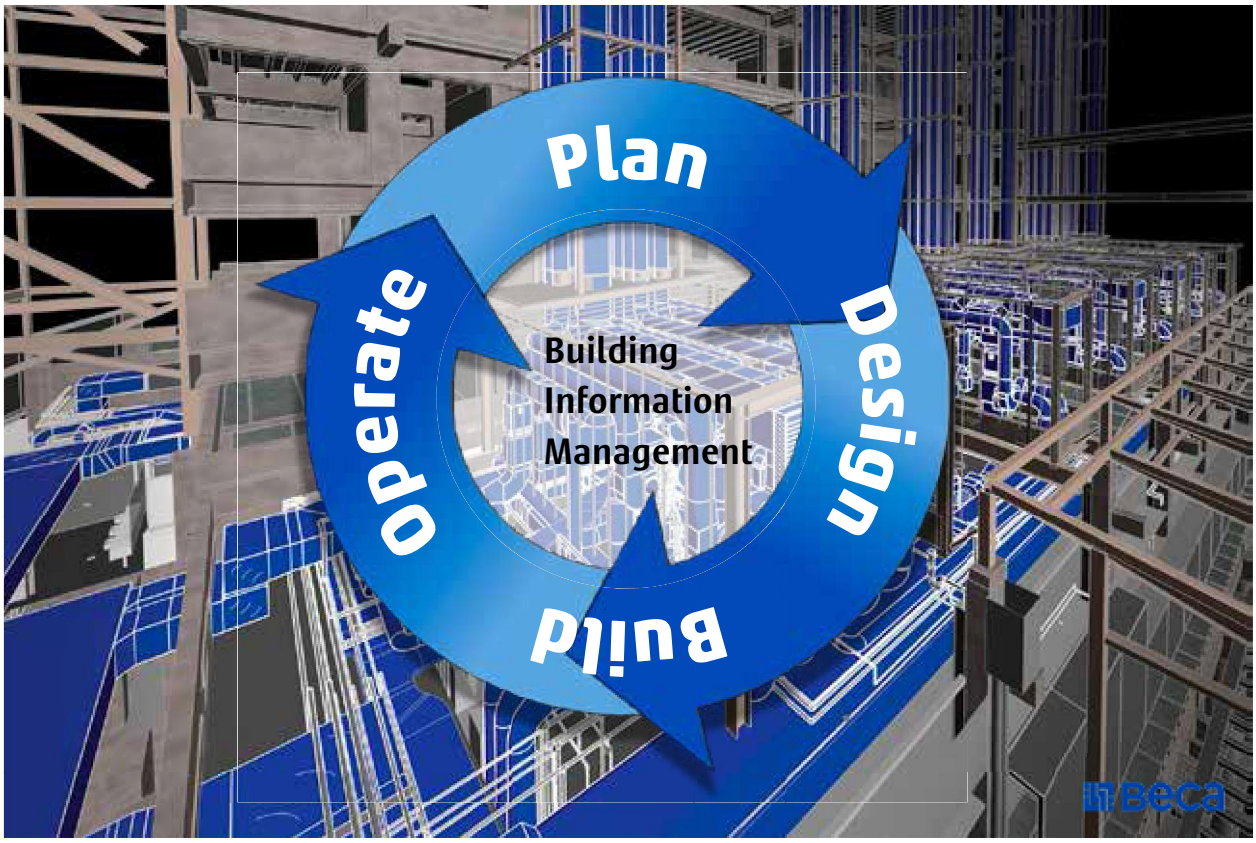

SURVEYING IN THE BIM CYCLE – REVISITED

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FOR MANY, BUILDING INFORMATION MANAGEMENT (BIM) IS A MYSTERY THAT IS YET TO BE SOLVED. FOR OTHERS, IT'S THE KEY THAT OPENS THE DOOR TO A NEW MARKET, NEW CLIENTS AND NEW OPPORTUNITIES.

The building and construction industry has been engaging with BIM at various levels for several years, and we have seen an increased use (and misuse) of the term occurring in everything from casual meetings through to legal construction contracts. BIM covers buildings, but also includes any built asset for which lifecycle management is required. This could be a plant room or a highway, a ship or a wastewater system.

This paper provides the basis for an understanding of BIM and explains where the opportunities lie for surveyors to get involved and realise the benefits that BIM offers for our profession. It draws on the material presented at the 2014 NZIS conference and the experience we have gained in the last 12 months from our engagement as surveyors with clients who are adopting BIM processes.

What does BIM mean to your client?

Clients increasingly claim an understanding of BIM, but in conversation it quickly becomes apparent that BIM is a term that means different things to different people. A surveyor needs to understand the different interpretations of BIM in order to engage with a client and provide useful advice and direction.

There are many well-known definitions of BIM, one of the simplest and most effective being "the structured sharing of digital information (data) within the built environment", but if your client has a different definition, then be prepared to understand it.

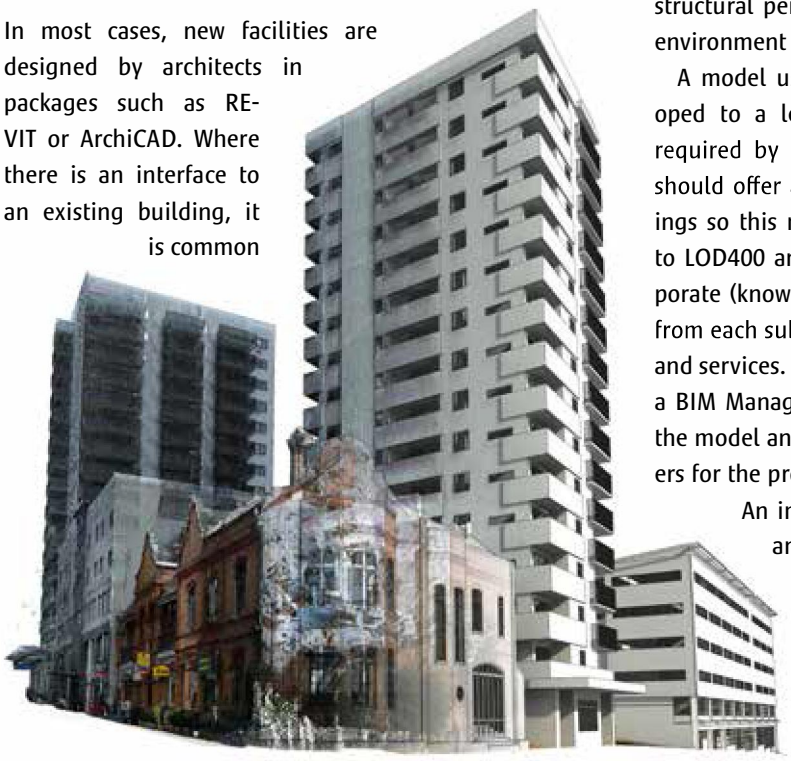
A 3D Survey

In many cases, a client wanting "data for a BIM" or "data for REVIT" is simply asking for a 3D survey of the facility,

presented as a 3D DWG. This is well within the capabilities of any surveyor and may be achieved through conventional survey techniques. The questions we need to ask are those we would ask for any survey project to ensure we capture the level of detail required by the client.

A 3D model

In most cases, new facilities are designed by architects in packages such as REVIT or ArchiCAD. Where there is an interface to an existing building, it is common for the existing building to be 'modelled' and the new building designed around it. A survey-accurate model of the existing building is required, especially in the case of complex facades or critical tie-in details, and this is an opportunity for a surveyor to get involved. Traditionally delivered as 2d CAD elevations, we now see laser scanners often used to capture the data, providing a highly visual, complete, 3-dimensional dataset that can be used as the basis of multiple deliverables. More specialised skills are required to develop the model, for which a surveyor may have in-house expertise or outsource to a specialist modelling house. Regardless of who develops the model, quality verification of the spatial information should still sit firmly with the surveyor.



3D Model from point cloud

A tool to optimise design and construction

New structures are commonly designed in 3D, allowing an architect or engineer to walk through the design, proof the concept with the client, make changes to the digital design and identify clashes between services and structures. Changes made early in the design process cost less than changes made late.

This model may be an architect's concept, or it may be a more detailed "design intent" model used as part of the tender documents. This is represented by the Level of Development (LOD) of the model. Design intent may commonly be LOD 200, moving to "developed design" at LOD300. At this level, fundamental clashes are resolved and further detailed structural and services design can commence. 3D models also allow the designer to analyse structural performance and make changes in the digital environment that will optimise the building.

A model used for construction layout must be developed to a level that includes the layout information required by the surveyor. For the greatest efficiency it should offer a replacement for traditional 2D DXF drawings so this means that the model has to be developed to LOD400 and be "for construction". LOD400 will incorporate (known as federating) the detailed shop drawings from each sub-trade, with sufficient detail to set out walls and services. At this level it is common to be working with a BIM Manager who will coordinate the development of the model and manage input from the various stakeholders for the project.

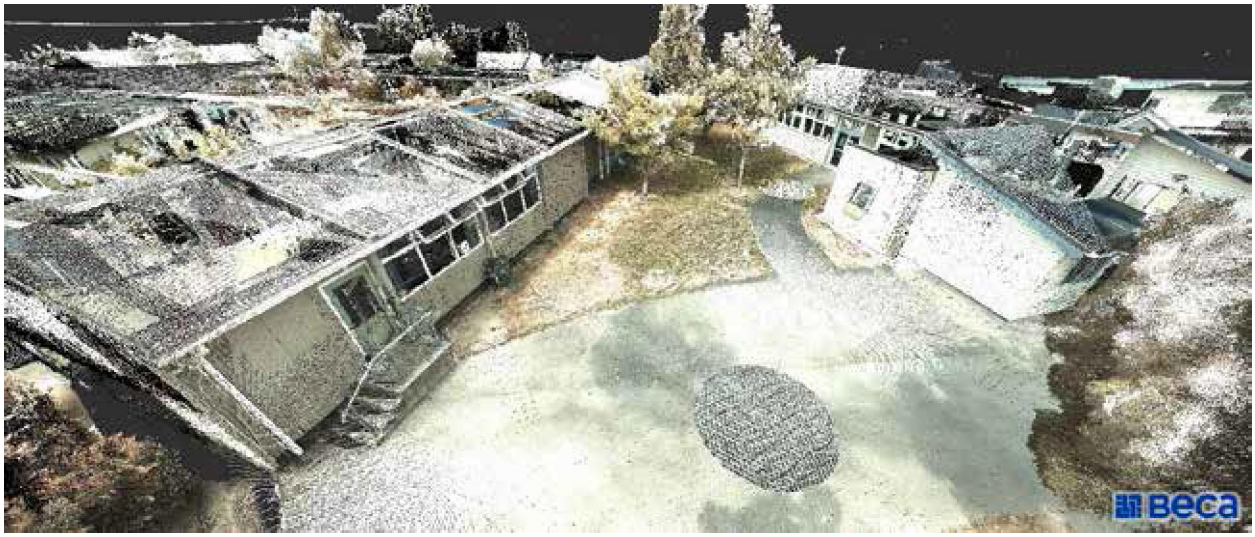
An important part of the construction process is an as-built survey. Where a project demands layout from the model, the model can be considered to be an as-built of the facility. However in many cases, an independent as-built is required and laser scanning has developed into a tool that is readily applicable to this task. The technique can be used for analysis of verification of construction against design as well as being a record of precisely what has been constructed.

A tool for Operations & Maintenance

A survey-accurate as-built of the completed facility is typically a requirement of the handover. In the current post-earthquake climate, an as-built point cloud captured through laser scanning offers a potentially much more valuable asset as an indisputable record of the condition of the facility (in terms of line and level) to support future earthquake claims.

3D models that include metadata (attribute data for each element of the model) allow the designer to analyse the running costs of the facility and make changes to plant and processes in the digital environment that will optimise the running of the building.

Apart from optimising the design and running costs, large facilities with critical or complex infrastructure are always looking at ways to streamline their operations and minimise downtime for the facility. Over the life of the building, this is where the greatest costs lie, so consequently the greatest opportunity for savings. A model developed to include non-geometric information includes



3D positional information and also extensive attribute data about the services in the building. A pump represented in the model, for example, can be interrogated for make, model, service history and technical specifications. A maintenance crew can go directly to the location of a failed component with the correct replacement parts and remove only the ceiling tiles required to access what they need, saving time and minimising disruption.

A model that has been developed for construction layout (i.e. is spatially accurate) and has the attribute data for relevant plant and machinery, is a tool that provides for significant efficiencies in the operation and maintenance of the building. Such a tool must be maintained in order to maintain relevancy, presenting another opportunity for a surveyor to capture spatial changes to the facility.

Construction layout and scanner

Where does surveying plug in to the BIM cycle?

The BIM cycle represents the lifecycle of assets in our built environment. Where an asset has a physical size and shape and requires design, construction, maintenance or renovation, there is a natural opportunity for a surveyor to get involved.

Surveyors offer a unique capability to capture the reliable spatial data that underpins the BIM cycle. We understand the hardware and software technology that is required to capture the data and can verify the accuracy of the underlying data and the resulting model.

In its most simple form, wherever data is required as an input to a BIM model, or where we need to translate data from the model to the real world for construction, the surveyor has unique applicable skills.

It is essential that we embrace the need to work solely with 3D data in order to get involved with BIM. Often, we capture or design in 3D only to represent it in 2D to our client. The leap from 2D to 3D is entirely within our expertise as surveyors and is increasingly expected from our clients, who are dealing daily with freely available 3D data from many different (often unverified) sources.

Our opportunity is to deliver in 3D with all the confidence and quality control that comes with engaging a survey professional.

3D data capture for BIM opens an opportunity to add value for our client by capturing data that is far richer, more visual and more versatile than conventional data. Increasingly, we use laser scanners to capture data for jobs

that appear conventional. The cost is similar to conventional methods and the results offer benefits including reduced risk of weather delays, reduced disruption for the client, more visual deliverables, and the ability to "virtually" revisit the site and extract different deliverables. In many cases, laser scanning is the only way to capture a complex or difficult site and provide the client with the data they need in an efficient manner.

The opportunities for equipment and software vendors to sell into this market have not been overlooked and we see surveying equipment increasingly sold into construction companies and left in the hands of a site foreman. Data workflows have been well designed to be simple and intuitive, but as we all know, the risks involved in construction layout can be considerable. Owning some flash kit and an enthusiastic operator is no substitute for a surveyor's qualified and practised approach to quality control.

What has happened in the past 12 months?

BIM remains "the structured sharing of digital information (data) within the built environment". One of the biggest changes has occurred for the clients, who demonstrate an increasingly sophisticated understanding of BIM, displayed through more mature project briefs and a more realistic upfront expectation of costs and value.

Beca's surveyors are proud to be engaged on a large number of projects around the country including those for which BIM adoption is at the advanced end of the scale. 12 months ago, we anticipated using 3D BIM model data for layout, and thanks to a great deal of commitment by our client and their BIM managers, the model is now at the stage where some of the 3D design data can be used directly for setout. These projects demonstrate tangible evidence of the benefits of BIM and provide leadership for the industry.

We see the ownership of survey technology by commercial construction companies increasing as the technology becomes easier to use. In some cases, the company employs a surveyor and in other cases, they rely on existing technical and site staff to operate the equipment. At one of our sites, we provide guidance to our client in the use of their own equipment for "bulk" repetitive layout, while we focus on quality control, structural layout, gridlines and levels.

Our clients and our client's clients are more aware of BIM and the benefits it can bring to a project. In some cases, the 3D model is employed purely for its benefit to the contractor in terms of enhanced coordination and reduced risk to the project timeline. In other cases, the building owner sees value from overseas examples of reduced operation and maintenance costs.

The New Zealand BIM handbook has been out for a year and will see a new revision in early 2016 in response to industry feedback and the New Zealand Construction Industry Council guidelines are being re-drafted to accommodate BIM.

The need for collaboration has never been greater and a new specialisation, BIM Manager, is gaining currency. The value of dedicated resources for coordination of the model is now well recognised. Project Managers are becoming more adept at working with model data to complete clash detection and project sequencing as tools from suppliers become more powerful and easier to use.

Through the education offered through the NZIS and others, we observe a growing understanding of BIM and the role of the surveyor in the BIM cycle and we are fortunate to be at the forefront of this technology as the wave reaches our shores.

FURTHER READING:
MBIE website including links to the NZ BIM handbook and other BIM resources: http://www.building.govt.nz/bim-in-nz

3D Point cloud for as-built