

Financial control of public- and private-sector construction projects in Singapore

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The financial control of construction projects is an integral part of effective project management. The subject has benefited from a number of advances in theory and techniques that have resulted from research. These have included value engineering, lifecycle costing, elemental cost planning, cost modelling, buildability, and the use of knowledge-based systems. Limitations to the use of these techniques often arise owing to a short-term view of construction being taken, the one-off nature of buildings, and the lack of continuous workloads.

The paper describes two case-study financial-control systems from the public and private sectors in Singapore. It then evaluates them against a critical framework of effective practice developed in the paper. The paper describes the limitations of the two systems, and suggests how they could be improved.

Keywords: design-stage cost control, cost modelling, financial control, private sector, public sector

Construction project management uses very rudimentary forms of financial control. Compared with the more advanced forms of analysis and decision making of other sectors, construction applies very simplistic techniques that have developed little over a long period. Most of these techniques appear to follow one of two approaches: that of designing a building and then

working out its cost, or that of setting a cost target for a building and then trying to design it within that constraint. In this regard, financial control is usually a support activity to the design and production process. Control is usually based on a series of estimates that are seldom related back to initial plans or budgets. In practice, the adoption of cost strategies, satisficing or optimization models, or the detailed evaluation of tradeoffs between cost and design variables, are rarely approached.

Recognizing this limitation in practice, researchers have made much effort to improve the control process and the estimates made. This has been happening over a long period, and it has included techniques for planning cost strategies¹, attempts to take broader views of costs and revenues in building investments², and attempts to model the tradeoffs between cost and design variables^{3,4} and to exploit recent advances in technology⁵. These techniques have been successful as theory. A coherent set of techniques has developed, and good attempts have been made to consolidate the academic discipline of financial control⁶⁻⁸. The discipline of value engineering⁹ has also emerged as a technique with an important part to play in project management. The concern with buildability¹⁰ at the design stage is not only concerned with financial control, but it obviously has economic consequences.

The practice of the financial control of buildings has not caught up with these valid advancements in theory. There is an implementation gap. The new priorities are to address the reasons for this gap, and to explore strategies for implementing the body of knowledge that

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already exists. One way of doing this may be to examine the extent to which theory can be applied in different contexts and in different sectors of the economy. This paper begins to do this by assessing the effectiveness of methods of financial control for public-sector housing projects in Singapore, and private-sector commercial developments in the Asia Pacific region. It compares their level of control with a critical framework of effective evaluation arising from theory.

CRITICAL FRAMEWORK OF EFFECTIVE FINANCIAL CONTROL

Before the nature of and performances of the case studies presented in this paper are examined, it is pertinent to define 'effective financial control'. The framework presented in this paper largely results from analysis of the body of previous work. First, financial control should be considered in terms of the broadest range of its project-management activities. In this regard, total building evaluation within project management should be seen as the time, cost and quality, and the certainty with which these targets can be achieved. Financial control should be judged not in terms of the extent to which it measures expenditure in isolation. Control should be viewed in terms of how it leads to the achievement of value for money in building procurement. An effective understanding is needed of the tradeoffs between time, cost and quality, and, ultimately, a means of their integration is also needed.

This holistic approach to financial control can be extended to apply to the timescale of the project activity. So many project-management approaches in general, and financial-control systems in particular, appear to be oriented to control over finite periods. These periods appear to correlate with the times over which the evaluator holds responsibility. The periods do not appear to correlate with the times over which the owner of a project bears a financial responsibility and interest.

Management implies the control of the outcome of a process through one's own actions. It is a more proactive role than the reactions that control involves. Control is usually interpreted as a negative activity that exercises restraint on what would otherwise be a free activity. However, if a systems view is taken, control is the capacity that a system has for the continual attainment of its objectives through management. Whether a true cost 'management' system either exists or is workable in practice is debatable. At this point, it is pertinent to contrast a true cost-management system with one that is based on the certification, reporting and authorization of expenditure after the cost-incurring activity is complete. This latter type of process is more aptly described as cost administration. The emergence of techniques of value engineering⁹ is a good example of the cost-management approach.

To complete the description of what ideal financial control should be, the lifetime of projects and the part of the life that any system embraces must be considered. A financial-control system should cover as many of the cost-incurring activities as possible at all the stages of a project. The argument has been made before¹¹ that the

most effective time to apply financial control is during the early stages of projects. It is at this point that the greatest scope exists for economies, and it is when the consequences of making changes to projects are at a minimum. An ideal financial-control system should, therefore, start at the earliest possible stage in the project, and then be applied to the complete lifecycle.

In summary, an ideal financial-control system should

- integrate the requirements for time, cost and quality by allowing informed tradeoff decisions throughout all stages,
- be managerially proactive rather than administratively reactive,
- be initiated at the earliest possible stage in a project,
- apply to as broad a range of a project's lifecycle costs and revenues as possible.

COMPARISON OF FINANCIAL-CONTROL PRACTICES IN SINGAPORE

Housing and Development Board

The Housing and Development Board (HDB) is Singapore's public-sector housing authority, and it is responsible for providing affordable mass housing. Its activities are undertaken under the guidelines of existing public-sector financial procedures and restraints, and with a keen concern for value for money¹². The board is responsible for large multistorey residential construction. It has built point and slab blocks of between 15 and 20 stories throughout Singapore's main island in large estates. The projects are highly homogeneous in terms of their appearance, size, complexity, design and function, means of construction, the contractors that build them, and their other resources. The balance of the time, cost and quality objectives for the projects has been mainly constant, with cost being a priority. The political prominence of the board, and the lack of a large alternative source of housing, means that the economics of the board's performance are a sensitive local issue. The organization is the client authority that also acts as the design and coordinating body through its own specialist staff. It has its own cost-consultant staff who comprise the Cost Management Unit of the Contracts and Administration Department of the Building and Development Division. The organization structure of the HDB is shown in Figure 1. It is a hierarchical and functional system without appointed project managers.

The HDB is a suitable organization to study in terms of effective financial control. Many of the new techniques of financial control mentioned above¹⁻³ have arisen from developments within large public-sector organizations such as the HDB. Within South-East Asia and beyond, the HDB is widely cited and consulted as a model of effective public-housing provision¹³. Within Singapore, the practices of the HDB have departed from those of the colonial forms of cost consultancy more substantially than those of other public agencies. There are no 'quantity-surveyor' appointments within the HDB, and tendering and project-documentation methods are not based on bills of quantities.

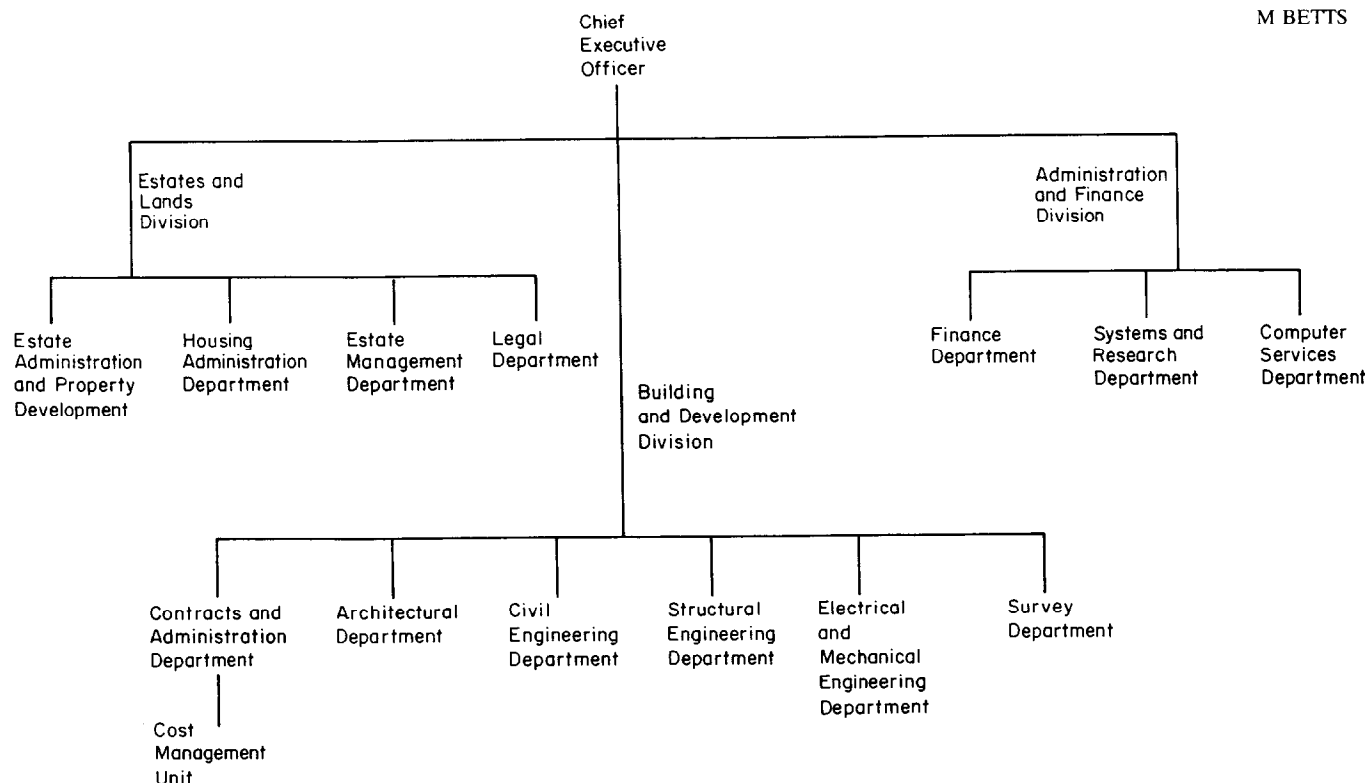


Figure 1. HDB organization structure

[Each person has hierarchical and functional responsibility to the heads of department. There are no formal matrix structures, communications channels or project managers.]

Cost-management system

The system of financial control used by the HDB has been documented¹⁴. It is a coordinated set of procedures, databases and cost models, developed over a period with in-house resources, to be applied to the ongoing programme of housing development. The system has four distinct phases. These correspond to the four stages of HDB evaluation that are applied to all buildings and estates:

- the prototype development stage,
- the planning and design stage,
- the construction stage,
- the maintenance stage.

At the prototype development stage, the unit evaluates new proposed designs from the Architectural Department before a site or estate is identified. Each proposed design, which will become a new HDB standard, is subject to extensive cost studies aimed at the examination of effectiveness and the seeking of optimization. The HDB uses cost models developed by them for design costs, resources costs and lifecycle costs that incorporate feedback from construction and maintenance experiences. The work includes, iteratively, cost-optimization studies for conceptual designs and effectiveness studies of design alternatives.

At the site planning and design stage, for the estate and its constituent buildings, more cost studies are carried out for the purposes of diagnosis, planning, budget control and checking. These are more closely related to the details of a site and the requirements of housing provision within an estate and for a project.

These include cost-diagnosis studies and the preparation of a formal cost plan and other budgetary control devices.

At the construction stage, the HDB follows highly regularized procedures as part of cost control. These procedures include cost comparative studies for large variation orders. Much information is fed back to future prototype and planning and design stages. This includes formal postcontract design reviews and cost evaluations on completion.

At the maintenance stage, the HDB applies further cost controls, and the resource and lifecycle cost models continue to be applied. One activity that is of primary importance at this stage is ensuring that maintenance-cost data is fed back to the earlier stages of future projects. Formal procedures exist to ensure that this happens. Figure 2 shows the sequence of processes within the cost-management system.

The HDB carries out this financial-control activity in a highly structured and formal way. Cost models are widely used within a system of relational databases that have been purpose-built within a long-term conceptual framework for total financial control. The board now has plans to develop an expert system for cost estimation¹⁴, and it continues to reexamine its system and its performance.

RHLB COST-CONSULTANCY SYSTEM

The nature of the HDB's projects and its situation are very different from local private-sector cost consultancies. Singapore is a major financial, commercial and retail centre for the region with a modern skyscraper city that includes many prestigious buildings. Private-

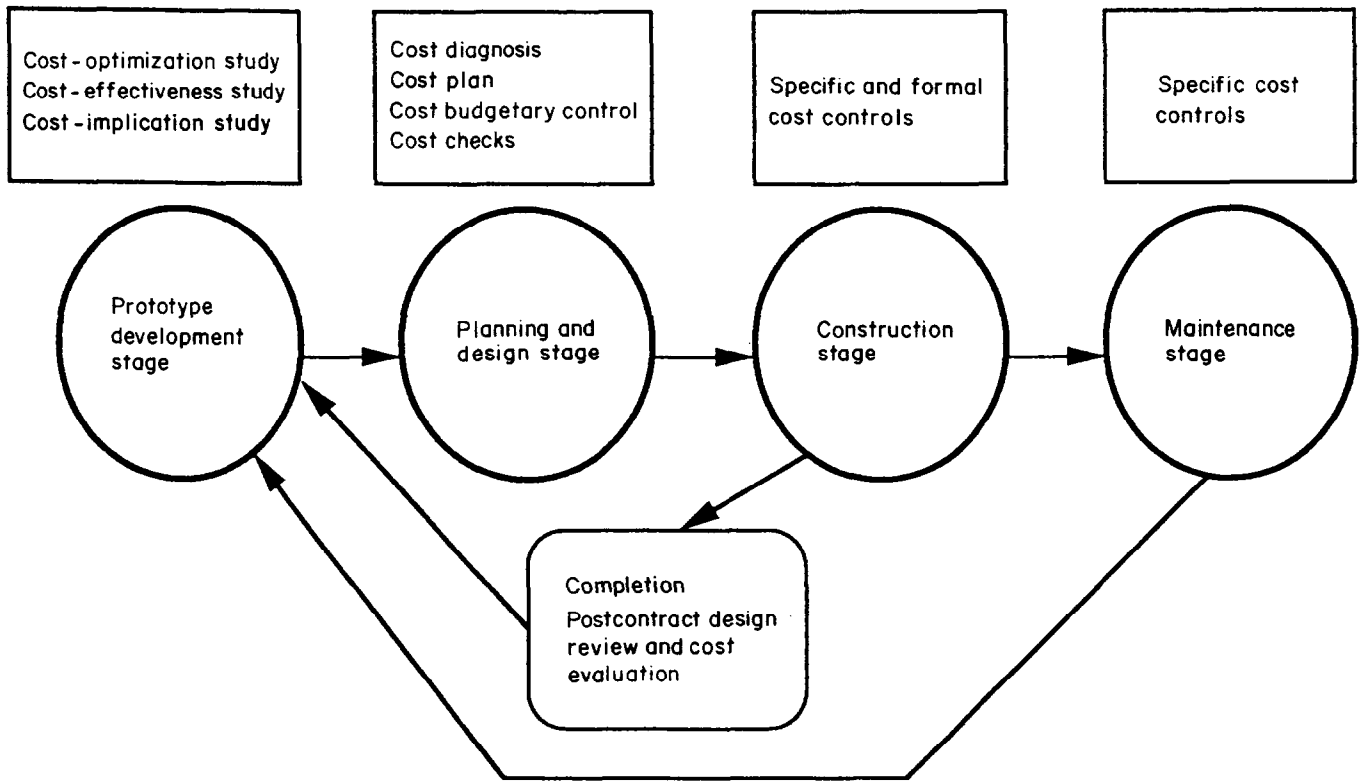


Figure 2. HDB cost-management system¹⁴

sector cost consultancy follows the UK quantity-surveying approach. The consultant is appointed late in the process after the design process is under way. The role of the consultant is to advise on the economics of building proposals after the taking of design decisions. Since the mid 1980s, the quantity-surveying profession has been adversely affected by intense fee-based competition. Thus, the role of the private cost consultant in Singapore is characterized by low fees and minimal service.

The diversity of private-sector projects is great, with some very spectacular one-off designs. Many internationally renowned architects have designed some of the more prestigious buildings, as the quality of aesthetic appearance is very important. Owners also appoint Chinese geomancy consultants to advise on the suitability of the design shape and layout from the viewpoint of Chinese superstition. Private owners treat these aspects of a building's design very seriously. Building cost is seldom a priority for such developers. The cost consultants are independent organizations that are appointed for a short period. Their responsibility and authority is very small. They see their role as that of checking and administration. Their place within a typical project organization structure is as shown in Figure 3. This shows a structure without an executive project manager in which authority, responsibility and communication between the parties is undefined.

The majority of their work is for private-sector clients. Contract sums range from US\$25 000 to US\$500M. The project's size and complexity and the building owner's needs vary with each appointment, and the role of the cost consultant must be adapted to meet these needs. The Rider Hunt Levett and Bailey

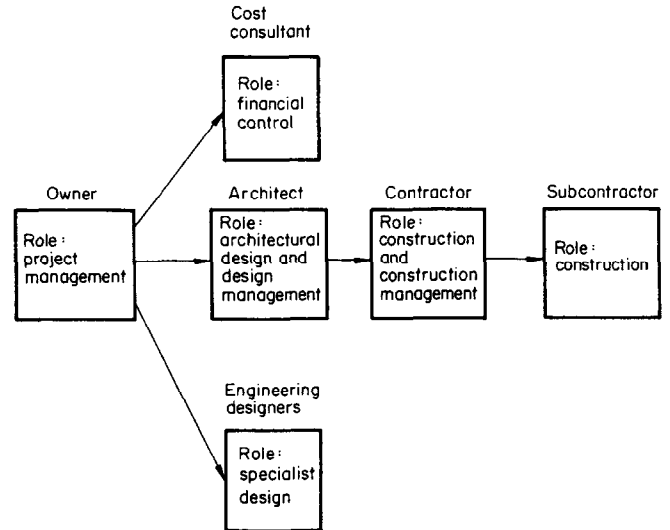


Figure 3. RHLB typical project-organization structure

[All the consultants have reporting and relationship structures with the owner and not with each other.]

(RHLB) system is suitable for study here, as Rider Hunt is one of the longest established and leading organizations within the Asia Pacific region. Although a fairly significant critical appraisal will be made, it should be acknowledged that the group probably represents the leading edge of current private practice in the region. The private cost consultant's role has several stages, each with its different goals. All recognize the objective of providing value for money for the building owner. The individual goals are described below.

Determination of budget

At the earliest stages of a building, the owner's consultants make every effort to define requirements for the building in general and for expenditure in particular. If it is defined, the budget becomes the responsibility of all the members of the design team. Its purpose and contributions to cost control are

- the establishment of the limit of expenditure that is necessary to meet the building owner's requirements,
- the provision for the building owner of a statement of the likely area and quality of building that is attainable within the limit of the expenditure, and of the recommended methods of construction and building procurement that are necessary to meet the required occupation date,
- the provision for the building owner of alternative budgets for different levels of quality of building and occupation dates, if necessary.

In practice, the information typically provided by the building owner is seldom sufficient to enable the cost consultant to give other than broad cost parameters. The first broad determination of the budget normally arises because of an enquiry from the building owner or the architect. It is frequently based on no more than a total gross floor area with a reference to a building of a similar type. The cost information is given in a range of high to low costs. The cost consultant allows the owner to decide which part of the range to use. The building owner often requests the cost consultant to advise only one figure, and not the range. In this case, the cost consultant normally considers the track record of the building owner's previous quality of buildings, and advises accordingly. If the building owner wishes to have an elemental cost plan prepared at this stage, the cost consultant would use historical price data from similar buildings. On the few occasions when this is carried out, it is an area where the cost consultant's advice is managerially proactive, and not administratively reactive.

Cost estimates at outline-proposal and scheme-design stages

Cost estimates at the outline-proposal and scheme-design stages are statements of the cost of an intended design that detail cost targets for the main elements of the building. Their purpose and contributions to cost control are

- the description, with the outline proposal drawings, of the chosen distribution of the resources made available by the budget to provide a balanced design to meet the building owner's needs,
- the setting of cost targets for the main elements, so that, as the design develops, targets can be checked and adjustments can be made so that costs can be kept within the budget,
- the provision for the whole design team of a control document that communicates the costs, quantity and quality parameters,
- the giving of an opportunity for a preliminary

consideration of lifecycle costs or value engineering, although neither of these techniques is commonly practised in this case study.

As early design information becomes available, a cost estimate is prepared that is based on an approximate quantity takeoff, albeit of a somewhat broad nature. When the design has reached the more advanced stages, further cost estimates are prepared. The cost consultant requires feedback from the building owner. This should include confirmation that the cost estimate prepared at outline stage is acceptable, confirmation of the brief, an indication of any alternatives given in a previous cost estimate that are preferred, and authority to proceed. Unfortunately, this confirmation is seldom forthcoming in practice. Owners often tell cost consultants to proceed without the establishment and confirmation of a clear brief from the building owner. The estimates prepared at this stage are seldom treated as control documents by the building owner or by members of the project team.

Cost checking

Cost checking occurs any time after the outline cost estimate has been prepared and prior to construction. Checks are made when substantially more detailed design information is passed to the cost consultant. The contributions to cost control are

- the allowing of flexibility in the design process for changes of mind, while cost control of the building is maintained within the framework of the cost estimate,
- the reduction of the amount of abortive design work and lost time caused by the design process being progressed before realization that the budget will be exceeded.

The two dominant guidelines that the cost consultant follows at this stage are (a) take note of the cost significance of an element, and (b) acknowledge the known variability of the cost of an element. Judgment is applied before the design team are notified of possible excess expenditure in a particular element. If an excess revealed during cost checking is so significant that it is unlikely that any compensating savings will occur elsewhere, this is notified immediately, and the design team are asked to consider modification of the design. Such modifications are not always made.

Pretender estimate

The pretender estimate is the cost consultant's final estimate of the contract sum. It is prepared with the use of information that is identical to that issued to tenderers, and it is prepared during the same tender period. Its purpose is

- to provide the design team and the building owner with a tool with which to assess the acceptability of tenderers' offers,
- to provide, in the private sector in Singapore and certain other Asian countries, a vehicle for commercial price negotiations after the receipt of tenders,

- to allow the cost consultants to check their price database against market conditions.

At this point in the life of the building, the cost consultant possesses all the design information, and tender documentation is issued to tenderers for the building. If the pretender estimate reveals a tender sum that is significantly different from the last approved cost estimate, the cost consultant identifies the area of overrun, and informs the building owner and the design team.

Frequently, the design team is made aware that its designs are exceeding the amounts allocated to the elements in the cost estimate, but it carries on without redesigning in the explicit hope that returned tenders will either come within the approved cost constraints, or that the building owner will approve an increase in cost. This is an obvious example of bad practice from a value-for-money viewpoint. To overcome this, there is a tendency for staff within the cost consultant's office to overestimate in their early- and pretender-stage estimates. A survey of data from nine offices within the organization showed that there was a clear tendency to overestimate in five of them. The other four neither overestimated nor underestimated¹⁵.

Tender report and recommendation

In the Asian system, all tenderers are required to submit full pricing information. The tender report is the cost consultant's report on the financial aspects of tenders received, and it is based on this pricing information. It is prepared after the tenders are submitted, but before the awarding of the contract. Its contributions to cost control are

- the provision for the design team and the building owner of an analysis of the ranking of the tenders received, any arithmetical errors and obvious pricing errors,
- the provision for the design team of sufficient cost-comparison information from the tenders to enable them to complete their technical reports on design matters,
- a source of information to be used during commercial price negotiations.

This information comprises, in tabular form, major financial comparisons, trade comparisons etc.

Financial statement

The financial statement is a report that is produced periodically throughout the construction stage of the building, and it compares approved budgets with awarded contract sums and subcontracts. It records the actual costs incurred and revised projections. It shows cost adjustments for design changes already instructed, and those known to be necessary but not yet instructed. Such documents are produced at regular intervals throughout the duration of the construction activities. Their role is

- to provide the design team and the building owner with an overview of committed and projected costs

for all contracts, and a reconciliation against approved budgets,

- to provide the design team and the building owner with details of the cost of instructions that vary the building, with a progressive status report on the completion of measurements and the agreement of variation costs with the contractor,
- to show the design team and the building owner whether the approved budget is likely to be exceeded so that revisions to funding can be made, or cost-reduction exercises can be considered.

Final account

After the construction has been completed, most building contracts in the Asian countries of the Pacific rim require a detailed summary showing the financial effect of design changes. The final account is a report that contains adjustments that have arisen from the final measurement and valuation. These include the cost effect of instructions issued to the contractor and the subcontractors during the construction period, and they set out the balance of any monies that are due for further certification and payment. Their purpose is

- to provide the design team, building owner, contractor and subcontractors with an overview of the final construction cost of the building, with all the remeasurements and variations taken into account,
- to provide the design team with the necessary financial information for the final certification,
- to provide detailed information about the cost of instructions,
- to provide cost data for feedback purposes for use by the cost consultant on future projects.

These are the activities of the private-sector cost consultants on projects. The consultants rarely play any role during the commissioning and occupancy stages of building-project lifecycles, and nor do they provide financial control information for them.

COMPARISON OF TWO SYSTEMS

Housing and Development Board system

In terms of the framework for effective cost control outlined in the earlier sections of this paper, the HDB system performs very well. With regard to managerial proactivity, the HDB system is highly advanced, with financial studies being carried out on prototypes before building estates are planned. When plans and designs are drawn up, extensive use is made of cost models at several levels. The HDB initiates the cost-management system at a very early stage. It provides much greater scope for the application of new theories of financial control than does the private-sector system. The HDB system is applicable to an extremely broad timescale, from the preinception stage to the stage of the use of buildings. This is possible because the board remains centrally and directly involved with projects throughout all the stages of their lifecycle. The system links cost information and procedures that follow through these stages. The board's activities are now being switched to having a much greater emphasis on maintenance and

upgrading. The board's current plans for enhancing its methods of financial control are concentrated in this area.

With respect to the requirement to integrate the requirements for time, cost and quality, the HDB system does not perform any better than most other systems. This is a serious drawback with the current state of advancement of financial-control theory. It is mainly caused by the hierarchical nature of the HDB organization structure and the lack of an appointed project manager. However, cost is of overriding importance within the objectives of HDB projects, and the balance of priorities is so well fixed that the HDB does not consider such tradeoffs important. Although quality has, of late, been given increasingly more emphasis, all the parties concerned well understand the quality levels for HDB buildings.

The HDB does make one criticism of its cost-management system. Although techniques and procedures are in place to allow effective financial management, the project organization structure acts as an obstacle. The lack of authority of the unit over design departments prevent economy being made a priority and the unit's recommendations being followed. Personality clashes between individuals from different departments also inhibit this.

Rider Hunt Levett and Bailey system

The first point to be made with regard to the RHLB system is that, in the determination of the budget, the consultant should be involved at the earliest possible stage. This is necessary if the process is to be managerially proactive and not administratively reactive. This is often not the case. There is also a need for clear and effective communications between the owner and the consultants. Poor communications and inadequate information, both of which are common, undermine this cost-control system.

Estimates of cost are uncertain, and interesting developments that deal with uncertainty include those by Mathur¹⁶. This case fails to reflect adequately such an approach, when, for example, owners reject the use of high-low ranges at the budget-determination stage in the mistaken belief that single figures represent certainty.

There are areas where managerial techniques could be offered by the consultant as cost estimates, with the use of elemental cost planning being one example. Often, the owner is unwilling to pay for these services. The intention is that the series of cost estimates and checks produced should be a means of controlling design development. The usual lack of time at this stage, and the fact that information is only available after design decisions have been taken, mean that these estimates are more often administrative than managerial. They are seldom responded to by other members of the project team.

Much of the consultant's activity is at the tender stage, with extensive reports and estimates being prepared. These activities are primarily carried out to aid in the negotiation processes, and to add to cost databases as feedback. In terms of the real scope for

financial management, it must be concluded that this is too late, and that these and the activities that follow are administrative.

The problem at the early stages of projects, and later, is the failure of owners to define and commit themselves to a budget. This leads to many problems at the later stages. The common failure to appoint or assign authority to an executive project manager also causes a lack of integration of the consultants, a failure to demand managerial actions from the cost consultant, and a nonintegrated and noncommunicative project team. These problems often occur in temporary multiple organizations, and the single organization of the HDB could overcome them. The typical organization structure for RHLB projects shown in Figure 3 would need to be changed for an executive project manager to be clearly appointed.

With regard to the critical framework, the case study does not integrate time, cost and quality requirements. Despite managerially proactive techniques being available, most of the work that the project team asks the cost consultant to perform is administrative and, consequently, it is largely ineffective. There is insufficient cost-control action at the earliest stages of the projects. There is no attempt to consider total project lifecycle costs despite the fact that techniques and opportunities to do this exist at the outline proposal stage.

This case demonstrates many inadequacies in consultant cost control, but it is far from being an untypical story. The responsibility for this position lies with many people, including owners, who do not delegate, and with members of the project team, who do not integrate, and who influence decisions before they are taken. The implications of cost-control scenarios like this are worrying. Late buildings, which are over budget and of substandard quality, are becoming the rule, rather than the exception. The situation has become endemic to some extent, with cost consultants systematically overestimating to preserve budgets, and contractors deliberately overbidding to provide scope for posttender negotiation. The improvement of cost-control systems requires organizational and attitudinal changes by the owner and the design team. It also requires that the cost consultant adopt a more proactive role.

CONCLUSIONS

The types of project and the situations faced by an organization such as the HDB are well suited to the current state of financial-control theory. Many features of theoretical developments are present in HDB practice. Theory is not well suited to projects, nor to the situation of the independent private-sector cost consultants, because of the diversity of their projects, the lack of continuous workloads, and the place that the consultant holds within the project team. An implementation strategy is required to achieve the critical framework of effective financial control within private-sector practice.

This paper has discussed the problems of financial control in Singapore. These are greater than those

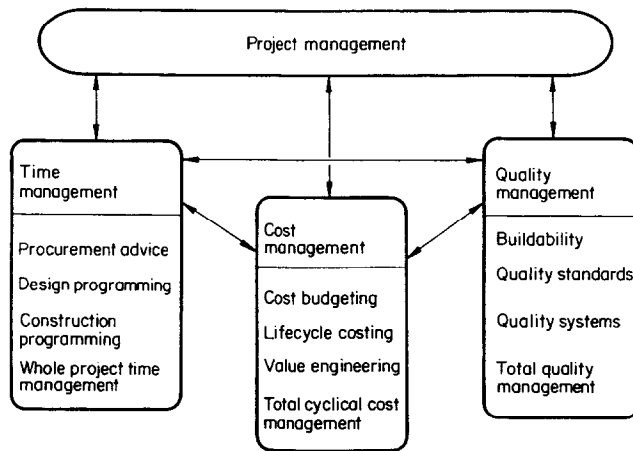


Figure 4. Proposed project-organization structure

faced elsewhere. In the UK, the quantity-surveying profession has been stronger in establishing a high-fee, high-service role, and a more respected place within the project team. In the USA, the cost engineer has proved successful in providing a service within architectural, engineering and contracting organizations. In both cases, the problem has been alleviated by the recognition of the need for defined project-management structures, and the appointment to a position of responsibility of a team-leading project manager.

The need in Singapore is to recognize the role of project managers in financial control. Whether in public- or private-sector systems, financial control will remain the responsibility of specialists. These specialists will only make an effective contribution if they are able to operate effectively within the project team. The critical success factors are organizational and behavioural. Organizationally, project-management structures are required that allow collaboration between different members of the project team. Behaviourally, mechanisms are needed to ensure that the conflicting objectives of different professional groups are managed and overcome. Both these groups of requirements are likely to require the appointment of an executive project manager, and the establishment of a project-organization structure such as that shown in Figure 4.

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