



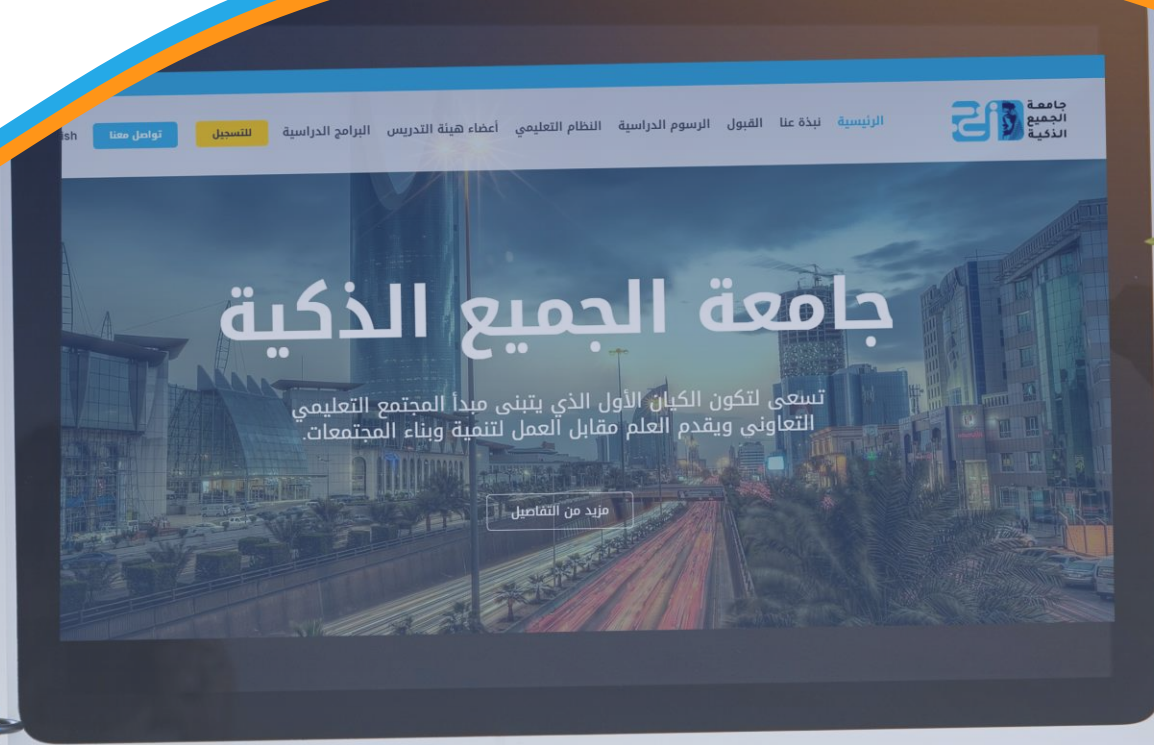
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Academic Staff Orientation

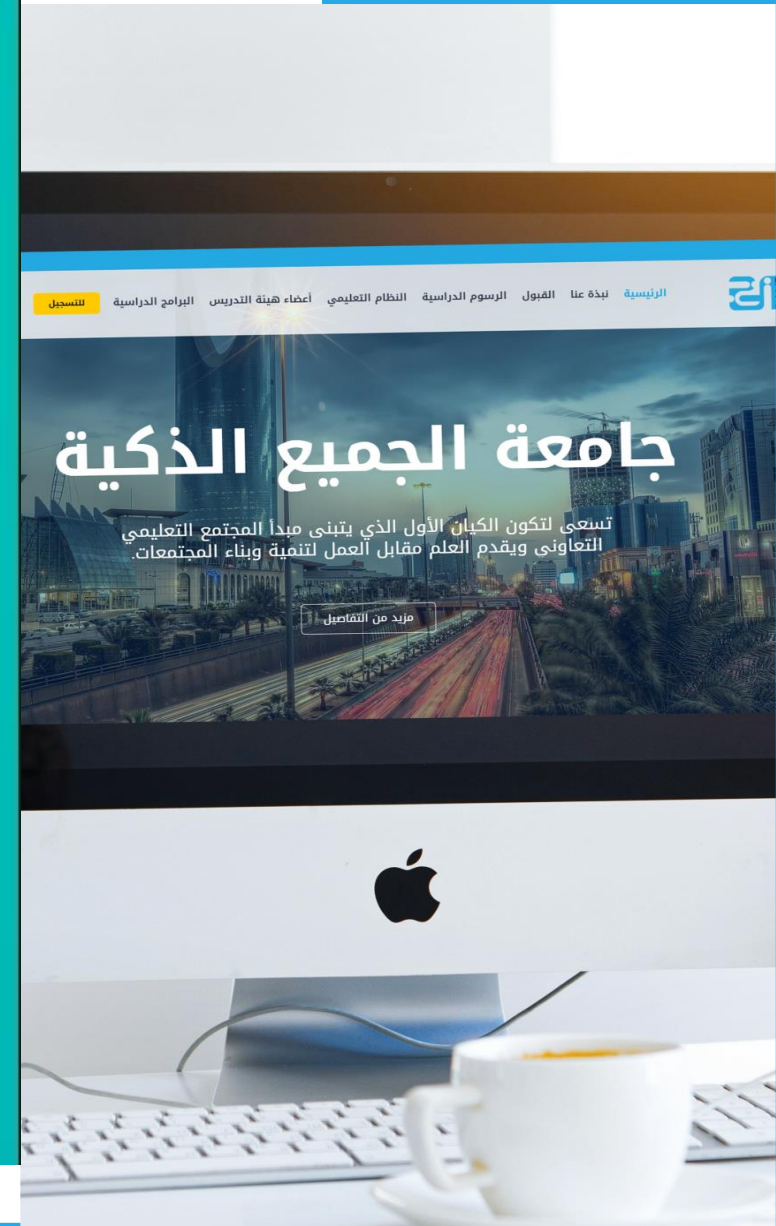


PhD. M.SC. BSc.
PMP. PMI-ACP. PMI - PBA.
P3O. 6Sigma,
Scrum master, TOT

د. صفوة العجب

Project Cost Management

Lecture7



Budgeting and Cost Estimation

PMG506 Advanced Project Management (APM)



Introduction:

Lecture 1: Projects in Contemporary Organizations



Project Initiation:

Lecture 2: Strategic Management and Project Selection

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Project planning

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Budgeting and Cost Estimation

First priority is, of course, obtaining resources with which to do the work. Senior management approval of the project budget does exactly that. A budget is a plan for allocating resources. Thus, the act of budgeting is the allocation of scarce resources to the various endeavors of an organization. The outcomes of the allocation process often do not satisfy managers of the organization who must live and work under budget constraints. It is, however, precisely the pattern of constraints in a budget that embodies organizational policy. The degree to which the different activities of an organization are fully supported by an allocation of resources is one measure of the importance placed on the outcome of the activity. Most of the senior managers try hard to be evenhanded in the budgetary process, funding each planned activity at the “right” level—neither overfunding, which produces waste and encourages slack management, nor underfunding, which inhibits accomplishment and frustrates the committed.

Budgeting and Cost Estimation

The budget serves as a standard for comparison, a baseline from which to measure the difference between the actual and planned uses of resources. This allows deviations from planned usage to be checked against the progress of the project, and exception reports can be generated if resource expenditures are not consistent with accomplishments. Indeed, the pattern of deviations can be examined to see if it is possible, or reasonable, to forecast significant departures from budget.

With sufficient warning, it is sometimes possible to implement corrective actions. Such forecasting helps to decrease the number of undesirable surprises for senior management.

7.1 ESTIMATING PROJECT BUDGETS

In order to develop a budget, we must forecast what resources the project will require, the required quantity of each, when they will be needed, and how much they will cost, including the effects of potential price inflation. Uncertainty is involved in any forecast, though some forecasts have less uncertainty than others.

In many fields, cost-estimating methods are well codified. For example, in fields such as construction, costs can often be estimated by *scaling* the various cost elements appropriately. Similarly, *parametric estimating* relies on well-known statistical correlations between various factors such as the total cost of a house relative to the square meter of living area.

A more interesting estimation technique that also depends on actual costs early in the life of a project is based on earned value analysis. Early actual costs on a project are compared to their estimates, and the remaining costs are adjusted by assuming a constant actual-to-estimate cost ratio.

7.1 ESTIMATING PROJECT BUDGETS

For multiyear projects, another problem is raised. The plans and schedules for such projects are set at the beginning of project life, but over the years, the forecast resource usage may be altered by the availability of alternate or new materials, machinery, or personnel—available at different costs than were estimated, giving rise to both the risk of inflation and technological risk. The longer the project life, the less the PM can trust that traditional methods and costs will be relevant.

There are two fundamentally different strategies for data gathering, top-down and bottom-up.

Top-Down Budgeting

This strategy is based on collecting the judgments and experiences of top and middle managers, and available past data concerning similar activities. These managers estimate overall project cost as well as the costs of the major subprojects that comprise it. These cost estimates are then given to lower-level managers, who are expected to continue the breakdown into budget estimates for the specific tasks and work packages that comprise the subprojects. This process continues to the lowest level.

7.1 ESTIMATING PROJECT BUDGETS

The advantage of this top-down process is that aggregate budgets can often be developed quite accurately, though a few individual elements may be significantly in error. Another advantage of the top-down process is that small yet costly tasks need not be individually identified, nor need it be feared that some small but important aspect has been overlooked.

Bottom-Up Budgeting

In this method, elemental tasks, their schedules, and their individual budgets are constructed, again following the WBS. The people doing the work are consulted regarding times and budgets for the tasks to ensure the best level of accuracy. Initially, estimates are made in terms of resources, such as labor hours and materials. These are later converted to dollar equivalents. The resulting task budgets are aggregated to give the total direct costs of the project. The PM adds such indirect costs as general and administrative (G&A), possibly a project reserve for contingencies, and then a profit figure to arrive at the final project budget.

7.1 ESTIMATING PROJECT BUDGETS

The advantages of the bottom-up process are those generally associated with participative management. Individuals closer to the work are apt to have a more accurate idea of resource requirements than their superiors or others not personally involved. In addition, the direct involvement of low-level managers in budget preparation increases the likelihood that they will accept the result with a minimum of grumbling. Involvement also is a good managerial training technique, giving junior managers valuable experience in budget preparation as well as the knowledge of the operations required to generate a budget.

Work Element Costing

Suppose a work element is estimated to require 25 hours of labor by a technician. The specific technician assigned to this job is paid \$17.50/hr. Overhead charges to the project are 84 percent of direct labor charges. The appropriate cost appears to be:

$$25\text{hr} \times \$17.50 \times 1.84 = \$805.00$$

7.1 ESTIMATING PROJECT BUDGETS

Industrial engineers have noted that during a normal eight hour day, no one actually works for all eight hours. Workers need breaks called “personal time.” This covers such activities as visiting the toilet, having a cigarette, and all the other time consuming activities engaged in by normal people. A typical allowance for personal time is 12 percent of total work time. If personal time was not included in the 25-hr estimate made above, then the cost calculation becomes:

$$1.12 \times 25 \text{ hr} \times \$17.50 \times 1.84 = \$901.60$$

If a specific machine is needed by the project and is the property of a functional department, the project may “pay” for it by transferring funds from the project budget to the functional department’s budget. The charge for such machines will be an operating cost (\$/hr or \$/operating cycle), plus a depreciation charge based on either time or number of operating cycles. Use of general office equipment, e.g., copy machines, drafting equipment, and coffeemakers, is often included in the general overhead charge.

Budgeting and Cost Estimation

7.1 ESTIMATING PROJECT BUDGETS

In addition to these charges, there is also the General and Administrative (G&A) charge. This is composed of the cost of senior management, the various staff functions, and any other expenses not included in overhead. G&A charges are a fixed percent of either the direct costs or the total of all direct and indirect costs.

Thus, a fully costed work element would include direct costs (labor, resources, and special machinery) plus overhead and G&A charges.

An Iterative Budgeting Process—Negotiation-in-Action

An iterative planning process with subordinates developing action plans for the tasks for which they were responsible. Superiors review these plans, perhaps suggesting amendments. The strength of this planning technique is that primary responsibility for the design of a task is delegated to the individual accountable for its completion, and thus it utilizes participative management. Estimated resource usage and schedules are a normal part of the planning process at all planning levels. Therefore, the superior constructing an action plan at the highest level would estimate resource requirements and durations for each of the steps in the action plan.

7.1 ESTIMATING PROJECT BUDGETS

Let us refer to the superior's resource requirements for a particular task as R . The subordinate responsible for that task estimates the resource requirements as r . In a perfect world, R would equal r . The probable relationship between the original estimates made at the different levels is $R \ll r$. This is true for several reasons.

*First, the farther one moves up the organizational chart away from immediate responsibility for doing the work, the easier, faster, and cheaper the job looks to the superior than to the one who has to do it. This is because the superior either does not know the details of the task, or has conveniently forgotten the details, as well as how long the job takes and how many problems can arise.

*Second, wishful thinking leads the superior to underestimate cost (and time), because the superior has a stake in representing the project to senior management as a profitable venture.

*Third, the subordinate is led to build-in some level of protection against failure by adding an allowance onto a budget that already may have a healthy contingency allowance.

7.1 ESTIMATING PROJECT BUDGETS

Assuming that the superior and subordinate are reasonably honest with one another, the two parties meet and review the subordinate's action plan. Usually, the initial step toward reducing the difference in cost estimates is made by the superior who is "educated" by the subordinate in the realities of the job. The result is that the superior's estimate rises. Encouraged by the boss's positive response to reason, the subordinate surrenders some of the protection provided for by the budgetary "slop," and the subordinate's estimate falls. The subordinate's cost estimate is still greater than the superior's, but the difference is considerably decreased.

Comments on the Budget Request Process

The budget process often begins with an invitation from top management for each division to submit a budget request for the coming year. Division heads pass the invitation along to departments, sections, and subsections, each of which presumably collects requests from below, aggregates them, and passes the results back up the organizational ladder.

7.1 ESTIMATING PROJECT BUDGETS

This sounds like bottom-up budgeting, but there is an important difference between this procedure and a true bottom-up system. Along with the formal invitation for submission of a budget request, in the iterative system another message is passed down—a much less formal message that carries the following kinds of information: the percent by which the wage bill of the organization may be increased or must be decreased, organizational policy on adding to or cutting the work force, the general attitude toward capital expenditures, knowledge about which projects and activities are considered to be high priority and which are not, and a number of other matters that, in effect, prescribe a set of limits on lower-level managers. As the budget requests are passed back up the organization, they are carefully inspected for conformity to guidelines. If they do not conform, they are “adjusted,” often with little or no consultation with the originating units. Senior management tends to adopt an autocratic stance on budget making for many reasons, but two are very common: the need to feel in control of the budget, and the feeling that a tight budget will somehow motivate subordinates to perform more efficiently. We know of no particular evidence to support such views, but they are quite common. Moreover, they lead to budgetary game playing and increase the uncertainty surrounding the budgetary process

7.1 ESTIMATING PROJECT BUDGETS

Cost Category Budgeting vs. Program/Activity Budgeting

Another facet of budgeting has to do with the degree to which a budget is category-oriented or program/activity-oriented. The traditional organizational budget is category-oriented often based upon historical data accumulated through a traditional, category-based, cost accounting system. Individual expenses are classified and assigned to basic budget lines such as phone, materials, personnel- clerical, utilities, direct labor, etc. or to production centers or processes. These expense lines are gathered into more inclusive categories, and are reported by organizational unit—for example, by section, department, and division. In other words, the budget can be overlaid on the organizational chart.

With the advent of project organization, it became necessary to organize the budget in ways that conformed more closely to the actual pattern of fiscal responsibility. This need gave rise to program budgeting i.e. divided by task/ activity and expected time of expenditure.

7.2 IMPROVING THE PROCESS OF COST ESTIMATION

The cooperation of several people is required to prepare cost estimates for a project. If the firm is in a business that routinely requires bids to be submitted to its customers, it will have “professional” (experienced) cost estimators on its staff. The major responsibility of the professional estimators is to reduce the level of uncertainty in cost estimations so that the firm’s bids can be made in the light of expert information about its potential costs. It is the job of the PM to generate a description of the work to be done on the project in sufficient detail that the estimator can know what cost data must be collected.

Even with the finest of experts working to estimate resource usage, the one thing that is certain is that things will not go precisely as planned. There are two fundamentally different ways to manage the risks associated with the chance events that occur on every project. The simpler and far more common way is to make an allowance for contingencies—usually 5 or 10 percent of the estimated cost. We strongly prefer another method in which the forecaster selects “most likely, optimistic, and pessimistic” estimates. The method is described in detail in Chapter 8. The method is applicable, to the estimation of resource requirements and costs for the determination of project budgets.

7.2 IMPROVING THE PROCESS OF COST ESTIMATION

Turning now to the problem of estimating direct costs, project managers often find it helpful to collect direct cost estimates on a form that not only lists the estimated level of resource needs, but also indicates when each resource will be needed, and notes if it is available (or will be available at the appropriate time). It also identifies the person to contact in order to get specific resources. This table can be used for collating the resource requirements for each task element in a project, or for aggregating the information from a series of tasks onto a single form. The matter of what overhead costs are to be added and in what amounts is unique to the firm, beyond the PM's control, and generally a source of annoyance and frustration to one and all. The allocation of overhead is arbitrary by its nature.

7.2 IMPROVING THE PROCESS OF COST ESTIMATION

A Special Case of Learning—Technological Shock

If the parent organization is not experienced in the type of project being considered for selection, performance measures such as time to installation, time to achieve 80 percent efficiency, cost to install, and the like are quite uncertain and often will be seriously underestimated. It is interesting to observe that an almost certain, immediate result of installing a new, cost-saving technology is that costs rise. Sometimes we blame the cost increases on resistance to change, but a more sensible explanation is that when we alter a system, we disturb it and it reacts in unpredictable ways.

To the extent possible, past knowledge of system actions and reactions should be built into estimates of future project performance.

Other Factors

- Depending on the reference, anywhere from about three-fifths to five-sixths of projects fail to meet their time, cost, and/or specification objectives.

7.2 IMPROVING THE PROCESS OF COST ESTIMATION

- Changes in resource prices are one of things that can increase risk by producing errors in cost estimates occur with particularly high frequency.
- The determination of which inputs account for a “significant” portion of project cost is not difficult, although it may be somewhat arbitrary.
- Further improvements can be made by taking into account the fact that the prices of different inputs often change at very different rates and sometimes in different directions.
- The proper level of breakdown in estimating the impact of price changes simply depends on the organization’s willingness to tolerate error.
- Other elements that need to be factored into the estimated project cost include an allowance for waste and spoilage.
- Over- and underestimation of cost can have a serious impact on the probability of winning the contract—or on the level of profit, if a win occurs.
- There is considerable opportunity for unethical behavior during cost estimation and bidding. Further, estimation and bidding practices vary widely from industry to industry.



7.2 IMPROVING THE PROCESS OF COST ESTIMATION

- Every project needs an “allowance for contingencies.”
- The wise PM takes into account as many known influences on the project budget as can be predicted.

SUMMARY

This chapter initiated the subject of project implementation by focusing on the project budget, which authorizes the project manager to obtain the resources needed to begin work. Different methods of budgeting were described along with their impacts on project management. Then, a number of issues concerning cost estimation were discussed, particularly the effect of learning on the cost of repetitive tasks and how to use the concept of the learning curve. Finally, methods for improving cost estimation skills were described.

Specific points made in the chapter were these:

- The intent of a budget is to communicate organizational policy concerning the organization's goals and priorities.
- There are a number of common budgeting methods: top-down, bottom-up, the program budget.
- A form identifying the level of resource need, when it will be needed, who the contact is, and its availability is especially helpful in estimating costs.
- It is common for organizations to fund projects whose returns cover direct but not full costs in order to achieve long-run strategic goals of the organization.



SUMMARY

- If projects include repetitive tasks with significant human input, the learning phenomenon should be taken into consideration when preparing cost estimates.
- The learning curve is based on the observation that the amount of time required to produce one unit decreases a constant percentage every time the cumulative output doubles.
- A method for determining whether or not cost estimates are biased is described. The method can be used to improve any estimation/forecasting process.
- Other major factors, in addition to learning, that should be considered when making project cost estimates are inflation, differential changes in the cost factors, waste and spoilage, personnel replacement costs, and contingencies for unexpected difficulties.

In the next chapter, we address the subject of task scheduling, a topic of major importance in project management. More research and investigation have probably been conducted on the subject of scheduling than any other element of project management.

GLOSSARY

Bottom-up Budgeting A budgeting method that begins with those who will be doing the tasks estimating the resources needed. The advantage is more accurate estimates.

Cost Categories

- **Direct (or Variable) Cost** These costs vary with output; e.g., labor costs, material costs, and sometimes the cost of capital equipment such as machinery that performs a specific function on each unit of output.
- **General & Administrative Cost (G&A)** The cost of administration; e.g., Accounting, Human Resources, and Legal not charged as an Indirect Cost and not included in Overhead Cost. Sometimes the G&A is not reported as a separate item but is included in overhead cost. G&A is usually charged as a fixed percent of a direct cost such as labor.
- **Indirect (or Fixed) Cost** These costs are associated with output, but do not vary with each unit of output; e.g., the cost of capital equipment not charged per piece of output, advertising, distribution, or sales. Costs are charged as a lump sum or as a fixed percent of some direct cost such as labor.



GLOSSARY

- **Overhead Cost** Costs incurred by the firm, but not associated with any specific product or class of products; e.g., cost of building and ground maintenance, utilities, cost of plant security, cost of health insurance and pension plans. Typically charged as a fixed percent of some direct cost such as labor.

Learning Rate The percentage of the previous worker hours per unit required for doubling the output.

Program Budgeting Budgeting by project task/activity and then aggregating income and expenditures by project or program, often in addition to aggregation by organizational unit or category.

Top-Down Budgeting A budgeting method that begins with top managers' estimates of the resources needed for a project. Its primary advantage is that the aggregate budget is typically quite accurate because no element has been left out. Individual elements, however, may be quite inaccurate.

Variances The pattern of deviations in costs and usage used for exception reporting to management.

Thank you

