Evolution of Quantity Surveying Practice in the Use of BIM – the New Zealand Experience

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Abstract

The research reported in this paper investigated the current state of evolution of quantity surveying practice in New Zealand (NZ) in the use of BIM. Following a literature review that included surveys by others of BIM usage in NZ a form of purposive non-random sampling was used to identify and interview people considered by the NZ industry to be at the leading edge of practice. It was found that where BIM modelling is being practiced on larger projects in NZ it is generally at level 1 or 2 as defined by Bew and Richards' maturity model (2008). In this environment it is not necessary for quantity surveyors to change existing practices as they can continue to measure from 2D drawings derived from the 3D model. Only one instance of a QS firm measuring directly from the 3D model was found. Derivation of quantities from 3D models and linking of object quantities with costing rates contained within rate libraries is possible using estimating software that is available in NZ however this has not happened to date. Barriers to this practice being adopted are the need to develop description and coding systems and the need for the firms to develop formal libraries.

Keyword: Building Information Modelling, Cost Modelling, 5D, Quantity Surveying

1. Introduction

As the use of Building Information Modelling (BIM) technologies has moved from the research and development arena into commercial use differences are emerging between the aspirations of the BIM concept and the realities of commercial practice. This paper is focussed on how 5D (cost related) practices are emerging in New Zealand.

The BIM concept (or aspiration) is one of a single data rich model from which information can be drawn by the various parties involved in the buildings life cycle. The American General Contractors 2006 definition of BIM is a fairly typical example of this aspiration:

> *Building Information Modelling is the development and use of a computer software model to simulate the construction and operation of a facility. The resulting model, a Building Information Model is a data rich, object oriented, intelligent and parametric representation of the facility from where views and data appropriate to various users' needs can be extracted and analysed to generate information that can be used to make decisions and improve the process of delivering the facility (p5).*

Part of this data rich concept is that BIM should be able to support and record the cost modelling and cost management dimension (5D) of the design and construction process. This paper seeks to report current developments in this area of 5D modelling within New Zealand.

2. Literature Review

The purpose of this section is to provide a brief overview of current practice with BIM particularly in the area of 5D taken from the international literature. This review both served to inform the focus of the investigation of practice in New Zealand and to provide a basis for comparison. The review is broken into three sections, the extent of BIM usage, model building practice and 5D BIM.

2.1 BIM Usage

Internationally the use of BIM appears to be growing. McGraw Hill (2009) reported that 48% of respondents to a survey were using BIM, up from 27% in 2007. A more recent survey in the UK by the RIBA owned NBS (2012) found that 31% of construction professionals were using BIM up from 13% in 2010. An Australian Survey in 2010 found that 60% of Architects and 26% Engineers said they used BIM on more than 60% of their projects (Allen Consulting Group 2010). Surveys of this nature inherently provide little information on the depth of use of BIM. In some jurisdictions usage is being given impetus by government mandating of BIM, the US Government Services Agency did so in 2007 (GSA 2007) more recently the UK Government has issued a requirement for government funded projects of "fully collaborative BIM level 2 (with all project and asset information, documentation and data being electronic) as a minimum by 2016" (UK Cabinet Office 2011) (see below for description of levels).

The British Standards Institute (BSI) has adopted a useful maturity model developed by Bew and Richards (2008 cited in BIM Industry Working Group 2011) which illustrates that BIM practice can cover a broad spectrum (figure 1 below).

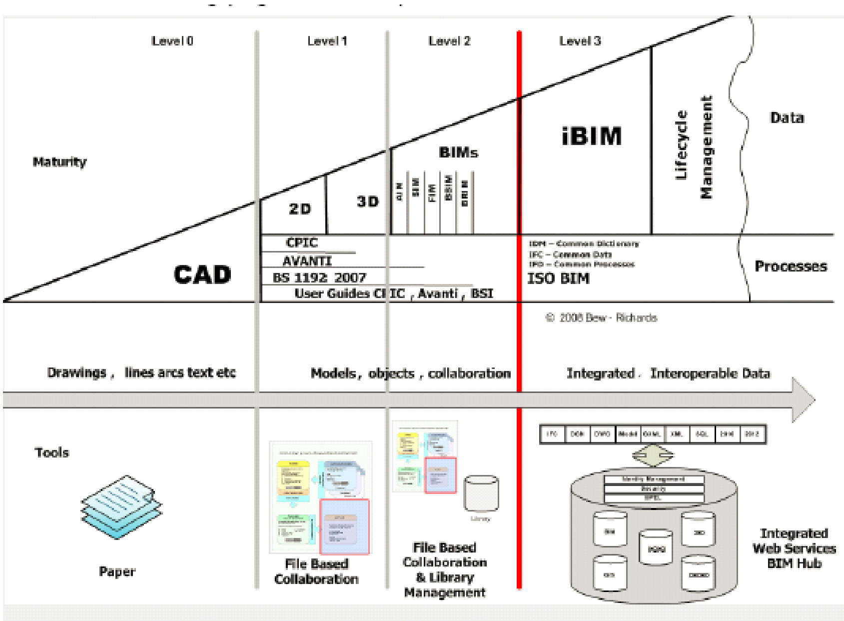

Figure 1. Bew & Richards 2008 as cited in BIM Industry Working Group (2011) p16.

Level Definitions

0. Unmanaged CAD probably 2D, with paper (or electronic paper) as the most likely data exchange mechanism.
1. Managed CAD in a 2D or 3D format using BS1192:2007 with a collaboration tool providing a common data environment, possibly some standard data structures and formats. Commercial data managed by standalone finance and cost management packages with no integration.
2. Managed 3D environment held in separate discipline "BIM" tools with attached data. Commercial data managed by an ERP. Integration on the basis of proprietary interfaces or bespoke middleware could be regarded as 'pBIM" (proprietary). The approach may utilise 4D programme data and 5D cost elements as well as feed operational systems.
3. Fully open process and data integration enabled by "web services" compliant with the emerging IFC/IFD standards, managed by a collaborative model server. Could be regarded as iBIM or integrated BIM potentially employing concurrent engineering processes.

BIM Industry Working Group (2011) p16 & 17.

None of the surveys reviewed used this model as a measure of the depth of adoption of BIM however it is adopted by this paper as basis of discussion.

2.2 Model Building Practice

The creation of a single integrated BIM model for a project (level 3) does not appear to be current practice. Eastman *et.al.* (2011) provide a useful review of currently available BIM platforms. None of those listed are developed to the point of facilitating a single model. For instance the AutoDesk Revit products have separate packages for Architecture, Structure and Mechanical and Electrical (MEP) which can be compared through another software package Navisworks but remain as separate models. Bentley's core product is Bentley Architecture to which can be added a array of additional systems which Eastman *et.al.* describe as only partially integrated (p82). Archicad is an architecture platform which can be interfaced with third party engineering platforms such as Tekla.

In a case study from Finland (Strenstrand 2010 cited in Firat *et.al.* 2010) there is an instance of the architecture, structural and MEP models being integrated for construction management purposes by importing into Tekla Structures CM module using IFC format. In addition the 2013 Revit suite is claimed to be integrated. Both these instances indicate that some progress is being made towards the evolution of the single model.

The level of detail in current modelling practice is not clearly reported. Eastman *et.al.* (2011) make passing reference to current practice of not undertaking 3D modelling at detail level and reliance on 2D sections for construction details. Similarly Taylor and Bailey (2011) make reference to the practice of modelling the building in 3D to a limited level of detail and then providing construction details (junctions etc) in 2D.

2.3 5D BIM

The issues surrounding cost modelling and management from BIM models have been reported in the literature for some time now. Implicit in the debate are three sub-processes:

1. The extraction of quantities of work to be done from the 3D model and arranging those quantities for estimating purposes.
2. The addition of costing data and the calculation of cost
3. The derivation of costing data from libraries (or databases).

In addition these sub-processes can be applied at any stage of the design evolution from concept design to construction details. For instance RICS documentation suggests that within the RIBA Plan of Work, an order of cost estimate would be made at initial appraisal stage, cost plans at each of concept, design development and technical design stages followed by pre and post tender estimates (RICS 2009).

2.3.1 Derivation of Quantities

Matipa, Kelliher and Keane (2008) based on work they had done in 2006 reported that BIM modelling had huge potential to facilitate designing to a budget but that quantity surveyors encountered serious software interoperability problems that needed to be overcome before the potential could be realised.

Kraus, Watt and Larson (2007) and McCuen (2008) both report that BIM authoring tools are capable of deriving quantities for an object in linear, area or cubic volume form. Hannon (2007) also agreed that quantities could be extracted but noted the difficulty of extracting quantities “to a format that traditional estimators are comfortable with” (p.IT.03.04). Firat *et.al.* (2010) report two case studies in Finland where quantities were taken off from BIM models however in one case they report that “the quantity take off obtained was not considered sufficiently reliable enough for use as the only source of information”(p5). Taylor and Bailey (2011) make reference to the need to manually measure some quantities where construction details are provided in 2D format.

Eastman *et.al.* (2011) describe the existence of third party software tools capable of extracting quantities from various BIM authoring tools which “allows estimators to use a takeoff tool specifically designed for their needs without having to learn all of the features contained within a given BIM tool” (p278). Vico a BIM related software company in a online release (2011) stated “There is no easy button” for quantity takeoff” and made clear that the ability of measurement software to produce a schedule of quantities is limited according to the way the model is built. Taylor and Bailey (2011) observe that for the contractor to develop cost and schedule forecasts from a designers 3D model, they must input reference codes and correct the model where 2D input was used instead of 3D “or make the decision to use 2D printouts and manual methods of estimating and scheduling”(p3). Whitmore 2012 reports in the context of Australia that design consultants have created their own libraries of objects “which results in differing information being extracted from BIM models for similar elements or products”(p19). He offers the opinion that standardising the naming of object properties is the essential next step.

2.3.2 The addition of costing data and the calculation of cost

Eastman *et.al.* (2011) give three primary options for this sub-process:

1. Exporting the quantities to estimating software or an Excel spreadsheet.
2. Linking the quantities of BIM components to estimating software via a plug-in or third party tool. They note that many of the larger estimating software packages provide such tools.
3. Using a BIM quantity takeoff package. Whilst they describe these tools as takeoff packages their detailed description shows them provide costing spreadsheet or database facilities as well as the ability to import manually derived quantities.

The literature reviewed did not discuss this sub-process in any detail and it is assumed to be largely unproblematic as it does not alter pre BIM practice. Whitmore 2012 reports that Rider Levett Bucknell in Australia extract quantities from BIM using a propriety measurement platform (DimensionX by Dimtronics) and then live link the data to their estimating software system “Qubit”.

2.3.3 The derivation of costing data from libraries (or databases).

There is discussion on this sub-process in the literature with authors including Kraus *et al.* (2007) Hannon (2007) Eastman *et.al* (2011) and Taylor and Bailey (2011) all seeing this as a desirable goal and a necessary part of effective BIM development.

In 2006 Phair reported that software was available to integrate RSMeans a US costing database with BIM models to enable continual updating of the project costs during conceptual project planning.

However Kraus *et al.* (2007) see the challenge of estimating using BIM is in “how the objects in the building model relate to items in a typical estimating database” (p.IT.01.02). They conclude that for efficient estimating in a BIM environment there is a need to be able to develop and adhere to standards for mapping the objects from the BIM model to the estimating database. They note attempts by various parties in the USA to develop standard protocols for authoring BIM models but go on to observe “that standardisation of how design objects would map to estimating databases is not on the list” (p.IT.01.3). Hannon (2007) also notes the difficulties of mapping design objects to estimating databases.

Bailey (2010) writing in the context of the USA describes preliminary work addressing the problem of mapping design objects to estimating database items. He envisages a future where designers will hold libraries of detailed standard BIM objects identified by codes and contractors will hold cost libraries for the same objects using the same coding system. If this is achieved efficient costing of the project as the design evolved could be realised. He reports progress being made with the use of the “OmniClass” coding system but notes that at this stage “published documentation only provides a level of codes suitable for conceptual and early schematic models and estimates” (p.2). He envisages that the next stage of development will enable some parts of the BIM model to be transferred to the estimating database as “intelligent 3D” with the remainder being addressed using more traditional techniques. More recently Taylor and Bailey (2011) have published an elaboration of this work demonstrating a coding system based on using Omniclass Table 22 at level 2 as its basis with sub-coding providing details on item classification, item configuration and size. The system is not fully developed and again is intended for use during early design stages rather than as a means of deriving quantities for traditional trade based estimating.

The Singapore industry appears to have made the most progress in agreeing a coding system to facilitate exchanges of information between computer based design models and costing systems. The Singapore Standard CP97: Parts 1 & 2 2002 “Code of Practice for Construction electronic standards (CEMS)” is aligned with Singapore Standards CP 93:2002 Classification of construction resources information and CP 83: 2000 Construction computer-aided design, to ensure a common classification and coding system is adopted across the industry.

2.3.4 Extent of 5D modelling in practice.

There is limited reporting of the extent of 5D modelling in practice. The only significant survey found was the RICS BIM Survey Report (BCIS 2011). That survey of members in the UK and USA found that only 10% of respondent QSs said they were regularly using BIM with a further 29% having some limited engagement. Of the responding firms only 6% reported they extracted quantities from a BIM often or very often.

3. New Zealand Practice

3.1 Research Method

The focus of the research for this paper was to identify how 5D practice was evolving at the leading edge of practice rather than provide a survey of the overall extent of practice. However it is accepted that 5D practice is dependent on both the structure of the industry and the modelling being done by design practitioners. An overview of the NZ context is therefore presented first. The extent of BIM usage has been researched by others and this is summarised next. 3D modelling and 5D practice was then investigated and is presented in that order below.

In order to determine current 3D and leading edge 5D practice those considered by industry to be at the leading edge were sort out in a form of purposive non-random sampling as discussed by Denscombe (2007). This was achieved by seeking advice from the Quantity Surveying Advisory group at the authors' institute. This group is comprised of representatives from most large QS firms and Contractors in Auckland. In addition as part of each interview the interviewees were asked who they considered the leading edge practitioners to be. Representatives of one firm of architects, two construction companies, five firms of quantity surveyors and a quantity surveying software supplier were interviewed. Information was also gathered from a member of the Auckland Revit user group, the President of the Pacific Association of Quantity Surveyors and two members of the NZIQS SMM committee. It is believed that this paper therefore provides a reasonable snapshot of the current state of play regarding 5D modelling in New Zealand in early 2012.

The interviews were semi-structured and varied according to the interviewee's role and experience with BIM. Interviews varied between ten minutes (we have no experience of BIM) and one and a half hours.

3.2 The New Zealand Context

New Zealand has a population of approximately 4m people of which about 1.4m people live in Auckland the principal commercial city. The New Zealand construction industry has a similar structure and practices to those found in the UK and Australia rather than those found in North America. A peculiarity of the New Zealand industry which arises in part from the small population size is the lack of large regular clients. The government procures construction related services through individual departments and agencies rather than through a central agency and does not mandate practices in the manner that occurs in other jurisdictions. To date neither the government nor any client group have mandated the use of BIM on its projects, nor become involved in efforts to establish protocols or coding systems.

Most forms of procurement practices can be found in NZ including various forms of integrated project delivery. However the dominant form remains the design – bid – build approach and the industry is structured to deliver in this manner. Design firms are separate entities to construction contractors and none of the larger contractors have in house design capabilities (when design and build type of projects are undertaken the design work is contracted out). Architecture firms tend to be separate from engineering firms and within engineering, civil and structural engineering is often contained within separate firms to mechanical and electrical. It is therefore common to find several design firms (a firm of architects plus two or more engineering firms) on the one project.

Boon (1996, 2001 &2008) described Quantity Surveying is a well established profession in New Zealand. Consultant or Professional Quantity Surveying firms (PQS) exist and are engaged on nearly all projects. Four of the larger firms have ties to and trade under the name of large international firms. Competition law means that neither fees nor levels of service can be standardised, PQS firms therefore provide a variety of services depending on client needs and requirements. Cost planning services can vary between the provision of estimates at the end of each design phase through to detailed cost planning of elements during numerous design iterations. Quantity surveyors are also employed by contractors in commercial management and estimating roles.

3.3 BIM Usage in New Zealand

Davies (2010) reported a survey of computer use and attitudes in the NZ construction industry conducted in 2009, this was based on a postal survey sent to 388 companies from which 80 completed responses (21%) were received. This was a survey of general computer usage not of BIM usage in particular. The survey found that all architect respondents use CAD of some form and that most were using some form of 3D modelling. Six of the architect respondents were using BIM models. Information on the computing practices of other design or quantity surveying firms was not included.

A more recent "National BIM Survey" (Masterspec 2012) was conducted as an online survey in late 2011. It had 524 respondents of which 89% were from Architect, Architectural Designer or Multi-disciplinary firms. It found that of the respondents 34% were aware of and currently using BIM, 54% were just aware of BIM and 12% were neither aware of nor using BIM. 92% of respondents expected to be using BIM in five years time. The survey identified that Autodesk (40%) and Graphisoft (37%) dominated the NZ CAD market.

McCartney and Kiroff (2011) investigated the factors affecting the uptake of BIM in the Auckland architecture, engineering and construction industry using a form of purposive non-random sampling and semi-structured interviews. They found that the interviewees were well aware of the benefits of BIM and did not consider the cost of implementation and training to be major factors restraining uptake. They identified the key barriers to uptake to be the need to do more design and engineering work early, a skill shortage in BIM modelling and the need for a paradigm shift towards a more integrated design and construction process.

3.4 3D Modelling Practices

The information in this section was collected from interviews with the organiser of the Auckland Revit user group, from the BIM managers of two major construction companies involved in tendering for larger projects and from the QS firms interviewed. The first interviewee provided insight into the practices the design professions share through the user group whilst the other two groups provided coverage of a significant proportion of non-residential projects in the Auckland market over the previous year. All the people interviewed were involved with projects where the contractor had been brought into the project after a tender process at the end of the design phase (including the production of construction documentation).

3D modelling using BIM authoring tools is commonly found on larger projects. Its use on small and medium projects is less common. Two quantity surveying firms who work on small to medium projects reported that they had yet to see a project modelled in 3D. Where 3D modelling is used it is rare to find that all design consultants have modelled in 3D. Instances were found where the architect had drawn in 2D and the structural and services engineers had modelled in 3D and where the architect and structural engineers had used 3D and the services engineers 2D. The interviewees were generally of the opinion that the structural engineering profession was the most advanced in the use of BIM and the services engineers the least advanced. The use of BIM by services engineers appeared to vary between using it simply as a drafting tool through to using its full performance modelling capabilities. In all cases where BIM was used separate architecture, structure and services models were produced. This is inevitable as the commercially available BIM authoring tools do not facilitate the production of a single integrated model (see 2.2 above).

Most architecture firms that were modelling in 3D were only taking their models to a level of detail equivalent to 1:100. Construction detailing to a greater level than this was being done in 2D. The architectural firm interviewed reported that whilst they sometimes did the preliminary design using a BIM authoring tool they started a new model at the commencement of developed design and did not flow through the model from preliminary design. Some architects within the firm did the preliminary design using Google's SketchUp before moving to a BIM authoring tool at the commencement of developed design.

In all instances covered by the interviews the contract documents were 2D drawings not the 3D model. Where a 3D model was provided to the contractor it was on the basis of "information only".

The industry has not established modelling protocols, these are therefore negotiated on a project by project basis. Tensions exist between how the design consultants can efficiently produce models that meet their purposes and the additional level of detail that can be required to enable location based scheduling and estimating information to be developed. Whether columns and lift shafts should be modelled as a single object which extends the full height of the building or be modelled on a floor by floor basis is a typical example of this tension. Coding or description protocols for objects in the models have not been agreed. Each organisation therefore has its own practices which are not always followed consistently.

The state of BIM practice where it exists can therefore be characterised as being between level 1 and early level 2.

3.5 5D Practices

3.5.1 Software Capability

Boon, Prigg and Mohammad (2011) looked at the issues of cost modelling through the design phases of the project in the NZ environment. They conducting experiments of practice in an academic environment based on advice from industry practitioners. The 5D modelling was not carried out using the capabilities embedded in the proprietary BIM authoring tool used to create the 3D models, instead third party proprietary estimating software (5D) was used. The data in the base BIM model was converted into DWF or DWFx files and exported to 5D software. The 5D software was used to derive the quantity data required for cost modelling, then to connect the quantity data to costing data using relational databases that form part of the 5D package.

The cost modelling practices undertaken in these experiments mimicked the breakdown of the design process into the following phases:

1. Early stage estimating using techniques such as a rate per m^2 of gross floor area (GFA).
2. Elemental cost estimating during the design process, based on a cost per unit of element (or sub-element) such as m^2 of internal walls measured in accordance with rules of measurement such as the New Zealand Institute of Quantity Surveyors' (NZIQS) Elemental Analysis of Cost of Building Works (1992) or the RICS new rules of measurement Order of Cost Estimating and Elemental Cost Planning (2009)
3. Estimating based on measurements derived from a construction ready model in accordance with a standard method of measurement such as NZS4204 (1995) or the UK SMM7.

They concluded that:

> Automation of elemental and sub-elemental estimating within a BIM environment is already substantially possible as there is a close alignment between BIM objects and sub- elements. To achieve automation of pricing by reference to a standard rate library it is necessary to develop a coding system and use it consistently. It is believed that this is possible within the current context of development of BIM (p31).

However they found greater difficulty with preparing quantities derived from a construction ready model in accordance with a standard method of measurement such as NZS4204 (1995) or the UK SMM7 due to the composite nature of objects within the model. The objects typically contain more than one trade, for instance an internal wall may include framing, dry lining, finishing and decorating trades.

3.5.2 Current Consultant Quantity Surveyor Practice

The information in this section is taken from interviews with three of the largest PQS firms in Auckland. They were selected on the advice of the QS Advisory group as described above as being consultants engaged on projects where at least some of the design consultants were using BIM authoring tools. Other firms were also suggested but they disqualified themselves in initial telephone approaches as not having worked on projects where they were aware of BIM authoring tools being used. The practices described below are therefore believed to represent leading edge practice in NZ as at early 2012.

3.5.2.1 Derivation of quantities

Two of the three firms did not extract quantities from 3D models, preferring to work in 2D format. They used estimating software tools to measure on screen from soft copies of 2D drawings. At times they also measured from hard copy. Neither of these firms had attempted to move to 3D format, those interviewed believed the firms' employees would be reluctant to retrain to use new software (younger employees being the exception to this).

The third firm had experience of extracting quantities from 3D models. Their experience was similar to that found by Boon, Prigg and Mohammad (2011) described above; extraction of quantities for preliminary and developed design phase estimating being relatively simple. The interviewee did however emphasise the importance of the QS being able to identify items that were not in the model at the time of quantity extraction.

When measuring for the purposes of preparing trade based schedules of quantities they also found greater difficulty. As described above where architects were using 3D models it was only to a level of detail equivalent to 1:100 drawings, the amount of information that could be extracted using the measurement software was therefore limited by the lack of detailed information in the model. Basic horizontal and vertical lengths and areas could be derived and taken into the scheduling software for descriptions to be added manually. This was seen as being of only marginal benefit over measuring from 2D softcopies of drawings although vertical dimensions were easier to obtain. Enumerated items such as doors and windows could be more easily derived automatically as they are separate objects within the model and typically had sufficient descriptive information for them to be scheduled with only minor editing. Some items such as timber framing in walls are not modelled and no benefit is gained over measuring from 2D drawings.

Where a well developed structural model was available considerable efficiency could be gained in the scheduling process. Concrete and reinforcing steel volumes could be easily derived but not formwork quantities as this is not modelled. In the case of precast concrete flooring planks it was found that more detailed schedules than had traditionally been provided could easily be derived from the models. These took the form of enumerated schedules listing each precast concrete plank by type length and location. Structural steel quantities could be derived in almost any desired form typically either by weight or by type of member and length. Scheduling by enumerating each steel part was also possible. The steel in fixing cleats etc could not be derived from the model as it was not detailed, it either had to be measured manually from 2D details or a weight allowance made. The interviewee reported an occasion where they had firstly derived the quantities for a complex roof truss using the measuring software and then manually checked the quantities. A small difference was found, the software showing some additional members that the experienced surveyor doing the manual measure could not find on the drawings, despite the drawings he was using being derived from the 3D model. Using the software these were traced down to a location that could be shown by rotating the 3D model but which was not visible on 2D drawings.

In the case of services the ease of scheduling was very dependant on the level of detail in the model. On one project the mechanical services engineer had developed a fully detailed model including embedding full specification details into the drop down boxes associated with each object. In this case scheduling was reported as being “amazingly easy”.

Whether quantities could be easily scheduled by location (e.g. separate quantities for each floor or zone) depended on how the 3D model had been constructed and the nature of location information desired. If vertical members such as columns and lift shafts had been drawn in the model as single objects running up the full height of the building the floor by floor quantities could obviously not be automatically derived. However if the desired location information was by blocks or horizontally divided zones these could be derived more easily.

3.5.2.2 The addition of costing data and the calculation of cost

Two of the firms used a third party estimating software package; the third used their own proprietary system. These estimating packages comprise a measurement “engine” and relational data bases within which quantities and costing rates are drawn together to produce an estimate. The difference between 3D and 2D versions of the package was only in the measuring engine the relational data bases are the same. These relational databases facilitate three ways of deriving the rate. Firstly by direct entry, secondly by building up the rate on a project specific basis in interconnected spreadsheets and thirdly by connecting to a central rate library.

When doing elemental estimating during the developed design phase none of the firms used the UK method of analysing the priced schedule of quantities of previous projects to determine element rates. Their practice is to build up rates for elements using approximate quantities and rates from schedules of quantities of similar projects. Because of this they do not maintain a centralised data base of element rates but do build up project based databases. An equivalent of the UK BCIS service does not exist in NZ.

The firms often price the schedule of quantities at the same time that contractors are preparing their bids. Typically they derive the prices used from a combination of reference to prices in SoQs on previous projects and by seeking advice on current prices from sub-contractors and suppliers. They do not maintain central libraries of unit prices for this purpose.

3.5.2.3 The derivation of costing data from libraries (or databases)

As described above it is not the current approach of these firms to maintain central rate libraries, neither does a national service equivalent to the UK BCIS exist. The ability to link with a central library had therefore not been tested by the interviewees. They did however all note that the absence of agreed coding or descriptions systems would be need to be overcome before this was possible.

Those interviewed were ambivalent as to the advantages of such libraries. The common opinion being that to automatically link project specific quantities to a central rate library was risky and that it was important to build up rates for each project during which professional judgment was exercised around costing variables such as project location and complexity as well as changing market conditions.

4. Development of a Coding System

The information in this section is derived from interviews with the facilitator of the Auckland Revit user group, the President of the Pacific Association of Quantity Surveyors and two members of the NZIQS SMM committee.

As noted above protocols for coding objects within BIM models have not yet been agreed in NZ. Some design firms have developed their own systems but in some cases regard this as their own intellectual property and do not wish to share it. Where systems are being developed they generally use a coding system based on the New Zealand Coordinated Building Information (CBI) classification and coding system established by ACBINZ (the Association of Coordinated Building Information in New Zealand). This is similar to the OmniClass system advocated by Bailey (2010) as described above. The use of this coding system is favoured in part as it is also used as the structure for “MasterSpec” a commercial specification system that is widely used by architectural firms.

The NZIQS have a sub-committee which is reviewing the NZ standard method of measurement (NZSMM). That group have concluded they should also adopt the CBI system. As the coding system adopted is similar to that used in the Singapore CEMS it is anticipated that the structure of the revised NZSMM will therefore also be similar. This alignment between the standards is likely to be further encouraged by global discussions currently underway between quantity surveyor groups including the RICS and the Pacific Association of Quantity Surveyors which it is understood is looking at developing an international SMM similar to the CEMS as a global standard.

It is likely therefore that at some stage in the future in NZ we will see some convergence in coding practice around the CBI standard. At that point we may also see the emergence of the use of formal rate libraries by QS firms but this currently looks to be some way off.

5. Conclusion

In New Zealand where BIM is being deployed on larger projects it is at level 1 or 2 as defined within the Bews and Richards (2008) model. At this level it possible for cost modelling to take place without PQS practices changing their existing procedures. Firms who do this do so by working from 2D drawings extracted from the 3D model and not the model itself. The primary difference between cost modelling in a BIM environment and quantity surveying practice in a non-BIM environment is in the ability to use software to extract quantities of objects with their appended properties direct from the BIM 3D model. Once the quantities are extracted they can be manipulated within relational data bases or spreadsheets in much the same manner as in a non-BIM environment. Within the BIM environment further potential exists to match object descriptions within the 3D model with libraries containing costing rates for the same objects thereby making the estimating process more efficient, however this process requires prior agreement of coding and description systems. Such agreement has not yet happened in NZ and appears to be only at the early stages of development internationally. This potential benefit could be gained using existing estimating software, the barrier is firstly with agreeing coding and description systems and secondly with NZ practices establishing formal rate libraries.

Within the NZ environment the ability to extract quantities directly from the BIM model exists but its use on large projects currently appears to be limited to one PQS firm. The extraction of quantities in this manner for estimating during the design phase does not appear to present significant problems and seems to be held back by a reluctance to adopt new practices. Extraction of quantities for incorporation into trade based schedules of quantities presents greater difficulties as the objects in the model do not always align with the trade based nature of the work to be done. However given that the firms interviewed already had the skills to measure from 2D soft copies of drawings the change to measuring from 3D models does not seem great and would provide some gains in efficiency.

Cost modelling in a BIM (5D) environment as currently practiced in NZ takes place outside of the core BIM model using 3rd party estimating software and not within the core BIM authoring software. This appears to be similar to international practice. The idea of costing data being embedded in the core BIM as part of the "data rich" environment that might be envisaged with level 3 BIM does not yet appear to be on the NZ industry's agenda.

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