ABSTRACT

This paper demonstrates the capabilities of BIM (Building Information Modeling) in leveraging Whole Life Cycle Cost (WLCC) data requirements to perform WLCC calculations and produce WLLC estimates. The research determines the extent to which WLCC data, such as time, interest rates, escalation rates and real costs can be attached to parametric BIM data to be used effectively to create speedier and more accurate real-time WLLC analysis. Without incorporating WLCC data in the BIM, a complete picture of a construction project’s WLCC cannot be formed from the default outputs of the model. BIM 5D applications such as CostX utilise the parametric properties of the model, providing users with the ability to generate information and quantities from the BIM to be used in a formatted cost plan. The benefit of the 5D process is that selected quantity surveying information in the BIM can be live linked from the model to the cost plan providing a real-time analysis of WLLC. The authors demonstrate in this paper how they leverage BIM, by incorporating WLCC data and calculations in a customised CostX workbook, thus providing the authors with the ability to live link the output values from the model to the values in the workbook to perform WLCC. This paper demonstrates the practical application of this process on a pilot project in order to complete a WLCC analysis.

Keywords: Building Information Model, Life Cycle, Parametric Properties, Whole Life Cycle Costs (WLCC), Whole Life Cost Analysis

INRODUCTION

Cole and Sterner (2000) define Whole Life Cycle Costing (WLCC) as the consideration of all ‘relevant’ costs and revenues associated with the ‘acquisition’ and ‘ownership’ of an asset. The scope of what is considered a ‘relevant cost’ is set out by Cole & Sterner as initial capital cost, occupation costs, operating costs and the costs incurred or benefited from its disposal.
Cole and Sterner (2000) state that WLCC has been in existence since the 1970’s but has not been implemented into standard practice. There are a number of barriers to adoption that have been mentioned over the last twenty years in academic and practice based publications. Those that are mentioned frequently are the lack of historical WLCC data, the complexity of the calculations and the lack of standardisation across the industry (Fu et al., 2007).

Due to the amount of variables that exist in WLLC, the Office of Government Commerce (OGC) (2007) in the United Kingdom recommends the use of standard spreadsheet software, which they state can be adapted to perform the required tasks, building in a facility for key variables. The OGC state that specialist WLCC software is not adaptable and cannot process variable data as efficiently as generic spreadsheets. The annex’s of BSI/BCIS (2008) seem to support this, as the recommended WLLC templates are outlined in spreadsheet form.

Another factor to take into account is the emergence of Building Information Modelling (BIM). BIM automates many of the technical procedures involved in the traditional disciplines of the construction industry including design and take-off (Sabol, 2008; Sylvester & Dietrich, 2010). BIM, though sophisticated can find itself restricted in incorporating the data requirements for WLLC and without an external application cannot produce a complete WLCC Analysis (WLLCA). The authors will investigate the possibility of developing a solution concept for WLCC leveraging the benefits of BIM.

**REPRESENTING WLLC**

**How to Carry Out the Calculations**

The complexity of the calculations and the time consuming nature of WLCC calculations are mentioned frequently as reasons for WLCC’s slow development (Fu et al., 2007). Pelzeter (2007) states that WLCC has been slow to catch on because there is a lack of practical knowledge in relation to ‘how to’ carry out the calculations. Some publications such as Eurovent (2005) and Fuller and Petersen (1996) express the scope of WLCC as a formula. This formula is generally outlined as follows;

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\text{Whole Life Cycle Cost (WLCC)} = \text{Initial Investment} + \text{OMR} + \text{D}
\]

The ‘initial investment’ includes costs associated with the construction of the asset which also include other construction related costs such as design team fees, planning charges and local county council contributions (BS-ISO, 2008; BSI/BCIS, 2008). Construction costs are priced and paid for immediately at the construction stage and therefore an escalation/discount time based adjustment is not applied. These costs can be directly applied from cost plan or Bill of Quantities (BOQ) cost items. Operation, Maintenance and Replacement (OMR) costs represent the costs incurred over the study period of the asset (Fuller & Petersen, 1996). Disposal (D) costs represent the cost incurred, or price benefitted from the disposal or sale of an asset. Evaluating operation, maintenance, replacement and disposal costs is an exercise in predicting the future costs of these events over the study period of the WLCC, so that economic evaluation can be applied not just to the construction cost but to the entire life cycle of the project. This is the essence of WLCC and is ingrained in the definitions outlined in all eminent standards (BS-ISO, 2008; BSI/BCIS, 2008; Langdon, 2007; Fuller & Petersen, 1996).

**Representing WLLC**

According to the BSI/BCIS (2008) the most prevalent methods in calculating WLCC in the United Kingdom and Ireland is a representation of the WLLC as a cash flow over a study period. However, comparing different building or component options through cash flow forecasting is difficult as different costs take place at different time frames. Thus these costs need to be evaluated at a comparable time base so that options may be evaluated in equivalent terms. The BSI/BCIS (2008) state that the comparable time base is usually present day, noted as year zero (0) on the WLLC estimate.
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