



PROJECT COST MANAGEMENT



Fundamentals of Project Cost

- Project Cost Management includes the processes involved in **planning, estimating, budgeting, financing, funding, managing, and controlling costs** so that the project can be completed within the approved budget.
- Costs is a resource sacrificed or foregone to achieve a specific objective or something given up in exchange.
- Cost are usually measured in monetary units like Rupees, US \$.
- Types Of Cost
 - *Direct Cost –Cost of labor, Resource, Machinery*
 - *Overhead Cost –Cost of building, rent, Maintenance, Insurance, Vacation*
 - *Administrative Cost –Coat due to Management Expenses, HRM & HRD activities*

Product Cost VS Project Cost

- Product Cost :

- $\text{Material Cost} + \text{Manufacturing Cost} + \text{Overhead Cost} = \text{Sales Price}$

- Where, $\text{Overhead Cost} = \text{Project other overhead costs} + \text{Project Cost} + \text{Profit}$*

- Project Cost = Project's Labor Cost + Resource Cost + Special Machinery Cost

Basic principles of Project Cost Management

- Profits are revenues minus expenses
- Life Cycle costing is estimating the cost of a project plus the maintenance costs of the products it produces
- Cash flow analysis is determining the estimated annual costs and benefits for a project
- Benefits and costs can be tangible or intangible
- Sunk cost should not be a criteria in project costing

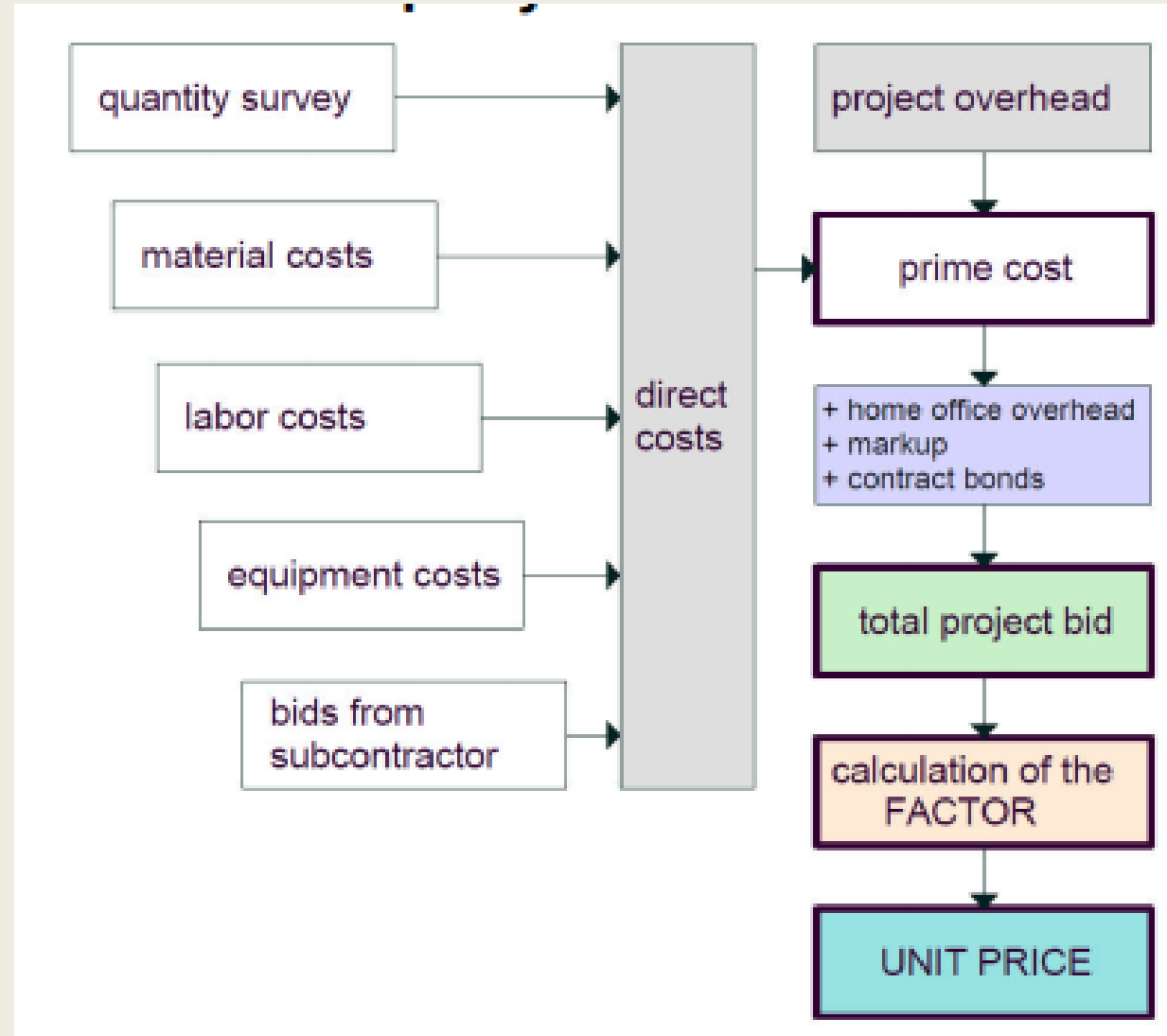
Basic Principles of Cost Management

- **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**).*

Project Cost Estimation Process



Project Cost Management processes

- ***Plan Cost Management***—The process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.
- ***Estimate Costs***—The process of developing an approximation of the monetary resources needed to complete project activities.
- ***Determine Budget***—The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.
- ***Control Costs***—The process of monitoring the status of the project to update the project costs and managing changes to the cost baseline.

Plan Cost Management

- Plan Cost Management is the process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.
- The cost management processes and their associated tools and techniques are documented in the cost management plan.
- The key benefit of this process is that it provides guidance and direction on how the project costs will be managed throughout the project.

Plan Cost Management

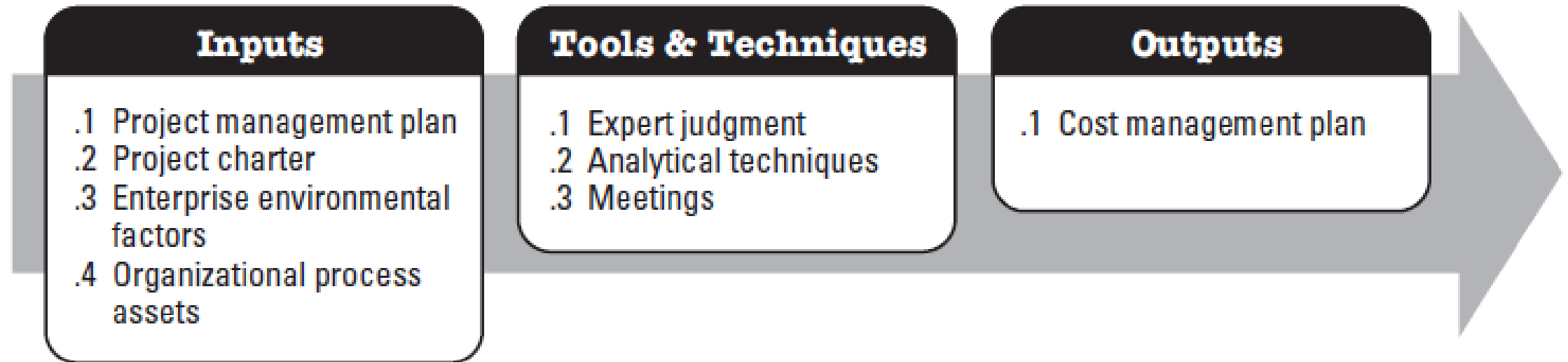


Figure 7-2. Plan Cost Management: Inputs, Tools & Techniques, and Outputs

Plan Cost Management: Inputs

- **Project Management Plan:** Scope baseline (statement and WBS), Schedule baseline (project cost), cost-related scheduling, risk, and communications decisions
- **Project Charter:** The project charter provides the **summary budget** from which the detailed project costs are developed.
- **Enterprise Environmental Factors:** Organizational culture and structure, Market conditions, Currency exchange rates, Published commercial information, Project management information system
- **Organizational Process Assets:** Financial controls procedures, Historical information and lessons learned knowledge bases; Financial databases; Existing formal and informal cost estimating and budgeting-related policies, procedures, and guidelines, etc.

Plan Cost Management: Outputs

Cost Management Plan

- cost management plan is a component of the project management plan and describes how the project costs will be planned, structured, and controlled.
- Units of measure
- Level of precision
- Level of accuracy
- Organizational procedures links
- Control thresholds
- Rules of performance measurement
- Reporting formats
- Process descriptions
- Additional details

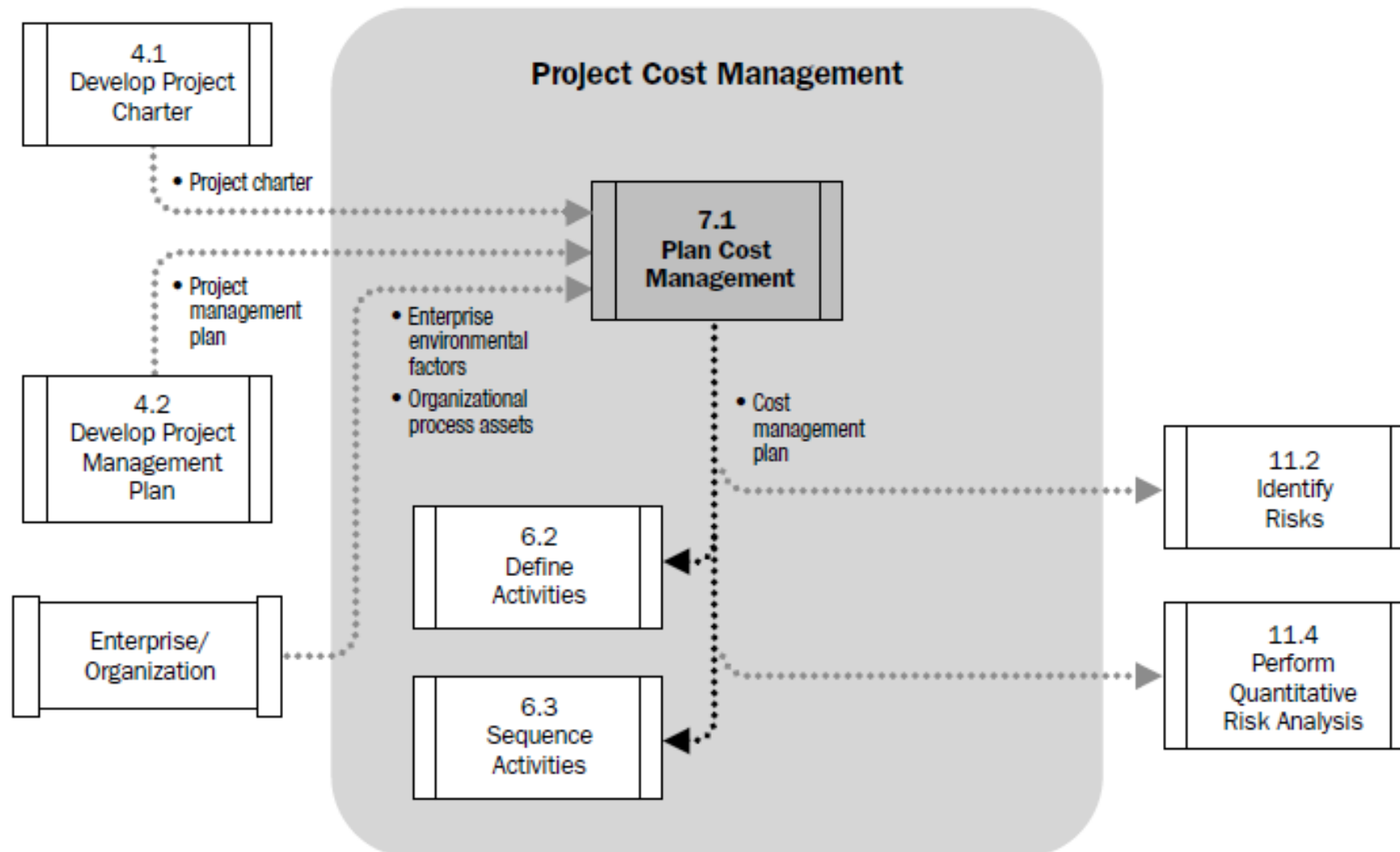


Figure 7-3. Plan Cost Management: Data Flow Diagram

Estimate Costs

- Estimate Costs is the process of developing an approximation of the monetary resources needed to complete project activities.
- Cost estimates are a prediction that is based on the information known at a given point in time.
- The key benefit of this process is that it determines the amount of cost required to complete project work.

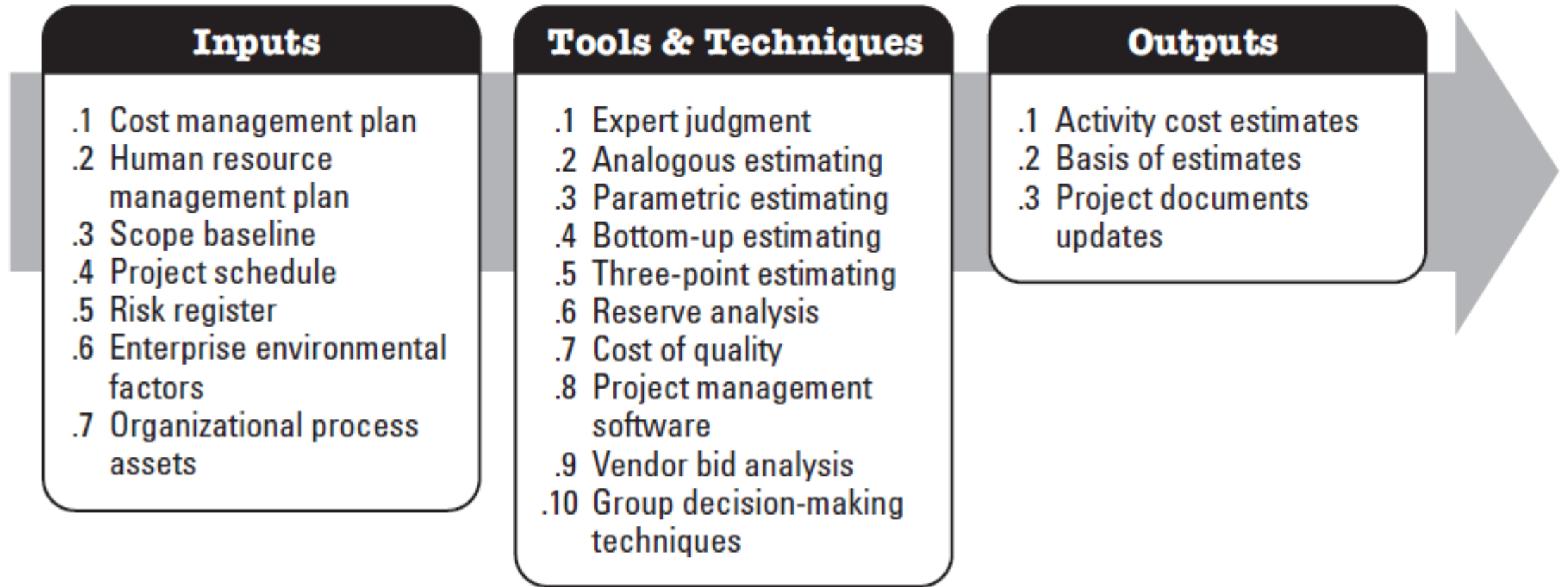


Figure 7-4. Estimate Costs: Inputs, Tools & Techniques, and Outputs

Cost Estimating Tools

- Analogous
 - *Comparison with other similar projects*
 - *Less accurate than other tools*
- Top-down
- Expert Judgement
- Data driven
 - *Determine Resource Cost Rates*
- Bottom-up
 - *Estimate made at the work package of the WBS and then rolled up*
- *Relatively more accurate*
- *Need sufficient information to make an accurate estimates*
- Parametric Modeling
 - *Mathematical modeling*
 - *Similar to analogous top-down*
 - *Better to be used with historical info*
- Project Management Software
- Vender Bid Analysis

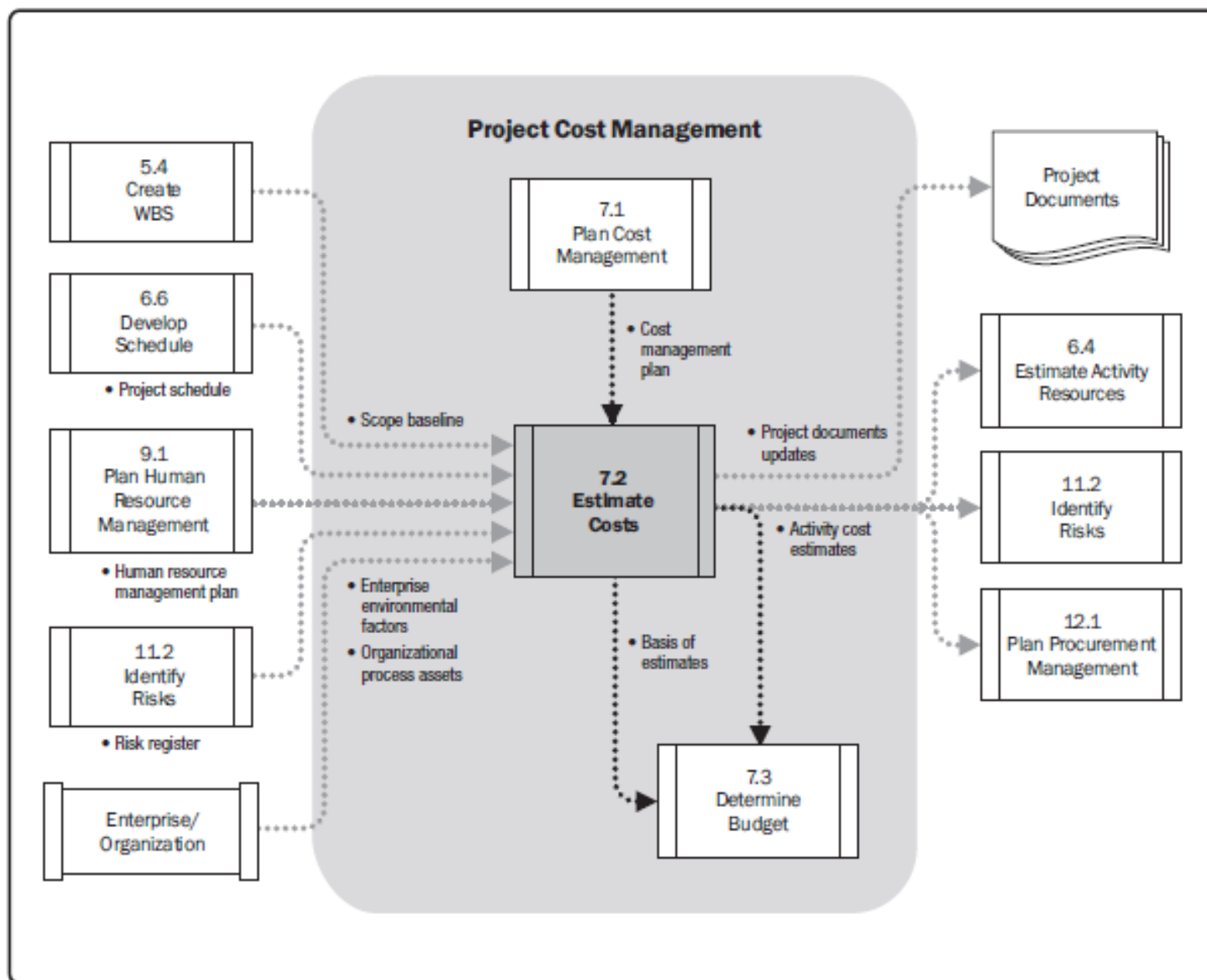


Figure 7-5. Estimate Costs Data Flow Diagram

Determine Budget

- Determine Budget is the process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.
- A project budget includes all the funds authorized to execute the project.
- The key benefit of this process is that it determines the cost baseline against which project performance can be monitored and controlled.

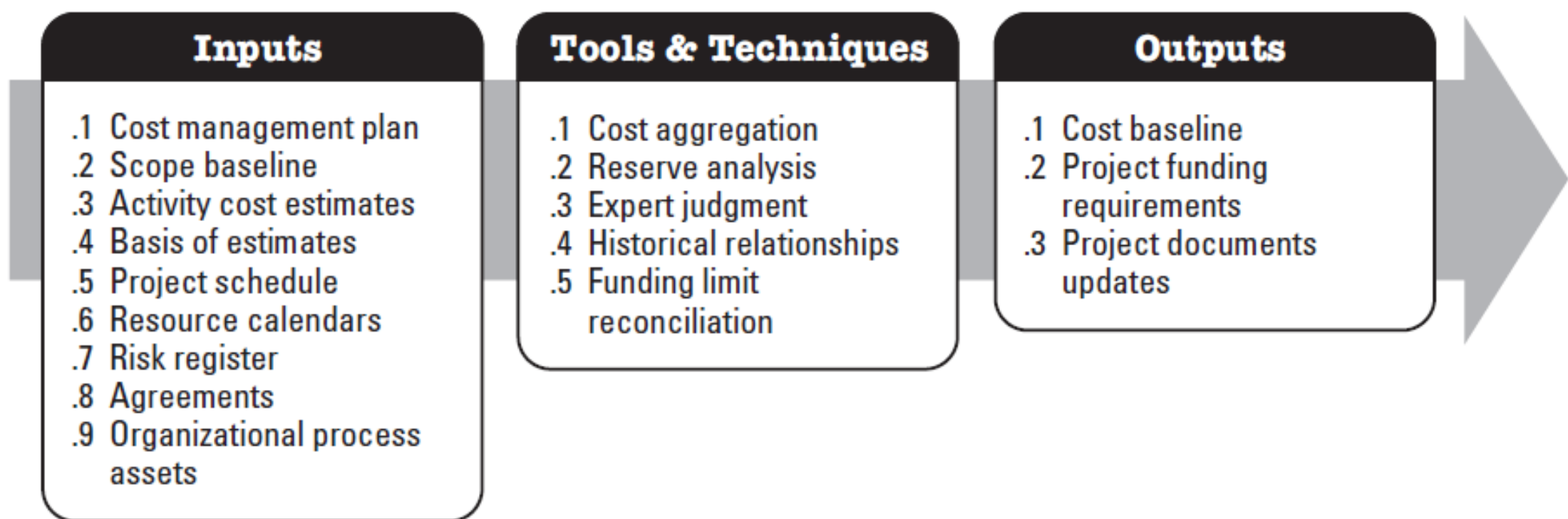


Figure 7-6. Determine Budget: Inputs, Tools & Techniques, and Outputs

Determine Budget: Outputs

■ Cost Baseline:

- *The cost baseline is the approved version of the time-phased project budget, excluding any management reserves, which can only be changed through formal change control procedures and is used as a basis for comparison to actual results.*
- *It is developed as a summation of the approved budgets for the different schedule activities.*

■ Project Funding Requirements:

- *Total funding requirements and periodic funding requirements (e.g., quarterly, annually) are derived from the cost baseline.*
- *The cost baseline will include projected expenditures plus anticipated liabilities.*
- *Funding often occurs in incremental amounts that are not continuous, and may not be evenly distributed, which appear as steps.*
- *The total funds required are those included in the cost baseline, plus management reserves, if any.*
- *Funding requirements may include the source(s) of the funding.*

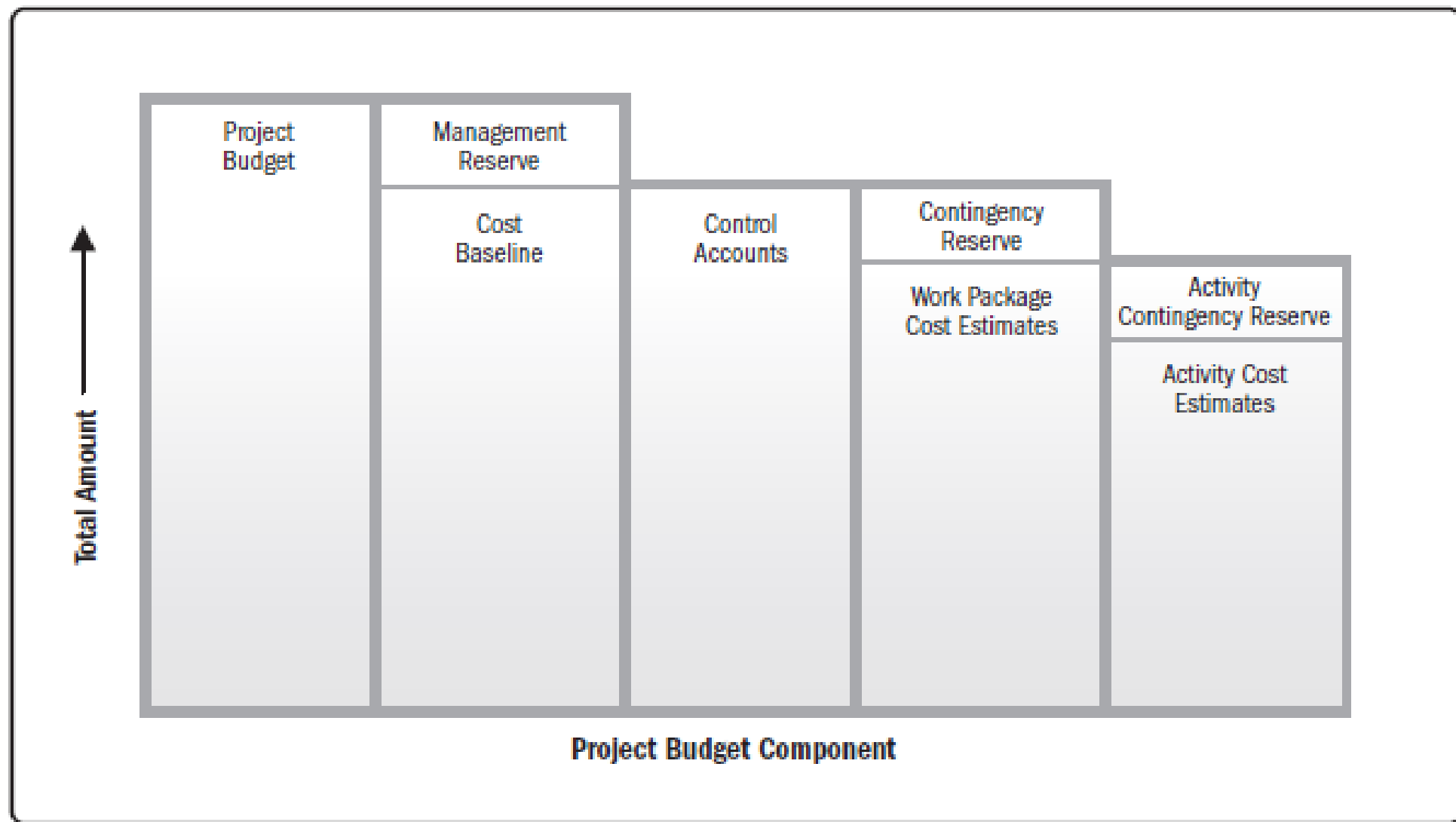


Figure 7-8. Project Budget Components

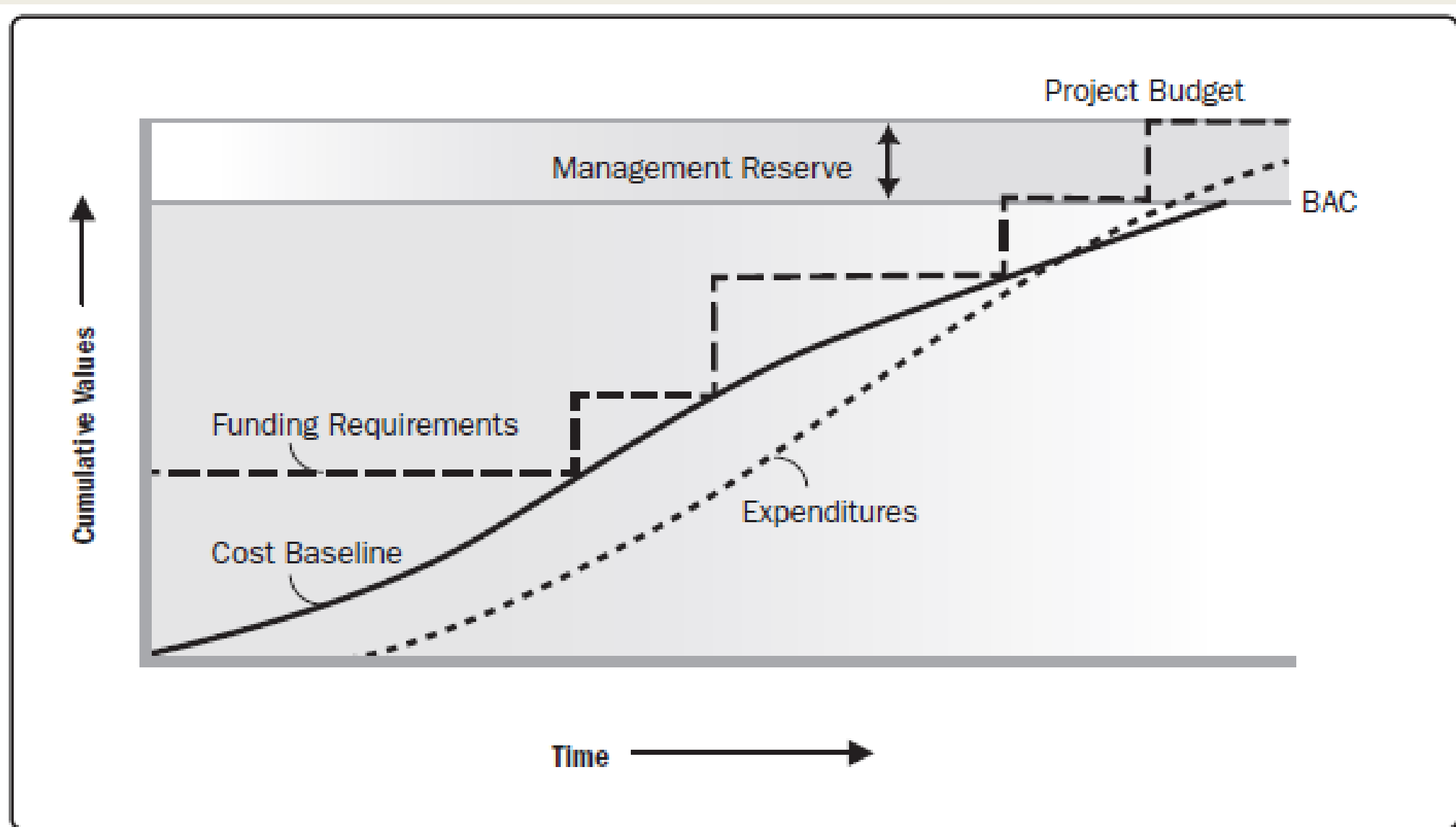


Figure 7-9. Cost Baseline, Expenditures, and Funding Requirements

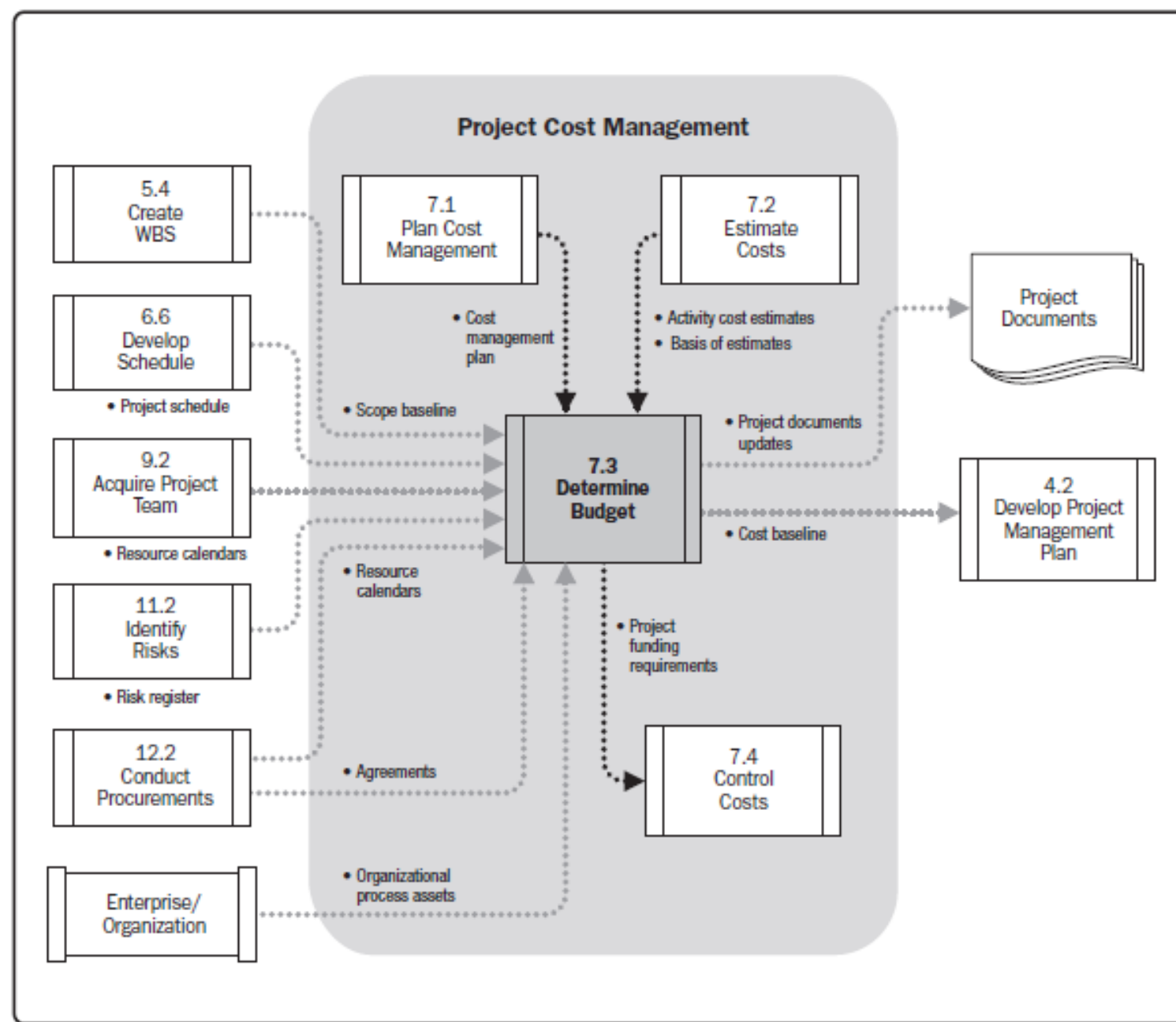


Figure 7-7. Determine Budget Data Flow Diagram

Control Costs

- Control Costs is the process of monitoring the status of the project to update the project costs and managing changes to the cost baseline.
- The key benefit of this process is that it provides the means to recognize variance from the plan in order to take corrective action and minimize risk.

Cost Control Baseline

- Influencing the factors that create changes to the authorized cost baseline;
- Ensuring that all change requests are acted on in a timely manner;
- Managing the actual changes when and as they occur;
- Ensuring that cost expenditures do not exceed the authorized funding by period, by WBS component, by activity, and in total for the project;
- Monitoring cost performance to isolate and understand variances from the approved cost baseline;
- Monitoring work performance against funds expended;
- Preventing unapproved changes from being included in the reported cost or resource usage;
- Informing appropriate stakeholders of all approved changes and associated cost;
- Bringing expected cost overruns within acceptable limits.

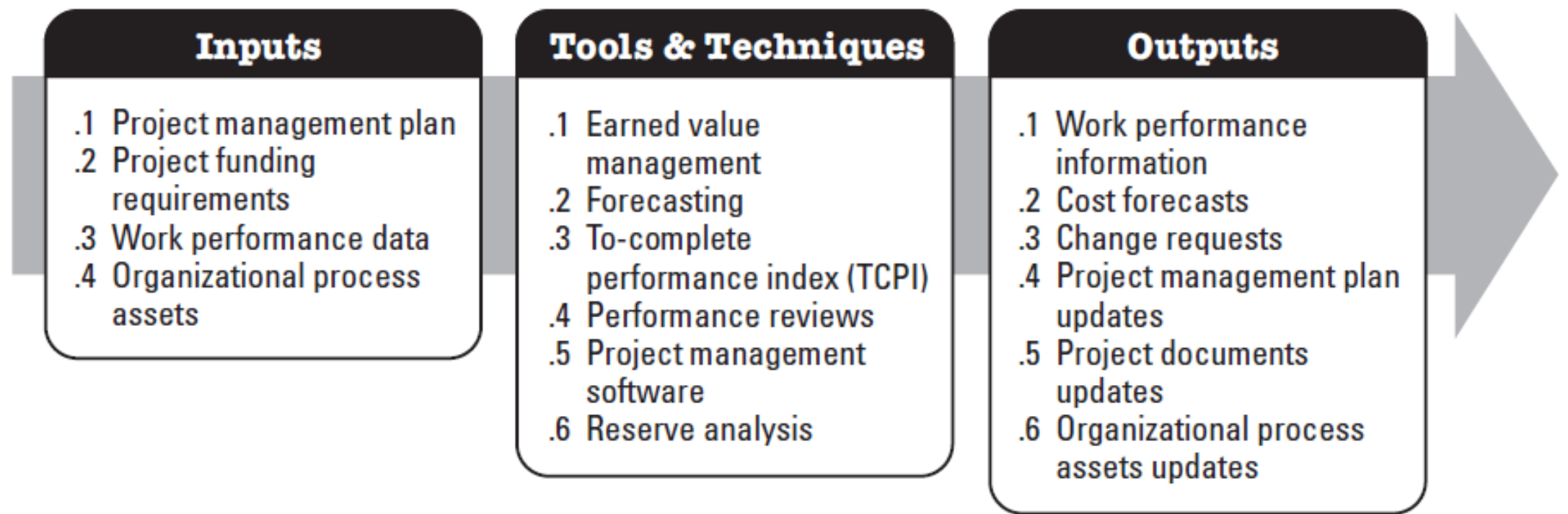


Figure 7-10. Control Costs: Inputs, Tools & Techniques, and Outputs

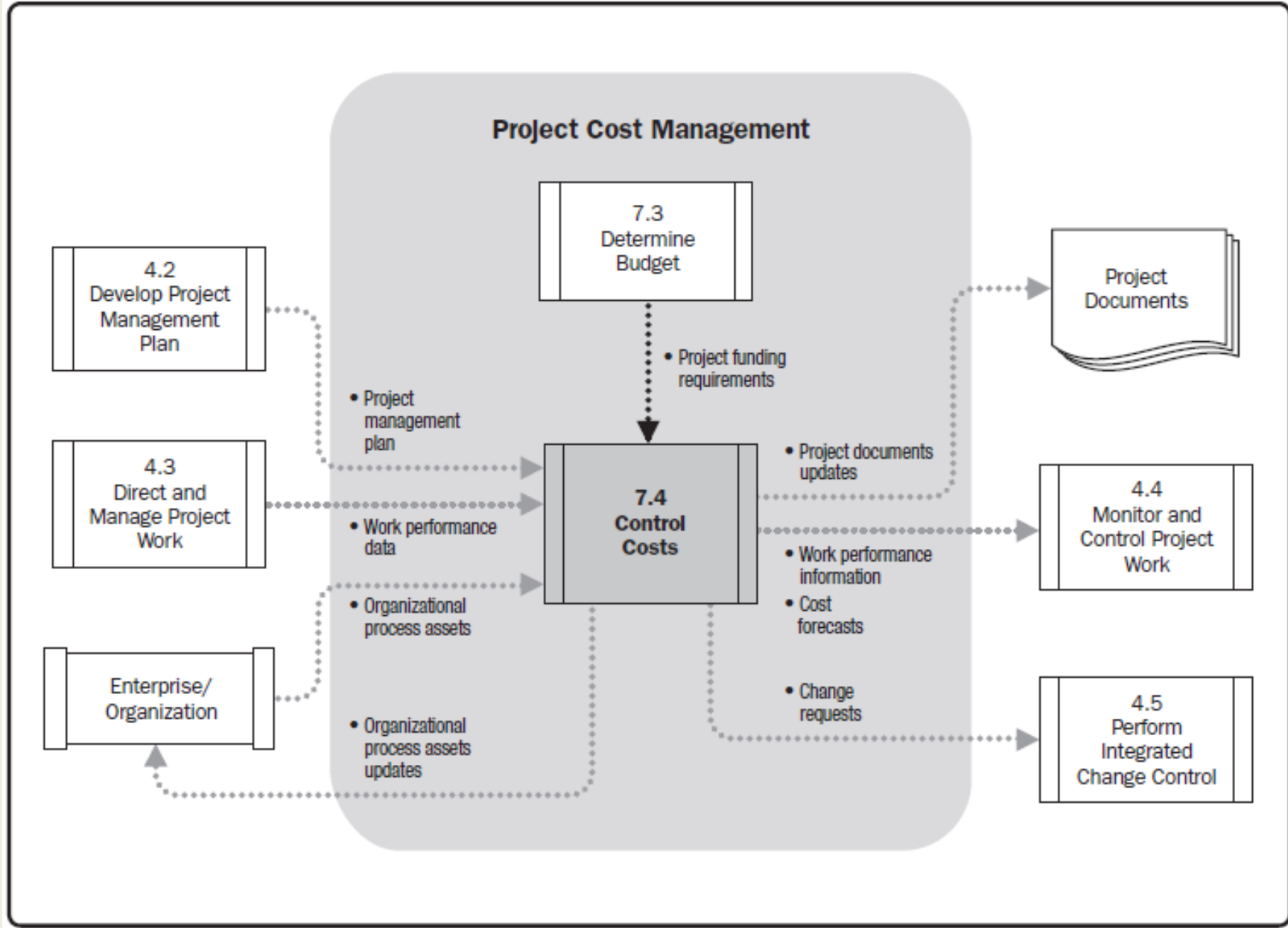


Figure 7-11. Control Costs Data Flow Diagram

Control Costs: Tools and Techniques

Earned Value Management

- A methodology that combines scope, schedule, and resource measurements to assess project performance and progress and commonly used method of performance measurement for projects.
- **It integrates the scope baseline with the cost baseline, along with the schedule baseline, to form the performance baseline,** which helps the project management team assess and measure project performance and progress.
- It is a project management technique that requires the formation of an integrated baseline against which performance can be measured for the duration of the project.
- The principles of EVM can be applied to all projects in any industry.
- EVM develops and monitors three key dimensions for each work package and control account:

Earned Value Analysis

EVM develops and monitors three key dimensions for each work package and control account:

- **Planned value.** Planned value (PV) is the authorized budget assigned to scheduled work. The total planned value for the project is also known as budget at completion (BAC).
- **Earned value.** Earned value (EV) is **a measure of work performed** expressed in terms of the budget authorized for that work. It is the budget associated with the authorized work that has been completed. The EV is often used to calculate the percent complete of a project. Project managers monitor EV, both incrementally to determine current status and cumulatively to determine the long-term performance trends.
- **Actual cost.** Actual cost (AC) is the realized cost incurred for the work performed on an activity during a specific time period. It is the total cost incurred in accomplishing the work that the EV measured.

Earned Value Analysis

Variances from the approved baseline will also be monitored:

- **Schedule variance.** Schedule variance (SV) is a measure of schedule performance expressed as the difference between the earned value and the planned value. The EVM schedule variance is a useful metric in that it can indicate when a project is falling behind or is ahead of its baseline schedule. The EVM schedule variance will ultimately equal zero when the project is completed because all of the planned values will have been earned.
 - *Equation: $SV = EV - PV$*
 - *where negative variance indicates time overrun.*
- **Cost variance.** Cost variance (CV) is the amount of budget deficit or surplus at a given point in time, expressed as the difference between earned value and the actual cost. The cost variance at the end of the project will be the difference between the budget at completion (BAC) and the actual amount spent.
 - *Equation: $CV = EV - AC$.*

Earned Value Analysis

- **Schedule performance index.** The schedule performance index (SPI) is a measure of schedule efficiency expressed as the ratio of earned value to planned value. It measures how efficiently the project team is using its time. Equation: $SPI = EV/PV$.
 - *An SPI value less than 1.0 indicates less work was completed than was planned.*
 - *An SPI greater than 1.0 indicates that more work was completed than was planned.*
 - *Since the SPI measures all project work, the performance on the critical path also needs to be analyzed to determine whether the project will finish ahead of or behind its planned finish date.*
- **Cost performance index.** The cost performance index (CPI) is a measure of the cost efficiency of budgeted resources, expressed as a ratio of earned value to actual cost. It is considered the most critical EVM metric and measures the cost efficiency for the work completed. Equation: $CPI = EV/AC$
 - *A CPI value of less than 1.0 indicates a cost overrun for work completed.*
 - *A CPI value greater than 1.0 indicates a cost underrun of performance to date.*

Similar Notations

- Budgeted cost of work scheduled (BCWS) = PV
- Budgeted cost of work performed (BCWP) = EV
- Actual cost of work performed (ACWP) = AC

Example

- 50 units of plantation have to be done in two weeks period. Per unit cost of plantation is estimated as Rs. 200 of which progress monitoring was done one week after the work was started. Only 40 % work was found completed and the account record showed that the actual expenditure (cost) for plantation per unit was Rs. 250.

Example

- Here,
 - $BCWS = 25 * 200 = \text{Rs. } 5000 = PV$
 - $BCWP = 20 * 200 = \text{Rs. } 4000 = EV$
 - $ACWP = 20 * 250 = \text{Rs. } 5000 = AC$

Now,

- Cost variance (CV) = $BCWP - ACWP$ or $CV = EV - PV = 4000 - 5000 = -1000$
(Indicating cost overrun)
- Schedule variance (SV) = $BCWP - BCWS$ or $SV = EV - AC = 4000 - 5000 = -1000$
(Indicating time overrun)

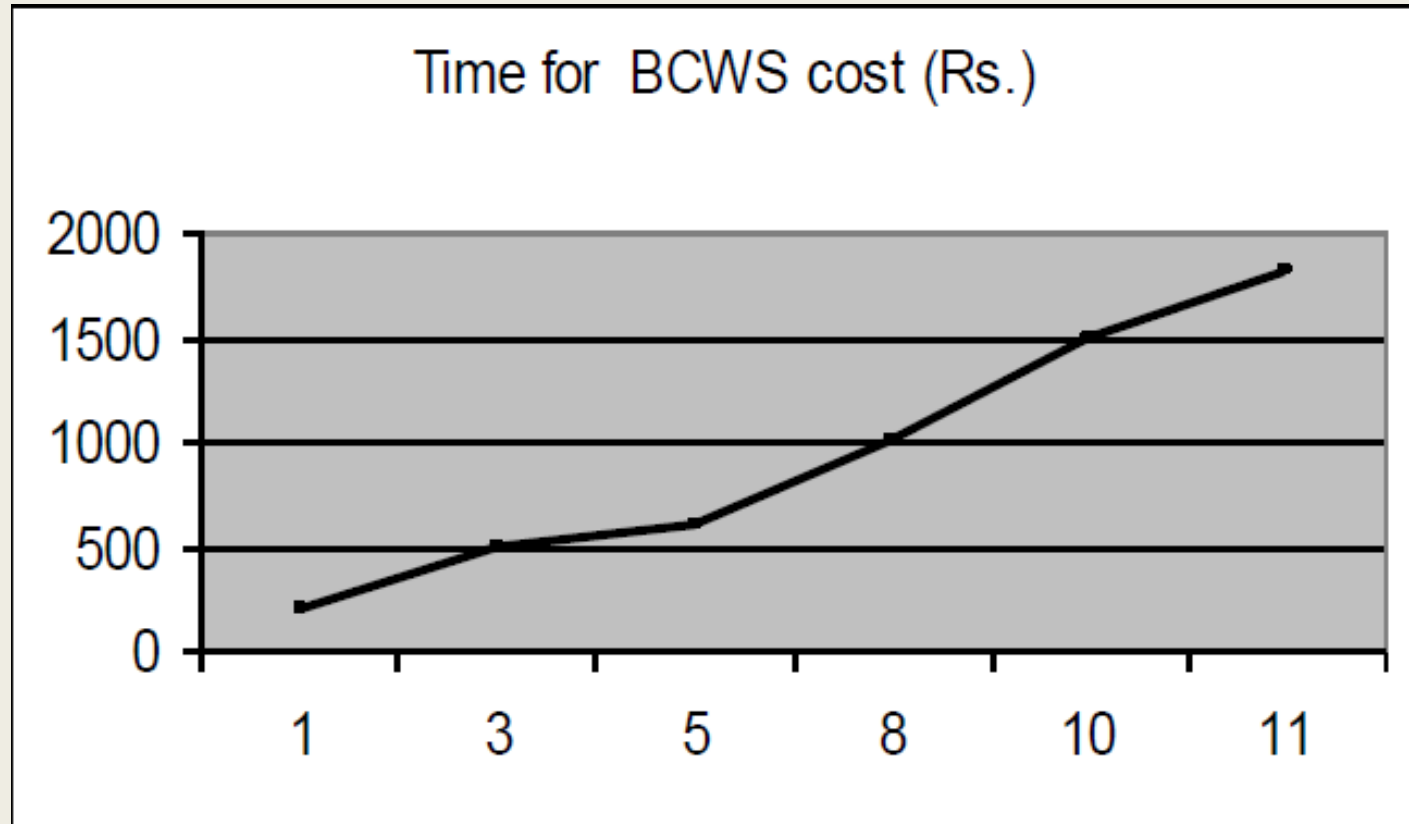
Example

- One of the key parameters used in variance analysis, said Harold Kerzner, is the “earned value” concept, which is the same as BCWP.
- Earned value is a forecasting variable used to predict whether the project will finish over or under the budget.
 - $Cost\ performance = BCWP / ACWP = 4000 / 5000 = 0.80$ ($CPI = EV / AC$)
 - $Schedule\ performance = BCWP / BCWS = 4000 / 5000 = 0.80$ ($\therefore SPI = EV / PV$)
- Since the cost performance is 0.80, the final cost would be: $50\ units * Rs\ 200 / 0.80 = Rs.\ 12500$ (instead of estimated Rs. 10,000)
- Since the schedule performance is 0.80, the time it requires for completion would be: $2\ weeks / 0.80 = 2.5\ weeks$ (instead of scheduled time 2 weeks)

We can graphically present both the cost and schedule variances by using **S – Curve**, which is also used as one of the effective tool in project control.

Activity	Cost (Rs.)	Duration (Week)	BCWS (Rs.)	BCWP (Rs.)	ACWP (Rs.)
A	200	1	200	200	200
B	300	3	500	600	450
C	100	5	600	800	500
D	400	8	1000		
E	500	10	1500		
F	300	11	1800		

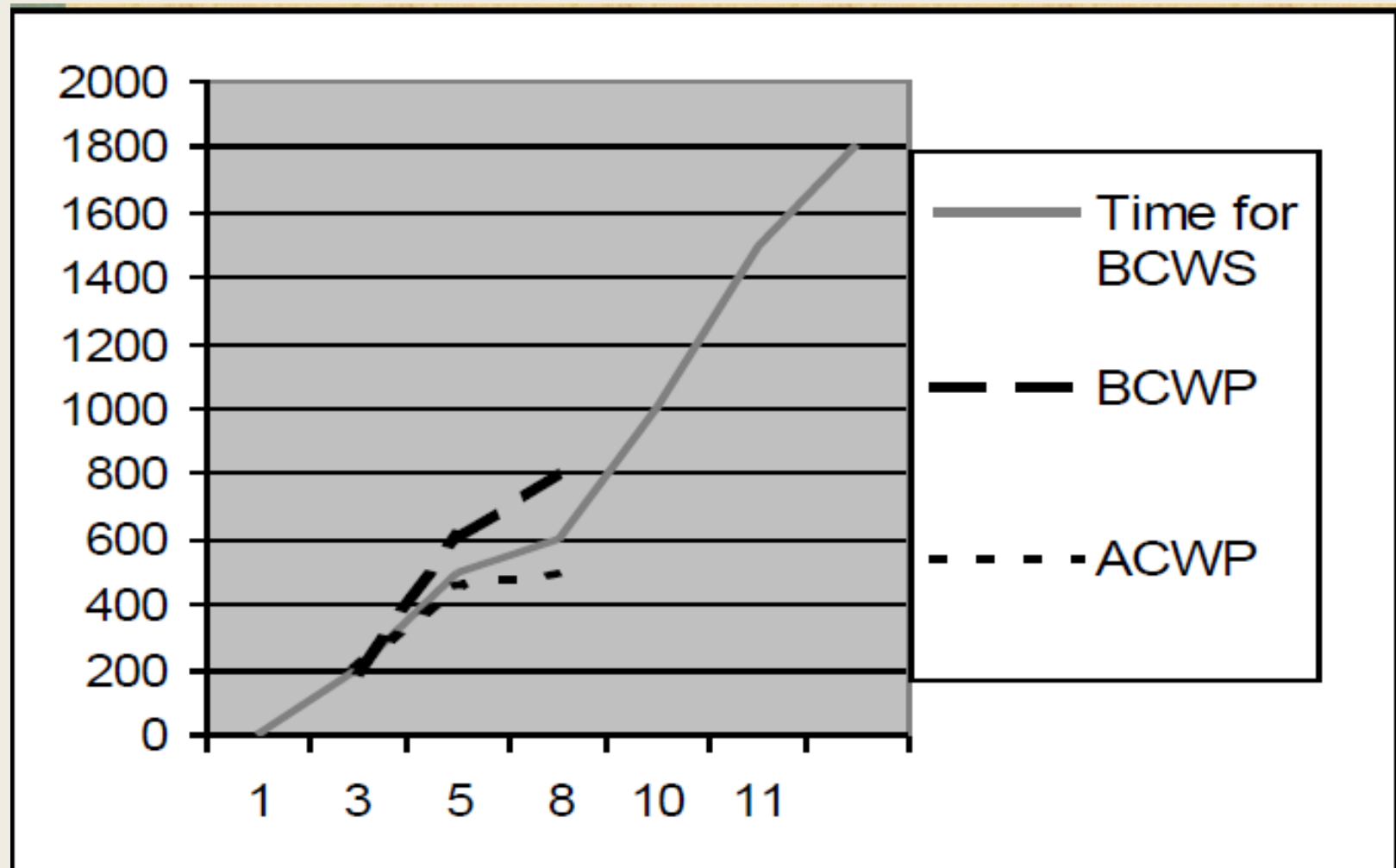
S Curve



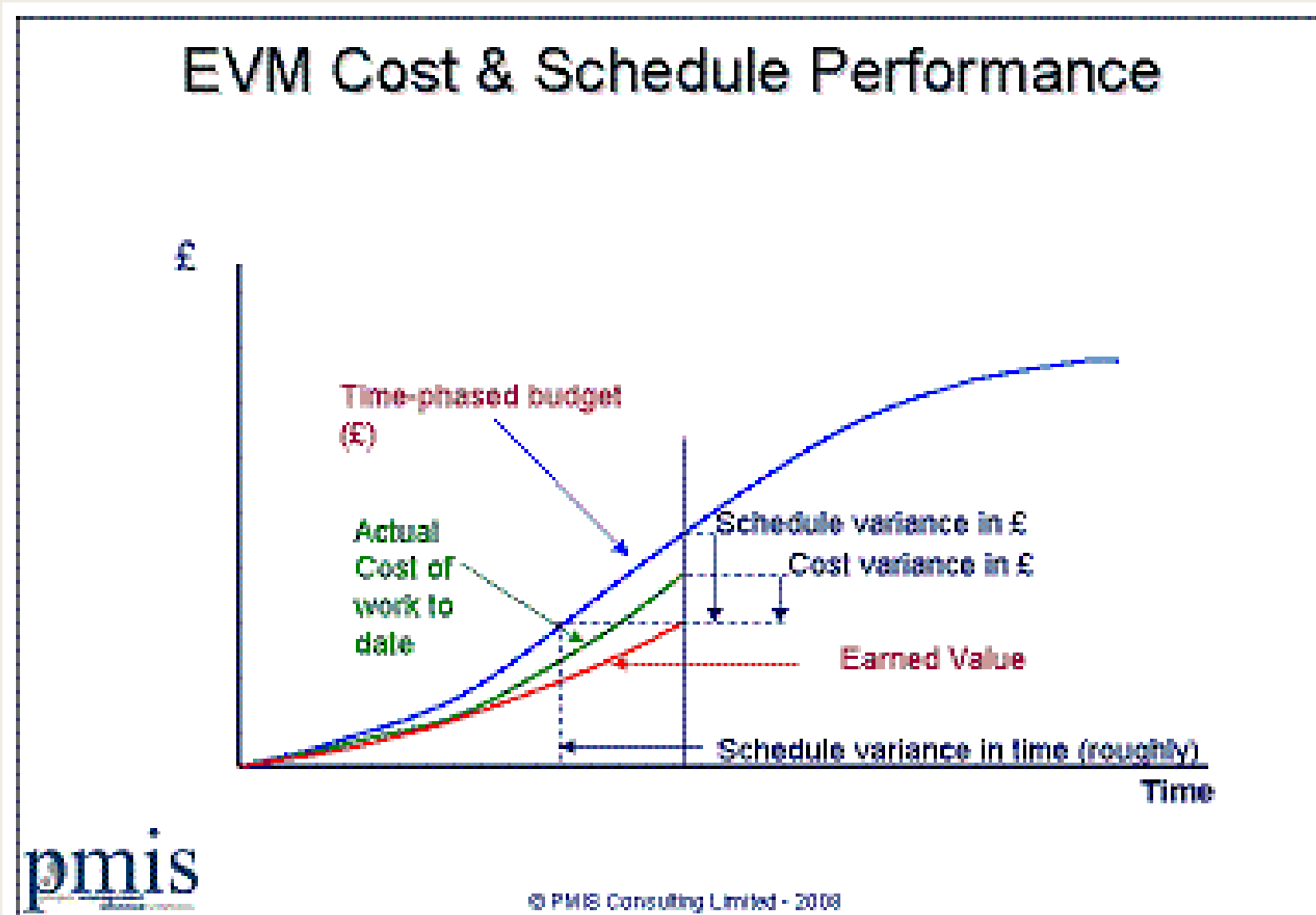
An **S-curve** is **defined** as: "A display of cumulative costs, labor hours or other quantities plotted against time.

The name derives from the **S**-like shape of the **curve**, flatter at the beginning and end and steeper in the middle, which is typical of most projects.

S Curve



Earned Value Management



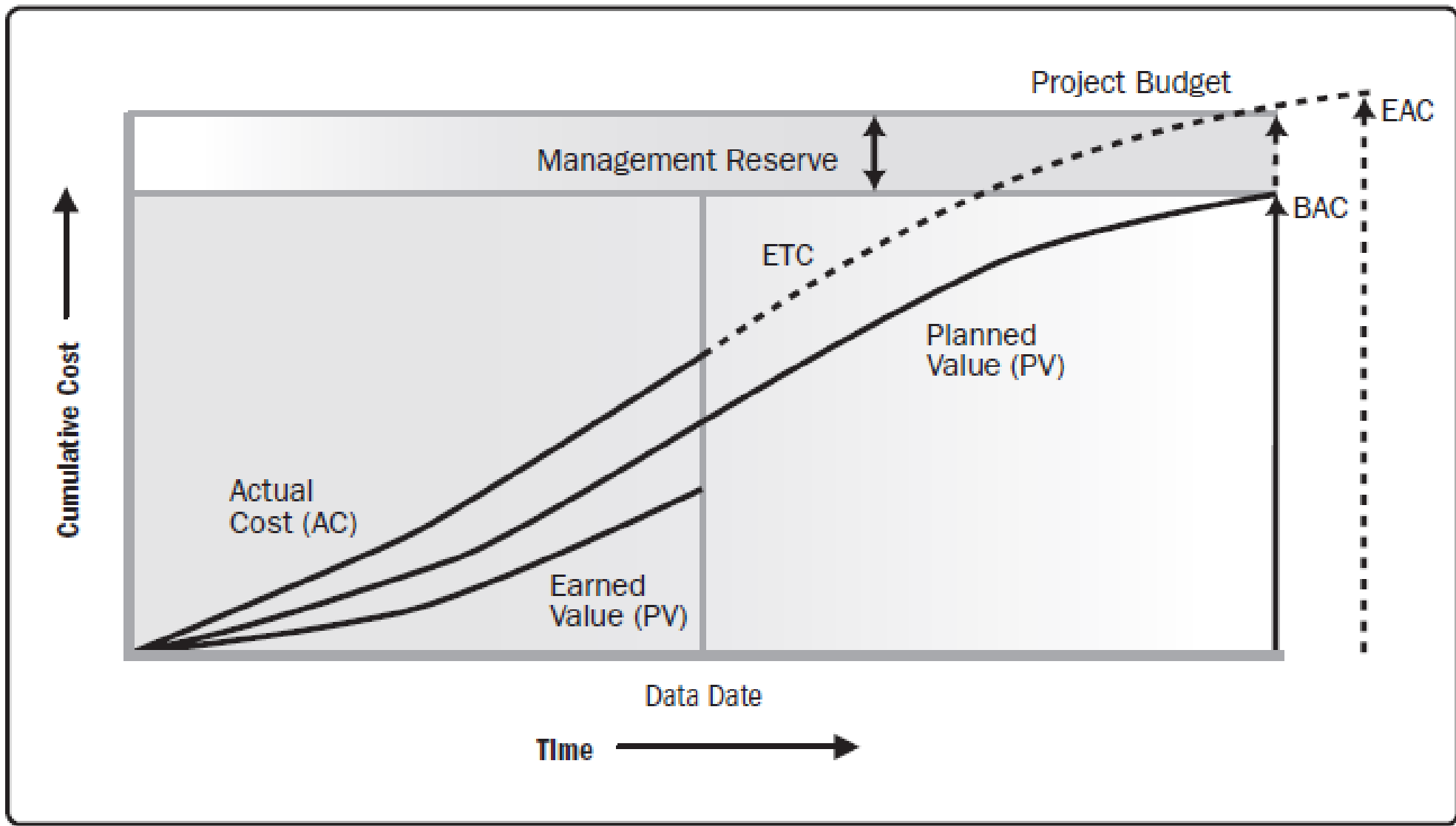


Figure 7-12. Earned Value, Planned Value, and Actual Costs

Control Costs: Tools and Techniques

Cont.

- **Forecasting:** As the project progresses, the project team may develop a forecast for the estimate at completion (EAC) that may differ from the budget at completion (BAC) based on the project performance.
- **To-Complete Performance Index (TCPI):** The to-complete performance index (TCPI) is a measure of the cost performance that is required to be achieved with the remaining resources in order to meet a specified management goal, expressed as the ratio of the cost to finish the outstanding work to the remaining budget.
- **Performance Reviews:** Performance reviews compare cost performance over time, schedule activities or work packages overrunning and underrunning the budget, and estimated funds needed to complete work in progress. **Variance analysis, Trend analysis, Earned value performance**

Earned Value Calculations Summary Table

Earned Value Analysis					
Abbreviation	Name	Lexicon Definition	How Used	Equation	Interpretation of Result
PV	Planned Value	The authorized budget assigned to scheduled work.	The value of the work planned to be completed to a point in time, usually the data date, or project completion.		
EV	Earned Value	The measure of work performed expressed in terms of the budget authorized for that work.	The planned value of all the work completed (earned) to a point in time, usually the data date, without reference to actual costs.	$EV = \text{sum of the planned value of completed work}$	
AC	Actual Cost	The realized cost incurred for the work performed on an activity during a specific time period.	The actual cost of all the work completed to a point in time, usually the data date.		
BAC	Budget at Completion	The sum of all budgets established for the work to be performed.	The value of total planned work, the project cost baseline.		
CV	Cost Variance	The amount of budget deficit or surplus at a given point in time, expressed as the difference between the earned value and the actual cost.	The difference between the value of work completed to a point in time, usually the data date, and the actual costs to the same point in time.	$CV = EV - AC$	Positive = Under planned cost Neutral = On planned cost Negative = Over planned cost
SV	Schedule Variance	The amount by which the project is ahead or behind the planned delivery date, at a given point in time, expressed as the difference between the earned value and the planned value.	The difference between the work completed to a point in time, usually the data date, and the work planned to be completed to the same point in time.	$SV = EV - PV$	Positive = Ahead of Schedule Neutral = On schedule Negative = Behind Schedule

Earned Value Calculations Summary Table

VAC	Variance at Completion	A projection of the amount of budget deficit or surplus, expressed as the difference between the budget at completion and the estimate at completion.	The estimated difference in cost at the completion of the project.	$VAC = BAC - EAC$	Positive = Under planned cost Neutral = On planned cost Negative = Over planned cost
CPI	Cost Performance Index	A measure of the cost efficiency of budgeted resources expressed as the ratio of earned value to actual cost.	A CPI of 1.0 means the project is exactly on budget, that the work actually done so far is exactly the same as the cost so far. Other values show the percentage of how much costs are over or under the budgeted amount for work accomplished.	$CPI = EV/AC$	Greater than 1.0 = Under planned cost Exactly 1.0 = On planned cost Less than 1.0 = Over planned cost
SPI	Schedule Performance Index	A measure of schedule efficiency expressed as the ratio of earned value to planned value.	An SPI of 1.0 means that the project is exactly on schedule, that the work actually done so far is exactly the same as the work planned to be done so far. Other values show the percentage of how much costs are over or under the budgeted amount for work planned.	$SPI = EV/PV$	Greater than 1.0 = Ahead of schedule Exactly 1.0 = On schedule Less than 1.0 = Behind schedule

Earned Value Calculations Summary Table

EAC	Estimate At Completion	The expected total cost of completing all work expressed as the sum of the actual cost to date and the estimate to complete.	<p>If the CPI is expected to be the same for the remainder of the project, EAC can be calculated using:</p> <p>If future work will be accomplished at the planned rate, use:</p> <p>If the initial plan is no longer valid, use:</p> <p>If both the CPI and SPI influence the remaining work, use:</p>	$EAC = BAC / CPI$ $EAC = AC + BAC - EV$ $EAC = AC + \text{Bottom-up ETC}$ $EAC = AC + [(BAC - EV) / (CPI \times SPI)]$	
ETC	Estimate to Complete	The expected cost to finish all the remaining project work.	<p>Assuming work is proceeding on plan, the cost of completing the remaining authorized work can be calculated using:</p> <p>Reestimate the remaining work from the bottom up.</p>	$ETC = EAC - AC$ $ETC = \text{Reestimate}$	
TCPI	To Complete Performance Index	A measure of the cost performance that must be achieved with the remaining resources in order to meet a specified management goal, expressed as the ratio of the cost to finish the outstanding work to the budget available.	<p>The efficiency that must be maintained in order to complete on plan.</p> <p>The efficiency that must be maintained in order to complete the current EAC.</p>	$TCPI = (BAC - EV) / (BAC - AC)$ $TCPI = (BAC - EV) / (EAC - AC)$	<p>Greater than 1.0 = Harder to complete Exactly 1.0 = Same to complete Less than 1.0 = Easier to complete</p> <p>Greater than 1.0 = Harder to complete Exactly 1.0 = Same to complete Less than 1.0 = Easier to complete</p>