

An abstract architectural wireframe of a skyscraper, rendered with a vibrant rainbow gradient. The lines of the building's facade transition from blue and purple on the left to yellow and orange on the right. The background is a dark, solid color.

# **INFO 6245** **Planning &** **Managing** **Information** **Systems** **Development**

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Module 6

Project Cost Management



# Topics of Discussion

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- Basic Principles
- Planning Cost Management
- Estimating Costs
- Determining the Budget
- Controlling the Costs

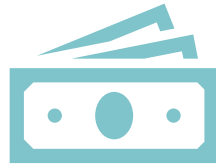


# Importance

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**IT projects have a poor track record for meeting budget goals**



**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**

Most important finding was the discovery of a large number of gigantic overages or “black swans”; a high-impact event that is rare and unpredictable, but not improbable in retrospect

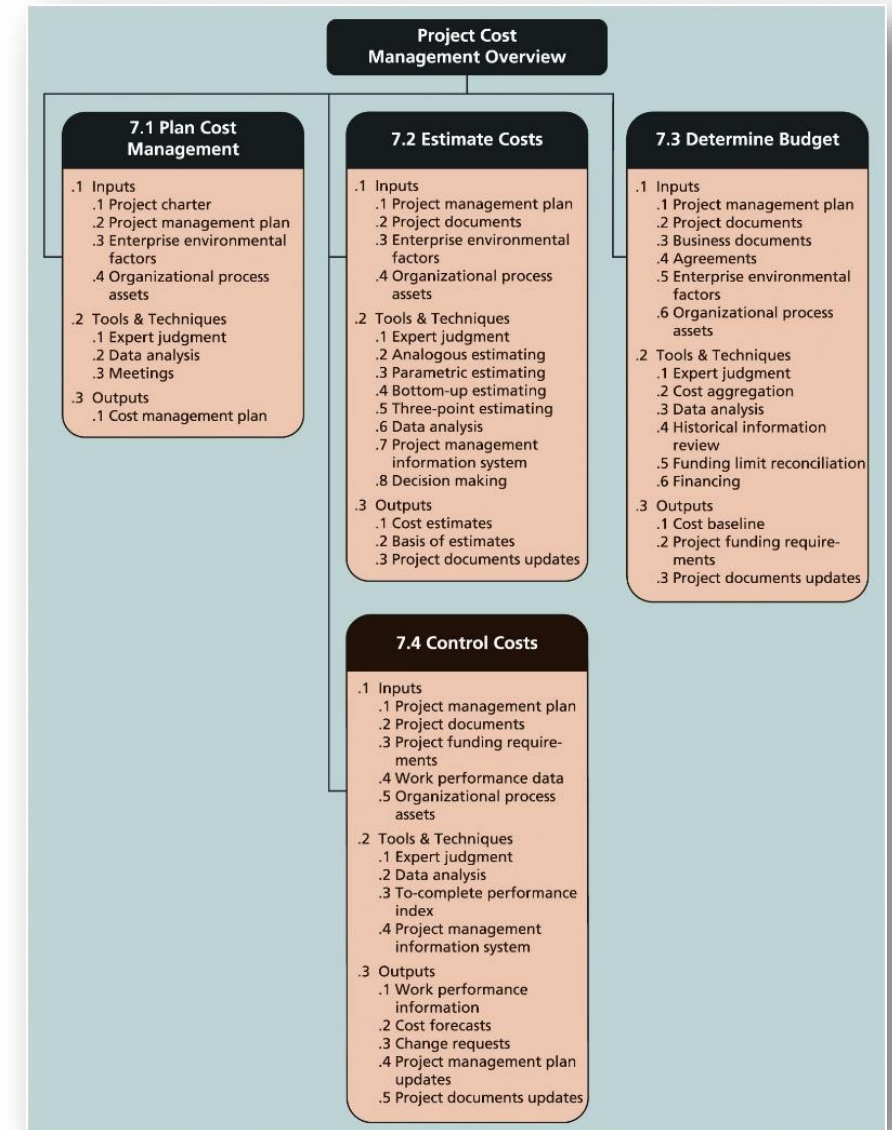
# Project Cost Management

- Cost is a resource given up in exchange of achieving an objective
  - Usually measured in monetary units like dollars that must be paid to acquire goods and services
- Project cost management includes the processes required to ensure that the project is completed within an approved budget



# PMI Summary

1. **Planning cost management** involves determining the policies, procedures, and documentation that will be used for planning, executing, and controlling project cost. The main output of this process is a cost management plan.
2. **Estimating costs** involves developing an approximation or estimate of the costs of the resources needed to complete a project. The main outputs of the cost estimating process are activity cost estimates, basis of estimates, and project documents updates.
3. **Determining the budget** involves allocating the overall cost estimate to individual work items to establish a baseline for measuring performance. The main outputs of the cost budgeting process are a cost baseline, project funding requirements, and project documents updates.
4. **Controlling costs** involves controlling changes to the project budget. The main outputs of the cost control process are work performance information, cost forecasts, change requests, and project management plan updates, and project documents updates.

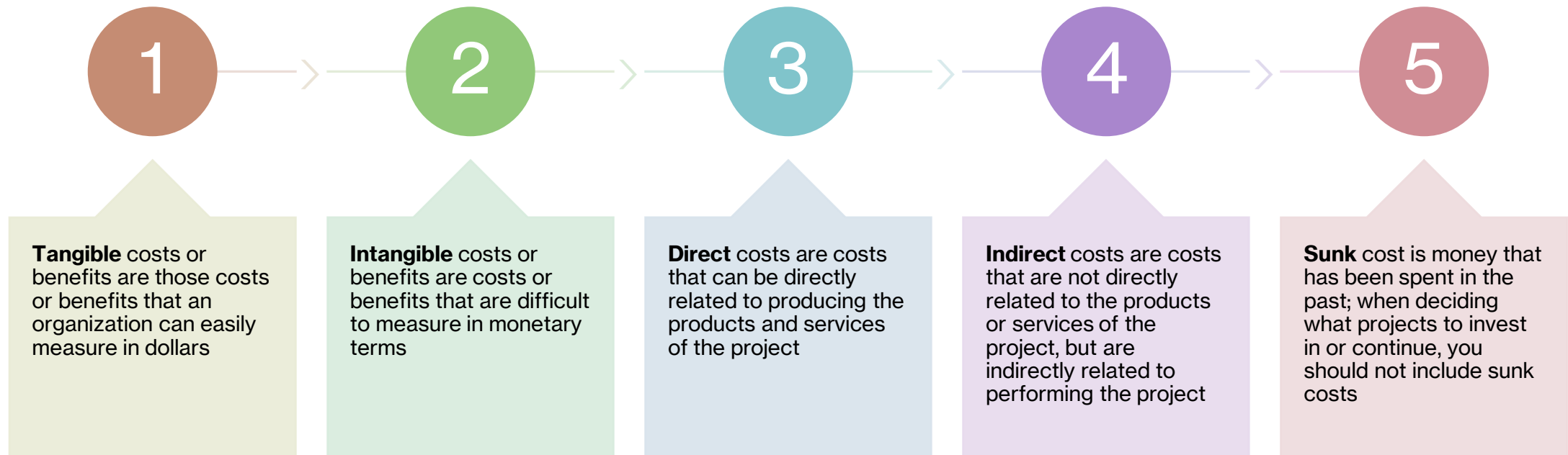


# Finance Terms

- **Profits:** revenues minus expenditures
- **Profit Margin:** ratio of profits to revenues
- **Life Cycle Costing:** considers total cost of ownership, or development plus support costs, for a project
- **Cash Flow Analysis:** determines estimated annual costs and benefits for a project and resulting annual cash flow
- **Profit Margin:** Revenues minus expenditures. To increase profits, a company can increase revenues, decrease expenses, or try to do both. Profit Margin is the ratio of profits to revenues
- **Return On Investment (ROI):** Key measure of the profit derived from any investment; A ratio comparing the gain or loss from an investment relative to its cost.
- **Net Present Value (NPV):** Difference between the present value of cash inflows and the present value of cash outflows over a period of time.
- **Payback Analysis:** Determines how long it may take to start, complete and pay for a project; Can provide organizations with the payback period and the value of a project.
- **Reserves:** 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)

# Types of Costs or Benefits

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# Principles



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



It is much more cost-effective to spend money on defining user requirements and doing early testing on IT projects than to wait for problems to appear after implementation. Correcting a software defect late in a project costs much more than fixing the defect early.



Because organizations depend on reliable IT, huge costs are associated with downtime.





# Planning Cost Management

# Planning Cost Management

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The first step to plan how the costs will be managed throughout the life of the project



The project team uses expert judgment, analytical techniques, and meetings to develop the cost management plan



estimates are usually done at various stages of a project and should become more accurate as time progresses.



Supporting details should be provided, to include the ground rules and assumptions used in creating the estimate, a description of the project (such as scope statement and WBS) used as a basis for the estimate, and details on the cost estimation tools and techniques used to create the estimate.



A large percentage of total project costs are often labor costs, including internal and external labor (employees and contractors). Contractors typically cost more to the project.

# Cost Management Plan

- **Level of accuracy:** Activity cost estimates normally have rounding guidelines, such as rounding to the nearest \$100. There may also be guidelines for the amount of contingency funds to include, such as 10 or 20 percent.
- **Units of measure:** Each unit used in cost measurements, such as labor hours or days, should be defined.
- **Organizational procedures links:** Many organizations refer to the WBS component used for project cost accounting as the control account (CA). Each control account is often assigned a unique code that is used in the organization's accounting system. Project teams must understand and use these codes properly.
- **Control thresholds:** Similar to schedule variance, costs often have a specified amount of variation allowed before action needs to be taken, such as 10 percent of the baseline cost.
- **Rules of performance measurement:** If the project uses EVM, as described later in this chapter, the cost management plan would define measurement rules, such as how often actual costs will be tracked and to what level of detail.
- **Reporting formats:** This section would describe the format and frequency of cost reports required for the project.
- **Process descriptions:** The cost management plan would also describe how to perform all of the cost management processes.





# Estimating Costs

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# Cost Estimates

- Project managers must take cost estimates seriously if they want to complete projects within budget constraints.
- After developing a good resource requirements list, PMs must develop several estimates of the costs for these resources.
- The list of activity resource requirements would describe
  - The skill level of the people needed to complete the activity.
  - The number of people and hours suggested to perform the activity.
  - The need for special software or equipment, and other requirements.

# Types of Cost Estimates

- A **rough order of magnitude (ROM)** estimate provides an estimate of what a project will cost. A ROM estimate can also be referred to as a ballpark estimate, a guesstimate, a swag, or a broad gauge. This type of estimate is done very early in a project or even before a project is officially started. Project managers and top management use this estimate to help make project selection decisions.
- A **budgetary estimate** is used to allocate money into an organization's budget. Many organizations develop budgets as part of their fiscal year planning or annual planning cycle.
- A **definitive estimate** provides an accurate estimate of project costs. Definitive estimates are used for making many purchasing decisions for which accurate estimates are required and for estimating final project costs.

Type of Estimate	When Done	Why Done	Typical Range
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%



# Tools and Techniques

## 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

## Three-point estimates

- Involve estimating the most likely, optimistic, and pessimistic costs for items

## Parametric estimating

- Uses project characteristics (parameters) in a mathematical model to estimate project costs

# Inaccuracies with IT projects



## **Estimates are done too quickly**

Developing an estimate for a large software project is a complex task that requires significant effort. Many estimates must be done quickly and before clear system requirements have been produced.



## **People lack estimating experience**

The people who develop software cost estimates often do not have much experience with cost estimation, especially for large projects. They also do not have enough accurate, reliable project data on which to base estimates. If



## **Human beings are biased toward underestimation**

Managers might make estimates based on their own abilities and skill levels and learning curves for the actual developer. Estimators also tend to undermine the integration and testing on large IT projects.



## **Management desires accuracy**

Management might ask for an estimate but really want a more accurate number to help them create a bid to win a major contract or get internal funding.

# Best Practices

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Before creating an estimate gather as much information as possible about the project, ask how the organization plans to use the cost estimate, and clarify the ground rules and assumptions



If the cost estimate will be the basis for contract awards and performance reporting, it should be a definitive estimate and as accurate as possible



It is important to clarify the ground rules and assumptions for the estimate. This information should be documented in the basis of estimates, along with ground rules and assumptions, known constraints, identified risks, and confidence level of the final estimate.



It is very important to have several people review the project cost estimate.



It is also helpful to analyze the total dollar value as well as the percentage of the total amount for each major WBS product/ service to put the right amount of emphasis on the ones that matter the most.



# Determining Project Budget



# Determining the Budget

Budgeting involves allocating the project cost estimate to individual work items over time

- Material resources or work items are based on the activities in the WBS for the project

Important goal is to produce a cost baseline for measuring project performance and to determine project funding requirements.

- Time-phased budget that project managers use to measure and monitor cost performance

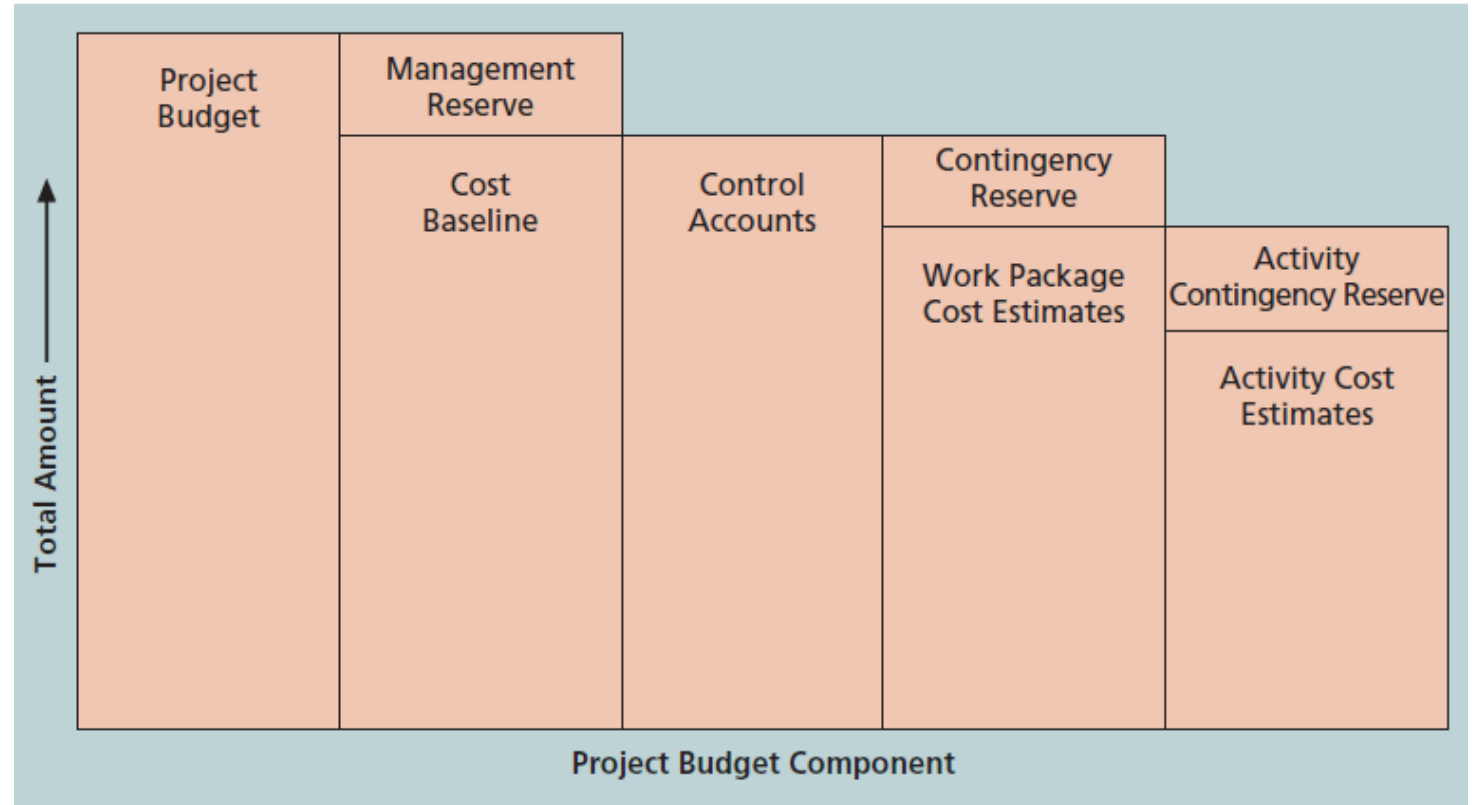
Many organizations require budget estimates to include the number of Full-Time Equivalent (FTE) for each month of the project. One FTE normally means 40 hours of work. One person could be assigned full time, or two people could be assigned half-time to provide one FTE.

Many organizations also want to know the amount of money projected to be paid to suppliers for their labor costs or other purchased goods and services.

Other common budget categories include travel, depreciation, rents and leases, and other supplies and expenses.

# Project Budget Elements

- The project budget is composed of the cost baseline plus management reserve.
- Control accounts are work package cost estimates plus contingency reserve.
- Work package cost estimates are activity cost estimates plus activity contingency reserve.





# Organization Uses

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Organizations use the budget to track costs across projects and non-project work and to look for ways to reduce costs. They also use the information for legal and tax purposes.

Cost budgeting provides information for project funding requirements. Most projects must rely on periodic funding to avoid cash flow problems. If the cost baseline shows that more funds are required in certain months than are expected to be available, the organization must make adjustments to avoid financial problems.



# Controlling Costs

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# Project Cost Control

- Activities involved in controlling project costs
  - 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
- Several tools and techniques assist in project cost control
  - Expert judgment, data analysis, project management information systems, and the to-complete performance index



# Earned Value

- 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 scope, time, and cost goals
- Earned value management involves calculating three values for each activity or summary activity from a project's WBS
  - Planned value
  - Actual cost
  - Earned value
- EVM is used worldwide, and most countries require EVM for large defense or government projects
- EVM is also used in such private-industry sectors as IT, construction, energy, and manufacturing.
- However, most private companies have not yet applied EVM to their projects because management does not require it, feeling it is too complex and not cost effective

# EV Calculations

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Term	Formula
Planned Value	Authorized budget
Earned value (EV)	$EV = PV$ of all completed work
Actual Cost (AC)	Realized Cost
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 to Complete (ETC)	$ETC = EAC - AC$





# Agile Project Cost Controls



# AgileEVM



AgileEVM is an adapted implementation of EVM



Uses the Scrum framework artifacts as inputs, uses traditional EVM calculations, and is expressed in traditional EVM metrics



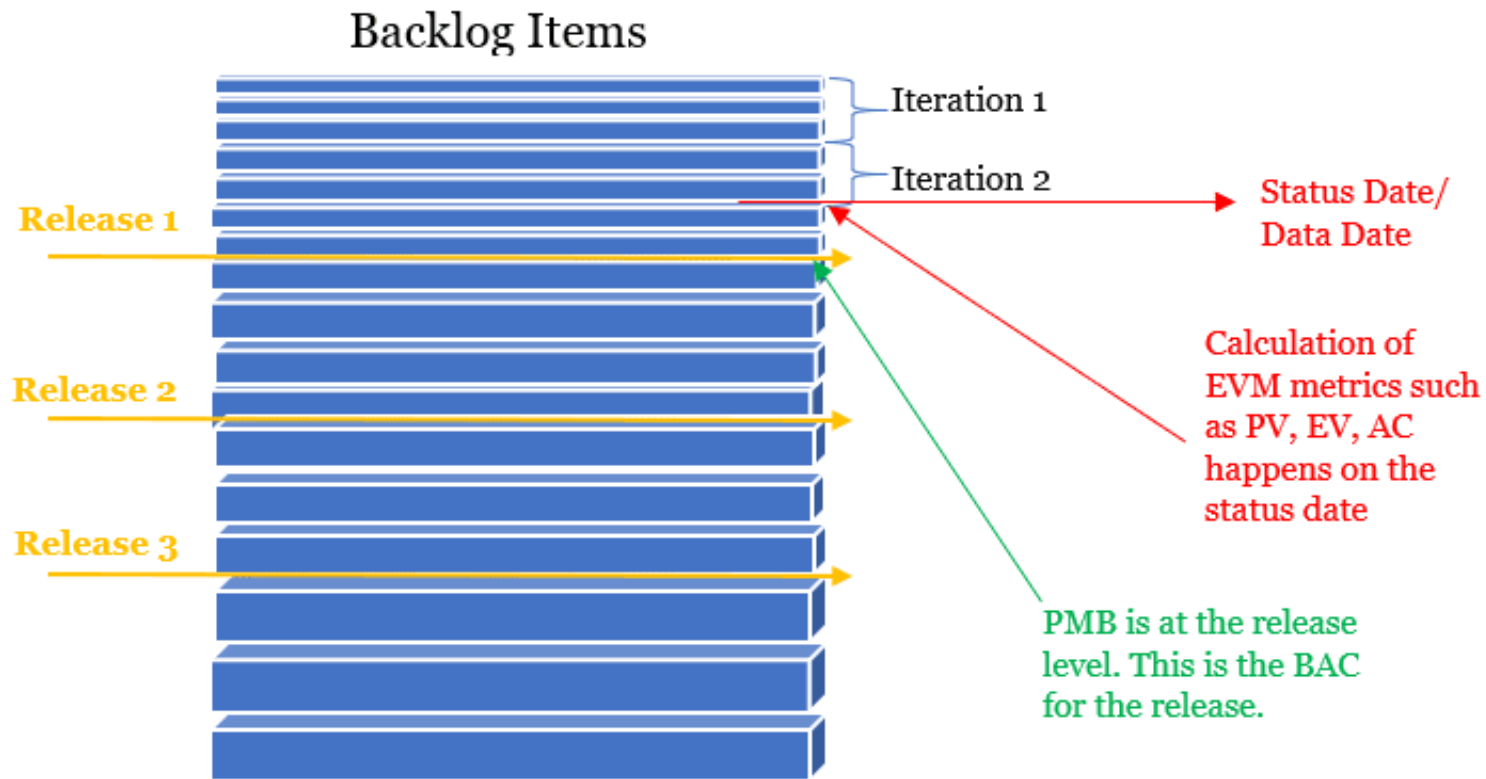
Requires a minimal set of input parameters; Actual cost of a project, an estimated product backlog, a release plan that provides information on the number of iterations in the release and the assumed velocity



All estimates can be in hours, story-points, team days or any other consistent estimate of size

The critical factor is that it must be a numerical estimate of some kind

# Agile – Definition of “Done”



- In Agile projects, the baseline at the release level, not at an iteration level must be considered.
- In Agile approaches, work is considered “done” at the end of each iteration (or sprint).
- Story points are used to relatively estimate work items being taken-up, but work is not considered to be fully “done” until the end of the iteration.
- Officially the project can be considered “done” once the number of story points that you have planned for the release are complete.
- We can status our interim checks at the end of each iteration



# Agile Cost Estimation

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Abbreviation	Expansion	Explanation
<b>PV</b>	Planned Value	Value of work planned to be accomplished at the <i>end of the iteration</i> .
<b>EV</b>	Earned Value	Value of work actually accomplished at the <i>end of the iteration</i> .
<b>AC</b>	Actual Cost	Actual cost incurred for work increment at the <i>end of iteration</i> .
<b>BAC</b>	Budget At Completion	Budget assigned to complete the work <i>for the entire release</i> . (not the iteration)

Items	Formula
<b>BAC (Budget at Completion)</b>	BAC = Number of Items in the Release * Cost Per PBI.
<b>PV (Planned Value)</b>	PV = % of planned complete * BAC
<b>EV (Earned Value)</b>	EV = % of actual complete * BAC
<b>AC</b>	AC is the money that you have spent so far at the end of the concerned or considered iteration.

# AgileEVM - Example

A project is being released in an Agile mode. Below are the details for the project:

- Product Backlog = 500 story points
- In the first release = 200 story points
- Velocity = 25 points per iteration
- Cost per point = \$1600
- At the end of 1<sup>st</sup> iteration, actual cost incurred was \$30,000.
- At the end of 1<sup>st</sup> iteration, story points completed were 20 story points.

With this, we can determine the following.

- Budget at Completion (BAC)
- Number of Iterations
- Planned value per iteration (PV) and Earned Value (EV) for the first iteration
- Schedule Variance (SV) and Cost Variance (CV)
- Schedule Performance Index (SPI) and Cost Performance Index (CPI)

# AgileEVM - Example

- Product Backlog = 500 story points
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- Velocity = 25 points per iteration
- Cost per point = \$1600
- End of 1<sup>st</sup> iteration, actual cost incurred was \$30,000.
- End of 1<sup>st</sup> iteration, 20 story points were completed.

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Budget at Completion (BAC) = Cost per point \* Number of story points = \$1600 \* 200 = \$320,000

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Total number of Iterations = Story points in a release / Velocity = 200 / 25 = 8

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Percentage (%) of planned complete at the end of first iteration = Iteration number / Total number of iterations = 1 / 8 = 12.5%

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Percentage (%) of actual complete at the end of first iteration = Total number of story points completed / Total number story points planned = 20 / 200 = 10%

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Planned Value (PV) for the iteration = % of planned complete \* BAC = 12.5% \* \$320,000 = \$40,000

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Earned Value (EV) for the iteration = % of actual complete \* BAC = 10% \* \$320,000 = \$32,000

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The actual cost (AC), as mentioned in the question = \$30,000.

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Schedule Variance (SV) = EV - PV = \$32,000 - \$40,000 = - \$8,000

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Cost Variance (CV) = EV - AC = \$32,000 - \$30,000 = + \$2,000

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One could say the release is behind schedule and under budget by looking at the performance metrics of SV and CV, respectively. This is because SV is negative (bad), & CV is positive (good).

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Schedule Performance Index (SPI) = EV / PV = \$32,000 / \$40,000 = 0.8

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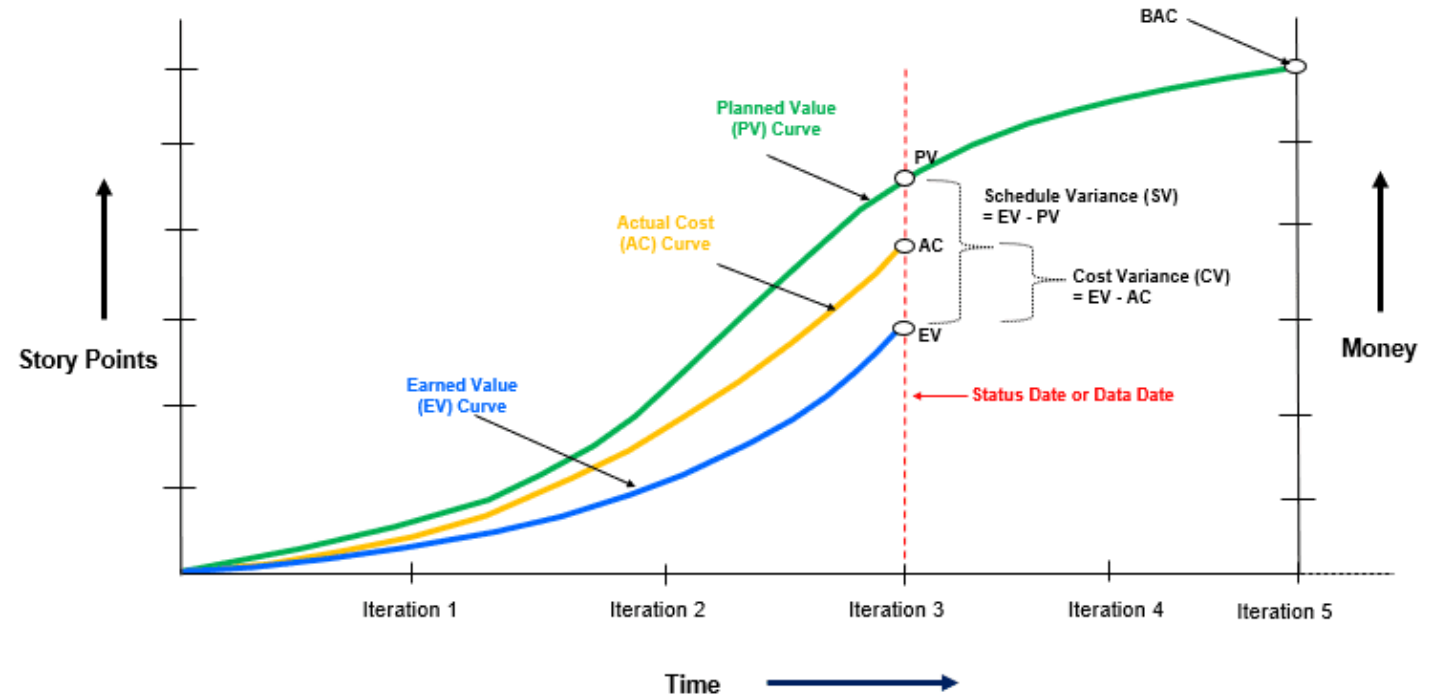
Cost Performance Index (CPI) = EV / AC = \$32,000 / \$30,000 = 1.07

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You could say the release is behind schedule and under budget by looking at the performance metrics of SPI and CPI, respectively. This is because SPI is below one (bad), whereas CPI is above one (good).

# Release Burn-up Chart

- The BAC is at the release level.
- The PMB line is along the EV curve.
- Our status date is at the completion of Iteration – 3
- On this date, we are measuring the foundational metrics of PV, EV and AC, as well as the current performance metrics of SV, SV, and hence, associated SPI and CPI.
- When you combine this representation with estimated story points in the product backlog, you can have the release burn-up chart.





# In-Class Group Exercise



# Cost Estimation for Team Project

## **Determine your Project Budget:**

- Use the template provided to calculate Labor Estimates & Project Budget.

## **For Labor Estimates:**

- Try to get as close as you can while making broad assumptions (-10% to +25% margins for a budgetary estimate).
- Base your estimate on Story Points and use 1 Hour per story point as your velocity.
- Consider upfront product planning, product designing, development & testing, customer support readiness, training, etc.
- Consider Project Management costs (Planning, Execution, Control, Closing, etc)

## **For Project Budgetary Estimate:**

- Labor Hours will be populated from first sheet.
- Use an estimated \$\$/Hour for labor hours.
- Consider Specific Tools required to build the project.
- Consider any Hardware you require for your project.
- Consider Training requirements.
- Add Contingency & Management Reserves

## **Confirm Your Estimate:**

- Use this website to conduct a comparative estimate: [Estimate My App](#)
- Consider Webapp/iOS/Android App depending on your team's project.
- Consider the feature options provided to understand what you want to add to your product.