Course Title

Project Engineering

Chapter 4

PROJECT MONITORING AND CONTROLLING

Lecture 9 (Week 9)

Project cost control, Project quality control and Project management information system (PMIS).

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Learning Objective

The main objective of this lecture is to understand about:

- Project cost control.
- Project quality control.
- Project management information system(PMIS)

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4.6 PROJECT COST CONTROL

All activities of any project consume resources (i.e. material, labor, equipment) and hence incur cost. For efficient and proper implementation of the project, it is as much necessary to have a check and control over the costs. [1]Cost control may be broadly defined as the process of controlling the expenditure in a project at all stages from its inception through its development. Cost control is not only monitoring of costs but also analyzing the data in order to take corrective action before it is too late. [2]

Cost control measure should start right from the inception of the project. In the CPM/PERT system, costs are calculated for individual activity or group of activities i.e. work packages, as they appear in network. Costs for these activities are broadly classified in two parts.

Direct Cost:

- It includes the cost materials, labor, equipment etc. which are directly consumed to perform an activity.
- Direct cost of a project is the sum total of direct costs of all the activities contained in the project. [3]

Indirect cost:

- Includes overhead items such as staff salary, rentals, expenses for developing infrastructure facilities, traveling etc.
- The nature of indirect costs is that they are spread over a group of activities of the project and cannot be calculated activity-wise. [3]

The direct cost together with indirect cost constitutes the basic cost unit for the work package and these costs are estimated simultaneously along with the activity durations in the planning and scheduling stage.

Cost control is mainly concerned with

- Influencing the factors which create changes to the cost baseline to ensure that changes are beneficial.
- Determining that the cost baseline has changed and
- Managing the actual changes as and when they occur.

Cost control implies good cost management, which must include:

- Cost estimating
- Cost accounting
- Project cash flow
- Company cash flow
- Direct labor costing
- Overhead rate costing
- Others, such as incentives, penalties and profit sharing

Elements of cost control and their descriptions

S.N	Elements of cost control	Description
1	Observation	Regular observation should be made on: Material consumed, manpower and equipment employed, other direct costs etc.
2	Comparison	The observed data must be compared with design standard by calculating variances

3	Identify reasons for variance	If the variance is large, it is important to know the reasons for the variance. For this it is important to check the purchase price of materials, quality, wastage, work condition etc.
4	Corrective action	If the variance cannot be justified then the middle level or higher level management takes the necessary action for bringing the cost of the project in to the track. Corrective action should be worked out and implemented, which may include re-scheduling of the project.

The effective cost control can also be achieved through:

- Thorough planning of the work items.
- Good estimate of time, labor, material and cost.
- Clear communication of the scope of required task.
- A disciplined budget and authorization of expenditure.
- Periodic assessment of time and cost of remaining work.
- Frequent comparison of actual progress and expenditure against plan.

Methods of cost control

1. Short term planning and control
2. Project cost models (S-curve or earned value analysis (EVA))
3. Accounting method of control
    a. Overall profit/loss account
    b. Profit –loss on valuation date
    c. Unit costing

1. Short term planning and control

In this method, the project is broken down in much smaller components and short terms plans for weeks and days are prepared. Such plans are easy to evaluate and monitor.

2. Accounting method of control

a) Overall profit/loss account

Profit/loss account is prepared after the project is completed. Profit / loss are determined and the reasons are analyzed. This information is used for the next project. This system is generally used for small projects only.

b) Profit –loss on valuation date

In this method profit/loss accounts are prepared for various periods after the project is started. This principle is used for large projects. Profit and loss for every month is calculated and plotted against time to note trend. This helps to access profitability of the project.

c) Unit costing

In this method, unit cost of each item is checked and compared with planned (or quoted by the contractor) cost of item, to determine if the items yield profit or not.

3. Project cost models (S-curve or earned value analysis (EVA)

It is also called the earned value management system (EVMS). If your budget spend plan shows you over spending and your schedule shows milestones slipping, you can know you may be in trouble. But you will have no way to make a quantitative assessment of how bad the trouble is? EVMS solves this problem by providing an accurate picture of spending and accomplishments related to a baseline plan.

Earned Value Analysis (EVA) is a method that allows the project manager to measure the amount of work actually performed on a project beyond the basic review of cost and schedule reports. [4]

"EVA is a standard method of measuring a project's progress (performance) at any given point in time, forecasting its completion date and final cost and analyzing variances in the schedule and budget as the project proceeds".

It compares the planned amount of work with what has actually been completed, to determine if the cost, schedule and work accomplished are progressing in accordance with the plan.

EVA compares three pieces of Information

1. Budgeted Cost of Work Scheduled (BCWS) / Planned Value

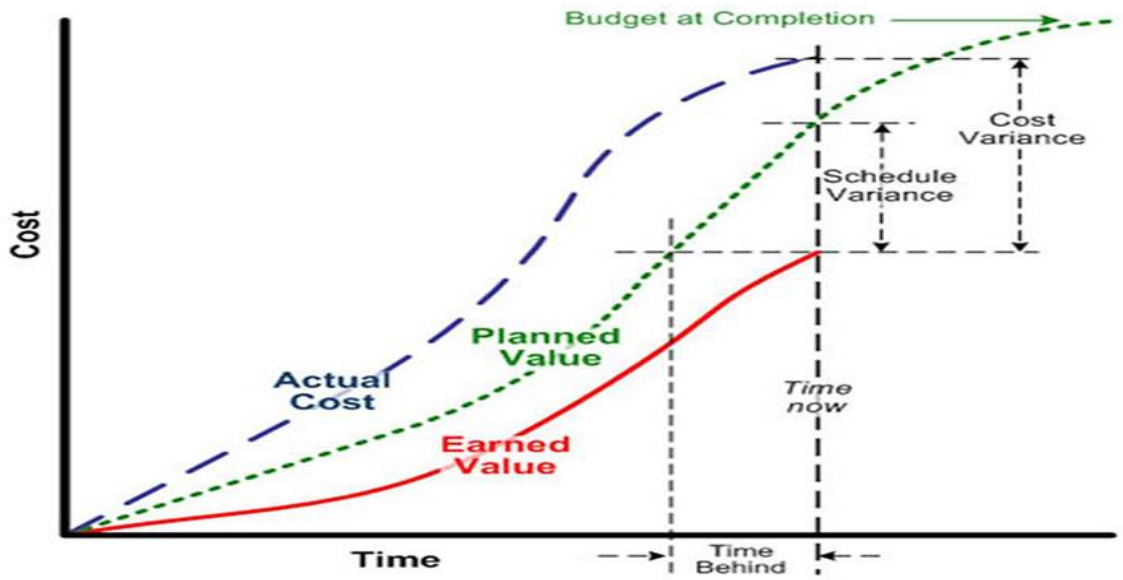
It is the budgeted amount of cost of the work *scheduled* to be accomplished in a given time period (including support and allocated overhead)

2. Actual cost of work performed (ACWP) /Actual Value

It is the amount actually expended in completing the particular work accomplished within a given time period.

3. Budgeted cost of work performed (BCWP)/Earned value

The value, in terms of your baseline budget, of the work accomplished by now (in dollars or hours), called the Earned Value.



Source: [5]

Some Derived Metrics in EVA (parameters in EVA)

1. Variances	Formula	Interpretation
Cost Variance (CV)	CV = BCWP – ACWP	• If CV is +ve, cost under run (actual budget expense is less than planned) • If CV is -ve, cost overrun (actual budget expense is greater than planned) • If CV is 0 No cost variance (actual expense is equal to planned)
Schedule Variance (SV)	SV = BCWP - BCWS	• If SV is +ve, Schedule under run (actual schedule is ahead of planned) • If SV is -ve, Schedule overrun (actual schedule is behind of planned) • If SV is 0 No Schedule variance (actual Schedule is equal to planned)
2.Variances expressed in percentage		
CV %	(BCWP – ACWP) ÷ ACWP *100%	• Over budget or under budget expresses in %, by what % does the cost under run or over run.
SV %	(BCWP – BCWS) ÷ BCWS *100%	• Behind or ahead schedule expressed in %, by what % does the Schedule under run or over run.
3.Indices		
Cost performance index	CPI = BCWP / ACWP	• If CPI ≥ 1, Better Performance for Cost, less budget. • If CPI < 1, Poor Performance for Cost, more budget.

Schedule Performance Index	SPI = BCWP / BCWS	• If SPI ≥ 1, Better Performance in Schedule, ahead of schedule. • If SPI < 1, Poor Performance in Schedule, behind of schedule.
4. Trends & Fore Cast		
Estimate at Completion OR New project cost	EAC = Original project Cost / CPI	
Schedule at Completion OR New Project time	SAC = Original project duration / SPI	

Example:

Suppose that an activity had 5-day duration and was expected to cost $10, 000. Set into the project, and prior to finishing an activity, the following data were obtained about the progress done to that activity:

- Have so far worked for 3.5 days on activity.
- 60% of an activity has been accomplished
- $ 8000 already spent on activity.

Perform the earned value analysis (EVA).

The following quantities can be easily computed:

- ACWP = 8000
- BCWP = 60%*10000 = 6000
- BCWS = 3.5*10000/5 = 7000
- Cost variance = BCWP – ACWP

  = 6000-8000 = - 2000(over budget)
- Schedule variance = BCWP – BCWS

  = 6000 - 7000 = -1000 (behind the schedule)

Similarly,

- CPI = BCWP/ACWP = 6000/8000 = 0.75(<1)
- SPI = BCWP/BCWS = 6000/ 7000 = 0.86 (<1)
- % overrun/under run = (8000-6000) / 6000

  = 33.33% (+ve) (cost overrun)

From above, a new activity duration estimate can be computed using the following method:

- New activity duration = original time estimate/ SPI

  = 5/0.86 = 5.8 (i.e. 6 days)

- New cost estimate = original cost estimate/CPI

  = 10000/0.75 = $ 13333.33

4.7 PROJECT QUALITY CONTROL

Quality is a perceptual, conditional, and somewhat subjective attribute and may be understood differently by different people. Quality is

- Degree of goodness
- Conformance to requirements or specification
- Zero defects
- Fitness for use
- Consistent conformance to expectation
- Doing things right first time
- Doing the right things

Quality may be defined as "The totality of features and characteristics of a product or services which bear on its ability to satisfy stated or implied need". Quality Concept moves through different stages such as inspection, quality assurance, quality control, and total quality to reach the quality concept called Total Quality Management (TQM).

Quality Related Process		
Process	**Description**	**References**
Quality Planning	Involves identifying the quality standards that are relevant to the project and determining how to ensure conformance to these standards.	ISO 8402:3.5
Quality Assurance	All the planned and systematic activities implemented within the quality system and demonstrated as needed, to provide adequate confidence that an entity will fulfil requirement for quality.	ISO 8402:3.5
Quality Control	The operational techniques and activities which together sustain the product, service or quality to specific requirements.	ISO 8402:3.5
Quality Inspection	It determines the acceptability of a product or a service or stages of construction. Includes measuring, examining and testing of product.	ISO 8402:2.15
Quality Audit	A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements.	ISO 8402:4.9
Quality Improvement	Actions taken throughout the organization to increase the effectiveness and efficiency of activities.	ISO 9004-1:5.6

Source: [6]

Quality in a project is:

The fulfillment of project responsibilities in the delivery of products and services in a manner that meets or exceeds the stated requirements and expectations of the owner, design professional, and constructor. The factors affecting quality in a project are:

1. Design.
2. Drawings.
3. Specifications.
4. Bid document.
5. Selection of contractor.
6. Socio-economic factors.
7. Environmental factors.

The aim of quality control is to ensure the production of items for their intended use with defects and variations from their prescribed standards within limits prescribed. [7]. It also aims to avoid wastage of time, materials and money by highlighting the point at which a production process is becoming defective. The cornerstone of quality control is specification.

Objectives

1. To maintain quality standards.
2. To ensure customer satisfaction.
3. To reduce costs associated with defective goods.

The process of quality control includes: [8]

1. Setting specific standards for construction performance, usually through plans and specifications.
2. Measuring variances from the standards.
3. Taking action to correct or minimize adverse variances and
4. Planning for improvements in the standards themselves and in conformance with the standards.

Cost of quality

Cost of quality in a project is a combination of following costs:

1. Costs to control quality (prevention and appraisal)
2. Costs of failure to control quality (internal and external failures)

Cost of quality becomes the cost to the company of doing things wrong, of not conforming to the specification. Qualities costs can be divided into four major categories the first two include the costs to try to control quality and the second two include the costs that result from failure to control quality.

Prevention costs:

The cost of preventing defective work is usually extended before the product is made or service rendered. These costs include:

- Design reviews and drawing checks
- Quality orientation program, education and training
- Process control

- Process orientations
- Suppliers evaluation and presentation
- Workers training

Appraisal costs:
The cost of appraisal is incurred for auditing service procedure to make sure they conform to prescribed work practices. These include

- Process capability measurement (e.g. control charts)
- Tests, gauges and test equipment
- Prototype inspection and tests
- In process and final inspection and tests
- Checking material furnished by suppliers
- Work in process goods testing and inspections

Internal failure costs:
Internal failure cost is applicable when the product is in factory and not been sold. These costs include:

- Expenses for producing items that are scrapped
- Redesign and reworking and downtime
- Retesting defective items
- Lost value of items sold as seconds
- Cost of delays and administration time to review non-conforming materials for disposition.

External failure costs:
These costs are applicable to goods when product has been sold. These costs include:

- Warranty cost
- Product liability (insurance and settlements)
- Consumers affairs (dealing primarily with customer complaints about quality)
- Field service (mostly repairs of what should have worked)
- Product returns, recalls.

4.8 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

Project operates in a dynamic environment, the project manager at every level require information with speed, precision and economy. PMIS is a database for the project which is designed for processing and systematizing the massive data generated in a project and feeding it to every level. [9] PMIS collects, analyses, stores, retrieves and disseminates project information for making project decisions. [10]It is a prerequisite of project control and vital for managing stakeholder expectations.

Requirements of PMIS

- Project forms are filled – in periodically based on the measurement of progress of each activity.
- The forms are entered in the PMIS and analysed to prepare a report for dissemination to all the concerned project personnel.
- Corrective actions are taken by the project manager based on performance deviations identified by PMIS reports.

PMIS reports should identify critical points so that corrective actions can be taken.

The main objective of the PMIS is to provide information to managers and supervisors of a firm in order to maximize its benefits through optimization of resources uses. Following are some of the specific objectives:

- to reduce project duration
- to make better use of resources
- to increase resources productivity
- to decrease cost/price
- to bring the new facts to the knowledge
- to reduce uncertainty in decision making

Source: [11]

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