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Why is the role of financial control on large construction projects commonly restrained to provision of bookkeeping services, auditing the clerical accuracy of invoices and cash flow forecasting to meet escalating engineering estimates? This article reviews opportunities for development of the finance function, partnership with cost engineering, and generally improved service to construction management.

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FINANCIAL CONTROL ON A LARGE CONSTRUCTION PROJECT*

The attitudes of senior construction staff may pose a basic problem to development. Some engineers are more interested in construction than in cost control. The imposition of a cost control discipline is an anathema to them, and a variety of avoidance tactics may be employed by them in order to prevent, circumvent or avoid controls. For this reason, objectives must be agreed upon at the beginning of the project: *how important is cost control?*

Another problem lies frequently with the finance staff. Accountants often have little knowledge and even less interest in the technical aspects on construction projects. Motivation and technical awareness are essential prerequisites for finance staff to perform a useful service for their management.

If these problems can be overcome, the financial control role on major construction sites can be developed to relieve management of administrative burden, to minimize waste, and to provide an early warning system of cost increases. This will involve indirect controls over commitments, direct controls over expenditures and meaningful reporting and interpretation of costs.

Before examining the potential role of a financial control department, some comments have to be made as to the environment set by project management.

PROJECT MANAGEMENT OBJECTIVES

The objective of project management must be clarified at an early stage and a complete commitment made by management to the stated objective. Failure to do so will result in confusion and personnel conflicts throughout the organization and increase the likelihood of failure to maintain control over costs. This is particularly important in partnership ventures, where individual partners may have different objectives.

Possible alternative objectives are:

1. **Build the project structure in a specified time and for a specified cost.**
   Since slippage in ~~item~~ time and cost are common to most projects, management and shareholders, in committing themselves to this objective, need also commit themselves to:
   a. an agreed period of some months design and policy planning — engineering, organization, financing, contracting strategy, policy on industrial relations, control measures — before construction commences. Prior agreement on

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these issues by both management and shareholders before financial commitments for construction are incurred is basic.

b. an agreed project schedule and budget, and a method of monitoring physical activity and actual costs incurred against the schedule and budget respectively, so as to highlight variances as early as possible and provide explanations of those variances to facilitate control measures. A project needs to be planned before it can be controlled. It is very important to establish *why* original cost estimates and/or schedules are not being met.

c. an agreed cancellation condition or option needs to be established early in the project. This will involve a review reaching back behind the estimated construction cost to the basic rationale for the project and the total cost of bringing it to fruition. In the event that cost or schedule variances prove uncontrollable or the original cost and time estimates prove to be totally understated, there should be prior agreement that the advantages of project cancellation be reviewed. Tolerance levels need to be established for this purpose, in terms of both project cost and duration. If these tolerance levels are exceeded, the entire rationale for the project needs to be reviewed in line with up-to-date guidelines on corporate profitability. It may be that the project should proceed, and new tolerance levels be set. Or it may be that project costs have increased so much, for example, that costs will never be covered by operating plant revenue. Subsequently, the plant will never run at a profit and it may be more economical to cancel it now.

2. **Build the project structure without formal constraints on time and cost.**
In the event that urgency and/or political pressure create a need for the project to be undertaken under flexible time and cost conditions, then the constraints in #1 above are not so binding, as was the case with some U.K. North Sea Oil production platforms. There is a commitment to build as soon as possible, for the least possible cost as interpreted by management. There is, however, no fixed budget, no time limit and no "cancellation condition" established in advance, i.e. condition of time and/or cost escalation which could result in project cancellation.

In this case, a modus operandi should be agreed upon by management and shareholders as soon as possible. This would involve re-estimation of project costs and rescheduling of physical activity on a periodic (e.g. every six months) basis to keep management and shareholders fully informed as to the project status, to facilitate financing and facilitate planning for the subsequent project operations stage when construction has been completed.

Following objective #2 would shift major financial emphasis away from budgetary control (since there is no fixed budget) towards cash flow forecasting (to ensure adequacy of funds to meet escalating project commitments).

This paper assumes the first objective. The importance of an independent (financial) cost control function in the case of the second objective is diminished because of the absence of reliable criteria against which to judge costs.

Having established a favorable environment within which the financial control function can develop, it is convenient to break activites of the function into five categories:

1. commitment controls,
2. expenditure controls,
3. management reporting,
4. treaury cashflow controls, and
5. internal auditing.

To carry out these five activities, the finance group may be broken down organizationally into groups as shown in **Figure 1.**

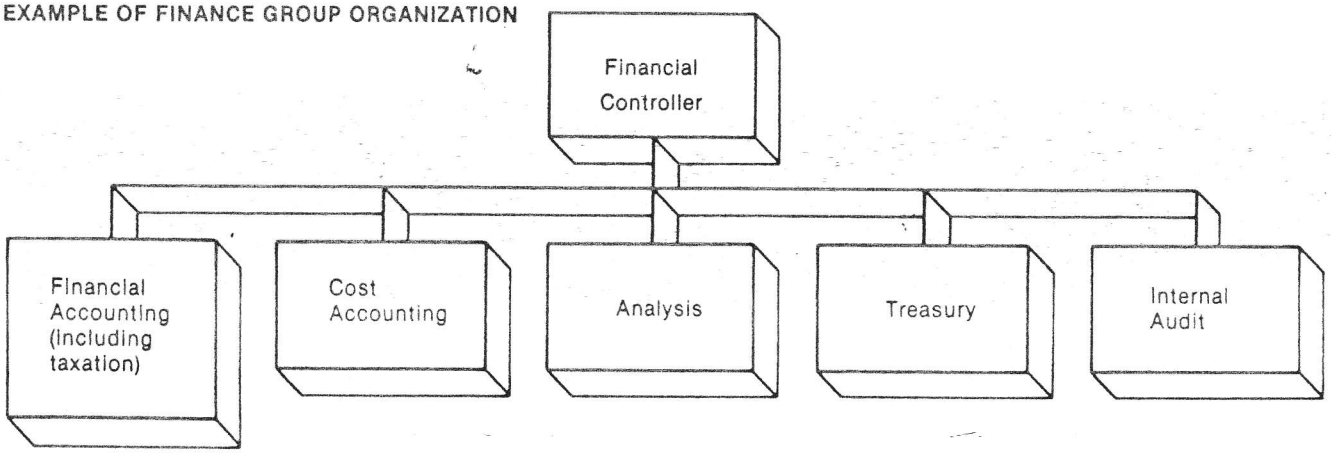
The main activities are now considered in more detail.

COMMITMENT CONTROL

1. A prerequisite for control over commitments and expenditures is a clear definition of these terms, and acceptance and understanding of the definitions by all concerned.

Taking expenditure first, it is helpful if accountants and cost engineers in particular can agree on the same definition. Problems occur as accountants tend to look

FIGURE 1
EXAMPLE OF FINANCE GROUP ORGANIZATION



at cash payments whereas cost engineers require costs incurred to date. Confusion and loss of credibility arises if cost engineers and accountants each keep separate records of actual costs, and report different actual costs to date. Accountants have to understand that if they report only cash dispursements as expenditures then they may lose credibility before engineering management.

The following definition of expeditures (including accruals) was agreed upon between acountants and cost engineers on one major project in which the author has been employed:

Expenditures reported in the Project Cost Status Reports will be:

(a) the value of goods and services approved for payment;

(b) the value of goods and services approved for credit to advances made to suppliers and contractors;

(c) any amount withheld from suppliers and contractors as "Hold Back;"

(d) approved non-cash charges and credits made to Project Direct Work and Indirect Cost Accounts.

Each month-end, accountants would review paperwork in process and collate charges for work done at month-end but not yet paid for; these would be included under (d).

2. Passing to definitions of commitments, one of two opposing concepts needs to be selected:
   a. Do we assume a "going concern" and ask what will it cost to complete existing contracts and purchase orders or
   b. do we ask what will the project cost be if it is cancelled now?

   The later concept is difficult to apply on a regular monthly basis in practice, due to the difficulty of assessing compensation to contractors for broken contracts. It may be appropriate, however, if the whole project is in question due to excessive delays or excessive cost overruns. The former concept has been usefully applied by the author in a definition of commitments as follows:

   Commitment represents the sum of conservative estimates of -

   (a) Direct costs:

   (i) Purchase orders issued (normally the face value, plus the value of revisions);

   (ii) Value of contracts signed (including issued change orders, and extra work orders);*

   (iii) Value of work on which a letter of intent has been signed;*

   (iv) Value of work commenced yet to be covered by contract.*

   (b) Indirect costs:

   (i) Expenditure (see definition above) to date for indirect salaries, including engineering, management and site supervision;

   (ii) Purchase orders issued, as (a) (i) above;

   (iii) Value on contracts, as (a) (ii)-(iv), above.*

   **"Value" is the forecast cost to complete, excluding contingency, as estimated by cost engineering, on cost reimbursable contracts; "value" is the face value of a fixed price contract, plus the estimated value of issued change orders and extra work orders.*

   The above definition of commitments treats lump-sum contracts, cost-reimbursable contracts and hybrids of the two on the same basis. The definition also attempts to give a measure of financial progress-to-date in terms of commitments (so defined) rather than expenditures.

3. Control must be concentrated on identifiable technical items (termed "control items") in line with the technical execution of the work, and the project cost estimate must be subdivided accordingly. Such subdivision enables over/under expenditures to be identifiable at an early date, helping avoid the situation of subsequent "surprises" as to project costs. These "control items" are the contracts and purchase orders by which the work is parcelled out for technical completion: final asset specification requirements must be subordinate to these control requirements. Commitments are recorded for each "control item."

4. To be preventive, control should be exercised before entering into a commitment for expenditure. The finanical role over commitments is indirect, rather than direct: construction management has responsibility for committing the company to contracts or purchase orders, but the finance function can and should ensure that the process of entering into a commitment has been properly followed. The most important control measure is the operation of formal tender committees, through which competitive bids are evaluated before finalizing contracts and purchase orders. This is achieved by the financial controller or his representative acting as secretary to the tender committees, keeping a proper record of minutes, ensuring that all management involved are represented on the tender committee, ensuring safe custody of bids and their proper evaluation. Of course Finance should also advise on the financial stability of the contractor and his cash flow position over the period of the contract.

   The tender committee operates in four stages for major contracts and purchase orders:

First stage:	The contracting strategy is chosen: fixed price, cost-reimbursable or negotiated contract? A fixed or percentage fee?
Second stage:	A bidders' list is compiled. The extent of local vs. international company participation, in particular, must be agreed upon, as well as the preparation of a check-bid.
Third stage:	Opening of the sealed bids and fixing of responsibility of bid-analysis.
Fourth stage:	Presentation of spreadsheets summarizing the results of the bid analysis and selection of the best bid.

Contractors must be specifically required in their contracts to follow the same formal tendering committee procedures, supervised closely by client finance representatives. If the client does not have a tight control and discipline over his contracting process, then neither will his contractors and their subcontractors.

EXPENDITURE CONTROL

Expenditure control over contractors involves a three-stage process in cost-reimbursable contracts:

1. Systems audit:

   The first stage is the examination of the contractor's accounting policies and procedures, diagnosing weaknesses and formally requesting that the contractor rectify said weaknesses. This stage is most conveniently carried out by

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the client's internal auditor (see Section 5 below).

2. Accounting checks:
The second stage involves verification of contractor invoices. Accountants, cost engineers and quantity surveyors (or contract administrators) are involved. In a cost reimbursable contract, the main burden of check falls on accountants. The optimum role of quantity surveyors involves their instruction and guidance of the accountants as to interpretation of the contract, and then themselves concentrating on claims and problem areas. There is little point in quantity surveyors duplicating the review by accountants. The accountants must be instructed by cost engineering as to checking of the cost coding. The accountants then check for evidence of a client's prior approval of costs and adequacy of documentary support for payroll (approved time sheets and client personnel approvals), plant charges (approved time sheets and contract rates) and materials costs (approved requisitions, purchase orders, goods received notes). They will also ensure that costs are cost-reimbursable under the contract and cost-coding is reasonable (invoices are best cost-coded by contractors under instruction by client cost engineering). In case of doubt they will refer to quantity surveyors or cost engineering, for example, to check that percentage completions shown for fabrication work are reasonable and consistent with physical measurements. Particular problem areas as to interpretation of contract are repairs ("major" repairs may not be reimbursable) and distinctions between cost-reimbursable charges and contractor's overheads. At the commencement of a new contract, accountants will need to verify contractor invoices 100 percent. Subsequently, if they are satisfied with the results of this intensive verification, and if cost engineering and auditors are also satisfied, then the verification may be reduced in quantity (not quality). A scientific basis of random sampling is desirable to reduce the immense workload upon client staff involved in 100 percent detailed checking.
Detailed schedules of work done, signed by the responsible accountants and quantity surveyors, are vital back-up for formal certification of work done under the contract, covering batches of invoices.

3. Analysis (cost engineering/accounting jointly): Construction contracts will be analyzed by cost engineering into identifiable categories of work and work progress will be monitored against budget estimates for these items. Cost engineers may, for example on a marine terminal, record direct manual labor manhours expended every week against the manhours forecasted in the last budget. Their analysis should include calculations of productivity achieved and compare it with productivity estimated in the last approved forecast.

In addition to this analysis, there should be regular (monthly at least) comparisons by accounting of unit costs incurred with unit costs estimated in the last approved forecast. Particular importance is attached to labor costs. For example, the marine terminal manual labor cost may have been budgeted at $20 per hour, and incurred at the rate of $30 per hour last month. There must be a prompt review of the reasons for the cost increase by both cost engineering and accounting. The contractor may be overcharging, or unforeseen cost increases were incurred necessitating re-estimation of project costs ("trending") by cost engineers.

MANAGEMENT REPORTING

1. A commonly held misconception is that budgetary control is not applicable to construction projects. In fact the discipline of a good system of budgetary control can be exercised at two levels:
   (a) Indirect Costs:
   The indirect costs or overheads of the client and each of the contractors can be subject to the same controls as operating companies. These involve analysis of department budgets on a monthly basis, and monthly reporting of expenditures and variances against budget.
   (b) Direct Costs:
   The normal procedure is for cost engineering to forecast the final cost of each "control item," compare this with latest approved budget and comment on variances. Complete forecasts are usually done quarterly or every six months, with partial re-estimates or "trending" every month.
2. An analyst working within finance (see **Figure 1**) can supplement cost engineering "trending" or an "early warning system" of cost overruns by comparing expenditure to date with forecast expenditure at the same level of physical completion. Whereas cost engineers concentrate on the forecast final costs of the project, the finance analyst concentrates on the costs to date. The important aspects of this so-called "S curve analysis" are:
   a. The comparison is done by a group independent of the cost estimators.
   b. Comparison of actual and forecast costs at the same level of physical completion removes the time element and highlights over/under expenditure at that level of completion. An alternative curve of forecast and actual expenditures against time, which is commonly shown, does not distinguish slippage in physical completion from genuine over/under spending. Physical completion is most conveniently measured in direct manhours (assuming indirect, supervisory time is incurred on a pro-rata basis). **Figure 2** illustrates these principles.

After a particular period of time since commencing the project, costs actually incurred are represented by OA"; physical percentage completion by OO'. By contrast, the last forecast anticipated expenditures corresponding to this level of completion would be only OA'; alternatively, the physical percentage completion represented by expenditures of OA" would be OO", not merely OO'.

The comparison between forecast final cost and latest approved budget (the distance BF on the graph) is a normal report on most construction projects. The analysis of differences between forecast and actual expenditures, at the same levels of physical completion, represents very important additional information, and provides an early warning system of cost increases. Analysis of this difference is more meaningful if forecast and costs are broken down

into cost types readily identifiable to both accountants and laymen:

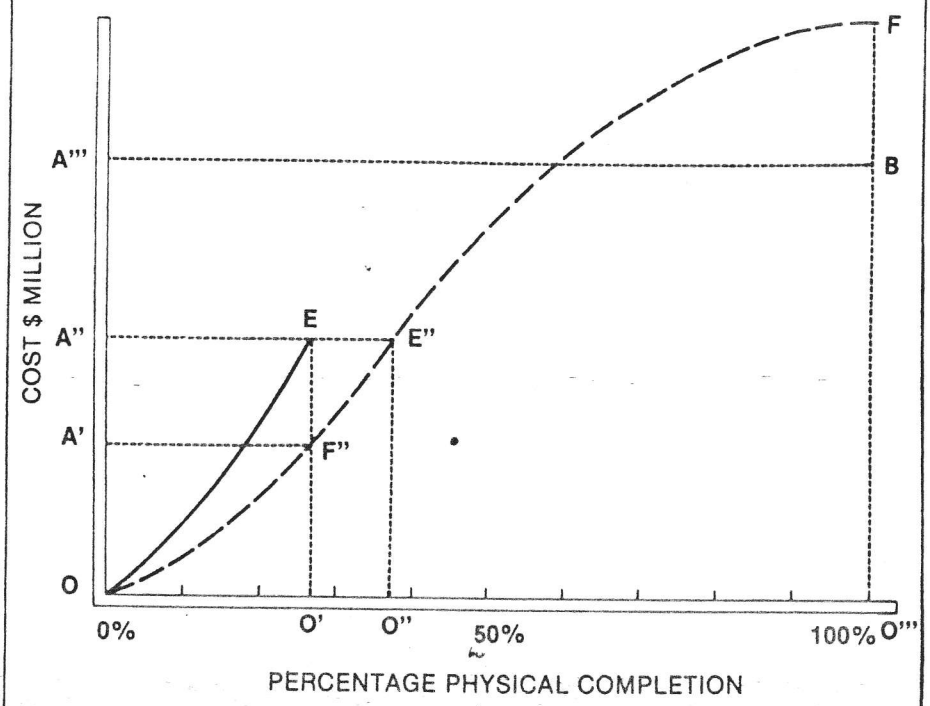
- plant,
- materials,
- labor, and
- fees and overheads.

This may draw attention to gaps in original estimates; alternatively, wastage may be indicated, requiring prompt audit investigation. Cases have occurred where cost engineers have devoted most of their efforts to forecasting manhours, making sophisticated assumptions and calculations concerning labor productivity, and then application of analysis of the type shown above has revealed cost overruns exceeding 100 percent of forecast on plant-hire and materials costs. It is totally fallacious to assume the whole project can be controlled by controlling the manhours alone: manhours (and their cost) are only part of the total picture.

Not only the whole project, but each major contract or purchase order should be subject to independent analysis by the finance analyst along the lines indicated. It is not necessary to be an engineer to identify the four main cost types listed above in the forecast and in the expenditures; analysis will then highlight problem areas for detailed investigation. This information should be fed back to cost engineering to improve future forecasts.

Each contractor should be required to forecast his expenditure and explain variances from it along these lines. The budgetary discipline has to cover the entire project if it is to be effective.

FIGURE 2
GRAPH OF COSTS AGAINST PHYSICAL COMPLETION



LINES:	OE	Curve of actual expenditure by physical completion
	OF"E"F	Forecast incurrence of expenditure by physical completion
DISTANCES:	OA'''	Last Approved Budget
	OA"	Actual expenditure to date
	OA'	Forecast expenditure at same level of physical completion as to-date
	BF	Discrepancy explained by cost engineering
	A'A"	Discrepancy commented upon by finance analyst

TREASURY AND CASH FLOW CONTROLS

Cash flow forecasting and explanation of variances from forecast are important, but tend to be very much more time-orientated in analysis than the budgetary control analysis described above.

A frequent treasury requirement is that cash flow forecasts are produced every month by currency for each of the next 12 months in order to ensure that funds are available when required. An analysis should be made every month of the cash calls forecast and actually made for the previous month and reasons obtained and reported for major discrepancies. By this means experience is gained from past errors and steady improvements can be made in the accuracy of future cash flow forecasts. After some experience, actual cash usage should normally be within 15 percent of the cash forecast for the next month for each currency.

Delays in one or two large payments on overseas purchase orders can result in enormous but temporary monthly variances which are not indicative of project underspending. The true explanations must be sought from the finance analyst, or cost engineers in the case of leads and lags in construction work on site. In the case of purchase order items, regular reference needs to be made to procurement expediting reports showing the latest status of orders and shipments.

Periodically a cash flow forecast by quarter to the end of the project will be required. This should be reconciled with the project cost forecast last made (whether or not approved as a budget) by cost engineering.

The observance of the provisions of any special funding agreements will need to be monitored, and action taken to ensure prompt drawdowns under the loan agreement are facilitated.

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Where foreign currency needs to be purchased, company policy of buying forward or spot should be monitored, disclosing the financial effect of adopting the particular policy.

INTERNAL AUDIT

The client's Internal Audit group will examine contractor's accounting policies systems and procedures, diagnose weaknesses and make recommendations for improvements. A formal report will set out audit findings and corrective action taken by the contractor and should be signed by the contractor's project manager. See **Figure 3.**

Contractor systems should be reviewed for every new major contractor organization involved in the project and then reviewed again periodically. Weaknesses not remedied to the auditor's satisfaction must be reported to client project management for action.

The internal audit's scope should not be restricted to purely accounting matters. With education from specialist client advisers, the auditors can review a large range of routine activities carried out by contractors. It is not necessary to have a degree in engineering to ascertain, for example, if concrete cube tests are being conducted by contractors with the required frequency, or if contractors are following laid down contracting procedures in letting work to subcontractors. Specialist advice should always be obtained from the client company organization.

Auditors may also be asked to undertake special assignments and investigations. Cost engineers and/or the financial analyst may diagnose increasing costs in certain activities carried out by a contractor and request an audit examination.

CONCLUSIONS

Stronger controls over costs and reduction of cost/time overrun "surprises" on capital construction projects will be facilitated by a stronger financial role in construction management teams. This in turn needs management dedication to strong cost controls, support for greater discipline in the contracting process, closer teamwork with cost engineering and independent monitoring by finance of forecasts of project final costs.

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FIGURE 3
EXAMPLE OF INTERNAL AUDIT REPORT

X Co. Internal Audit Report

Contractor: YCO.
Date of Audit: March 1981
Systems Review: Materials Procurement

Weakness	Recommendation	Corrective Action Taken
1. Materials not checked by storeman on receipt.	1. Check materials and agree with purchase order copy approved by X Co.	1. Storeman instructed in writing to check materials received and agree with purchase order copy approved by X Co.

X Co. Representative ..... Date.....	Y Co. Project Manager..... Date.....