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# Auditing construction costs during building design

## A case study of cost planning in action

Auditing  
construction  
costs

259

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**Abstract** *Building cost planning was originally developed in the framework of traditional procurement methods with conventional documentation, tendering and administration processes. With the advent of alternative forms of procurement with more fluid approaches to design stages and documentation, the need for sound cost planning does not appear to diminish. As a process established on solid theoretical foundations, cost planning should be robust enough to adapt and flourish in a variety of procurement environments. However, little documentation and analysis of transformed and adapted forms of cost planning appear to have been made. This case study of a design-construct company in Melbourne, Australia, presents and explores a contemporary form of building cost planning integrated into a design cost management approach adopted by a construction company experienced in alternative forms of procurement. The article traces this process on a design-construct project from inception to the end of the design development stage and tender. Whilst the fundamental framework of cost planning remains intact, the focus and detail in each of the stages are guided by the company's priority for greater financial control over the cost and value implications of design and other decisions. This recently established working model of design cost management in this company has been designed to deliver added value to the client through a better balance of time, cost and quality in each project.*

### Introduction

The basic principles of cost planning (or design cost management) have been described by many authors over the last 50 years (Ministry of Public Building and Works, 1968; Bathurst and Butler, 1983; Seeley, 1996; Ferry *et al.*, 1999). In more recent years these authors have been joined by luminaries including Morton and Jaggar (1995), Flanagan and Tate (1997), Smith (1998), Smith and Love (2000) and most recently by Jaggar *et al.* (2002) who have pioneered the process of building design cost management using project simulations from the Internet-based building cost information service. All these authors stress the basic principles of cost planning as:



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- to establish a frame of reference for the process (set a realistic budget and cost targets for various parts of the project);
- to develop a method of checking that this budget and the cost targets are being maintained (elemental cost planning); and
- to provide the means for taking remedial action when the cost targets or the overall budget are not being maintained.

These principles have stood the test of time within the conventional procurement methods where design and construction are separated. However, in the last few decades we have seen a shift away from these more traditional procurement methods in response to changing client demand to ones that are both integrated and management-focused (Masterman, 2002). Design and build methods have been adopted more extensively to the extent that they are becoming the primary form of procurement in many countries. In fact, in the UK, the Comptroller and Auditor-General (2001) has recommended three procurement strategies for future construction projects, these being design and build, prime contracting, and public-private partnerships.

This UK government recommendation indicates a growing acceptance of the alternative forms of procurement becoming the mainstream client choice. Construction practitioners must adapt to this new environment by offering their skills, expertise and judgement integrated into the new forms of procurement. The roles of design manager and design cost manager are responses to these changes and trends and this paper attempts to describe some features of this environment and the new and changing roles that are emerging.

The process of cost planning/cost management in the integrated (design-build) procurement method has not been documented extensively to date. This is probably due to commercial confidentiality within these organisations. There is a need to discover the structure, content, personnel and organization required in such a firm and, using a case study of a design-build company in Australia, we attempt to redress this neglect and absence of information. The significance of this study is that the design cost management system was not developed specifically for the needs and requirements of the client but, more importantly, to achieve the aims and objectives of the design-build organization throughout the design development stages. The case study is based on an apartment development project, with a design cost management system developed for the pre-construction phases. Our study emphasises that design cost management is more than just "cost planning". It follows a process of planning the cost implications of a project early in its design stages and controlling the costs and design development simultaneously (Jaggar *et al.*, 2002).

### Case study background

In company A, design cost management is an integral process for both development and design-build construction projects to ensure that construction budgets are maintained, design risks are managed, projects are delivered on time and to a level of quality that meets or exceeds company, client and end-user expectations. It is an essential process in achieving a good balance in the time, cost, and quality triangle. In this company the project manager is employed from the earliest stages in inception all the way through to the construction stages. Because of this early and continuing involvement the project manager has a more intimate knowledge of the project than he/she would have under any other form of procurement method. This knowledge must assist in the sound delivery of the project within the parameters of time, cost and quality.

Company A at any given time has at least a dozen large projects running simultaneously between two states of Australia (New South Wales and Victoria). Currently, there are less than 30 per cent of projects structured under a conventional system, that is where the design is completely developed and documented, tendered and, once construction is commenced, the architect acts as contract administrator and agent to the client. The prevailing favoured method of procurement is a hybrid of conventional and design and construct contracts. In fact, novation (i.e. the discharge and substitution of an alternative contract) and project management procurement-based arrangements now account for about 63 per cent of company A's projects. In this case study company A was contracted to undertake a "design-construct" project with design consultants being contractually novated to them.

### Design cost management

In design-build procurement methods, the developer, the client, the design team and the construction team are ideally the one body, but in practice they may pursue their own interests. So, conflicts can arise that affect the design and budget development of the project. In the subject project of the case study, the design was outsourced to an architectural firm. However, expectations, design and construction programs were managed by the one design-build company. Conflicts continually arose between competing design ideas that ran up against the problem of maintaining budget compliance whilst still ensuring financial feasibility (profit). This is the reason why the function of design cost management proved so crucial. The position needed to balance design management, cost management and design integrity as well as appreciating issues of buildability, quality and construction programming (time). The development of the role of the design cost manager and the design cost management process will now be discussed in relation to experience in the case study. The client had their own cost consultant to provide independent cost advice and this consultant worked alongside the project manager prior to and during tender negotiations.

### The design cost manager

The common criteria for measuring and evaluating a project's objectives and performance are known as the triangle of cost, time, and quality (Smith, 1998; Walker, 2002). It would therefore be suitable to structure the project management team (of the design-builder or the client) in a similar model (Figure 1):

- project manager;
- design cost manager; and
- design manager.

To maintain the necessary single source of responsibility, the overall leadership would be maintained by the project manager (all three factors and particularly time), assisted by a design cost manager (cost) and design manager (quality).

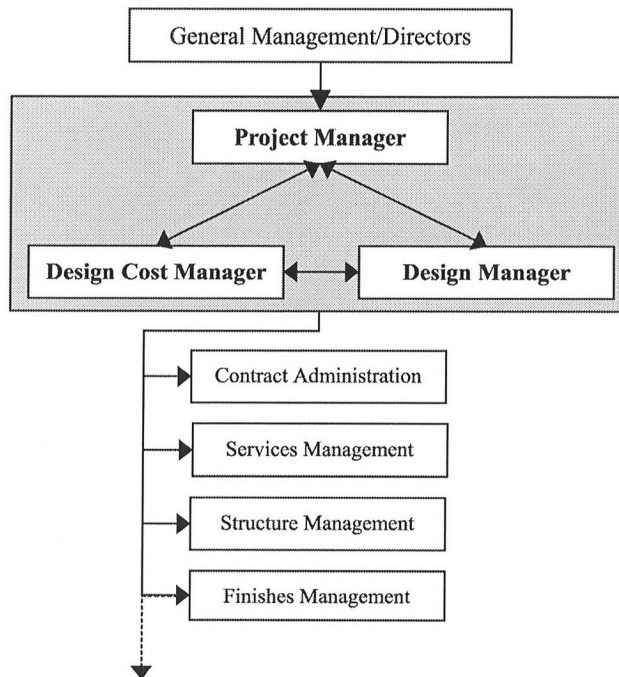
The company established a project organisation with the following attributes to manage time, cost and quality in the project:

- The project manager (PM) was the overall project leader, manager and interface between design, cost, time, buildability and construction programming.

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#### Design Cost Management (DCM) Organisation

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**Figure 1.**  
Design cost management  
organisation – tiered  
reporting and  
responsibilities

- The design manager (DM) was responsible for issuing all documentation, new and revised. The DM would facilitate communication between design consultants and ensure that consultants work within the boundaries of the project brief and quality requirements. The DM was responsible to and reported directly to the project manager.
- The design cost manager (DCM) was responsible for verifying that the design development was in accordance with approved project budgets, project brief and quality requirements, working closely with the design manager. The DCM was also responsible to and reported directly to the project manager.
- The interaction and close working relationship between the DCM and the DM is crucial to the successful development of project documentation that matches the time, cost and quality constraints of the brief. The failure of these parties to work together could jeopardise the PM's and the project objectives.

The organisation of design cost management for design-build projects is summarised in Figure 1. The PM was involved in all facets of the project, particularly relating to programming (time), construction and personnel issues during the design development process. The design manager and design cost manager would report directly to the project manager. The design manager's focus was the management of the design program, in relation to scheduling, time, project briefs and quality benchmarks as well as inter-agency co-ordination. The DM also chaired the design workshops between the client, consultants and contractor. The design cost manager's concerns were concentrated on cost control in the design development process. However, during the construction stages the contract administrator would remain the primary manager and facilitator of the cost control and reporting process. An experienced contract administrator with extensive site knowledge and understanding of the design builder's methods of construction and organisation is considered the best person to translate the design documentation to final construction. All other management personnel, such as services, finishes and structure managers, reported directly to the project manager during the construction process. Interaction between these managers, the design manager and the design cost manager was required during the design development process.

### **Design cost management process**

The design cost management activities and stages during the design of a construction project are based on the case study of an apartment development in company A. The project is a large-scale private apartment development in the central business district of Melbourne, Australia. The project value was approximately A\$85 million with 450 apartments for eventual sale. It was a



mixed-use project of commercial, recreational, accommodation and conference facilities for a client organisation that used a project management group to take care of its requirements. The organisation of design-construct in this company for this construction project is representative of the design cost management approach adopted by this company.

The schematic designs were inclusive of architectural drawings, structural drawings, services operations briefs and initial documentation. Selective tenders were called and, upon award of the tender, the design consultants, including architect, structural and services engineers, were transferred contractually by novation to the management of company A. It was then the responsibility of the contractor to design, specify and document the project and produce construction drawings in accordance with client requirements and the approved schematic drawings. As the design consultants did not become novated until after the tender award prior to design development, the majority of "cost planning" was already carried out with the client and their cost consultant. The inherent complication that novation posed was the shift in accountability/responsibility (from the design consultant's point of view) from the client to the design and construct contractor.

The vision and marketing for the project were clear from the outset; affordable, modern, architectural style living, appealing to young, successful singles and couples without children. The apartments varied in size, but were predominantly two bedrooms of approximately 70 square metres of total apartment area. Single-bedroom, three-bedroom and studio-style apartments were also available. The focus throughout the feasibility and design process was to maintain the architectural quality, whilst maintaining budget compliance and cost-effectiveness as well as retaining valuable and customer-attractive features.

The benchmark for quality was outlined at the outset of the project and remained "the guiding brief" through the early feasibility and budget establishment stages. That is, quality had to be above the market "budget" standard used by many developers in the market. However, the standard aimed to be below the higher quality, but more expensive market superior standard provided by only a few developers. This presented company A with an opportunity provided by this perceived "gap" in the market, which this developer chose to fill. The development proved successful in the pre-construction marketing phase with close to 70 per cent of the apartments sold "off the plan" in the first few days of sale.

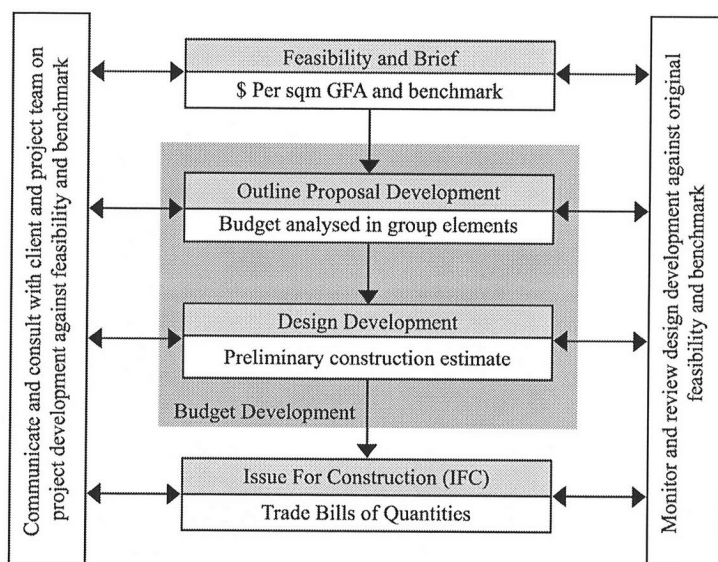
The design cost management process can be summarised in the following flow chart in Figure 3. During the initial feasibility development of a project, the client's need and expectations are translated into a schematic design with a budget value (Smith, 1998; Flanagan and Tate, 1997). It is then during the design development that the scheme becomes realised to more detail. Allinson (1997) believes that it is this transition between schematic and detail

development that is an important aspect of project management. The theory behind the “sign-off gateway” (Allinson, 1997) is that it provides a formal review process, applicable at all stages of the design development to ensure that the design is proceeding in accordance with the brief and feasibility. Inspection of Figure 2 shows that the sign-off gateway is formally incorporated at three key stages of the process:

- (1) feasibility;
- (2) outline proposal; and
- (3) design development.

There are two main issues relating to a sign-off gateway: the entry and the exit. The “exit” step would ensure that the established intentions have been achieved and the “entry” to question whether the project and the team are ready to go forward to the next stage. Allinson (1997) also identified that there are particular criteria for review at each gateway and these would be concerned with:

- *The strategic aim*: has the project progressed in line with the stated performance statements and intended aims declared in the brief?
- *Specific deliverables*: has the project progressed in line with deliverable requirements of program, quality and budget?
- *Project plan*: has the project achieved what was planned?
- *Responsibilities and accountabilities*: have the responsibilities and accountabilities for each team member been clearly identified and understood?



**Figure 2.**  
Design cost management  
process: overview

The methodology of the sign-off gateway also requires a remedial action plan if sign-off was not approved. With this in mind, the design cost management process incorporates an overall remedial action activity at all stages. Inspection of Figure 1 indicates remedial action being mainly confined to the latter stages of the design development phase; tender documentation. In the design cost management model, as shown in Figure 3, the remedial action process is more pervasive and rigorous than the traditional approach top cost planning. The advantage of adopting the process and sign-off stages proposed in Figure 3 is that it can be adopted in any pre-construction project arrangement; design-build, project management, management contracting, construction management or traditional.

In the early feasibility stages of projects – and the case study was no exception – there is usually very little information available to aid the cost planning of the project. Even so, it is at this point in time that the initial global dollar figure is discussed and generally not forgotten by the client. It often remains fixed and is often established for the life of the project as the budget. In most cases, feasibility estimates are established on functional units rate; that is, a rate per unit (per square metre or function unit such as per student, per bed,

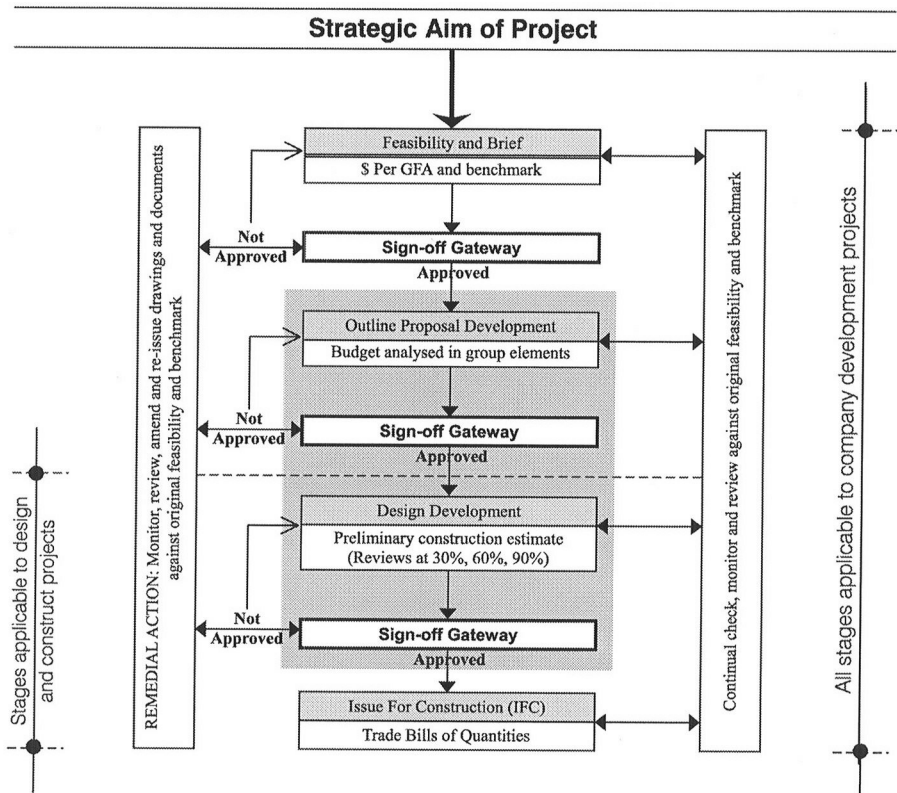


Figure 3.  
Design cost management  
process: detailed  
summary



per car-park space, per hotel room etc.). The case study was established on the superficial rate method based on a cost square metre of gross floor area (GFA). When providing feasibility estimates at company A, the rate per square metre is always a net rate building cost based on current day pricing of similar company-based projects. To develop a gross (all-in) rate, percentage allowances are applied for preliminaries, external works and services, margin, escalation and contingency to reflect the individual site, design, timing and complexity.

Upon approval of the feasibility, the sign-off gateway approves the movement forward to the next stage, schematic outline proposal stage. In the case study, this proved to be an integral part of the design cost management process, as it analysed and tested the viability of the budgets and the design. To assist in the development of the cost plan, the budget was analysed into five main group elements:

- (1) preliminaries;
- (2) structure;
- (3) services;
- (4) trades; and
- (5) other.

Based on previous project data, the structure was estimated using a rate per square metre. Services were analysed using the same basis but were broken down into further elements of mechanical, electrical, hydraulics, lifts and transportation, fire protection and building maintenance unit (BMU). In the case study, the established quality or benchmark was extremely important in analysing the services, as there were considerable cost and design implications when choosing between say split system heating and air-conditioning systems and condenser systems. Similarly for lifts, the expected waiting interval, number of lifts and speed of lifts all have significant cost implications. The trades section was again estimated based on previous projects. The only detailed analysis was the façade (or building envelope), as again the impact of glass types, shading coefficient, wall-to-floor ratio and type of curtain wall system all had to be considered interactively as they affected the end cost.

The sign-off gateway at this point was a lengthy, but crucial process. Before approving the outline proposal design and “freezing” (confirming) the document, the budget was tested for viability in the marketplace. Testing the budget involved seeking the professional opinions of cost consultants. It also involved early input from potential subcontractors on the major issues of the project:

- services;
- façade; and
- fit-out.

Services consultants were appointed in providing cost estimates and design options for incorporation into a preliminary construction budget and outline

specification. Façade consultants and subcontractors were involved in value management and design workshops with the design team to ensure that the design was viable within both buildability and cost parameters. Similar discussions and meetings were held with a fit-out and joinery subcontractor to ensure a feasible design solution. Critical design decisions were made at this point and established the framework for the outline design and specification of the project.

The design development (tender documentation) of the project was fast-tracked (overlapping design development) as it continued in parallel with the budget viability process. However, the “frozen” (or fixed) outline design and specifications were communicated to the design team through the issue of a cost plan package. This included the initial elemental cost plan, outline specification document, preliminary construction estimate and records of all documents, drawings and minutes of meetings relating to the agreed or frozen design. The intention was that, as the design developed, it would be these documents that were used in the monitoring and review process. Their viability was approved against the original feasibility and benchmark. Unfortunately, this framework came under a great deal of pressure in the case study. The design cost management process assumed higher priority than the linked design management system, simply because this was a commercially driven project. The need to maintain the budget and the financial feasibility of the project determined most of the design decisions during the design development stage.

During design development, the critical role of the design cost manager was to carry out cost checks at significant stages. As an example, three major cost checks at stages approximating 30 per cent, 60 per cent and 90 per cent of the completed design were needed before documents were issued for construction (IFC documentation in Figure 3). Each of these critical stages has a “sign-off gateway” and approval is required from the project manager. The design manager provides confirmation of the status of documentation and compliance with the design program. The design cost manager, in conjunction with the design manager, verifies the status of a compliant scope of works, confirmed by subcontractors’ or cost consultants’ budget cost checks. If at any point in time the gateway checks discover non-compliant designs, this must be communicated to the project manager and all documentation reviewed against the “frozen” set of documents.

Lack of space prevents the authors from providing a complete and detailed overview of each of the stages in the design cost management model used in the case study. However, details of the first two stages, feasibility and sketch plans, are shown in Figures 4 and 5.

### Conclusion

The case study described in this paper was a development project and the stages preceding the design development process (feasibility, outline proposal and sketch design) related to a design-build development project. The authors

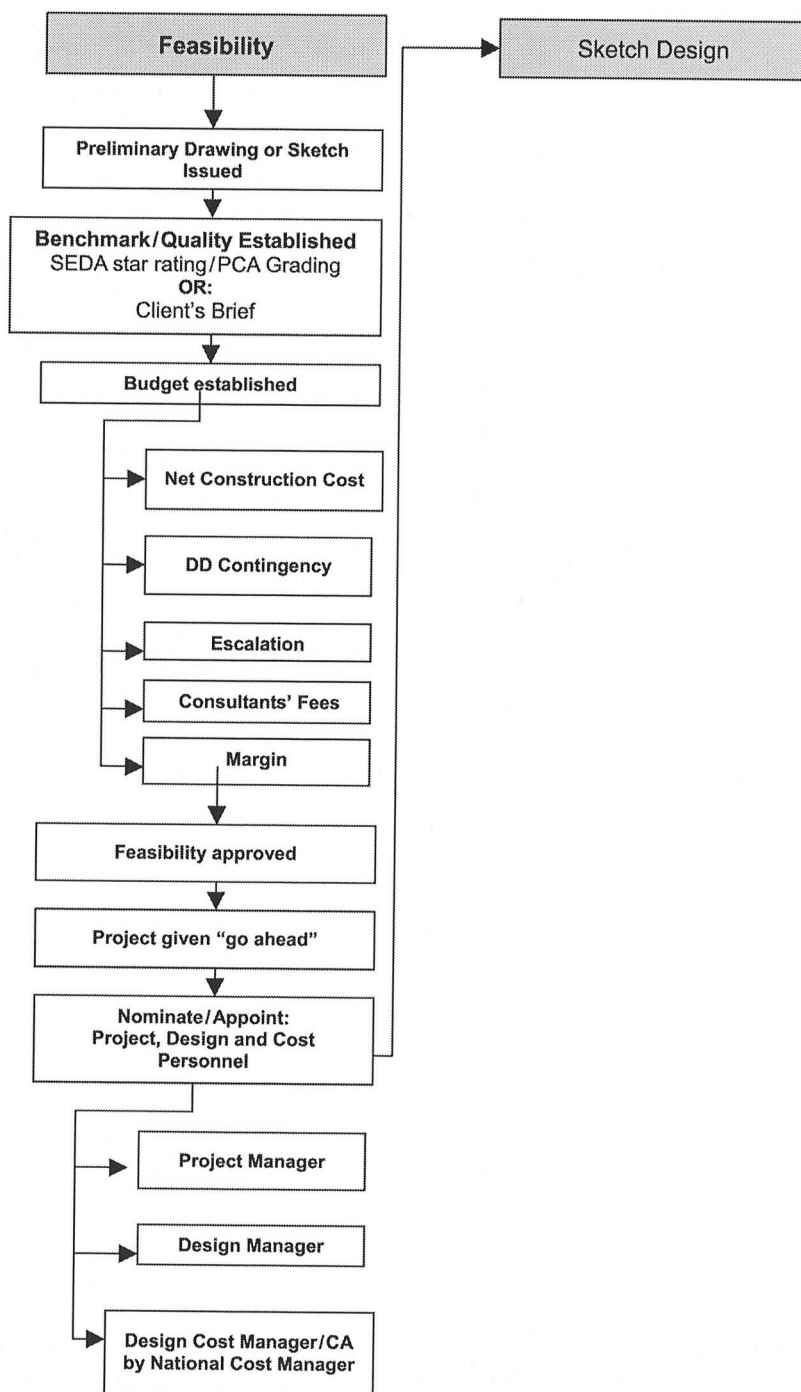
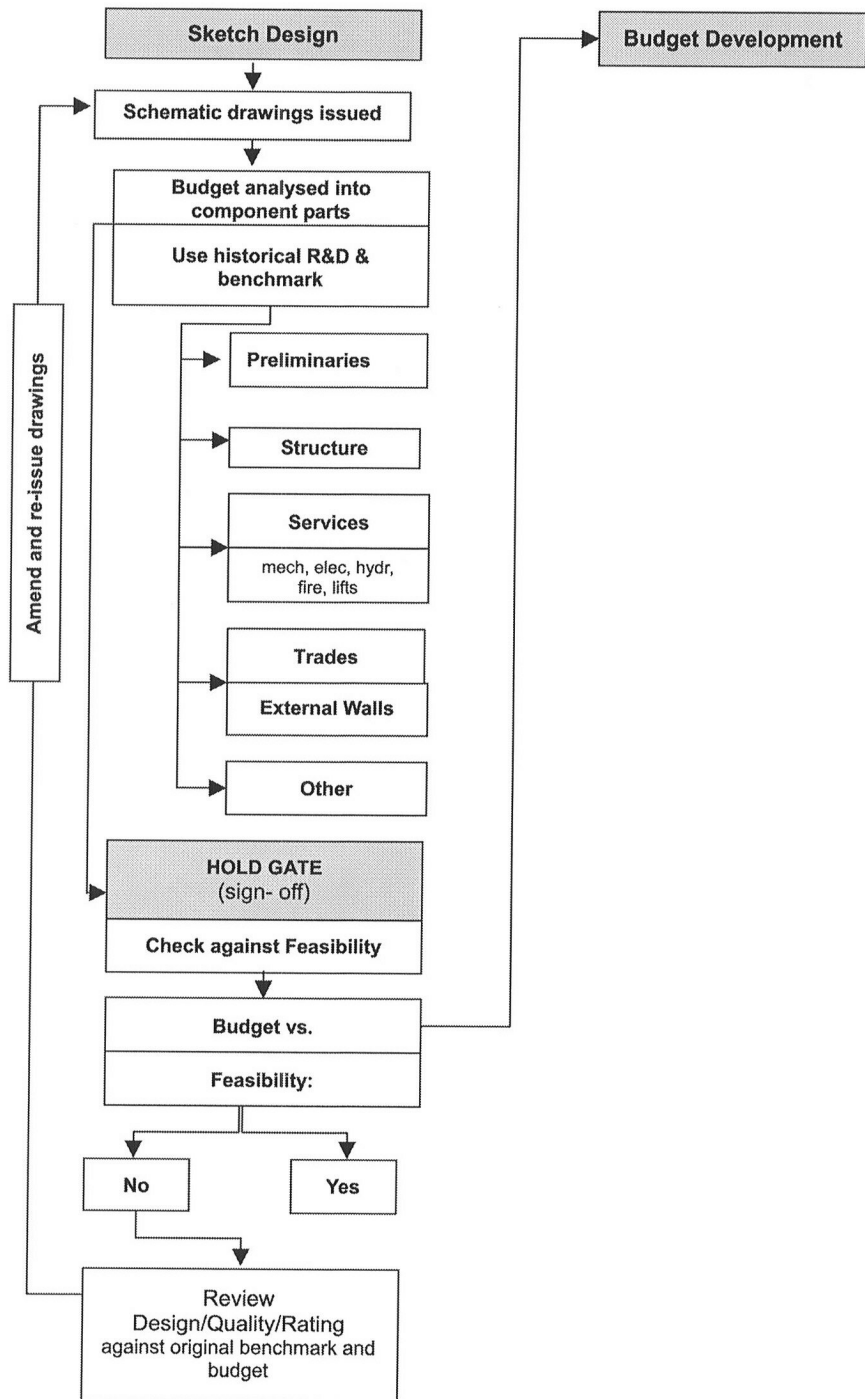


Figure 4.  
Flow chart of the  
feasibility stage of the  
design cost management  
process



**Figure 5.**  
Flow chart of the sketch  
plan stage of the design  
cost management  
process

believe that professional cost managers, cost planners and quantity surveyors can learn from the approach presented in this case study. The process and stages described may be adapted by the project team prior to the appointment of a contractor in a traditional procurement method where design and construction are separated. Whilst the design cost managers in the case study aligned their interests with the construction company, the role is also equally relevant to a client's project team and/or design team. In summary, the authors believe that the following lessons can be learned from this design build case:

- The design cost management process is more defined and prescriptive.
- Positive measures to provide equal balance to project time, cost and quality.
- Clear lines of responsibility provided, especially with the "sign-off" gate procedure.
- Frame of reference and remedial action are more pervasive and rigorous than in traditional cost planning.
- The approach described appears to be robust enough to cope with a range of procurement methods to the advantage of clients and members of the design team.

#### References

- Allinson, A. (1997), *Getting There by Design: An Architect's Guide to Design and Project Management*, Architectural Press, Butterworth-Heinemann, Oxford.
- Bathurst, P.E. and Butler, D.A. (1983), *Building Cost Control Techniques and Economics*, Heinemann, London.
- Comptroller and Auditor-General (2001), *Comptroller and Auditor General Modernising Construction*, H C 87 Session 2000-2001, HMSO, London.
- Ferry, D.J., Brandon, P.S. and Ferry, J.D. (1999), *Cost Planning of Buildings*, Blackwell Science, Oxford.
- Flanagan, R. and Tate, B. (1997), *Cost Control in Building Design*, Blackwell Science, Oxford.
- Jaggar, D., Ross, A., Love, P.E.D. and Smith, J. (2002), *Building Design Cost Management*, Blackwell Science Publications, Oxford.
- Masterman, J.W.E. (2002), *An Introduction to Procurement Systems*, E&FN Spon, London.
- Ministry of Public Building and Works (1968), *Cost Control in Building Design*, HMSO, London.
- Morton, R. and Jaggar, D. (1995), *Design and the Economics of Building*, E&FN Spon, London.
- Seeley, I.H. (1996), *Building Economics*, Macmillan, London.
- Smith, J. (1998), *Building Cost Planning for the Design Team*, Deakin University Press, Geelong.
- Smith, J. and Love, P.E.D. (2000), *Building Cost Planning in Action*, Deakin University Press, Geelong.
- Walker, A. (2002), *Project Management in Construction*, 4th ed., Blackwell Publishing, Oxford.