis for estimating the cost of the current project

- **Bottom-up estimates**: involve estimating individual work items or activities and summing them to get a project total

- **Parametric modeling** uses project characteristics (parameters) in a mathematical model to estimate project costs

Typical Problems with IT Cost Estimates

- Estimates are done too quickly

- Lack of estimating experience

- Human beings are biased toward underestimation

- Management desires accuracy (uncertainty?)

Sample Cost Estimate

- Before creating an estimate, know what it will be used for, gather as much information as possible, and clarify the ground rules and assumptions for the estimate

- If possible, estimate costs by major WBS categories

- Create a cost model to make it easy to make changes to and document the estimate

Surveyor Pro Project Cost Estimate

WBS Items	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	WBS Level 1 Totals	% of Total
1. Project Management				$306,300	20%
Project manager	960	$100	$96,000		
Project team members	1920	$75	$144,000		
Contractors (10% of software development and testing)			$66,300		
2. Hardware				$76,000	5%
2.1 Handheld devices	100	$600	$60,000		
2.2 Servers	4	$4,000	$16,000		
3. Software				$614,000	40%
3.1 Licensed software	100	$200	$20,000		
3.2 Software development*			$594,000		
4. Testing (10% of total hardware and software costs)			$69,000	$69,000	5%
5. Training and Support				$202,400	13%
Trainee cost	100	$500	$50,000		
Travel cost	12	$700	$8,400		
Project team members	1920	$75	$144,000		
6. Reserves (20% of total estimate)			$253,540	$253,540	17%
Total project cost estimate				$1,521,240	

* See software development estimate

Surveyor Pro Software Development Estimate

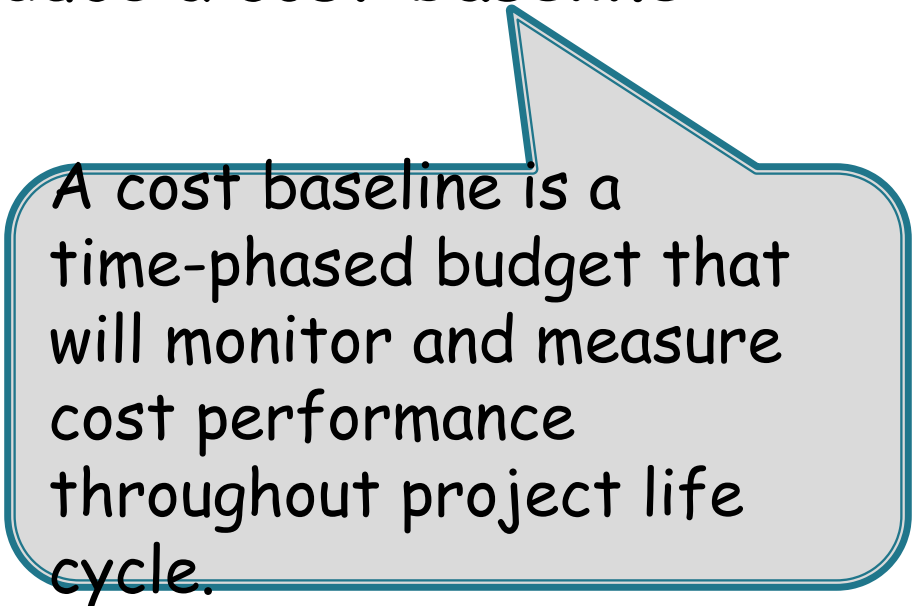**Surveyor Pro Software Development Estimate Created October 5**

1. Labor Estimate	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	Calculations
Contractor labor estimate	3000	$150	$450,000	3000*150
Project team member estimate	1920	$75	$144,000	1920*75
Total labor estimate			**$594,000**	Sum above two values
2. Function point estimate**	Quantity	Conversion Factor	Function Points	Calculations
External inputs	10	4	40	10*4
External interface files	3	7	21	3*7
External outputs	4	5	20	4*5
External queries	6	4	24	6*4
Logical internal tables	7	10	70	7*10
Total function points			**175**	Sum above function point values
Java 2 languange equivalency value			46	Assumed value from reference
Source lines of code (SLOC) estimate			8,050	175*46
Productivity*KSLOC^Penalty (in months)			29.28	3.13*8.05^1.072 (see reference)
Total labor hours (160 hours/month)			4,684.65	29.28*160
Cost/labor hour ($120/hour)			$120	Assumed value from budget expert
Total function point estimate			**$562,158**	4684.65*120

**Approach based on paper by William Roetzheim, "Estimating Software Costs," Cost Xpert Group, Inc. (2003) using the COCOMO II default linear productivity factor (3.13) and penalty factor (1.072).

Determining the Budget

- Cost budgeting involves allocating the project **cost estimate** to individual work items **over time**

- The WBS is a required input to the cost budgeting process since it defines the work items

- Important goal is to produce a **cost baseline**

> A cost baseline is a time-phased budget that will monitor and measure cost performance throughout project life cycle.

Surveyor Pro Project Cost Baseline

Surveyor Pro Project Cost Baseline Created October 10*

WBS Items	1	2	3	4	5	6	7	8	9	10	11	12	Totals
1. Project Management													
1.1 Project manager	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	96,000
1.2 Project team members	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	144,000
1.3 Contractors		6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	66,300
2. Hardware													
2.1 Handheld devices				30,000	30,000								60,000
2.2 Servers				8,000	8,000								16,000
3. Software													
3.1 Licensed software				10,000	10,000								20,000
3.2 Software development		60,000	60,000	80,000	127,000	127,000	90,000	50,000					594,000
4. Testing			6,000	8,000	12,000	15,000	15,000	13,000					69,000
5. Training and Support													
5.1 Trainee cost									50,000				50,000
5.2 Travel cost									8,400				8,400
5.3 Project team members							24,000	24,000	24,000	24,000	24,000	24,000	144,000
6. Reserves				10,000	10,000	30,000	30,000	60,000	40,000	40,000	30,000	3,540	253,540
Totals	20,000	86,027	92,027	172,027	223,027	198,027	185,027	173,027	148,427	90,027	80,027	53,567	1,521,240

Controlling Costs

- Project cost control includes:
  - Monitoring cost performance
  - Ensuring that only appropriate project changes are included in a revised cost baseline
  - Informing project stakeholders of authorized changes to the project that will affect costs
- Many organizations around the globe have problems with cost control

Project Portfolio Management

- Many organizations collect and control an entire suite of projects or investments as one set of interrelated activities in a portfolio

- Five levels for project portfolio management

  1. Put all your projects in one database

  2. Prioritize the projects in your database

  3. Divide your projects into two or three budgets based on type of investment

  4. Automate the repository

  5. Apply modern portfolio theory, including risk-return tools that map project risk on a curve

Benefits of Portfolio Management

- Schlumberger saved $3 million in one year by organizing 120 information technology projects into a portfolio
- ROI of implementing portfolio management software by IT departments:
    - Savings of 6.5 percent of the average annual IT budget by the end of year one
    - Improved annual average project timeliness by 45.2 percent
    - Reduced IT management time spent on project status reporting by 43 percent and IT labor capitalization reporting by 55 percent
    - Decreased the time to achieve financial sign-off for new IT projects by 20.4 percent, or 8.4 days

Best Practice

A global survey released by Borland Software in 2006 suggests that many organizations are still at a low level of maturity in terms of how they define project goals, allocate resources, and measure overall success of their information technology portfolios; some of the findings include the following:

- Only 22 percent of survey respondents reported that their organization either effectively or very effectively uses a project plan for managing projects
- Only 17 percent have either rigorous or very rigorous processes for project plans, which include developing a baseline and estimating schedule, cost, and business impact of projects
- Only 20 percent agreed their organizations monitor portfolio progress and coordinate across inter-dependent projects

Cost-Benefit and Cash-Flow

Steps:

- Identifying and estimating all of the costs and benefits of carrying out the project and operating the system

- Express the costs and benefits in common units (e.g. $)

- Evaluate the result:

  - Consider the cost of the capital (interest rate);

  - The cost spend over time (life cycle of investment)

Cash-flow Measures

year	P1	P2	P3	P4
0	-100,000	-1,000,000	-100,000	-120,000
1	10,000	200,000	30,000	30,000
2	10,000	200,000	30,000	30,000
3	10,000	200,000	30,000	30,000
4	20,000	200,000	30,000	30,000
5	100,000	300,000	30,000	75,000
Net profit	50,000	100,000	50,000	75,000

net profit =
= benefit - cost

PBP – 5th year

PBP – 5th year

PBP – 4th year

PBP – 4th year

Pay-back period: break-even point

Return of Investments (ROI)
*ROI = (average_annual_profit/total investment) * 100*

Cash-flow Measures

year	P1	P2	P3	P4
0	-100,000	-1,000,000	-100,000	-120,000
1	10,000	200,000	30,000	30,000
2	10,000	200,000	30,000	30,000
3	10,000	200,000	30,000	30,000
4	20,000	200,000	30,000	30,000
5	100,000	300,000	30,000	75,000
Net profit	50,000	100,000	50,000	75,000

Return on investment (ROI or accounting rate of return ARR) =
(average_annual_profit/total investment) * 100

Average annual profit (P1) = 50,000/5 = 10,000
ROI(P1) = (10,000/100,000) * 100 = 10%;
ROI(P2) = (20,000/1,000,000)*100 = 2%;
ROI(P3) = (10,000/100,000)*100 = 10%
ROI(P4) = (15,000/120,000)*100 = 12.5%

Cash-flow Measures

Net present value: *PV = (value in year t)/(1+ r)^t*

Discount rate e.g. interest rate

Discount factor: *1/(1+r)^t*

Table of NPV discount factors

Discount rates

Year	5%	8%	10%
1	0.9524	0.9259	0.9091
2	0.9070	0.8573	0.8264
3	0.8638	0.7938	0.7513

100/(1+0.1)=0.9091

NPV for Project 1

year	Cash-flow	Discount factor (10%)	Discount cash-flow
0	-100,000	1.0000	-100,000
1	10,000	0.9091	9,091
2	10,000	0.8264	8,264
3	10,000	0.7513	7,513
4	20,000	0.6830	13,660
5	100,000	0.6209	62,090
Net profit	50,000		NPV: 618

Cash-flow Measures

Internal rate of return: measure of profitability in terms of percentage return – directly comparable with interest rate.

Discount rate that will turn NPV to zero
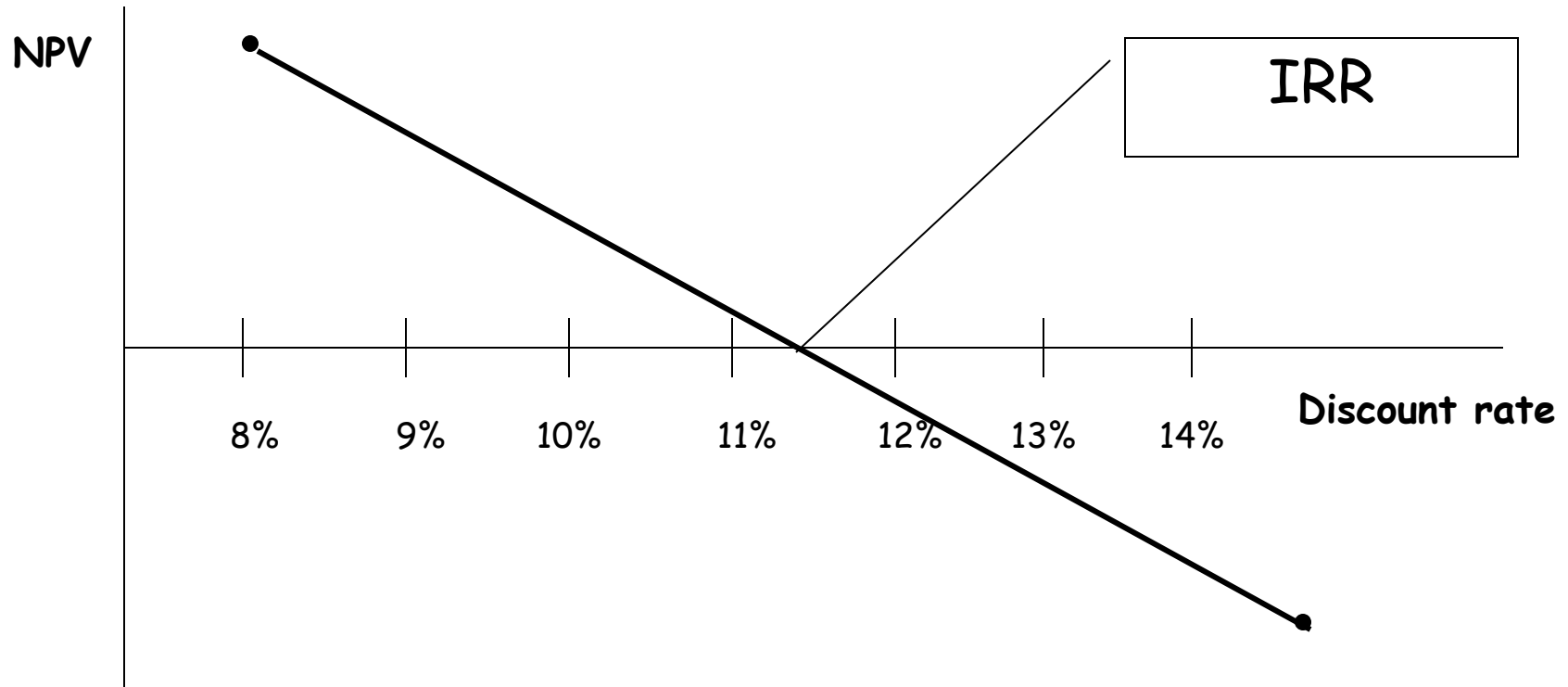
Earned Value Management (EVM)

- **EVM** is a project performance measurement technique that integrates scope, time, and cost data

- Given a **baseline** (original plan plus approved changes), you can determine how well the project is meeting its goals

- You must enter actual information periodically to use EVM

- More and more organizations around the world are using EVM to help control project costs

Earned Value Management Terms

- The **planned value (PV)**, formerly called the budgeted cost of work scheduled (BCWS), also called the budget, is that portion of the approved total cost estimate planned to be spent on an activity during a given period

- **Actual cost (AC)**, formerly called actual cost of work performed (ACWP), is the total of direct and indirect costs incurred in accomplishing work on an activity during a given period

- The **earned value (EV)**, formerly called the budgeted cost of work performed (BCWP), is an estimate of the value of the physical work actually completed

- EV is based on the original planned costs for the project or activity and the rate at which the team is completing work on the project or activity to date

Rate of Performance

- **Rate of performance (RP)** is the ratio of actual work completed to the percentage of work planned to have been completed at any given time during the life of the project or activity

- Brenda Taylor, Senior Project Manager in South Africa, suggests this term and approach for estimating earned value

- For example, suppose the server installation was halfway completed by the end of week 1: the rate of performance would be 50% because by the end of week 1, the planned schedule reflects that the task should be 100 percent complete and only 50 percent of that work has been completed

Earned Value Calculations for One Activity after Week One

ACTIVITY	WEEK 1
Earned Value (EV)	5,000
Planned Value (PV)	10,000
Actual Cost (AC)	15,000
Cost Variance (CV)	−10,000
Schedule Variance (SV)	−5,000
Cost Performance Index (CPI)	33%
Schedule Performance Index (SPI)	50%

Earned Value Formulas

Term	Formula
Earned Value	$EV = PV \text{ to date} \times RP$
Cost Variance	$CV = EV - AC$
Schedule Variance	$SV = EV - PV$
Cost Performance Index	$CPI = EV/AC$
Schedule Performance Index	$SPI = EV/PV$
Estimate at Completion (EAC)	$EAC = BAC/CPI$
Estimated Time to Complete	Original Time Estimate/SPI

Rules of Thumb for Earned Value Numbers

⬜ Negative numbers for cost and schedule variance indicate problems in those areas

⬜ CPI and SPI less than 100% indicate problems

⬜ Problems mean the project is costing more than planned (over budget) or taking longer than planned (behind schedule)

⬜ The CPI can be used to calculate the **estimate at completion** (EAC), an estimate of what it will cost to complete the project based on performance to date; the **budget at completion** (BAC) is the original total budget for the project

Earned Value Chart for Project after Five Months