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Open budget and Cost Control, Monitoring and Accounting

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Abstract: ***Role of budget open budget and cost control is described and analysed within illustrative examples for making decisions. As budget is the base for the future so it gives the future prospects for cost ascertained and maintained. This paper shows the calculated impact of budget on cost control through imaginary illustrations and figures, it also proposed the importance of budget as a tool for controlling cost***

Keywords: Cost control, Open budget, Accounting, Monitoring, Cost accounting

1. Introduction

During the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process. These tools serve the dual purpose of recording the financial transactions that occur as well as giving managers an indication of the progress and problems associated with a project. The problems of project control are aptly summed up in an old definition of a project as "any collection of vaguely related activities that are ninety percent complete, over budget and late."[1] The task of project control systems is to give a fair indication of the existence and the extent of such problems.

In this paper, we consider the problems associated with resource utilization, budgeting, accounting, monitoring and control during a project. In this discussion, we emphasize the project management uses of budgeting information. Interpretation of project accounts is generally not straightforward until a project is completed, and then it is too late to influence project management. Even after completion of a project, the budgeting results may be confusing. Hence, managers need to know how to interpret budgeting information for the purpose of project management. In the process of considering management problems, however, we shall discuss some of the common budgeting systems and conventions, The limited objective of project control deserves emphasis. Project control procedures are primarily intended to identify deviations from the project open budget rather than to suggest possible areas for cost savings. This characteristic reflects the advanced stage at which project control becomes important. The time at which major cost savings can be achieved is during open budgeting and design for the project. During the actual construction, changes are likely to delay the project and lead to inordinate cost increases. As a result, the focus of project control is on fulfilling the original design open budget s or indicating deviations from these open budget, rather than on searching for significant improvements and cost savings. It is only when a rescue operation is required that major changes will normally occur in the construction open budget.

Finally, the issues associated with integration of information will require some discussion. Project management activities and functional concerns are intimately linked, yet the techniques used in many instances do not facilitate comprehensive or integrated consideration of project activities. For example, schedule information and cost accounts are usually kept separately. As a result, project managers themselves must synthesize a comprehensive view from the different reports on the project plus their own field observations. In particular, managers are often forced to infer the cost impacts of schedule changes, rather than being provided with aids for this process. Communication or integration of various types of information can serve a number of useful purposes, although it does require special attention in the establishment of project control procedures.

2. The Open Budget

For cost control on a project, the construction open budget and the associated cash flow estimates can provide the baseline reference for subsequent project monitoring and control. For schedules, progress on individual activities and the achievement of milestone completions can be compared with the project schedule to monitor the progress of activities. Contract and job specifications provide the criteria by which to assess and assure the required quality of construction. The final or detailed cost estimate provides a baseline for the assessment of financial performance during the project. To the extent that costs are within the detailed cost estimate, then the project is thought to be under financial control. Overruns in particular cost categories signal the possibility of problems and give an indication of exactly what problems are being encountered. Expense oriented construction open budgeting and control focuses upon the categories included in the final cost estimation. This focus is particular relevant for projects with few activities and considerable repetition such as grading and paving roadways.

For control and monitoring purposes, the original detailed cost estimate is typically converted to a project budget, and the open budget is used subsequently as a guide for

[1] *Peter F., "Database Structures for Project Management," Proceedings of the Seventh Conference on Electronic Computation, ASCE, 1979.*

management. Specific items in the detailed cost estimate become job cost elements. Expenses incurred during the course of a project are recorded in specific job cost accounts to be compared with the original cost estimates in each category. Thus, individual job cost accounts generally represent the basic unit for cost control. Alternatively, job cost accounts may be disaggregated or divided into work elements which are related both to particular scheduled activities and to particular cost accounts.

In addition to cost amounts, information on material quantities and labour inputs within each job account is also typically retained in the project budget. With this information, actual materials usage and labour employed can be compared to the expected requirements. As a result, cost overruns or savings on particular items can be identified as due to changes in unit prices, labour productivity or in the amount of material consumed

In developing or implementing a system of cost accounts, an appropriate numbering or coding system is essential to facilitate communication of information and proper aggregation of cost information. Particular cost accounts are used to indicate the expenditures associated with specific projects and to indicate the expenditures on particular items throughout an organization. These are examples of different perspectives on the same information, in which the same information may be summarized in different ways for specific purposes. Thus, more than one aggregation of the cost information and more than one application program can use a particular cost account. Separate identifiers of the type of cost account and the specific project must be provided for project cost accounts or for financial transactions. Cost budgeting purposes, labour and material quantities are aggregated by type no matter for which physical component they are employed. For example, particular types of workers or materials might be used on numerous different physical components of a facility. Moreover, the categories of cost accounts established within an organization may bear little resemblance to the quantities included in a final cost estimate. This is particularly true when final cost estimates are prepared in accordance with an external reporting requirement rather than in view of the existing cost accounts within an organization.

One particular problem in forming a open budgeting terms of cost accounts is the treatment of contingency amounts. These allowances are included in project cost estimates to accommodate unforeseen events and the resulting costs. However, in advance of project completion, the source of contingency expenses is not known. Realistically, a budget budgeting item for contingency allowance should be established whenever a contingency amount was included in the final cost estimate.

A second problem in forming a open budget is the treatment of inflation. Typically, final cost estimates are formed in terms of real dollars and an item reflecting inflation costs is added on as a percentage or lump sum. This inflation allowance would then be allocated to individual cost items in relation to the actual expected inflation over the period for which costs will be incurred.

An example of a small open budget shown in Table 1-1. This budget might be used by a design firm for a specific design project. While this budget might represent all the work for this firm on the project, numerous other organizations would be involved with their own budgets. In Table 1-1, a summary budget is shown as well as a detailed listing of costs for individuals in the Engineering Division. For the purpose of consistency with cost accounts and managerial control, labour costs are aggregated into three groups: the engineering, architectural and environmental divisions. The detailed budget shown in Table 1-2 applies only to the engineering division labour; other detailed budgets amounts for categories such as supplies and the other work divisions would also be prepared. Note that the salary costs associated with individuals are aggregated to obtain the total labour costs in the engineering group for the project. To perform this aggregation, some means of identifying individuals within organizational groups is required. Accompanying a budget of this nature, some estimate of the actual man-hours of labour required by project task would also be prepared. Finally, this budget might be used for internal purposes alone. In submitting financial bills and reports to the client, overhead and contingency amounts might be combined with the direct labour costs to establish an aggregate billing rate per hour. In this case, the overhead, contingency and profit would represent allocated costs based on the direct labour costs.

Table 1.1: Example of a Small Open budget for a Design Firm

Personnel Architectural	Budget Summary
Division	67,251.00
Engineering	45,372.00
Environmental Division	28,235.00
Total	140,858.00
Other Direct Expenses	
Travel	2,400.00
Supplies	1,500.00
Communication	600
Computer Services	1,200.00
Total	5,700.00
Overhead	175,869.60
Contingency and Profit	95,700.00
Total	418,127.60
Engineering Personnel Detail	
Senior Engineer	11,562.00
Associate Engineer	21,365.00
Engineer Technician	12,654.00
Total	45,372.00

Table 1-2 illustrates a summary budget for a constructor. This budget is developed from a project to construct a wharf. As with the example design office budget above, costs are divided into direct and indirect expenses. Within direct costs, expenses are divided into material, subcontract, temporary work and machinery costs. This budget indicates aggregate amounts for the various categories. Cost details associated with particular cost accounts would supplement and support the aggregate budget shown in Table 1-2. A profit and a contingency amount might be added to the basic budget of 1,715,147 shown in Table 1-2 for completeness.

Table 12-3: An Example of a Open budget for a Wharf Project (In dollars)

	Material Cost	Subcontract Work	Temporary Work	Machinery Cost	Total Cost
Steel Piling	292,172	129,178	16,389	0	437,739
Tie-rod	88,233	29,254	0	0	117,487
Anchor-Wall	130,281	60,873	0	0	191,154
Backfill	242,230	27,919	0	0	300,149
Coping	42,880	22,307	13,171	0	78,358
Dredging	0	111,650	0	0	111,650
Fender	48,996	10,344	0	1,750	61,090
Other	5,000	32,250	0	0	37,250
Sub-total	849,800	423,775	29,560	1,750	1,304,885

Summary	
Total of direct cost	1,304,885
Indirect Cost	
Common Temporary Work	19,320
Common Machinery	80,934
Transportation	15,550
Office Operating Costs	294,458
Total of Indirect Cost	410,262.
Total Project Cost	1,715,147

For the purpose of project management and control, it is not sufficient to consider only the past record of costs and revenues incurred in a project i.e. budget. Good managers should focus upon future revenues, future costs and technical problems. For this purpose, traditional financial budgeting schemes are not adequate to reflect the dynamic nature of a project. Accounts typically focus on recording routine costs and past expenditures associated with activities.[2] Generally, past expenditures represent sunk costs that cannot be altered in the future and may or may not be relevant in the future. For example, after the completion of some activity, it may be discovered that some quality flaw renders the work useless. Unfortunately, the resources expended on the flawed construction will generally be sunk and cannot be recovered for re-construction (although it may be possible to change the burden of who pays for these resources by financial withholding or charges; owners will typically attempt to have constructors or designers pay for changes due to quality flaws). Since financial accounts are historical in nature, some means of forecasting or projecting the future course of a project is essential for management control.
For project control, managers would focus particular attention on items indicating substantial deviation from budgeted amounts.

In addition to changes in productivities, other components of the estimating formula can be adjusted or more detailed estimates substituted. For example, the change in unit prices due to new labour contracts or material supplier's prices might be reflected in estimating future expenditures. In essence, the same problems encountered in preparing the detailed cost estimate are faced in the process of preparing exposure estimates, although the number and extent of uncertainties in the project environment decline as work progresses. The only exception to this rule is the danger of quality problems in completed work which would require re-construction. Each of the estimating methods described above require current information on the state of work accomplishment for particular activities. There are several possible methods to develop such estimates, including [3].

i) **Units of Work Completed**
For easily measured quantities the actual proportion of completed work amounts can be measured. For example, the linear feet of piping installed can be compared to the required amount of piping to estimate the percentage of piping work completed.

ii) **Incremental Milestones**
Particular activities can be sub-divided or "decomposed" into a series of milestones, and the milestones can be used to indicate the percentage of work complete based on historical averages. For example, the work effort involved with installation of standard piping might be divided into four mile stones:

- Spool in place: 20% of work and 20% of cumulative work.
- Ends welded: 40% of work and 60% of cumulative work.
- Hangars and Trim Complete: 30% of work and 90% of cumulative work.
- Hydrotested and Complete: 10% of work and 100% of cumulative work. Thus, a pipe section for which the ends have been welded would be reported as 60% complete.

iii) **Opinion**
Subjective judgments of the percentage complete can be prepared by inspectors, supervisors or project managers themselves. Clearly, this estimated technique can be biased by optimism, pessimism or inaccurate observations. Knowledgeable estimates and adequate field observations are required to obtain sufficient accuracy with this method.

iv) Cost Ratio
The cost incurred to date can also be used to estimate the work progress. For example, if an activity was budgeted to cost 20,000 and the cost incurred at a particular date was 10,000, then the estimated percentage complete under the cost ratio method would be 10,000/20,000 = 0.5 or fifty percent. This method provides no independent information on the actual percentage complete or any possible errors in the activity budget: the cost forecast will always be the budgeted amount. Consequently, managers must use the estimated costs to complete an activity derived from the cost ratio method with extreme caution.

Systematic application of these different estimating methods to the various project activities enables calculation of the percentage complete or the productivity estimates used in preparing job status reports.

[2] *For a fuller exposition of this point, see W.H. Lucas and T.L. Morrison, "Management Accounting for Construction Contracts," Management Accounting, 1981, pp. 59-65.*

[3] *For a description of these methods and examples as used by a sample of construction companies, see L.S. Riggs, Cost and Schedule Control in Industrial Construction, Report to The Construction Industry Institute, Dec. 1986.*

In some cases, automated data acquisition for work accomplishments might be instituted. For example, transponders might be moved to the new work limits after each day's activity and the new locations automatically computed and compared with project open budgets. These measurements of actual progress should be stored in a central database and then processed for updating the project schedule.

Suppose that we wish to estimate the total cost to complete piping construction activities on a project. The piping construction involves 1,000 linear feet of piping which has been divided into 50 sections for management convenience. At this time, 400 linear feet of piping has been installed at a cost of 40,000 and 500 man-hours of labour. The original budget estimate was 90,000 with a productivity of one foot per man-hour, a unit cost of 60 per man hour and a total material cost of 30,000. Firm commitments of material delivery for the 30,000 estimated cost have been received.

The first task is to estimate the proportion of work completed. Two estimates are readily available. First, 400 linear feet of pipe is in place out of a total of 1000 linear feet, so the proportion of work completed is 400/1000 = 0.4 or 40%. This is the "units of work completed" estimation method. Second, the cost ratio method would estimate the work complete as the cost-to-date divided by the cost estimate or $40,000/$ 90,000 = 0.44 or 44%. Third, the "incremental milestones" method would be applied by examining each pipe section and estimating a percentage complete and then aggregating to determine the total percentage complete. For example, suppose the following quantities of piping fell into four categories of completeness:

Complete (100%)	380 ft
hangars and trim complete (90%)	20 ft
ends welded (60%)	5 ft
spool in place (20%)	0 ft

Then using the incremental milestones shown above, the estimate of completed work would be 380 + (20)(0.9) + (5)(0.6) + 0 = 401 ft and the proportion complete would be 401 ft/1,000 ft = 0.401 or 40% after rounding.

Once an estimate of work completed is available, then the estimated cost to complete the activity can be calculated. First, a simple linear extrapolation of cost results in an estimate of 40,000/0.4 = 100,000. For the piping construction using the 40% estimate of work completed. This estimate projects a cost overrun of 100,000 - 90,000 = 10,000.

Second, a linear extrapolation of productivity results in an estimate of (1000 ft.) (500 hrs/400 ft) (60/hr) + 30,000 = 105,000. for completion of the piping construction. This estimate suggests a variance of 105,000 - 90,000 = 15,000 above the activity estimate. In making this estimate, labour and material costs entered separately, whereas the two were implicitly combined in the simple linear cost forecast above. The source of the variance can also be identified in this calculation: compared to the original estimate, the labour productivity is 1.25 hours per foot or 25% higher than the original estimate.
The forecasting procedures described above assumed linear extrapolations of future costs, based either on the complete experience on the activity or the recent experience. For activities with good historical records, it can be the case that a typically non-linear profile of cost expenditures and completion proportions can be estimated. Figure 1-1 illustrates one possible non-linear relationships derived from experience in some particular activity. The progress on a new job can be compared to this historical record. For example, point A in Figure 1-1 suggests a higher expenditure than is normal for the completion proportion. This point represents 40% of work completed with an expenditure of 60% of the budget. Since the historical record suggests only 50% of the budget should be expended at time of 40% completion, a 60 - 50 = 10% overrun in cost is expected even if work efficiency can be increased to historical averages. If comparable cost overruns continue to accumulate, then the cost-to-complete will be even higher.

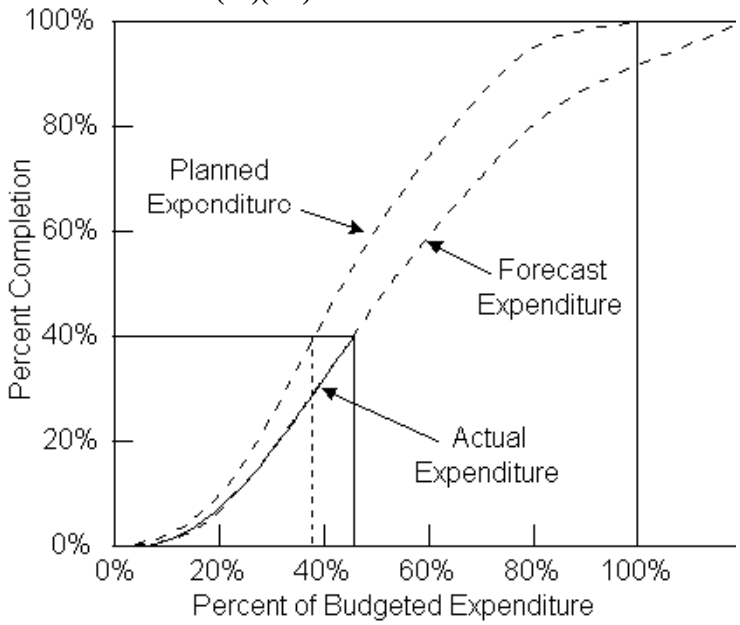

Figure 1.1: Illustration of Proportion Completion versus Expenditure for an Activity

3. Open Budget Systems and Cost Accounts

The cost accounts described in the previous sections provide only one of the various components in a financial budgeting system. Before further discussing the use of cost accounts in project control, the relationship of project and financial budgeting deserves mention. Budgeting information is generally used for three distinct purposes:

- Internal reporting to project managers for day-to-day open budgeting, monitoring and control.
- Internal reporting to managers for aiding strategic open budgeting.
- External reporting to owners, government, regulators and other outside parties.

External reports are constrained to particular forms and procedures by contractual reporting requirements or by generally accepted budgeting practices. Preparation of such external reports is referred to as financial accounting. In contrast, cost or managerial budgeting is intended to aid internal managers in their responsibilities of open budgeting, monitoring and control.

Project costs are always included in the system of financial accounts associated with an organization. At the heart of this system, all expense transactions are recorded in a general ledger. The general ledger of accounts forms the basis for management reports on particular projects as well as the financial accounts for an entire organization. Other components of a financial budgeting system include:

- The accounts payable journal is intended to provide records of bills received from vendors, material suppliers, subcontractors and other outside parties. Invoices of charges are recorded in this system as are checks issued in payment. Charges to individual cost accounts are relayed or posted to the General Ledger.
- Accounts receivable journals provide the opposite function to that of accounts payable. In this journal, billings to clients are recorded as well as receipts. Revenues received are relayed to the general ledger.
- Job cost ledgers summarize the charges associated with particular projects, arranged in the various cost accounts used for the project budget.
- Inventory records are maintained to identify the amount of materials available at any time.

In traditional bookkeeping systems, day to day transactions are first recorded in journals. With double-entry bookkeeping, each transaction is recorded as both a debit and a credit to particular accounts in the ledger. For example, payment of a supplier's bill represents a debit or increase to a project cost account and a credit or reduction to the company's cash account. Periodically, the transaction information is summarized and transferred to ledger accounts. This process is called posting, and may be done instantaneously or daily in computerized systems.

In reviewing budgeting information, the concepts of flows and stocks should be kept in mind. Daily transactions typically reflect flows of dollar amounts entering or leaving the organization. Similarly, use or receipt of particular materials represents flows from or to inventory. An account balance represents the stock or cumulative amount of funds resulting from these daily flows. Information on both flows and stocks are needed to give an accurate view of an organization's state. In addition, forecasts of future changes are needed for effective management.

Information from the general ledger is assembled for the organization's financial reports, including balance sheets and income statements for each period. These reports are the basic products of the financial budgeting process and are often used to assess the performance of an organization. Table1-5 shows a typical income statement for a small construction firm, indicating a net profit of 330,000 after taxes. This statement summarizes the flows of transactions within a year. Table 1-6 shows the comparable balance sheet, indicated a net increase in retained earnings equal to the net profit. The balance sheet reflects the effects of income flows during the year on the overall worth of the organization.

Table 1-5: Illustration of Budgeting Statement of Income

Income Statement for the year ended December 31, 19xx	
Gross project revenues	$7,200,000
Direct project costs on contracts	5,500,000
Depreciation of equipment	200,000
Estimating	150,000
Administrative and other expenses	650,000
Subtotal of cost and expenses	6,500,000
Operating Income	700,000
Interest Expense, net	150,000
Income before taxes	550,000
Income tax	220,000
Net income after tax	330,000
Cash dividends	100,000
Retained earnings, current year	230,000
Retention at beginning of year	650,000
Retained earnings at end of year	$880,000.00

Table 1-6: Illustration of Budgeting Balance Sheet

Balance Sheet	
March 31, 20xx	
Assets	Amount
Cash	150,000
Payments Receivable	750,000
Work in progress, not claimed	700,000
Work in progress, retention	200,000
Equipment at cost less accumulated depreciation	1,400,000
Total assets	3,200,000
Liabilities and Equity	
Liabilities	
Accounts payable	950,000
Other items payable (taxes, wages, etc.)	50,000
Long term debts	500,000
Subtotal	1,500,000
Shareholders' funds	
40,000 shares of common stock	
(Including paid-in capital)	820,000
Retained Earnings	880,000
Subtotal	1,700,000
Total Liabilities and Equity	3,200,000

In the context of private construction firms, particular problems arise in the treatment of uncompleted contracts in financial reports. Under the "completed-contract" method, income is only reported for completed projects. Work on

projects underway is only reported on the balance sheet, representing an asset if contract billings exceed costs or a liability if costs exceed billings. When a project is completed, the total net profit (or loss) is reported in the final period as income. Under the "percentage-of-completion" method, actual costs are reported on the income statement plus a proportion of all project revenues (or billings) equal to the proportion of work completed during the period. The proportion of work completed is computed as the ratio of costs incurred to date and the total estimated cost of the project. Thus, if twenty percent of a project was completed in a particular period at a direct cost of 180,000 and on a project with expected revenues of 1,000,000, then the contract revenues earned would be calculated as 1,000,000(0.2) = 200,000. This figure represents a profit and contribution to overhead of 200,000 - 180,000 = 20,000 for the period. Note that billings and actual receipts might be in excess or less than the calculated revenues of 200,000. On the balance sheet of an organization using the percentage-of-completion method, an asset is usually reported to reflect billings and the estimated or calculated earnings in excess of actual billings.

As another example of the difference in the "percentage-of-completion" and the "completed-contract" methods, consider a three year project to construct open budget t with the following cash flow for a contractor:

Year	Contract Expenses	Payments Received
1	700,000	$900,000
2	180,000	250,000
3	320,000	150,000
Total	1,200,000	1,300,000

The supervising architect determines that 60% of the facility is complete in year 1 and 75% in year 2. Under the "percentage-of-completion" method, the net income in year 1 is 780,000 (60% of 1,300,000) less the 700,000 in expenses or 80,000. Under the "completed-contract" method, the entire profit of 100,000 would be reported in year 3.

The "percentage-of-completion" method of reporting period earnings has the advantage of representing the actual estimated earnings in each period. As a result, the income stream and resulting profits are less susceptible to precipitate swings on the completion of a project as can occur with the "completed contract method" of calculating income. However, the "percentage-of-completion" has the disadvantage of relying upon estimates which can be manipulated to obscure the actual position of a company or which are difficult to reproduce by outside observers. There are also subtleties such as the deferral of all calculated income from a project until a minimum threshold of the project is completed. As a result, interpretation of the income statement and balance sheet of a private organization is not always straightforward. Finally, there are tax disadvantages from using the "percentage-of-completion" method since corporate taxes on expected profits may become due during the project rather than being deferred until the project completion. As an example of tax implications of the two reporting methods, a study of forty-seven construction firms conducted by the General Budgeting Office found that 280 million in taxes were deferred from 1980 to 1984 through use of the "completed-contract" method. [4]

It should be apparent that the "percentage-of-completion" budgeting provides only a rough estimate of the actual profit or status of a project. Also, the "completed contract" method of budgeting is entirely retrospective and provides no guidance for management. This is only one example of the types of allocations that are introduced to correspond to generally accepted budgeting practices, yet may not further the cause of good project management. Another common example is the use of equipment depreciation schedules to allocate equipment purchase costs. Allocations of costs or revenues to particular periods within a project may cause severe changes in particular indicators, but have no real meaning for good management or profit over the entire course of a project. As Johnson and Ka open budget argue.[5]

Today's management budgeting information, driven by the procedures and cycle of the organization's financial reporting system, is too late, too aggregated and too distorted to be relevant for managers' open budgeting and control decisions....

Management budgeting reports are of little help to operating managers as they attempt to reduce costs and improve productivity. Frequently, the reports decrease productivity because they require operating managers to spend time attempting to understand and explain reported variances that have little to do with the economic and technological reality of their operations.

The management budgeting system also fails to provide accurate product costs. Cost are distributed to products by simplistic and arbitrary measures, usually direct labour based, that do not represent the demands made by each product on the firm's resources.

As a result, complementary procedures to those used in traditional financial budgeting are required to accomplish effective project control, as described in the preceding and following sections. While financial statements provide consistent and essential information on the condition of an entire organization, they need considerable interpretation and supplementation to be useful for project management.

4. Example Calculating net profit

As an example of the calculation of net profit, suppose that a company began six jobs in a year, completing three jobs and having three jobs still underway at the end of the year. Details of the six jobs are shown in Table 1-7. What would be the company's net profit under, first, the "percentage-of-completion" and, second, the "completed contract method" budgeting conventions?

[4] *As reported in the Wall Street Journal, Feb. 19, 1986, pg. A1, c. 4.*
[5] *H.T. Johnson and R.S. Kaopen buget , Relevance Lost, The Rise and Fall of Management Accounting, Harvard Business School Press, pg. 1, 1987.*

Table 1-7: Example of Financial Records of Projects

Net Profit on Completed Contracts (Amounts in thousands of dollars)			
Job 1	1,436		
Job 2	356		
Job 3	738		
Total Net Profit on Completed Jobs	1,054		
Status of Jobs Underway	Job 4	Job 5	Job 6
Original Contract Price	4,200	3,800	5,630
Contract Changes (Change Orders, etc.)	400	600	-300
Total Cost to Date	3,600	1,710	620
Payments Received or Due to Date	3,520	1,830	340
Estimated Cost to Complete	500	2,300	5,000

As shown in Table 12-7, a net profit of 1,054,000 was earned on the three completed jobs. Under the "completed contract" method, this total would be total profit. Under the percentage-of completion method, the year's expected profit on the projects underway would be added to this amount. For job 4, the expected profits are calculated as follows:

Current contract price	= Original contract price + Contract Changes = 4,200 + 400 + 4,600
Credit or debit to date	= Total costs to date - Payments received or due to date = 3,600 - 3,520 = - 80
Contract value of uncompleted work	= Current contract price - Payments received or due = 4,600 - 3,520 = 1,080
Credit or debit to come	= Contract value of uncompleted work - Estimated Cost to Complete = 1,080 - 500 = 580
Estimated final gross profit	= Credit or debit to date + Credit or debit to come = - 80. + 580. = 500
Estimated total project costs	= Contract price - Gross profit = 4,600 - 500 = 4,100
Estimated Profit to date	= Estimated final gross profit x Proportion of work complete = 500. (3600/4100)) = 439

Similar calculations for the other jobs underway indicate estimated profits to date of 166,000 for Job 5 and -32,000 for Job 6. As a result, the net profit using the "percentage-of-completion" method would be 1,627,000 for the year. Note that this figure would be altered in the event of multi-year projects in which net profits on projects completed or underway in this year were claimed in earlier periods.

5. Control of Project Cash Flows

Section 1.3 described the development of information for the control of project costs with respect to the various functional activities appearing in the project budget. Project managers also are involved with assessment of the overall status of the project, including the status of activities, financing, payments and receipts. These various items comprise the project and financing cash flows described in earlier chapters. These components include costs incurred (as described above), billings and receipts for billings to owners (for contractors), payable amounts to suppliers and contractors, financing open budget cash flows (for bonds or other financial instruments), etc.

As an example of cash flow control, consider the report shown in Table 1-8. In this case, costs are not divided into functional categories as in Table 1-4, such as labour, material, or equipment. Table 1-8 represents a summary of the project status as viewed from different components of the budgeting system. Thus, the aggregation of different kinds of cost exposure or cost commitment shown in Table 12-0 has not been performed. The elements in Table 1-8 include:

1) Costs

This is a summary of charges as reflected by the job cost accounts, including expenditures and estimated costs. This row provides an aggregate summary of the detailed activity cost information described in the previous section. For this example, the total costs as of July 2 (7/02) were 8,754,516, and the original cost estimate was 65,863,092, so the approximate percentage complete was 8,754,516/65,863,092 or 13.292%. However, the project manager now projects a cost of 66,545,263 for the project, representing an increase of 682,171 over the original estimate. This new estimate would reflect the actual percentage of work completed as well as other effects such as changes in unit prices for labour or materials. Needless to say, this increase in expected costs is not a welcome change to the project manager.

2) Billings

This row summarizes the state of cash flows with respect to the owner of the facility; this row would not be included for reports to owners. The contract amount was 67,511,602, and a total of 9,276,621 or 13.741% of the contract has been billed. The amount of allowable billing is specified under the terms of the contract between an owner and an engineering, architect, or constructor. In this case, total billings have exceeded the estimated project completion proportion. The final column includes the currently projected net earnings of 966,339. This figure is calculated as the contract amount less projected costs: 67,511,602 - 66,545,263 = 966,339. Note that this profit figure does not reflect the time value of money or discounting.

3) Payables

The Payables row summarizes the amount owed by the

contractor to material suppliers, labour or sub-contractors. At the time of this report, 6,719,103 had been paid to subcontractors, material suppliers, and others. Invoices of 1,300,089 have accumulated but have not yet been paid. A retention of 391,671 has been imposed on subcontractors, and 343,653 in direct labour expenses have been occurred. The total of payables is equal to the total project expenses shown in the first row of costs.

4) Receivables

This row summarizes the cash flow of receipts from the owner. Note that the actual receipts from the owner may differ from the amounts billed due to delayed payments or retain age on the part of the owner. The net-billed equals the gross billed less retention by the owner. In this case, gross billed is 9,276,621 (as shown in the billings row), the net billed is 8,761,673 and the retention is 514,948. Unfortunately, only 7,209,344 has been received from the owner, so the open receivable amount is a (substantial!) 2,067,277 due from the owner.

5) Cash Position

This row summarizes the cash position of the project as if all expenses and receipts for the project were combined in a single account. The actual expenditures have been 7,062,756 (calculated as the total costs of 8,754,516 less subcontractor retentions of 391,671 and unpaid bills of 1,300,089) and 7,209,344 has been received from the owner. As a result, a net cash balance of 146,588 exists which can be used in an interest earning bank account or to finance deficits on other projects. Each of the rows shown in Table 1-8 would be derived from different sets of financial accounts. Additional reports could be prepared on the financing cash flows for bonds or interest charges in an overdraft account.

Table 1.8: An Example of a Cash Flow Status Report

Costs 7/02	Charges 8,754,516	Estimated 65,863,092	% Complete 13.292	Projected 66,545,263	Change 682,171
Billings 7/01	Contract 67,511,602	Gross Bill 9,276,621	% Billed 13.741	Profit 966,339	
Payables 7/01	Paid 6,719,103	Open 1,300,089	Retention 391,671	Labour 343,653	**Total** 8,754,516
Receivable 7/02	Net Bill 8,761,673	Received 7,209,344	Retention 514,948	Open 2,067,277	
Cash Position	Paid 7,062,756	Received 7,209,344	Position 146,588		

The overall status of the project requires synthesizing the different pieces of information summarized in Table 1-8. Each of the different budgeting systems contributing to this table provides a different view of the status of the project. In this example, the budget information indicates that costs are higher than expected, which could be troubling. However, a profit is still expected for the project. A substantial amount of money is due from the owner, and this could turn out to be a problem if the owner continues to lag in payment. Finally, the positive cash position for the project is highly desirable since financing charges can be avoided.

The job status reports illustrated in this and the previous sections provide a primary tool for project cost control. Different reports with varying amounts of detail and item reports would be prepared for different individuals involved in a project. Reports to upper management would be summaries, reports to particular staff individuals would emphasize their responsibilities (e.g. purchasing, payroll, etc.), and detailed reports would be provided to the individual project managers. For example, if work already completed is of sub-standard quality, these reports would not reveal such a problem. Even though the reports indicated a project on time and on budget, the possibility of re-work or inadequate facility performance due to quality problems would quickly reverse that rosy situation.

6. Schedule Control

In addition to cost control, project managers must also give considerable attention to monitoring schedules. Construction typically involves a deadline for work completion, so contractual agreements will force attention to schedules. More generally, delays in construction represent additional costs due to late facility occupancy or other factors. Just as costs incurred are compared to budgeted costs, actual activity durations may be compared to expected durations. In this process, forecasting the time to complete particular activities may be required.

The methods used for forecasting completion times of activities are directly analogous to those used for cost forecasting. For example, a typical estimating formula might be:

$$D_f = Wh_t \qquad (12.5)$$

where D_f is the forecast duration, W is the amount of work, and h_t is the observed productivity to time t. As with cost control, it is important to devise efficient and cost effective methods for gathering information on actual project accomplishments. Generally, observations of work completed are made by inspectors and project managers and then work completed is estimated as described in Section 12.3. Once estimates of work complete and time expended on particular activities is available, deviations from the original duration estimate can be estimated. The calculations for making duration estimates are quite similar to those used in making cost estimates in Section 1.3.

For example, Figure 1-2 shows the originally scheduled project progress versus the actual progress on a project. This figure is constructed by summing up the percentage of each activity which is complete at different points in time; this summation can be weighted by the magnitude of effort associated with each activity. In Figure 1-2, the project was ahead of the original schedule for a period including point A, but is now late at point B by an amount equal to the horizontal distance between the open budgeted progress and the actual progress observed to date.

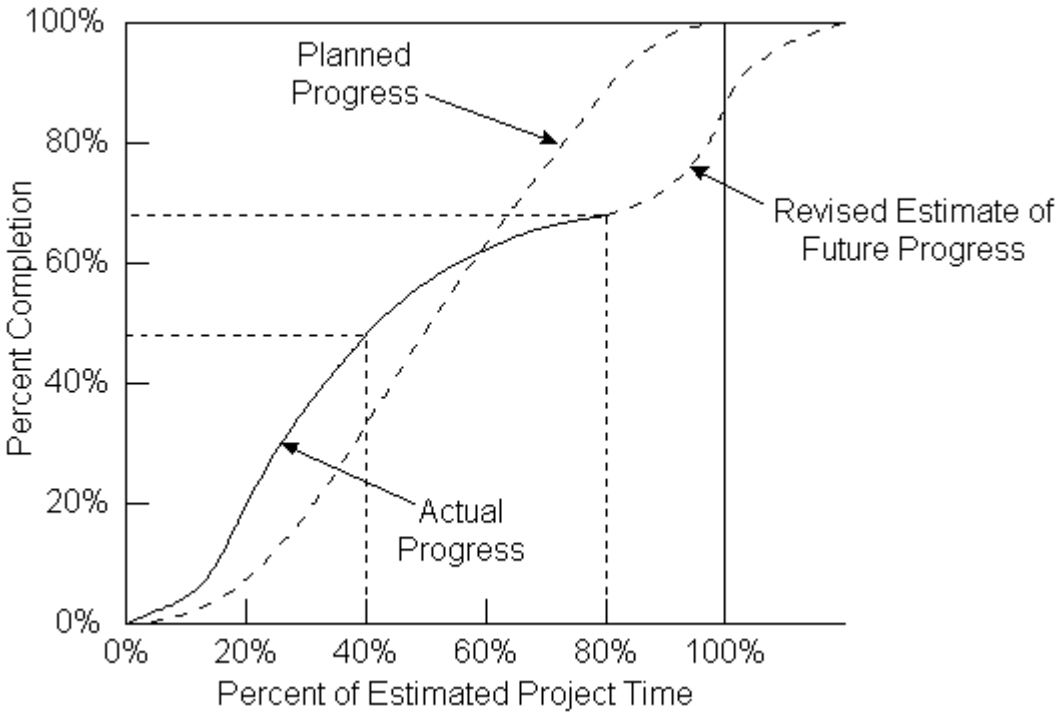

Figure 12-2: Illustration of Open budgeted versus Actual Progress over Time on a Project

Schedule adherence and the current status of a project can also be represented on geometric models of a facility. For example, an animation of the construction sequence can be shown on a computer screen, with different colours or other coding scheme indicating the type of activity underway on each component of the facility. Deviations from the open budgeted schedule can also be portrayed by colour coding. The result is a mechanism to both indicate work in progress and schedule adherence specific to individual components in the facility.

In evaluating schedule progress, it is important to bear in mind that some activities possess float or scheduling leeway, whereas delays in activities on the critical path will cause project delays. In particular, the delay in open budgeted progress at time t may be soaked up in activities' float (thereby causing no overall delay in the project completion) or may cause a project delay. As a result of this ambiguity, it is preferable to update the project schedule to devise an accurate portrayal of the schedule adherence. After applying a scheduling algorithm, a new project schedule can be obtained. For cash flow open budgeting purposes, a graph or report similar to that shown in Figure 1-3 can be constructed to compare actual expenditures to open budgeted expenditures at any time. This process of re-scheduling to indicate the schedule adherence is only one of many instances in which schedule and budget updating may be appropriate, as discussed in the next section.

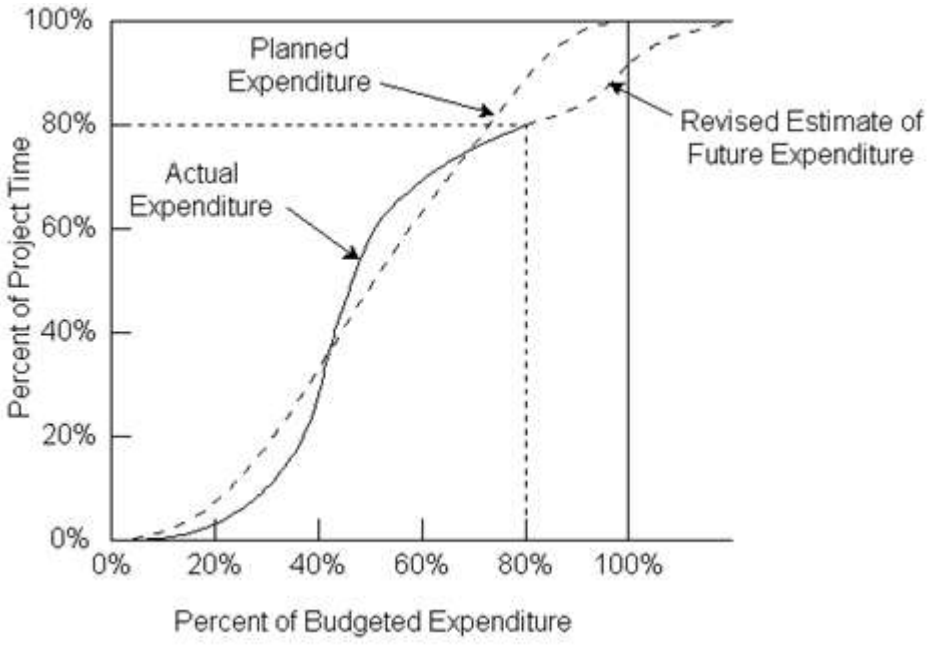

Figure 1-3: Illustration of Open budgeted versus Actual Expenditures on a Project

7. Schedule and Budget Updates

Scheduling and project open buget ning is an activity that continues throughout the lifetime of a project. As changes or discrepancies between the open buget and the realization occur, the project schedule and cost estimates should be modified and new schedules devised. Too often, the schedule is devised once by a open buget ner in the central office, and then revisions or modifications are done incompletely or only sporadically. The result is the lack of effective project monitoring and the possibility of eventual chaos on the project site.

On "fast track" projects, initial construction activities are begun even before the facility design is finalized. In this case, special attention must be placed on the coordinated scheduling of design and construction activities. Even in projects for which the design is finalized before construction begins, change orders representing changes in the "final" design are often issued to incorporate changes desired by the owner.

Periodic updating of future activity durations and budgets is especially important to avoid excessive optimism in projects experiencing problems. If one type of activity experiences delays on a project, then related activities are also likely to be delayed unless managerial changes are made. Construction projects normally involve numerous activities which are closely related due to the use of similar materials, equipment, workers or site characteristics. Expected cost changes should also be propagated though out a project open budget . In essence, duration and cost estimates for future activities should be revised in light of the actual experience on the job. Without this updating, project schedules slip more and more as time progresses. To perform this type of updating, project managers need access to original estimates and estimating assumptions.

Unfortunately, most project cost control and scheduling systems do not provide many aids for such updating. What is required is a means of identifying discrepancies, diagnosing the cause, forecasting the effect, and propagating this effect to all related activities. While these steps can be undertaken manually, computers aids to support interactive updating or even automatic updating would be helpful.[6]

Beyond the direct updating of activity durations and cost estimates, project managers should have mechanisms available for evaluating any type of schedule change. Updating activity duration estimations, changing scheduled start times, modifying the estimates of resources required for each activity, and even changing the project network logic (by inserting new activities or other changes) should all be easily accomplished. In effect, scheduling aids should be directly available to project managers.[7] Fortunately, local computers are commonly available on site for this purpose.

References

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[6] Tersine, R.J., Principles of Inventory and Materials Management, North Holland, 1982.

[6] *One experimental program directed at this problem is a knowledge based expert system described in R.E. Levitt and J.C. Kunz, "Using Knowledge of Construction and Project Management for Automated Schedule Updating," Project Management Journal, Vol. 16, 1985, pp. 57-76.*

[7] *For an example of a prototype interactive project management environment that includes graphical displays and scheduling algorithms, see R. Kromer, "Interactive Activity Network Analysis Using a Personal Computer," Unpublished MS Thesis, Department of Civil Engineering, Carnegie-Mellon University, Pittsburgh, PA, 1984.*