ASSESSING THE IMPACT OF NEW RULES OF COST PLANNING ON BUILDING INFORMATION MODEL (BIM) SCHEMA PERTINENT TO QUANTITY SURVEYING PRACTICE

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Not until recently, the establishment of a whole life cycle budget for a constructed facility largely depended on the initiative of using the standard method of measurements (SMM) structural approach to the development of a cost or budget plan. This method, argues the RICS (2009), "created inconsistency in measurement and descriptions, resulting in the production of unclear basis for the estimates". The constraints associated with traditional cost planning and estimating tend to be compounded by the complexity associated with the deployment of building information model (BIM) technology that is pertinent to the achievement of whole life cycle cost management of a constructed facility. This research is aimed at exploring the impact of the new rules of measurement on the building information model schema pertinent to the quantity surveying practice on construction based projects. The research presumes that even though the new rules of measurement are not mandatory, they are likely to influence cost planning and estimating practice because they have been developed with a view to setting "the best practice" in the development of cost plans. The likely impact could subsequently affect the current building information model schema for cost management.

Keywords: building information model, cost planning, quantity surveying, standard method of measurement.

INTRODUCTION

The cost planning process arose out of the need to plan effectively the cost of a construction project from inception through design and continuing throughout the construction phase (Corbett and Rowley, 1999). Because of financial constraints that were triggered by the war, the Ministry of Education developed cost limits with a priority to stabilize school building costs (Ashworth, 2004). Even with the advent of more modern procurement strategies such as prime contracting and public private partnerships (PPP), the necessity of a sound cost plan does not appear to diminish (Kirkham, 2007). Managerial Auditing Journal (2004) stated that "the need for effective cost planning has become increasing important following the recession in the late 2000s". With an increased use of a cost plan, Kirkham (2007) found that there has been a swift increase in the use of Information Technology (IT)-supported cost

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planning systems; that emphasize the continuous evolution of the cost plan in tandem with the design evolution (Best and Valence, 2002). However, the constraints associated with traditional cost planning and estimating tend to be compounded by the complexity associated with the deployment of IT, let alone that of building information modelling (BIM) technology that is pertinent to the achievement of whole life cycle cost management of a constructed facility. This research was aimed at exploring the impact of the new rules of measurement on the building information model schema pertinent to the quantity surveying practice on construction based projects.

RATIONALE FOR THE RESEARCH

The current cost planning process has been found to be inconsistent, inaccurate and providing a poor cost management service to the architecture, engineering, construction and facilities management (AEC/FM) industry (RICS, 2009). Until 2009, there was no specific guidance set down into the measurement of building works for the purposes of providing cost estimates and cost plans. In the absence of these rules, quantity surveyors would have a tendency to adopt the rules that existing within the Standard Method of Measurement (SMM). This led to inconsistencies which made it difficult for clients to understand what was included, consequently resulting in clients having doubts about the cost advice they were receiving (RICS, 2009). The main research problem has been that while the RICS new rules of measurements (NRM) would tackle the inconsistency within cost planning mechanism, the BIM schema for the data pertinent to cost management in the building information model (BIM) remains static, and overly reliant on schemata from other domains of the schema. Therefore, the rationale for this research was to highlight the importance of using the new rules of measurement as a springboard to provide semantic richness to the schema pertinent to cost management within the building information model.

INDICATIVE RELATION BETWEEN THE STANDARD METHOD OF MEASUREMENT AND THE BUILDING INFORMATION MODEL

Building Information Modelling (BIM) is a set of interacting policies, processes and technologies generating a "methodology to manage the essential building design and project data in digital format throughout the building's life-cycle" (Pentila, 2006). Building Information Models are made of 'smart' objects which represent physical elements like doors and columns and encapsulate 'intelligence'. An AEC/FM smart object is different to a CAD entity that holds little or no meta-data (ibid). Object intelligence, also referred to as 'semantic richness' (Halfway and Froese, 2002) and data flows between BIM stakeholders are both critical and detectable variables of BIM maturity (Halfway and Froese, 2002). This means that BIM data flows are varied and include the transfer of structured/ computable (e.g: databases), semi-structured (e.g: spreadsheets) or non-structured/non-computable data (e.g: images) between computer systems (Halfway and Froese, 2002). There is an interchange and exchange of data when professionals are working on a built environment product, regardless of the system to implement the exchange or inter change. A BIM data exchange is when a BIM player exports or imports data that is neither structured nor computable. A typical example of data exchange is the export of 2D CAD drawings out of 3D object-based models resulting in significant loss of geometric and semantic data (ibid). Interchanges assume 'adequate interoperability' between the sender and the receiver systems — Interoperability is defined as "the ability of two or more systems or

components to exchange information and to use the information that has been exchanged" (Succar, 2009). BIM interchange — an interoperable exchange of BIM data — may occur in many technical ways including the exchange of proprietary (ex: RVT and DGN), open-proprietary (like DWF and many eXtensible Markup Languages) or non-proprietary file formats (ex: IFC and CIS/ 2) (Succar, 2009).

At the simplest level, BIM tools enable collaboration between users through better visual understanding of the building artifact. However, collaboration is greatly enhanced if the partners can share their models not only for viewing, but for direct analysis, editing and development. Collaboration is also needed for moving model data between BIM software supporting different phases of building, especially between design and fabrication. In order for collaboration to be efficient and effective, the object-based data exchanged needs to include geometric shape, appropriate levels of detail regarding embedded components, building piece structure and assembly property data. It needs to address design intent, fabrication and other production details, and the interface between systems, such as connections and pass-throughs (Eastman *et al.*, 2008).

The indicative relationship between the "new rules of measurement" and the BIM is that the information model schema is developed using the information model, and represents the data under different domains as shown in Figure 1. While some domains have actual or physical data types, the NRM or the SMM can only be modelled using the "process model"; which requires an "abstract" data type objectification to ensure that it is incorporated in the schema. Such data types exist in the current schema. The international alliance for interoperability –or the Building Smart Alliance – (2009) explains that the industry foundation classes (IFC) is the neutral file format that is used to model building products. The IFC schema is developed is developed by various components within the alliance, as shown in Figure 1. Even though the IFC schema has no domain for Quantity Surveying (Figure 1), there are many domains that contain necessary data that could be used for elementary quantity surveying such as IfcQuantityResource.

However, it can be argued that IfcQuantityResource may not articulate the necessary processes that are now covered in the New Rules of Measurement (NRM). Essentially the NRM are, a virtual schema, because it sets out formal stages to the cost planning process; and considering that the processes could be articulated under IfcProcess, one could argue that there is a case for considering NRM in the overall IFC schema, which would provide the semantics of cost management. The NRM "schema" provides the basis of a codified framework for elemental cost planning that, if incorporated in the IFC schema, would enhance the involvement of a quantity surveyor in the provision of cost management services to the project team as early as possible through a BIM. However, the new rules make no mention of the possible application of the "building information model" based data available on the market. This research examines the possibility of integrating the NRM into an IFC schema that could enhance the participation of the quantity surveyor on a project team that uses BIM as a strategy for collaboration.

RESEARCH DESIGN AND METHOD

The key research question was that.

- Could the building information model and the new rules of measurement drive a whole new thinking to cost planning processes.

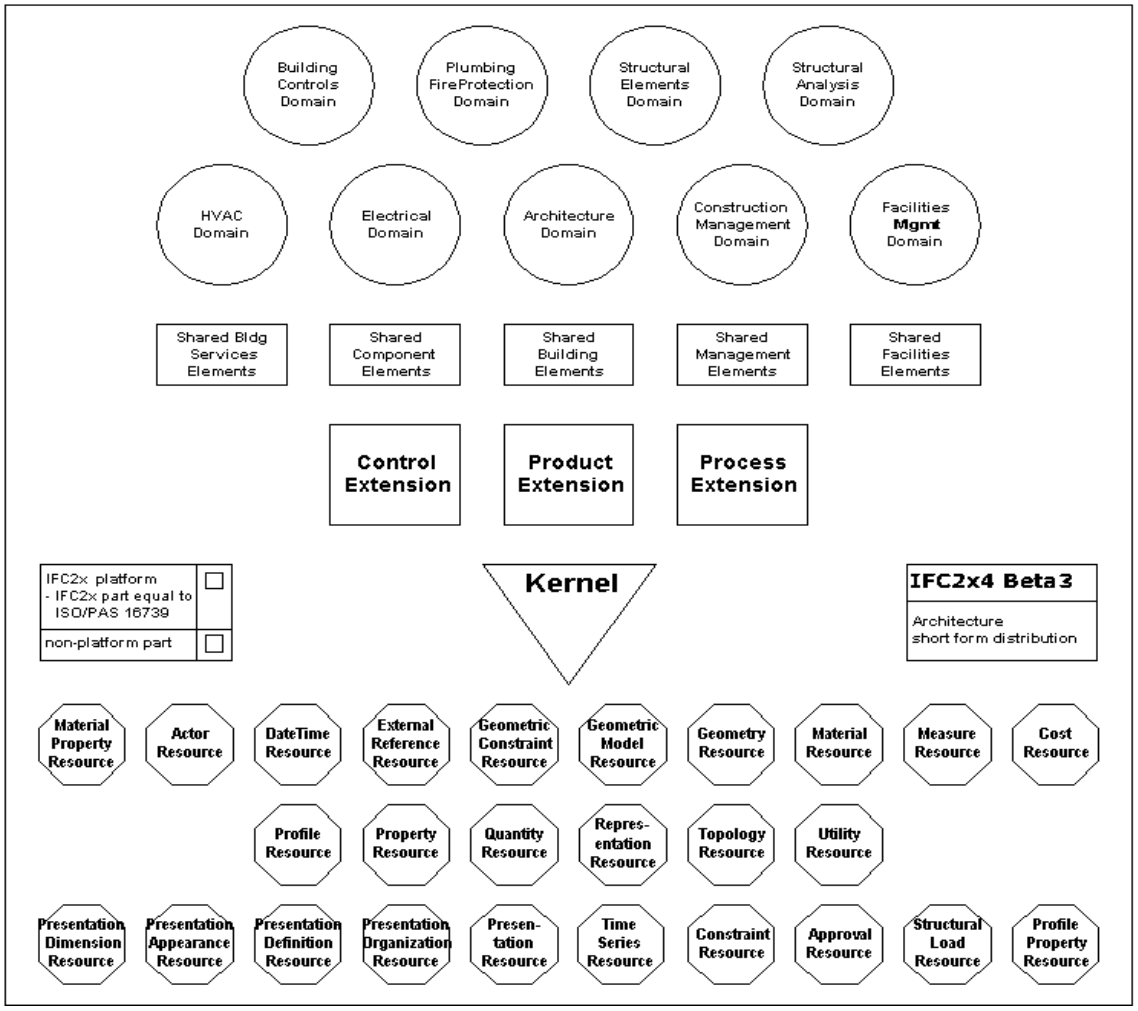

Figure 1: Schematic overview of the IFC2x4 Beta 3 (Source: BuildingSMART Alliance, 2009).

To answer the research question, firstly, a questionnaire survey about knowledge based information regarding BIM, and the ambiguity or lack of consistency with current cost planning systems (strategies) was used as a data collection tool. It was circulated using a web based system. The primary data was used in testing the knowledge of surveyors about the RICS's approach to the generation of NRM, as well as the use of ICT to an advanced level such as incorporation of BIM.

Secondly, a case study was used to validate the answers that could be used to develop a strategy for contributing to the development of a QS friendly process based schema in the future product model. A total of 36 valid responses were obtained from the survey.

ASSESSING THE IMPACT OF NEW RULES OF MANAGEMENT ON THE BIM SCHEMA

Based on the response from the survey, the following results were extracted.

1. Primary results from the survey indicated that the majority of respondents adopted an electronic approach to the cost planning process.
2. The responses indicates that (63%) of the respondents recognize the current cost planning system to be useful, as such this may impact on their resistance to change (A number of professionals choose not to adopt or implement the NRM).

3. Out of the 30 respondents who utilize electronic systems, 21 (70%) adopt in house techniques, 10 (33%) draw upon published software and 6 (20%) have their own bespoke software which is tailored to their organization.
4. The majority of respondents have in house or adhoc systems amalgamated with a hybrid approach to cost planning (The effectiveness of the incorporation of the NRM may be minimal, as the majority of the work will more than likely be done by hand, and then manually inputted into a spreadsheet on some sort).
5. With (57%) adopting the rules that exist within the SMM for developing cost plans, this provides an area of concern because it has been established that the use of these rules lead to inconsistencies in the production of cost plans, with clients doubting the advice they receive, yet construction industry professionals persist in their use (The data yielded 19 out of the 30 members (63%) of the RICS who answered this question adopt this approach to cost planning, and that even though the NRM where published in March 2009, these rules are not being implemented in the industry by some respondents).
6. 55% of respondents implemented the NRM either at an electronic level, a paper based level or a mixture of both.
7. There is good array of awareness of software systems that are in use in the construction industry. 32 out of the 36 (89%) respondents are aware of MS excel.
8. With the majority of respondents 63% not aware and 23% unsure of any visualization tools, one could have expected this response from the range of professionals yielded in this survey.
9. With only 8 of the 36 respondents (22%) not aware of building information models, this will add validity to the research as the majority of respondents are aware of building information models in use.

ISSUES AND CHALLENGES OF IMPLEMENTATION THE NEW RULES OF MEASUREMENTS INTO A SCHEMA

For a building product model to mature to a stage where they can be used adequately, the industry would face challenges. For instance, Succar (2009) has of the view that "there are voluminous possibilities attributed to BIM representing an array of challenges which need to be addressed by Architecture, Engineering, Construction and Facilities Management (AEC/FM) stakeholders"; especially with the maturity levels necessary for implementation, as shown in Figure 2. Despite the challenges, BIM is continuing its proliferation in both industrial and academic circles as the 'new CAD paradigm (Succar, 2009). Succar (2009) argued that building information models (BIM) is seen as a catalyst for change, poised to reduce industry's fragmentation, improve its efficiency/effectiveness and lower the high costs of inadequate interoperability. These assertions — abridged as they maybe — include several mental constructs derived from organizational studies, information systems and regulatory fields (Succar, 2009).

For the quantity surveying profession there is an opportunity to consolidate the BIM schema with the information from the NRM so as to improve the consistency and efficiency in the provision of cost management in the development process. BIM would make a positive impact on the cost planning process as it would improve the speed as well as create a consistent approach to the allocation of cost resources.

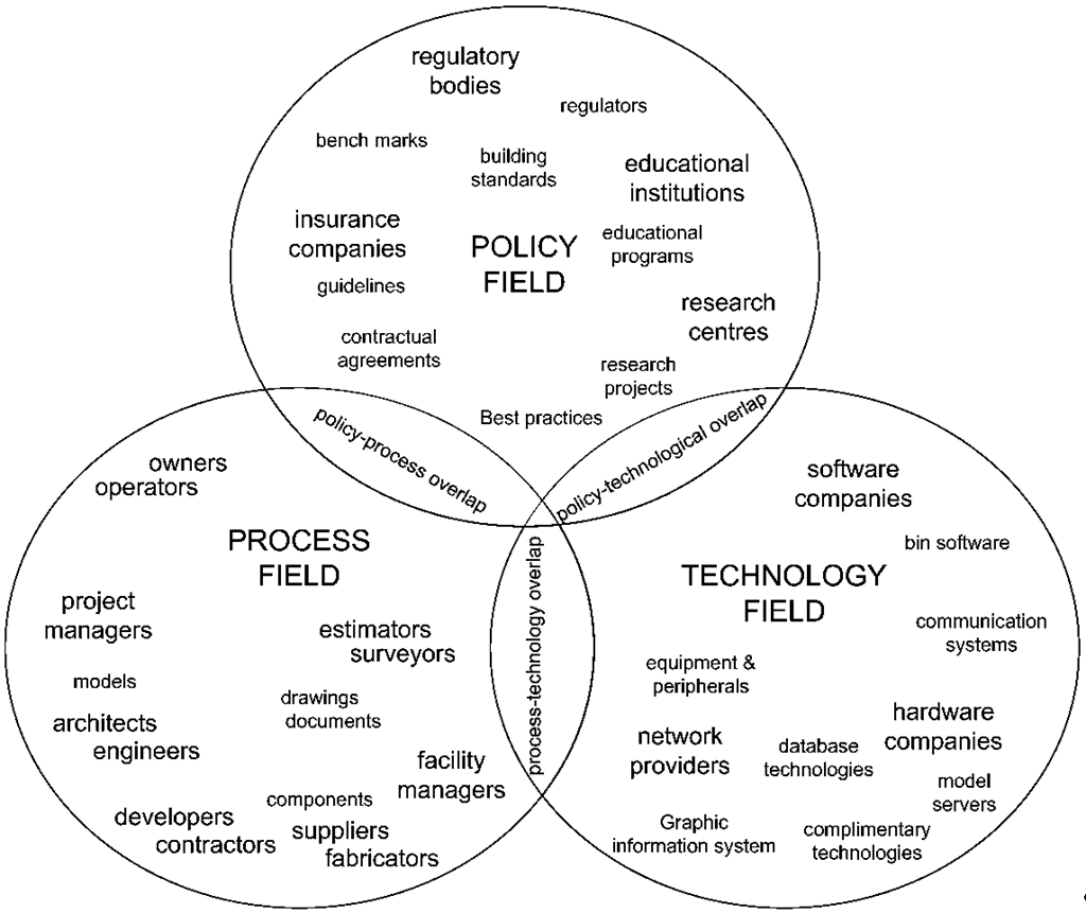

Figure 2: Three interlocking Fields of BIM activity — Venn diagram (Source: Succar, 2009).

The greatest challenge however is that of engaging in the development of abstract data types that could be recognized by other domains in the schema. This requires a fully "a quantity surveying mind" with high software modelling knowledge that can model the processes in developing a cost plan. For example, the EXPRESS (language) specification for ENTITY IfcProcess (Figure 3): "A process is a set of activities that are interrelated or that interact with one another. Processes use resources to transform inputs into outputs. Processes are interconnected because the output from one process becomes the input for another process. In effect processes are "glued" together by means of such input output relationships" (buildingSMART, 2009). "An IfcProcess is defined as one individual activity or event, that is ordered in time, that has sequence relationships with other processes, which transforms input in output, and may connect to other processes through input output relationships. An IfcProcess can be an activity (or task), or an event. It takes usually place in building construction with the intent of designing, costing, acquiring, constructing, or maintaining products or other and similar tasks or procedures" (buildingSMART, 2009; Grilo and Jardim-Goncalves, 2009).

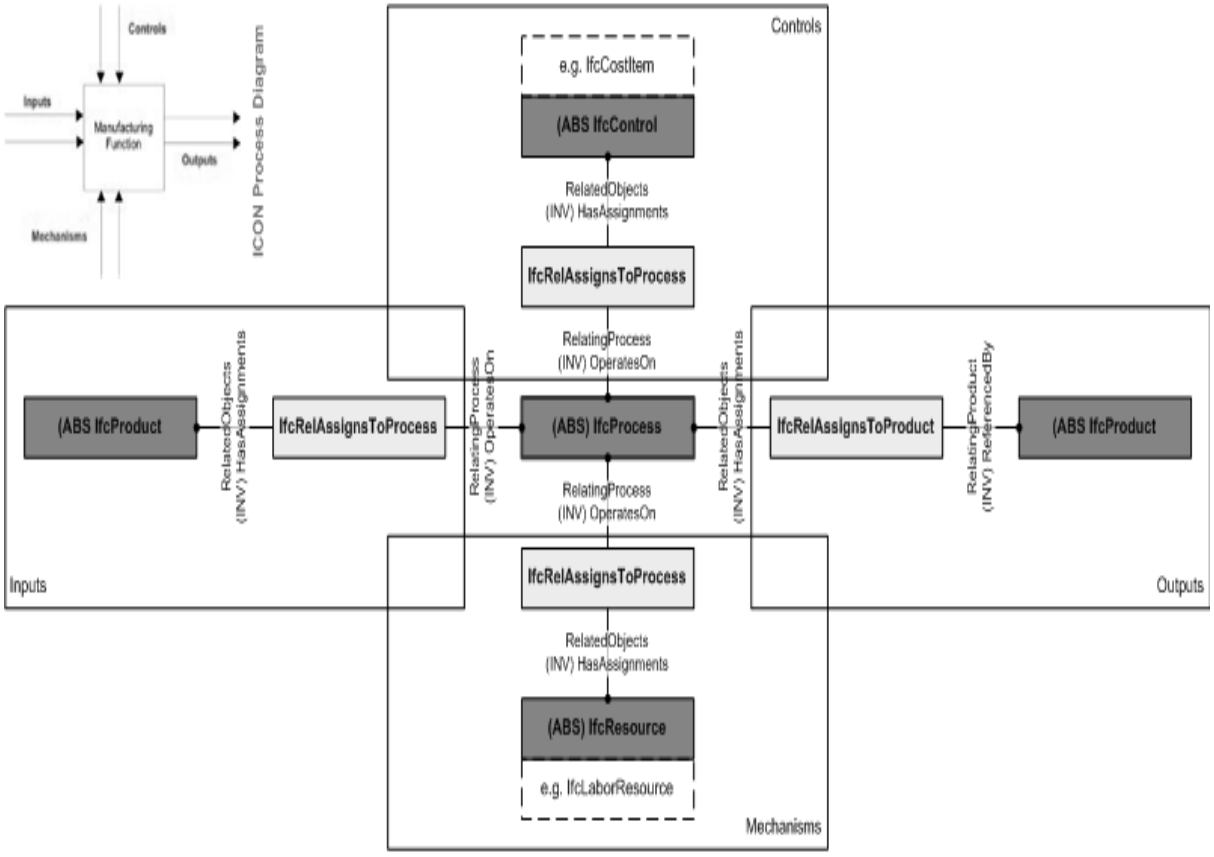

Figure 3: The IfcProcess relationships shown in comparison to the ICON process diagram (Source: BuildingSmart, 2009)

CONCLUSION

The key argument is that the process of making a cost plan using the NRM needs to be "objectified" into entities that would have "Abstract Data Types" (ADT) to be used to model the cost planning process (Figure 3). Such data types need to interoperate with other domains in the IFC schema, at the "interoperability level". As the schema stands, data types related to cost planning and management are embedded in other domains such as "construction management domain" and the like. There are 53 entities in "IfcSharedBuildingElements" none of which articulates the "process" of cost planning. The results from the survey indicated that the use of cost checking mechanisms is comprehensive within the sector, and need not be overemphasized. However, there is little evidence of it being transferred to a more formal model to facilitate the decision making in an integrated format like that of the BIM.

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