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CHAPTER THREE

COST CONTROL IN BUILDING DESIGN



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CHAPTER THREE

COST CONTROL IN BUILDING DESIGN

3.1 INTRODUCTION

This chapter describes principles of cost control and techniques of cost control in design stages. Reason for study of principles of cost control and techniques of cost control is elaborated in this chapter. Approximate estimating techniques are briefly explained and general accuracy of such techniques quoted. Capability of approximate estimating techniques to meet design cost control requirements is also explained

3.2 PURPOSE AND PRINCIPLES OF COST CONTROL

Flanagan and Tate (1997) state the purpose of control in precise terms as follows:



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1. To give client good value for money

Value for money dictates that client's expenditure has to be a balance between quality, fitness for the purpose, initial capital cost and life cycle cost of the product. In this research life cycle cost is not taken into consideration. The proposed research cost model assists cost advisor to check above factors against appropriate tested cases in the case base. Case base consists of design data base and cost data base. The structure of cost and design database is explained in chapter six.

2. To achieve the required balance of expenditure between the various parts of the buildings

Allocation of costs between functional groups (eg: elements) should meet client's requirements and designers' requirements. Cost can be allocated between standard elements as listed out by RICS. In the proposed research cost model cost is presented

hierarchically. Cost structure of the model includes elemental costs, sub elemental costs, SMM level costs, project specific costs and measured project specifics. Model has 20 building elements and 13 project specific elements to present cost with cost targets.

3. To keep expenditure within the amount allowed by the client

Once the client accepts first estimate it becomes the **amount allowed by the client**. This amount is **the budget** for the construction cost. As long as the client does not authorize extra works, variations or design changes the final account should not exceed the first estimate. This establishes the fact that first estimate shall be realistic and be prepared with due care.

Flanagan and Tate (1997) identify the principles of cost control as follows:

1. There must be a frame of reference which must be adhered to. Establishing frame of reference has two parts:

- a) preparing realistic first cost estimate
- b) planning how to distribute the estimate between the parts of the building

2. There must be a method of checking or a feed back system

3. There must be a means of remedial action

Approximate estimating techniques, which cannot fulfill above requirements cannot control costs meaningfully with the design process. The relevance of these principles and their applications are discussed next.

3.3 COST CONTROL DURING DESIGN STAGES

In the research context design stages mean: Briefing stage, Sketch plan stage and Working drawing stage. Work quantum of each stage was described in the Chapter Two. This paragraph briefs on important aspects of cost control with respect to design stages.

3.3.1 Cost control in Briefing stage

Preparing a detailed and comprehensive brief and setting up a realistic first estimate are major functions at this stage. In traditional practice interpolation method is used to set the realistic estimate. Setting realistic first estimate is first principle out of three principles of cost control. The proposed research cost model establishes the realistic first estimate with the aid of cost and design database. Realistic first estimate is distributed between 20 building elements and 13 project specific elements from the Briefing stage itself. Two parts of principle one of cost control are met in the research cost model at Briefing stage. In traditional cost planning only part one, establishing realistic first cost estimate, can be met. Single rate estimate techniques fail to establish first cost estimate realistically.



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3.3.2 Cost control in Sketch design stage

This stage consists of Outline proposals stage and Scheme design stages. In traditional practice, an Outline cost plan is produced first. Outline cost plan consists of substructure, superstructure, internal finishes, fittings, services, external works, preliminaries, contingencies and provision for unforeseen design eventualities and escalation. Detailed cost plan is produced at Scheme design stage. Traditional cost planning fulfils the second part of the principle one at this stage. But research cost model fulfils the two parts of principle one at Briefing stage itself. Design and cost information input into the proposed cost model can be reviewed and invalid assumptions can be overridden at this stage. Therefore, for the research cost model, refining cost and design information takes place at Sketch design stage. Single rate estimating techniques cannot fulfill either parts of principle one.

3.3.3 Cost control in Working drawing stage

During detail design stage decision must be made on every matter related to design, specification, construction and cost. Every part and component of the building must be fully designed and all designs must be completely cost checked. Remedial actions are taken if necessary. Accordingly, Principle 2 and 3 of cost control are implemented at this stage. The traditional elemental cost planning checks the elemental costs against the targets. If target is exceeded money is channeled from an element, which has surplus money. If this is not possible reducing quantities (down sizing) or changing specification level or both in a prudent way can remedy the problem. The research model cost model checks cost targets against elements at this stage and remedial actions are taken, if required, to keep the construction cost within the realistic first estimate.

3.4 APPROXIMATE ESTIMATING TECHNIQUES

The objective of the approximate estimating is to provide a preview of probable tender figure. Approximate estimating techniques are used by cost advisors to predict the cost of buildings. There are many techniques available to cost advisor in this exercise. All these techniques can be described as models. Purpose of the modeling is to increase the understanding and/ or to predict the future. The role of cost model is to predict a future situation and to interact with other decision-making processes to add an economic dimension to the problem (Brandon, 1987).

Cost models provide reference points to cost advisor. Cost advisor refers the model before his knowledge and skill is applied to a particular forecasting situation.

Skitmore and Patchell (1990) give a fairly lengthy list of approximate estimating techniques (models). These are tabulated in Table 3.1. For more details of each technique readers should refer to original literature. The chapter four of the report describes the practice of approximate estimating in local organizations in Sri Lanka. It also describes the level of use of different techniques in the local organizations.

Table 3.1 Approximate estimating techniques

Estimate technique	Relevant Contract type	General accuracy	Deterministic/probabilistic
1 UNIT	All	25-30%	Deterministic
2 GRAPHICAL	Process plant	15-30%	Deterministic
3 FUNCTIONAL UNIT	Buildings	25-30%	Deterministic
4 PARAMETRIC	Process plant	15-30%	Deterministic
5 EXPONENT	Process plant	15-30%	Deterministic
6 FACTOR	Process Plant	10-15%	Deterministic
7 COMPARATIVE	All	25-30%	Deterministic
8 INTERPOLATION	Buildings	25-30%	Deterministic
9 CONFERENCE	Process Plant	?	Deterministic
10 FLOOR AREA	Buildings	20-30%	Deterministic
11 CUBE	Buildings	20-45%	Deterministic
12 STOERY ENCLOSURE	Buildings	15-30%	Deterministic
13 BOQ PRICING (Conventional)	Construction	10-20%	Deterministic
14 SIGNIFICANT ITEMS	PSA Buildings	10-20%	Deterministic
15 APPROXIMATE QUANTITIES	Construction	15-25%	Deterministic
16 ELEMENTAL	Buildings	20-25%	Deterministic
17 CPU	Buildings	20-25%	Deterministic
18 ELSIE	Offices		Deterministic
19 NORMS (schedules)	Buildings	10-20%	Deterministic
20 REGRESSION	All	15-20%	Deterministic/ Probabilistic
21 LU QIAN	Buildings	?	Deterministic
22 RESOURCE	All	5-8%	Deterministic
23 PERT-COST	All	N/A	Probabilistic
24 CPS	Buildings	6.5% (based on 4 cases)	Probabilistic
25 RISK ESTIMATING	Construction	N/A	Probabilistic
26 HOMOGENISED ESTIMATING	Buildings	N/A	Deterministic

Source : Skitmore and Patchell (1990 : 78,79)

Table 3.1 provides a list of estimating techniques applicable to building construction and other fields like Mechanical etc. These estimating techniques are categorized into two broader approximate estimating categories for the purpose of this dissertation research. It should be noted that only estimating techniques applicable to buildings have been categorized.

1. Early stage approximate estimating techniques –requirement is to establish broader financial feasibility of the project. These techniques shall be used to establish the realistic first cost estimate. The unit method, interpolation method, cube method, storey enclosure method, functional unit, floor area method, regression techniques are examples for this category.
2. Later stage approximate estimating techniques-requirement is to forecast the probable tender figure. Approximate quantities method, elemental estimating, BOQ pricing, PERT COST, CPS are examples for this category.

The table 3.1 gives methods of estimating techniques, general accuracy of each technique, field of application and whether the technique is deterministic or probabilistic.



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3.4.1 Early stage approximate estimating techniques

3.4.1.1 Unit Method

This perhaps the simplest technique used for prediction. Method provides basis to compare similar buildings.

Ex: Number of pupils in a school- Cost/pupil
Number of beds in a hospital-Cost/bed

3.4.1.2 Cube method

The approximate cost per volume (cube) is calculated from historical data and multiplied by the volume of the proposed building to work out the construction cost of proposed building . The method is rarely used in practice.

3.4.1.3 Superficial area method

This is the most commonly used estimating technique at the early stages of the design process. Cost of the building is divided by floor area of the building to compute unit construction cost for that building. This unit cost is multiplied by floor area of the proposed building with due adjustments for quality and local conditions etc.

3.4.1.4 Storey enclosure method

The method attempts to compensate factors such as storey height and shape of the building. This method uses weighting factors. These weighting factors are considered subjective. Method pays no attention to services cost. This technique is very rarely used in practice.



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3.4.2 Later stage approximate estimating technique

3.4.2.1 Elemental estimating technique

Building is decomposed into a number of elements, which can be measured from sketch drawings. Elements are priced and elemental costs are obtained. The sum of the all elements with allowance for preliminaries and design contingencies provides the cost of the building. This is the most important cost planning technique in the deign process. RICS has published standard list of elements for elemental cost planning.

3.4.2.2 Approximate quantities estimating technique

The method requires a fairly developed design. Many items of work are grouped together to minimize measurement time. Composite rates are derived from BOQ and used for pricing the

grouped items. This method is considered as the most reliable estimating techniques so far explained.

3.4.2.3 Pricing bill of quantities

Pricing bill of quantities provides most accurate form of estimating. BOQ is measured in accordance with a standard method of measurement (SMM). The method provides uniform basis to compare item costs. BOQ is used as most efficient project financial control tool in the construction industry. However, method can only be used at detail design stage since it requires complete design information.

3.5 TRADITIONAL AND ALTERNATIVE ESTIMATING TECHNIQUES

The research survey questionnaire included questions to explore the use of various alternative estimating techniques. These include regression methods, empirical methods, simulation techniques, heuristics and knowledge based expert tools. The response shows that organizations do not use these techniques in construction cost forecasting. Fortune and Lees (1994) explains that traditional techniques have highest incidence of use in UK. The use of alternative cost techniques (ACT) is relatively low.

Fortune and Hinks (1999) have made a national survey of quantity surveying practices (2300 firms) to find out what early estimating techniques were offered to clients. The key findings of the survey are as follow:

- Traditional single point deterministic methods continue to be the most popular model in use for building project price forecasting.
- Among the more advanced techniques, only life cycle costing models are achieving popularity.
- Use of statistical and knowledge based techniques are very low.
- Advanced techniques are preferred by multi-disciplinary and project management practices

These results show that trend in use of traditional estimating techniques and alternative estimating techniques in UK and Sri Lanka is not greatly different.

3.6 DESIGN COST PLANNING

The cost planning is a system of relating the design of buildings to their cost, so that, while taking full account of quality, utility and aesthetic requirements, the cost is planned to be within the economic limit of expenditure (Flanagan and Tate, 1997).

In traditional practice **cost plan** is formulated in the Scheme design stage. The **cost plan** is an statement of how the design team proposes to distribute the available money among the elements of building. In this research a cost plan is differentiated from an estimate for following reasons (Flanagan and Tate, 1997):

- 1.0 The cost plan is not specific for a particular design solution.
- 2.0 The cost plan is referred to continuously throughout the design process.
- 3.0 The cost plan help the design team to detail the design (specification requirements) within a structured cost frame work

The research cost model is essentially a cost planning model with the capability to predict cost from Briefing stage.

Southgate (1988) has proposed a new approach to cost planning using a new functional list. The objective of new approach is to compare and use cost and design information between different types of buildings (eg: hotel and office). The new approach uses the capability of computer database techniques to manipulate information.

3.7 SUMMARY

Design cost control is an essential activity in the design stage cost advice. Models, which cannot fulfil the purpose of cost control and Principles of cost control, are least preferred. The research cost model properly identifies this crucial requirement and introduces the

mechanism to cope with these requirements. This chapter explained how the Principles of cost control are applied to three design stages with both traditional elemental cost planning and proposed research cost model. Commonly used approximate estimating techniques were briefly explained. The use of alternative estimating techniques as revealed by the research is very low. Use of traditional approximate estimating techniques or extensions to traditional techniques seems continuing. Computer technology can be applied to eliminate weaknesses of traditional models.



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