

Project Cost Management

PMG 213

Lecture 7

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*Cost Budgeting, Control and
Reporting*



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Cost Control, Budgeting and Reporting :

1. Overhead costs
2. Standard costs
3. Joint Costs
4. Job Order and Process Costing
5. Introduction to cost control
- 6 Project Formats:
 - 6.1 Contracting Party Viewpoints
- 7 Establishing Baselines for Control:**
 - 7.1 Cost Control Variables**
- 8 Status Evaluation and Control:**
 - 8.1 Cost/Schedule Integration**
- 9 Reporting and Analysis:**
 - 9.1 Frequency of Reports**
 - 9.2 Variance Analysis**
 - 9.3 Report Distribution**

Seventh: Establishing baselines for control:

The primary mission, or goal, of a project is the completion of a set of objectives that, when achieved, represents completion of the project.

All contracting parties, whether the owner, the architect, the engineers, or the contractors, are interested in knowing how the project is coming along. To satisfy such an interest, a standard or baseline must be developed, against which progress may be measured.

Identification of objectives is important, and should be done in the early stages of a project. Therefore, before data is collected or progress measured, a budget baseline is established to use as a yardstick to measure progress.

Budget baselines are generated through the estimating process. If the project scope is not fully defined, this estimate will be approximate and may vary. As the scope becomes more defined, the budget estimates are updated.

Example: Building a Commercial Software App

Initial Scope: Launching a basic version with 5 core features.

Baseline Estimate: \$150,000 budget and 6 months duration.

Update Rule: If the client adds a 6th feature (Scope Creep), the baseline budget is officially updated to \$175,000 before measuring further progress

7.1 Cost Control Variables

Budget baselines are determined by establishing various control categories. Establishing control categories that are fully compatible with the overall project objectives requires a review of four major cost control variables. These are (1) organization, (2) computerization, (3) level of control, and (4) elements of control .

1-Organization

Cost control during various stages of a project deals with variances between budgeted, earned, and actual costs in each control category. These categories are established based on an integrated control structure that takes into consideration what work is performed, who performs the work, who is accountable for the work, what the project's cost accounting code is, the project's contractual relationship, the project's work location, the project's system components, and so on—in other words, a work breakdown structure.

Work Breakdown Structure (WBS): A WBS is “a product-oriented family tree division of hardware, software, facilities and other items that organizes, defines and displays all of the work to be performed in accomplishing the project objectives”.

A WBS can graphically display the work to be done, whether it is a division of engineering, procurement, or construction, and helps to correlate tasks, schedules, estimates, performance, and technical interfaces .

The WBS acts as a vehicle for integrating baseline cost and time plan, and thus is an aid in relating plans to objectives.

The WBS also provides the mechanism for accumulation of actual and forecast costs and schedule data in support of overall project analysis and reporting. The WBS normally consists of two sections: definition and execution. The definition section is used to define the scope and establish initial cost estimates and schedules that will be used as a baseline against which actual and forecast information will be measured. The execution section defines the strategy selected for a particular project.

The WBS is a matrix in which each item is referenced by two codes. First, a definition code defines the location and type of work being performed. Next, an execution code shows how these items will be packaged for contracting. Many projects fail to meet their specific objectives when project engineers develop a WBS that consists of only one section and that functions as “all things for all people.” The proper procedure is to establish a WBS during the conceptual phase, expand it during the design phase, and then modify it as required throughout the life of a project.

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WBS and Chart of Accounts: Breaking a project into many manageable subprojects using a WBS requires breaking down project cost along scheduled activities. Therefore a WBS should be accompanied by a cost breakdown structure (CBS) for cost planning. A CBS is a **catalog of all cost elements** expected within a project. The sum total of these elements will equal the project budget (Neil, 1988). The WBS is made up of project elements that are related to work tasks while the CBS is comprised of project elements that are related to cost control accounts. Figure 5.2 shows the relationship between WBS and CBS for an engineering-procurement-construction project.

PHASES	INDIRECTS (1)	DIRECTS		
		Labor	Material	Equipment
Conceptual Engineering	\$	WH \$	\$	\$
Detailed Engineering	\$	WH \$	\$	\$
Procurement	\$	WH \$	\$	\$
Construction	\$	WH \$	\$	\$
Startup	\$	WH \$	\$	\$
Other (2)	\$			

Legend:



The **COST BREAKDOWN STRUCTURE (CBS)** is composed of all elements in the matrix for which dollars (\$) are budgeted. The total dollar value of all of these elements equals the project budget.



The **WORK BREAKDOWN STRUCTURE (WBS)** is composed of those direct labor elements in the matrix for which work-hours (WH) are budgeted and lend themselves to work progress measurement.

Footnotes:

1. Supervision above first level, staff, facilities, supplies and services, travel, etc.
2. Home office overhead, contingency reserve, profit, etc.

Work Packaging: A work package is a well-defined scope of work that usually terminates once a deliverable product or service produces an identifiable or measurable result. A work package may consist of one or more activities or tasks with multiple resources and include one or more cost accounts. These tasks may be related to such areas as engineering, procurement, manufacturing, construction, and start-up. For engineering, the deliverable tasks are the drawings, specifications, procedures, and other items required by vendors or field personnel. For procurement, they include the delivery of materials and equipment.

For manufacturing, the deliverable may be the whole product or a part of the product that is being produced. For construction, the deliverable is the constructed facility, or it may be a partial facility, such as an area or specific construction phase. For startup, the deliverables include system tests and operational certificates. A work package, therefore, provides the structure for efficient integration of engineering, procurement, manufacturing, construction, and startup.

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2- Computerization

Although a manual approach to cost control may be appropriate for some small projects, today's computers are affordable for virtually any size job. Mainframes with work stations may be appropriate for very large projects, but personal computers (PCs) are now affordable for any project, no matter how small. There are many PC applications available that can be customized to meet a project's cost control needs. The needs of the project determine the type of system to use. As new software and hardware systems capture the market, technology constantly evolves. Advancements in computer technology have made it easy to network computer stations in order to share and transfer information between multiple users and to integrate various programs used for estimating, scheduling, work packaging, forecasting, and payroll, as well as other databases.

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Mainframe computers use expensive hardware and software, but they provide for more centralized data processing and support. Mainframes also provide efficient remote job entry by allowing for better, faster, and more complete interaction between functions and locations on the project. PCs are used both as standalone processing units as well as acting as terminals transferring data and interacting between the mainframe and other work stations.

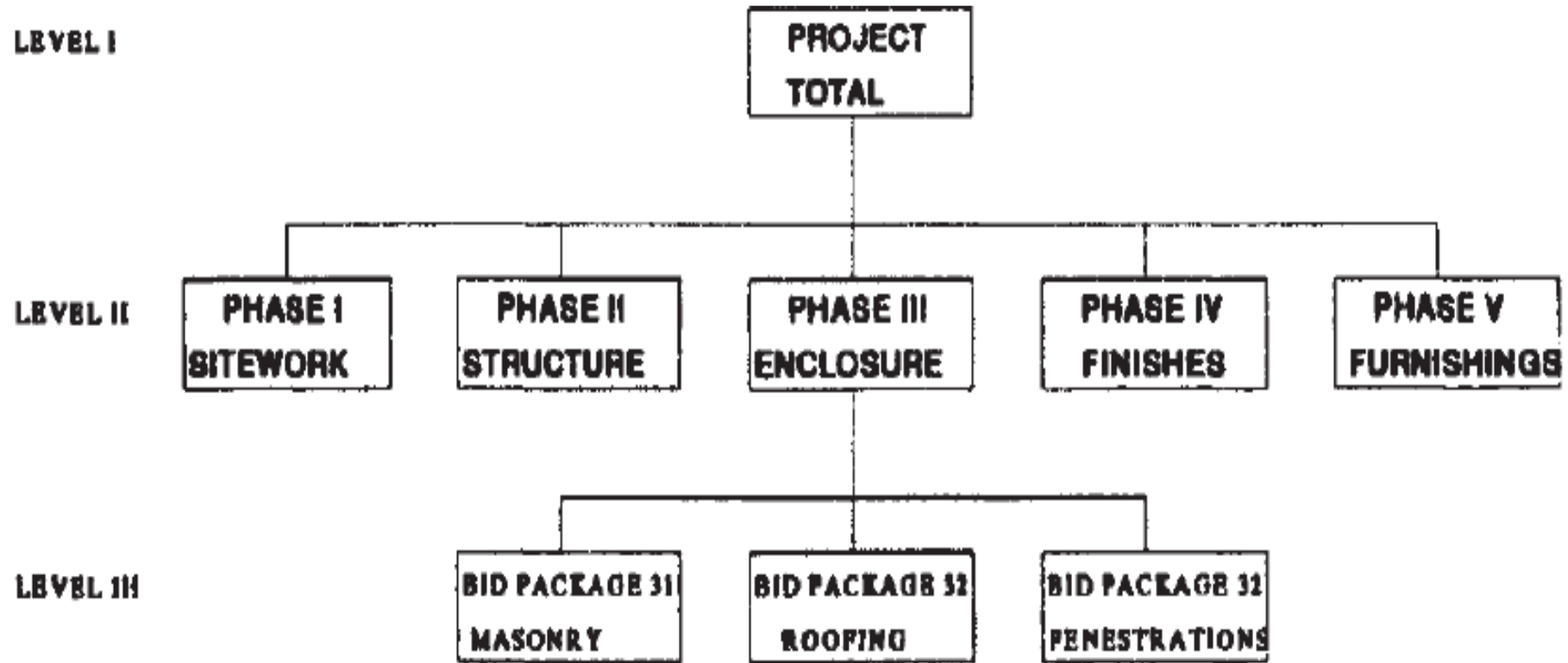
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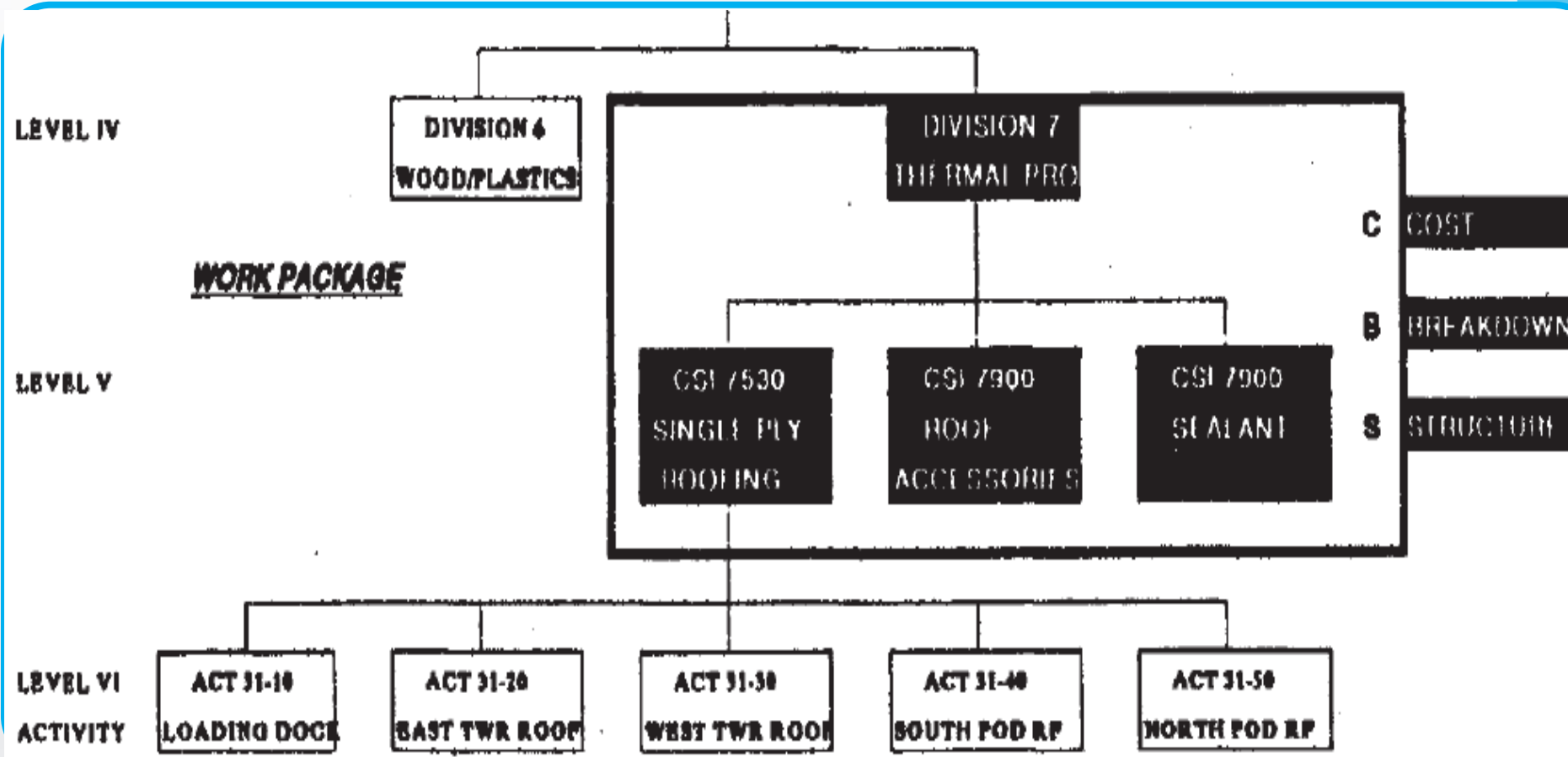
3- Level of Control:

Determining the optimum level of detail to match the cost budget to the schedule is the key to developing the WBS. An optimum level of detail considers the project's size and complexity, the contracting philosophy of the parties involved, the project's organization and responsibility structure, and allows for a level of assumed risks and any operational constraints. At the corporate level, a project is generally viewed in a highly summarized form that focuses on the project's impact to the corporate budget, financial control of the project, and current reforecasting of project costs. At the project level, more detail is needed, although a summary form is still required. Cost control by contractors requires very detailed information about every task performed. A properly designed WBS can be summarized at the lowest level and be rolled up to provide the cost control information needed at the next higher level. An example of a WBS for a \$25 million construction facility is shown in Fig. 5.3.

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Figure 5.3 Sample work breakdown structure (WBS).





4-Elements of Control:

A cost control system consists of five control elements that are tied to the various stages of a project (Fig.4). The first step is to establish a baseline estimate to use as a plan to monitor and control costs. The estimate includes quantities, unit costs, productivity, wage rates, etc. The estimate is produced by the owner, the engineer, the construction manager, or with actual bids. “The very best estimate is some combination of all of these, helping to ensure a more thorough understanding by project participants of the project’s scope and cost expectations”. Once the baseline estimate is produced, monitoring the progress can begin. Data collection must be related to the same WBS used to establish the baseline estimate. Variance analysis is accomplished by comparing the actual data collected to the baseline estimate.

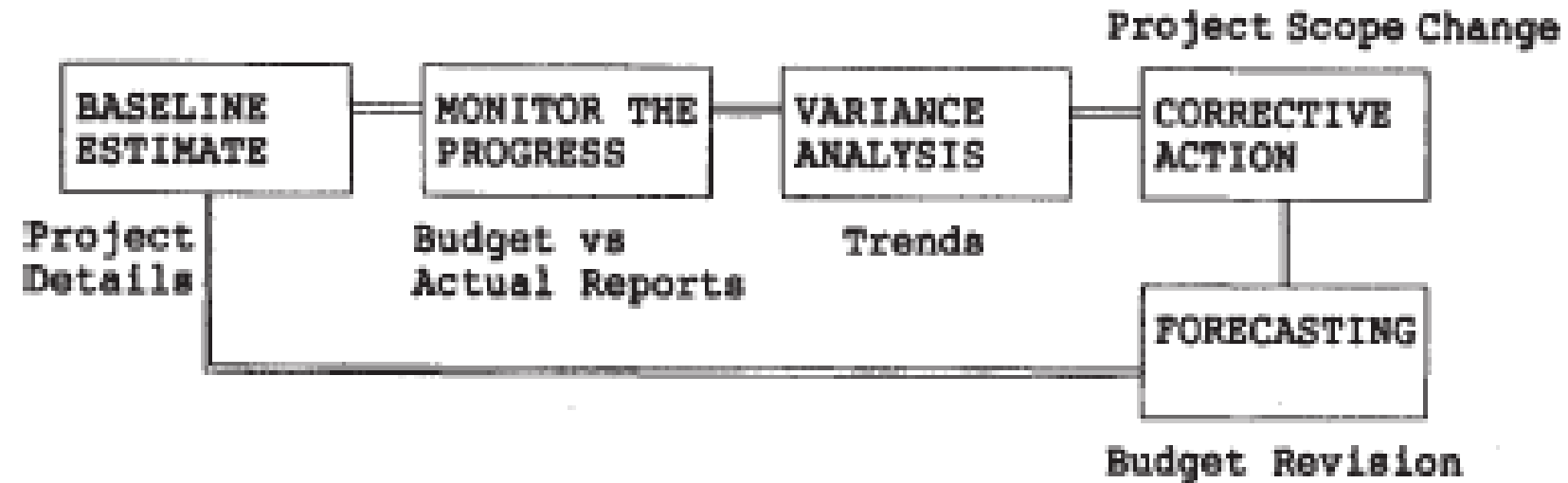


Figure 5.4 Elements of control.

Changes from the baseline estimate can be identified, thus providing management with early warnings that allow decisions and corrective actions to occur before a problem arises. The baseline estimate may require periodical reforecasting in order to include the results of variance analysis . These elements are discussed in detail in the following section.

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Example: \$25M Facility Roll-up

Executive Level View: "Phase II Structure: On Budget (\$5 Million Spent)."

Contractor Level View: "Task 2.4.1 Masonry Material Cost: \$12,000 over budget due to supplier price spike."

Corrective Action: Switch to a pre-approved secondary local supplier to stabilize the remaining baseline

Eighth: STATUS EVALUATION AND CONTROL:

1- Cost/Schedule Integration:

There are several reasons to promote the integration of costs and schedules. Schedules produce the starting and completion dates, the percentage completed, and durations of the remaining tasks—essential information for a cost engineer calculating cash flow and variance analyses. The budget estimate provides data for workhour and craft breakdowns, quantities installed or produced, expended workhours and costs that are used by the scheduler to determine durations, percentages completed, labor force loading, earned workhours, and overall cost.

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-Performance Measurement

The performance measurement system ties together the various elements of a WBS, enabling an objective monitoring of project progress and performance via the concept of earned value . In 1967 the U.S. Department of Defense (DOD) and the Department of Energy (DOE) established the Cost/ Schedule Control Systems Criteria (C/SCSC) to use for control of selected federal projects. Although this system is primarily used on large projects, certain useful features of this system are applicable to other, smaller projects as well. The system consists of three major elements: the budgets, which are time phased to provide a Budgeted Cost of Work Scheduled (BCWS); the actual costs, which are captured as Actual Cost of Work Performed (ACWP); and the earned value concept, which is used to determine the Budgeted Cost of Work Performed (BCWP). By comparing these three major elements, several conclusions about cost and schedule performance can be made .

-Measuring Work Progress

There are six methods for measuring work progress (Neil, 1988):

- Units completed
- Incremental milestone
- Start/finish
- Supervisor opinion
- Cost ratio
- Weighted or equivalent units

The units completed method can be used for tasks that involve repeated production of easily measured pieces of work. In the units completed method, a ratio is calculated by dividing the total units completed by the total units budgeted to generate a percent complete.

The incremental milestone method can be used for any control account that includes sequential subtasks. Completion of any subtasks is considered to be a milestone if it represents a specified percentage of the total installation when completed.

The start/finish method can be used for tasks that lack definable intermediate milestones, thus making it difficult to assign partial progress. With this method, an arbitrary percentage is assigned to the start of the task, and 100 percent is earned when the task is finished

The supervisor opinion method is a highly subjective approach. This approach is used for tasks where a discrete method is not possible.

The cost ratio method can be used for tasks that either involve a long period of time or are continuous over the life of a project. In this method the percentage completed is calculated by dividing actual cost or workhours expended-to-date by those forecasted for completion.

The method of weighted or equivalent units is used for tasks that involve a long period of time and are composed of several subtasks, each with a different unit-of-work measurement. Each subtask is weighted according to the estimated level of effort required. As quantities are completed for each subtask, they are converted into equivalent units.

Units Completed: Installing 200 out of 500 office computers = 40% complete.

Incremental Milestone: Completing the "System Architecture Document" earns a fixed milestone weight of 15% of the design phase.

Start/Finish: A 2-day testing task is assigned 0% progress at start and immediately becomes 100% only when passing all tests.

Supervisor Opinion: A creative director looks at a custom UI design prototype and estimates it is roughly "75% done" based on experience.

Cost Ratio: Expending \$30,000 out of a forecasted \$60,000 total budget = 50% complete

-Earned Value or Achieved and Accomplished Values

The above methods are used for determining progress for a single type of work. **Earned value or achieved and accomplished value** are terms used for determining overall percentage completed of a combination of unlike work tasks or of a complete project. Earned value techniques are applicable to both fixed budgets and variable budgets, although the application of these techniques is different for the two situations. **Performance against schedule** is simply a comparison of what was planned to be done against what was done, while performance against budget is measured by comparing what was done to what has been paid for. The above can be expressed in these ways:

Performance Against Schedule:

Scheduled Variance (SV)=BCWP-BCWS

Schedule Performance Index (SPI)=(BCWP)/(BCWS)

Performance Against Budget:

Cost Variance (CV)=BCWP-ACWP

Cost Performance Index (CPI)=(BCWP)/(ACWP)

Mid-Project Audit at Month 6
Planned Value (BCWS): \$30,000 (What we expected to achieve). **Earned Value (BCWP): \$24,000** (Value of work actually completed). **Actual Cost (ACWP): \$21,000** (What we actually spent). **Calculations: Cost Variance (CV):** ($\$24,000 - \$21,000 = +\$3,000$) (Favorable/Under budget).

Schedule Variance (SV): ($\$24,000 - \$30,000 = -\$6,000$) (Unfavorable/Behind schedule).

CPI: ($24,000 / 21,000 = 1.14$) (Efficiency: Generating \$1.14 of work for every \$1.00 spent)

A positive variance and an index of 1.0 or greater reflects favorable performance. These calculations are used to determine forecasted costs for completion; there are three basic methods of using them:

Method 1 assumes that work from a specified point forward will progress at planned rates whether or not these rates have prevailed to this point. This is expressed as

EAC=ACWP+BAC-BCWP where:

EAC=estimated at completion

ACWP=actual cost of work performed to date

BAC=original budget at completion

BCWP=budgeted cost of work performed to date

Method 2 assumes that the rate of progress to date will continue to prevail and is expressed as : $EAC = BAC / CPI$

Where:

CPI=Cost Performance Index

.Practical Example (to add):Project Metrics: (BAC = \$100,000), (ACWP = \$40,000), (BCWP = \$30,000), (CPI = 0.75).

Method 1 (Atypical Variances): Future work will go strictly as planned.

($EAC = ACWP + BAC - BCWP = \$40,000 + \$100,000 - \$30,000 = \$110,000$).

Method 2 (Typical Variances): Current structural inefficiencies will continue.

($EAC = BAC / CPI = \$100,000 / 0.75 = \$133,333$).

Ninth: REPORTING AND ANALYSIS:

The purpose of cost control reports is to inform management of the project status. To be effective, the reports used for cost control should be brief, concise, timely, factual, and limited to pertinent information. The shorter and more concise the report, the faster feedback can be obtained and appropriate corrective action taken.

Cost control reporting systems have progressed from manually-recorded information systems to today's computerized systems. Computerized systems can not only make extrapolations from status data, but they can also select information for inclusion in different reports. Computer-generated reports can also allow users to browse and view information on video displays. Simply having the information on a computer is not enough; appropriate information must be readily obtainable and presented in a clear, intelligible manner.

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1- Frequency of Reports:

Cost control reports should be coordinated with project scheduling as well as with accounting cutoff dates. Optimally these reports are issued each month. Cutoff dates for reports must be strictly adhered to in order to be of practical use; any major changes occurring after the cutoff date may be presented in an accompanying narrative report.

2 - Variance Analysis:

Variance reporting is a system that emphasizes cost and schedule control during all stages of design, construction, manufacturing, or operations. The purpose is to report to the client and the company all deviations from the budget. Every cost report should include an explanation of overruns and underruns since the last report. Furthermore, the cost engineer should be able to account for all changes made to the initial forecast at project inception.

3- Report Distribution:

The best guide for the distribution of cost reports is to decide if the reports are needed for general information only or if they are actually used for decision making, and at what level those decisions are made. Depending on the intended distribution of the report, cost control reports can be grouped into the following categories:

Multilevel Cost Reporting. Not everyone in a company needs access to all of the information contained in the project control system. Multilevel reporting systems allow for different levels of objective determination and reporting.

Examples of these include:

- Cost summary
- Labor rate
- Quantity and workhour
- Variance reporting.

Combined Cost/Schedule Reporting: These reports are generated by extrapolating information from both the cost and the schedule systems.

Examples of these reports include:

- Cash flow report
- Cost/schedule performance curves
- Productivity profile
- Productivity trend chart
- Bulk quantity curves

Miscellaneous Reports. A number of other reports may be products of a cost control system.

Examples of these may include:

- Material requisition status
- Subcontractor status
- Vendor drawing status
- Fabrication status
- Critical items report
- Quality trends

Every project is a unique situation, each with its own specific reporting requirements. Some samples of common cost control reports are shown in [Figs. 5.8](#) through [5.9](#). To illustrate how a planner moves from the control to the detailed level, reference is made to Fig. 5.8. This figure is called a *control account baseline*. It is a document that takes a control schedule work package (in this case service water piping) and plans it out in detail. Note how the piping system is broken down into the work tasks required for its completion (large pipe, valves, etc).

These are then scheduled in bar chart format. As is so often the case, these tasks are overlapping and there is some flexibility in their sequencing (soft logic). Use of the bar chart format with float shown for each bar gives the field the flexibility they need for accomplishing the work. Also note from the other information included on the baseline that the document provides the basis for earned value control and progress payments. Figure 5.9 is a representation of a reporting format using the service water piping of Fig. 5.8 as an example. The many control accounts, in turn, can be summarized at various levels or for the whole project using earned value.

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Control Account Baseline

Project _____

Date _____

Rev. _____

Account Code		Description											Total Control			
SWP00000		Service Water Piping											W-H 3000			
Weight	Activity	U/M	Latest Estimate	19xx											19xx	
				D	J	F	M	A	M	J	J	A	S	O	N	D
0.25	Large Hangers	EA	100													
0.30	Large Pipe	LF	2000													
0.10	Large Valves	EA	10													
0.15	Large Pipe Weld	EA	150													
0.20	Small Pipe	LF	1500													
			ABC1234												KKR3662	
			EFG7234												EYW4493	
Total Control 1.00																
Control Item Large Pipe		U/M LF	Qty. 2000	W-H	380	660	510	560	660	230	Total					
				W-H	380	1040	1550	2110	2770	3000	Cumulative					
				%	13	35	52	70	92	100	Cumulative					

Figure 5.8

Field Engineer

Figure 5.9 M

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Thank You