SPM
Project Cost Management

Day 7: Project Cost Management

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Last Class We Discussed

- What is Project Time Management ?

- Project Time Management Processes

- Myers-Briggs Personality Type Indicators

- Network Diagrams - ADM & PDM

- Task Dependencies

- SMART Criteria

- Determining Critical Path

- PERT

- Agile and Time Management

Today's Learning Objectives

- What is Project Cost Management ?

- Project Cost Management Processes

- Types of Costs/Benefits

- Learning Curve Theory

- Types of Cost Estimates

- Cost Estimation Tools and Techniques

- EVM (Earned Value Management)

- EVM Terminologies

- Project Portfolio Management

Importance of Cost Management

↪ **IT Projects** have a poor track record for meeting budget goals.

↪ A **cost overrun** is the additional percentage or dollar amount by which actual costs exceed estimates

↪ A 2011 Harvard Business Review study reported an average cost overrun of 27 percent. The most important finding was the discovery of a large number of gigantic overages or "black swans"

Case Study - What Went Wrong ?

UK's National Health Service IT modernization program was called the greatest IT disaster in history with an estimated **$26 billion overrun**

The program had problems due to incompatible systems, resistance from physicians, and arguments among contractors about who's responsible for what

It finally got scrapped in 2011

What is Cost and Cost Management ?

- Cost is a resource sacrificed or foregone to achieve a specific objective or something given up in exchange to meet project goals.
- Costs are usually measure in monetary units like dollars or other currencies.
- Tech professional often treat cost overrun lightly as it seems to be a common understanding that requirements and scope are often bound to increase as project moves forward in tech.
- Cost Estimates are also often associated with Accounting and therefore ignored by IT professionals and Managers alike.
- Other aspects like - adapting to newer technologies, business process and methodologies also impact cost overruns.

Cost management process

Resource planning

Cost estimation

Budgeting

Cost control

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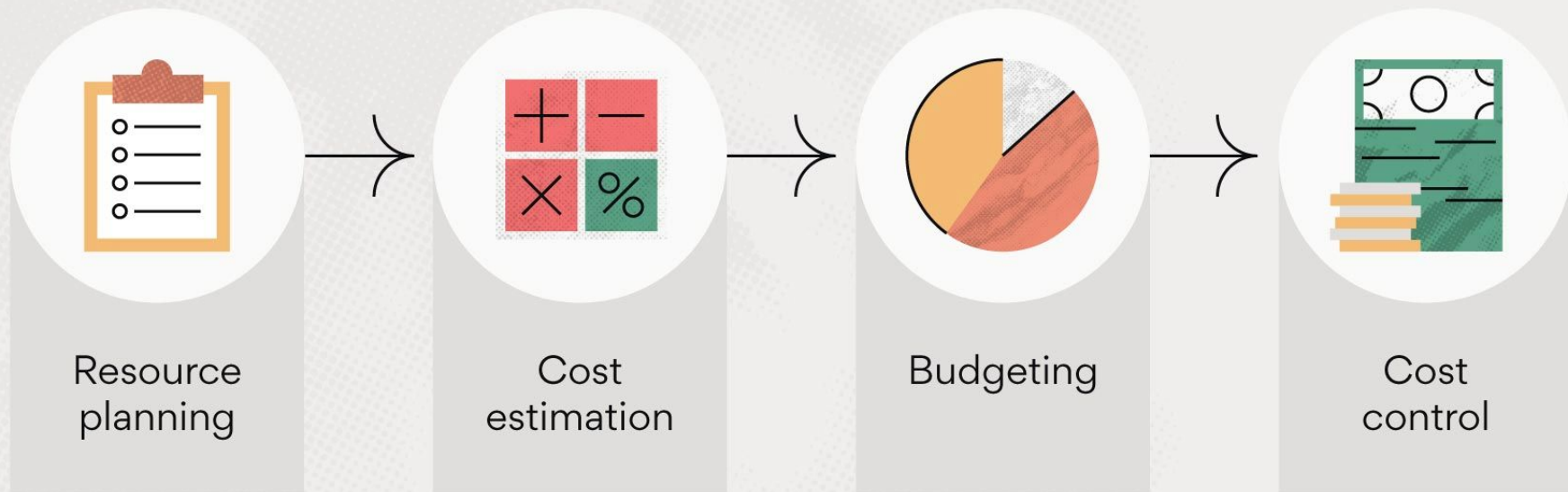
Project Cost Management Processes

1. **Resource Planning** : Determining policies, procedures, and documentation that will be used for planning, executing and controlling project cost.

2. **Cost Estimation**: Developing an approximation or estimate of the costs of the resources needed to complete a project

3. **Budgeting**: Allocating the overall cost estimate to individual work items to establish a baseline for measuring performance.

4. **Cost Control**: Controlling changes to the project budget.

Project Cost Management Process Flow

Planning

Process: **Plan cost management**

Outputs: Cost management plan

Process: **Estimate costs**

Outputs: Activity cost estimates, basis of estimates, project documents updates

Process: **Determine budget**

Outputs: Cost baseline, project funding requirements, project documents updates

Monitoring and Controlling

Process: **Control costs**

Outputs: Work performance information, cost forecasts, change requests, project management plan updates, project documents updates, organizational process assets updates

Project Start

Project Finish

Basic Principles

Because most executive board members are more interested and have better understanding in financial terminologies that IT terms, it is advisable for IT Project managers to speak their language:

- Profits are revenues minus expenditure

- Profit Margin is the ratio of revenue 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

- ROI cannot be measured unless benefits measurement process is in place.

Case Study

A 2015 report by Project Management Institute (PMI) found that

Only 20% of organizations report having a high level of benefits realization maturity

39% of high performing organizations report high benefits realization maturity compared to 9 percent of low performers

Michael Dell, CEO of Dell, reached his goal to make his company "carbon neutral" in 2008.

As of March 2012, Dell had helped its customers save almost $7 billion in energy costs

In 2014 Dell reported being on track toward reaching their goal of recovering 2 billion pounds of used electronics by 2020.

You can actually download their current carbon footprint whitepaper from their website.

Types of Costs and Benefits

Tangible costs/benefits - easily measurable (monetarily) i.e in currencies.

Intangible costs/benefits - difficult to measure in monetary terms

Direct Costs - Directly related to the products and services of the project. PM(s) should focus on direct costs as they can be controlled.

Indirect Costs - Costs not directly related but can yet impact the performance of the project

Sunk Cost - Money spent in past. It is important to remember not to get emotional about sunken costs and make decisions based on it.

Learning Curve Theory

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**: for the <u>known-unknowns</u>, i.e. future situation that are predetermined or partially planned for.
- **Management Reserves**: for the <u>unknown-unknowns</u> i.e. for unpredictable situations

1) Planning Cost Management

Expert judgement, analytical techniques and meetings are all required for planning proper cost management.

Cost Management Plan includes:

- Level of accuracy and units of measure
- Organizational procedure links (on the basis of WBS)
- Control Thresholds - Just like schedule variance, costs often have a specified amount of variation i.e cost variance allowed before action needs to be taken, often 10% of the baseline costs
- Rules of performance measurement - Earned Value Management (EVM)
- Reporting Formats
- Process Descriptions

2) Cost Estimation

Cost estimation must be taken seriously if projects are to be completed within budget constraints.

What's important ?

- Types of cost estimates,

- HOW to prepare estimates

- And typical problems associated with 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	−25% to +75%
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 Estimation Tools and Techniques

Cost Estimation Effort should be an integral part of comprehensive planning and design process in Project Management requiring active participation of engineering designers, marketing, manufacturing, finance, and top/upper management.

There are 3 basic tools/techniques for cost management for IT PM:

Top-down or Analogous Estimate: use actual cost of previous or similar project for estimating current project cost

Bottom-up estimates: Estimate individual work/activities or process cost and summing it up to find a project total estimate

Parametric Modeling: use Project characteristics/parameters in a mathematical model to estimate project costs

Survey on Software Cost Estimation Techniques
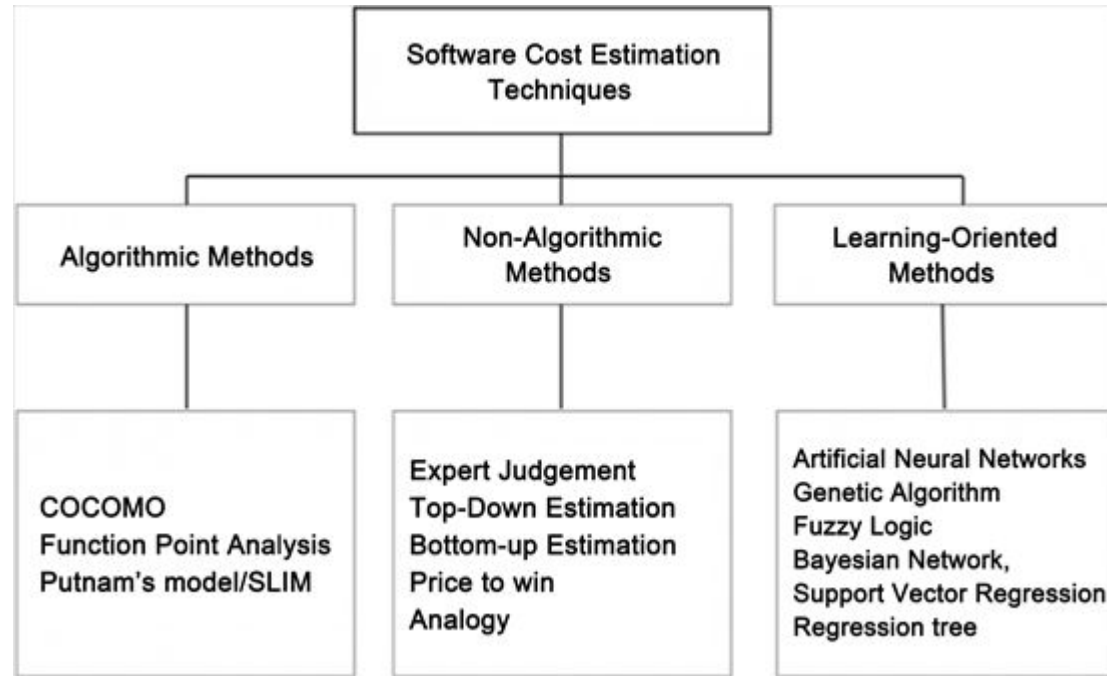
COCOMO Model (Constructive Cost Model)

It is a single variable software cost estimation model developed by Barry Boehm in 1981.

It uses a basic regression formula, with parameters that are derived from historical project data and current project characteristics.

Heirarchy/Types of COCOMO model:

- BASIC - quick/rough estimate
- Intermediate - moderate investigation/estimate
- Detailed

Surveyor Pro Project Cost Estimates (sample)

Surveyor Pro Project Cost Estimate Created October 5	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	WBS Level 2 Totals	% of Total
WBS Items					
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

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 language 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 (27 hours/function point)*			4,725	27*175
Cost/labor hour ($120/hour)			$120	Assumed value from budget expert
Total function point estimate			**$567,000**	4,725 *120

* Based on historical data

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Best Practices

Go through Alvin Alexander's book called "Cost Estimating in an Agile Development Environment", 2015.

Function points are means of measuring software size in terms that are meaningful to end users

User Stories are a common way to describe requirements in a simple, concise way

Developers can analyze user stories to estimate function points and person-hours

3) Budgeting

➢ Involves allocating the project cost estimate to individual work items over time.

➢ WBS is a required input for cost budgeting process as it defines the work items

➢ Goal is to produce a cost baseline.

  ○ Cost Baseline - is a time-phased budget that project managers use to

     measure and monitor cost performance

Surveyor Pro Project Cost Baseline (sample)

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

4) Cost Control

Controlling cost and cost constraints throughout the project is cost control.

Cost Control includes:

- Monitoring Cost Performance
- Ensuring that only appropriate changes are included in a revised cost baseline
- Informing project stakeholders of authorized changes to the project that will affect costs

More on cost control techniques…

Earned Value Management (EVM)

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

- Given a baseline (original plan + approved changes) one can determine how well the project is meeting its goals.

- One must enter actual information periodically to use EVM

- Multitude of organizations globally use EVM to help with cost control in their projects.

EVM Terminologies

Planned Value (PV) - also formerly known as budgeted cost of work scheduled (BCWS), budget in general tongue is that portion of the approved total cost estimate planned to be spent on an activity during a given period.

Actual Cost (AC) - also called actual cost of work performed (ACWP) is the total direct and indirect costs incurred during a given period

Earned Value (EV) - also called budgeted cost of work performed (BCWP) is an estimate of the value of the physical work actually completed. It is based on original planned costs for the project and the rate at which the team is completing work on the project to date.

Rate of Performance (RP)

- Ratio of actual work completed to percentage of work planned to have been completed at any given time during the life of the project or activity

- Brenda Taylor, Sr. PM in South Africa suggested this term and approach for estimating earned value.

- CASE: server installation was halfway completed by end of week 1. RP would be 50% because by end of week 1, planned schedule reflects that task should be 100% complete and only 50% of work has been completed.

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%

The earned value calculations in Table 7-4 are carried out as follows:

$$EV = 10,000 * 50\% = 5,000$$

$$CV = 5,000 - 15,000 = -10,000$$

$$SV = 5,000 - 10,000 = -5,000$$

$$CPI = 5,000/15,000 = 33\%$$

$$SPI = 5,000/10,000 = 50\%$$

Formulas

Term	Formula
Earned value (EV)	$EV = PV$ to date $* RP$
Cost variance (CV)	$CV = EV - AC$
Schedule variance (SV)	$SV = EV - PV$
Cost performance index (CPI)	$CPI = EV/AC$
Schedule performance index (SPI)	$SPI = EV/PV$
Estimate at completion (EAC)	$EAC = BAC/CPI$
Estimated time to complete	Original time estimate/SPI

What do the numbers mean ?

Cost Variance (CV) - if its is negative it means that performing the work cost more than planned and vice-versa is true when its positive.

Schedule Variance (SV) - negative SV means it took longer than planned to perform the work while positive SV means vice-versa.

Cost Performance Index(CPI) - EV/AC. Can be used to estimate projected cost of completing the project. CPI 1 or 100% would mean that the planned and actual cost are equal i.e costs are exactly as budgeted. If CPI is less than 1 or below 100%, project is over budgeted and if it's higher than 1 or above 100% then project is under budget.

Schedule Performance Index (SPI) - EV/PV. Same as CPI but with schedule/time instead of cost. Eg: If SPI is less than one or 100% project is behind schedule.

Furthermore,

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

CPI and SPI if less than 100% indicates problems i.e project is costing more than planned (over budget) or taking longer than planned (behind schedule)

CPI can be used to calculate the estimate at completion (EAC) - estimate of what will it cost to complete the project based on performance to date. While, Budget at completion (BAC) is the original total budget for the project.

Sample EV Chart in next slide: $100,000(BAC) original time estimate = 12 months

CPI = 81.761 | SPI = 94.203

EAC = BAC/CPI = $122,308

Estimated time = Original time estimate / SPI = 12.74 months
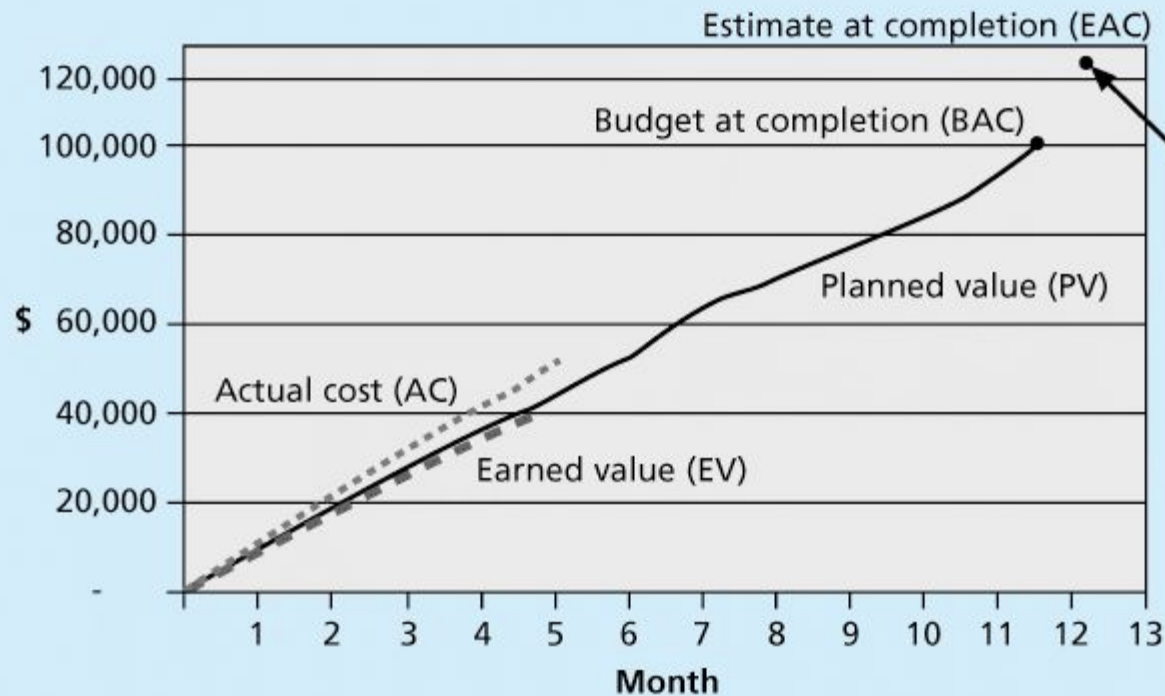
EVM Global Presence

- EVM is used worldwide, particularly popular in Middle East, South Asia, Canada and Europe.

- Most countries require EVM for big scale defense projects or government projects

- EVM is also used in private-industry sectors as IT, construction, energy and manufacturing

- Most mid to small scale companies however do not entertain EVM to their project management due to its complexity and cost factor.

Project Portfolio Management

Organizations collect and control entire suite of projects/investments as a set of interrelated activities in a portfolio.

5 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.

Softwares to Assist in Cost Management

- Spreadsheets

- Centralized Financial Applications (More sophisticated)

- Enterprise PM softwares

- Portfolio Management Softwares

Top 10 softwares for project cost management:

https://www.g2.com/categories/project-cost-management

Recent Case Studies on PPM Software

- 2014 Gartner report says market continues to grow, with annual sales over $1.65 billion. The pace of change is driving the demand for enterprise software to help manage projects.

- Forrester estimates ROIs of 250% from PPM tools

- Pfizer and Ford use PPM software to improve transparency of their projects

- Schlumberger saved $3 million in one year by organizing its 120 IT projects into a portfolio as it helps reduce redundancy.

Quiz Practice

If the actual cost for a WBS item is $1500 and its earned value is $2000, what is its cost variance, and is it under or over budget ?

a) CV is -ve $500, i.e. over budget
b) CV is -ve $500, i.e. under budget
c) CV is +ve $500, i.e. over budget
d) CV is +ve $500, i.e. under budget

Quiz Practice

If a project is halfway completed, its SPI is 110%, and its CPI is 95%, how is it progressing?

a)   Ahead of schedule | Under Budget
b)   Ahead of schedule | Over Budget
c)   Behind Schedule | Under Budget
d)   Behind Schedule | Over Budget

THANK YOU

happy weekends