USE OF BIM AS A COST PLANNING TOOL

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ABSTRACT

Generally in the early design planning process, various design options are available to achieve the goals of budget, construction period, function or quality. Selecting the sound and efficient design option is important process to make project successful.
Now, current issues regarding cost planning are that a large proportion of building cost is committed in early design stage. However, it is generally little cost advice is offered by the QS professionals, and the architect often determines optimal design solutions by rule of thumb. Therefore, in decision-making process and mechanism at early design stage, there are still room for improvement for QS as well as for design team members.
Building Information Modeling (BIM) is the process of generating and managing building data during its life cycle. By innovating BIM, which all the alternative options and necessary various design information are entered, it is available to simulate how the cost and contents are influenced when design requirements are changed, and to search for the most cost-effective design solution.
Merits of use of BIM are to integrate the concept of various design/engineering data linked to cost estimation. Especially at this early design-decision making stage, increase of the speed and reduction of resources by utilizing BIM as a tool are extremely beneficial.

Keywords: Cost planning tool, Optimum design solution, Building Information Model(BIM), Simulation cost models

INTRODUCTION

Cost planning and cost controls are at the heart of QS services. This paper discusses for advancing the cost planning approach at the early design process, such as most cost-effective design solution to support the clients maximize the value of their investments, utilizing BIM as a simulation tool by feeding back from the cost information data and cost advice at the early design process.

COST PLANNING ROLE

Bathurst and Bulter (1977) define cost planning as "the term used to describe any system of bringing cost advice to bear upon the design process". Thus *cost planning* is used as the generic terms to cover the various techniques which have been derived for:-

1) The prediction of tender value.
2) The cost control of the design such that the anticipated tender value does not exceed the budget figure.
3) The comparative costing of differing solutions for components or elements of construction.
4) The prediction of the total life cycle cost of a building, its subsystems, components and/or parts over its productive lifetime.

Therefore, the term of cost planning is summarized as follows:-

(1) Cost estimation: To predict the total cost which the client will have to pay for the building.
(2) Provide optimum design solution: To allow the selection, from a range of possible design alternatives at early design stage, of the optimum design according to some predefined criterion of economic performance.

Various cost estimation methods are currently available which allow the prediction tender value within known limits and considerable work is being undertaken to make this process more accurate.

There are also specific methodologies for the application of optimum design solution and the process of becoming aware of a suitable data base for, even though it is only at an early design stage.

THE DESIGN PROCESS AND COST ADVISE

The building design process is a complex interaction of skill, judgment, knowledge, information and time which has its objective to satisfy the client's demands for building.

Design process relates to the following three operations:-

a) The identification of *design parameters* which are understood to be the factual limitations upon the building such as the shape of the site, the location, building regulations and the like. These constraints are usually fixed and treated as the non-negotiable constraints.
b) The identification of *dependent variables* which are those factors described in the brief and are defined in terms of a performance specification. These factors include the required space, number of accommodations, environment, quality and cost.

These can be compromised more easily. Even here some may be inflexible due to a specific demand which takes precedence over all other needs.

c) The identification of *independent variables* which are not specifically specified but are to be considered in the design, i.e. future energy costs, future requirements for maintenances, future styles of workplace configuration etc.

The design process can be defined as *The management of constraints*. The first step in the design process is the identification, classification and selection of the above constraints. The process of design then proceeds from here by manipulating design variables so as to satisfy the non-negotiable constraints (design parameters) and optimizing those which are negotiable. It is possible for a set of non-negotiable constraints to be in conflict resulting in a design with no solution; in this case the non-negotiable constraints must be revised. For example, take the design of a floor slab. A floor slab must support a certain weight to use, and this is a non-negotiable constraint. The choice of materials and the aesthetic qualities of the building might be negotiable.

Cost advise at the early design process

The role of QS as a cost planner is to provide information with regards to initial and future costs so that the design team can make decisions knowing the cost implications of those decisions.

Once a design team has a set of requirements and a cost target established, they will start exploring alternatives as part of the design process. In the absence of other information, they will tend to evaluate a building concept primarily based on its performance merits and, at best, secondarily consider a subjective estimate of the relative costs of the design alternatives. Ad-hoc cost studies or trade studies may be prepared for significant issues, but tools to regularly support this process are lacking. Tools and information need to be provided to a design development team so that they can more proactively and objectively consider the cost implications of various design approaches on a regular basis. A building cost model or life cycle cost model provides an objective basis for evaluating design alternatives from a very early stage in the development cycle.

Use of Cost Model for evaluating design alternatives

As the design team proceeds through the design process, the cost model is used to project and accumulate project costs to use as a factor in evaluating design alternatives and to refine the design to meet cost targets. If it is determined after extensive evaluation that the client's requirements cannot be achieved at the target cost, the requirements and targets will need to

be re-evaluated and modified.

COST PLANNING PROCESS

Current practice

QS should be involved in projects from the outset and provides above cost planning advice directly to clients and designers in a manner which matches the client's needs for cost advice on initial and life cycle .
However, in practice, the designer often determines optimal design solutions from a database of intuition, experience and by 'rule of thumb'. Therefore, design decision-making process and mechanism at early design stage are still room for improvement for QS as well as for design team members.
Besides, currently the Client's requirements are getting more diversified, complicated and specialized and this would be even more time and manpower resources required to get a sound optimum design solution at this process.

The direction of cost planning

As architecture is concerned with the creation of space. A good building design will capture and articulate space to satisfy both quantitatively and qualitatively the demands of the processes to be accommodated. The total number of design decisions which must be taken is enormous. They vary, for example, from the choice of structural frame type to building shapes, from the number of storey to the type of specification grade level.

Selecting a comparable design

The variety of exhaustive study for design is limited due to the constraint of resources and time. But it can be overcome by utilizing BIM simulation model. A prerequisite for BIM retrieval will be well defined set of attributes (cost, size, specification, etc.,) and criteria.
How much can the selected attributes and criteria be able to select the performance of the comparable design in relation to the desired performance of the proposed design?
To achieve the optimum performance for the investment in the building, value engineering provides a means for assessing the performance versus cost of each design element and building component. In the early design phase, when value engineering properly applied then it considers alternative design solutions to optimize the expected cost/worth ratio of projects at completion. Therefore, value engineering can be used as an effective tool for a creative, organized approach aiming at optimizing cost performance of a building design and it

achieves saving or enhances building value to meet its required function.

Adjustment for quality and quantity

This adjustment to obtain the cost of an element in the proposed design is a linear model. That is to say, it assumes that cost is linearly related to size and quality at an early design stage. There is, unfortunately, little evidence to support the use of this model. This problem can be overcome if there is an adequate information base to develop reliable BIM simulation models for these adjustments.
As BIM is a powerful costing tool to take off quantities for fast and accurate estimate even if it is at very early design stage, and cost data can be associated with each element resulting in a detailed cost schedule. This *cost attributing* is parametric and dynamic so that any change to the model will result in a change to the project cost estimate.

MERITS OF BIM SIMULATION MODEL

In the past, using traditional approaches, it would be very time consuming to measure and cost design change proposals.
BIM is the process of generating and managing building data during its life cycle. By innovating BIM, which all the alternative options and necessary various design information are entered, it is available to simulate how the cost and contents are influenced when design requirements are changed, and to search for the most cost-effective design solution.

Merits of use of BIM are to integrate the concept of various design/engineering data linked to cost estimation. Especially at this early design-decision stage, increase of the speed and reduction of resources by utilizing BIM as a tool are extremely beneficial.

The followings are the specific examples:-

1) At early design stage, design data from BIM will provide you with all measurements and cost information which link to building components. These will show the budgetary construction cost electronically. That makes the cost planning services more efficiently.
2) When design change proposal arises and design data at BIM altered these information automatically transferred to the cost plan generated by BIM. It will be the dynamic real-time cost analysis that is very powerful tool and provides enormous assistance for designers and clients ensuring they are on the right way to *Design to Cost*.
3) The benefit utilizing BIM is not limited to the initial cost estimation. Its potentials are expandable to the life-cycle-cost and life-cycle-CO_2. In this domain, accumulations of data have to be reinforced from now on.

CONCLUSION

Rapid developments of BIM have provided faster, more accessible and more powerful tool, enabling QS to operate more efficient cost planning services at the early design stage.

The following merits can be derived by utilizing BIM as Cost Planning tool at the early design stages:-

1) To provide cost estimation to meet the requirements at design process on real time by utilizing BIM simulation model
2) To provide a cost effective solutions by using cost attributing features of the BIM to assess alternative design.
3) Using a BIM for quantification leads to faster, more accurate cost estimate even at the early design stage.

REFERENCES

Bathurst,P.E. and Butler, D.A. (1977) *Building Cost Control Techniques and Economics*, Heinemann