Chapter 1: Introduction

What is Building Information Modelling (BIM)?

There is still no common definition for BIM. People are talking about 3D BIM, 4D BIM, 5D BIM, 6D BIM, 7D BIM, etc. For this paper, BIM is defined as the process of generating and managing the data of a building throughout its life cycle. It is important to remember that BIM is not just about technological change but also changing the process itself.

The adoption of BIM has been increasing in the Architectural, Engineering and Construction industry recently, which has accelerated the industry's transformation into a more 'digital project lifecycle environment'. The main reason for this is because of the perceived benefits of BIM over the traditional computer aided design (CAD) system. The adoption of BIM is also driven by the recent policies and strategies made by certain governments, for example the UK, Malaysia and Singapore Government.

BIM adoption in construction projects will have a great impact on all of the professions that are involved. Each profession will experience both opportunities and threats from the increased use of BIM in construction projects. This uncertainty of how BIM can affect professions is the reason why Quantity Surveying organizations and institutions are worried. They don't know what their future is. Will BIM be able to do quantity surveyors' job with the click of a button (measurements)? Do we still need quantity surveyors in the future?

The preparation of bills of quantities (BQ) still represents a significant proportion of work and associated fees for some QS firms. Many QS are worried that the adoption of BIM could threaten the client's requirement for QS services. The measurement and pricing of construction works are considered to be important services that quantity surveyor provides. It is argued that since BIM has the potential to calculate these costs in an automated way, the need for quantity surveyors on construction project is reduced, as other professions (such as architects, engineers and contractors) could calculate the cost of the building themselves with the "click of a button" by using the currently available BIM software.

The major question is "Will BIM threaten the viability of the QS profession?"

Chapter 2: Building Information Modelling

2.1 Introduction

BIM is a 3D modelling technique that was developed from the traditional CAD system. It is an information-based software that can generate models to simulate the planning, design, construction and operation of a building. There are many definitions of a building. However, they all seem to agree that BIM is a digital representation of a building.

The RICS (2012) describes BIM as a new technology and a new way of working. This means that it requires more than a simple installation of new software; it also requires a change from the traditional work processes in order for all project team members to share and effectively work on a common information pool.

2.2 Benefits

There are many benefits of BIM, which includes:

- Collaborative approach
- Faster decision making process
- More accurate estimations
- Better representation and visualization of architect's design
- Reduce the number of reworks
- Facilities management

The idea of collaboration is not new, but the adoption of BIM makes it easier since the project team members share a single building model or several coordinated models. This means that all the stakeholders in the construction project share the same design, cost and scheduling information at the same time, which will be updated regularly. By sharing the information through BIM, the project team members can communicate their ideas and actions more effectively.

The decision making process can also be improved using BIM. The ability to keep the date and information of the project up to date and easily accessible enables the project team members to have a better understanding and vision of the project, which means that they will be able to make decisions faster and more effectively. Multiple 'what if' scenarios can also be generated to allow a more creative design and efficient decision making process.

The inability of clients to read drawings affects their ability to specify the brief effectively (Barrett and Stanley, 1999). There is a considerable gap in the designer and client communication process, meaning that the designer often fail to communicate their ideas to the client completely, which usually results in client dissatisfaction. Since BIM can generate 3D models of a building, it allows a better representation and visualization of the architectural design. The effective use of BIM allows the project team members to establish what the client requires and need from the project with more accuracy. BIM technology allows Clients to 'virtually' walk around their building to confirm that the project design requirements are met.
The use of BIM will result in construction documents with reduced errors and omissions, as potential problems are identified in the early stages of the project. As a result, there will be fewer issues in the plans and therefore reduce the amount of reworks required on site. Conflicts on site are considered to be costly and will affect both the cost budget and time schedule. Clarity is another benefit of BIM during the construction stage, which is especially useful for complex projects. BIM can be used to prepare and simulate the construction sequence and identify any mistakes before it occurs on site.

Once the project is completed, the information about the installed materials and maintenance requirements for the systems in the building can be linked to the BIM model. This can be used for facilities management allowing the owner and owner's maintenance team to have a better understanding of the building's operations. Lice cycle costing can also be obtained through BIM's ability to control information.

2.3 Challenges

The major challenges for the adoption of BIM can be summarized into:

a. Lack of standardization
b. Legal and contractual issues
c. The industry's resistance to change
d. Interoperability and compatibility issues
e. High initial cost of entry and implementation
f. Lack of sufficient information and knowledge on BIM
g. Conflict of interest between construction professionals

The implementation of BIM requires a significant change in the way business works at almost every level within the building process. There is also a great need for standards to define what BIM is and provide an implementation strategy to ensure that they are correctly and consistently performed.

As mentioned earlier, BIM is a process that promotes collaborative relationship between the project team members. This means that they have to work together effectively to prevent any wasted investments. Every team member should ensure that only useful information is integrated into the building mode, as irrelevant data/information may not give the results that are required. Rubbish in, rubbish out.

Interoperability between software applications is another major challenge. Not all engineers, architects and consultants use the same software. Individuals and firms are used to their own preferred system, software application and processes. Therefore, interoperability is particularly important in the construction process due to the large number of data exchanges and updating that takes place.

Dealing with the costs associated with training, and software and hardware upgrades are considered to be great barriers to the adoption of BIM, especially for smaller firms, Most firms are not willing to make an investment unless they perceive the long-term benefits to their own organization and/or if the client is willing to subsidize these costs.

BIM means different things to different project team members. Due to the large number of firms and individuals involved in a construction project, BIM will cause the issue of responsibility and ownership of the building model, and intellectual property rights. This often forces the project team members to rely on traditional contracts and drawings. The legal and contractual issue needs to be resolved first. There is a lack of clear understanding about the roles and responsibilities in the BIM process.

Chapter 3: The Current BIM Practice

BIM Applications

The current BIM practices are 3D, 4D, 5D and even 6D BIM. 3D BIM are being used for clash detection which is to find out any discrepancies between architectural, structural and M&E drawings. Furthermore, 3D BIM gives the Client and the design team an earlier look up on the building that will be built at the end of construction. So that they are able to make more decision at the pre-tender stage to avoid the variation works during construction.

4D BIM is the use of BIM for construction phased schedule. The schedule can be prepared by using software that to extract the quantity from BIM and apply the production rate and input of location information.

5D BIM is the use of BIM for cost plan preparation and estimates. The cost plan can be prepared based on quantities extract from BIM and applied with the unit rate and mark up.

6D BIM is the input of documentation and specification into the designed BIM. So that the 6D BIM can be used for design analysis on energy, solar, wind, CFDs, etc. 6D BIM can even be used for facility management.

5D BIM– Quantity take off

There are a lot of software being used for 5D BIM in the market. For example:
- Glodon
- Vico
- Buildsoft
- Autodesk Revit
- Cost X

Cost X is one of the BIM software being commonly used in Malaysia, Hong Kong, Australia, and Brunei. Cost X have its' own build-in work sheet that links all the quantity between the drawings and the cost plan.

5D BIM– Take off labelling

Labelling of the measurement is one of the important criteria to used 5D BIM in more efficient way. First of all, while the primary quantities being measured from BIM (e.g length of beam, length of walls, and height of column), those quantities should be labelled in a correct way before being extracted to the work sheet. Then, after all the measured quantities being extracted to the work sheet, the measurement table can be prepared based on the information on each label.

Wall measurement, QS Tag: Lvl1-IW-C30-150 = 7m

Location	Element	Type	Thickness	Primary Qty	Input height	Secondary Qty (BQ)
Level 1	Internal Wall	Con. Grade 30	150mm thick	7m	3m	21m2

Columns measurement, QS Tag: Grd~1st-C30-300x300 = 3m

Location	Element	Type	Primary Qty (Height)	Length	Width	Secondary Qty (BQ)
Ground to 1st	Column	Con. Grade 30	3m	0.3m	0.3m	0.27m3

Beams (concrete) measurement, Qs Tag: Lvl2-UP-C30-150X500-150 = 10m

Location	Element	Type	Slab thickness	Primary Qty	Input width x (depth-slab)	Secondary Qty (BQ)
Level 2	Upper floor beam	Con. Grade 30	150mm thick	10m	0.15 x (0.5 – 0.15)	0.525m3

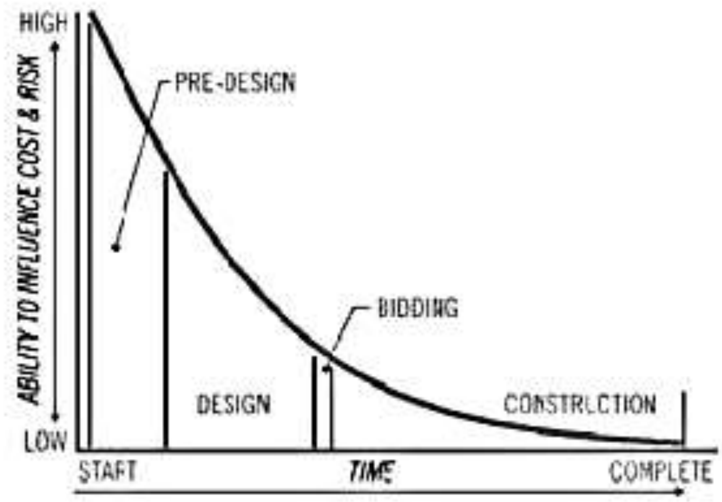
Beams (formwork) measurement

Location	Element	Type	Slab thickness	Primary Qty	Girth = Width + (Height-slab)x2	Secondary Qty (BQ)
Level 2	Upper floor beam	Con. Grade 30	150mm thick	10m	0.15 + (0.5 – 0.15)x2	8.5m2

5D BIM– Cost certainty

A cost plan prepared by using BIM gives the cost certainty to the estimator. The quantities measured from the BIM are those actual dimension of the building which going to be built on site. Furthermore, from time to time, any updates on the design can be easily captured with using BIM software to compare the latest model to previous mode.

Furthermore, 5D BIM also lower the risk of redesign during construction. This is because any discrepancies or design issues are being captured during the design stage, where Client and design team already have a better design visualisation before tender and construction.



Golden rules of 5D BIM

5D BIM provide a better value for quantity surveyors on preparing cost plan and estimates, providing that it was being used in a proper way. The followings are the rules of using 5D BIM:

i. Accurate geometry
ii. Model the way it's built
iii. Define rooms and departments correctly
iv. Give the 5D QS an early look at your model
v. Correct model base point
vi. Define objects with correct level / storey
vii. Use proper object tool (i.e. column tool)
viii. Checking for objects within objects
ix. Consistent naming conventions – resist editing
x. Include a classification code

Chapter 4: Quantity Surveying and BIM

Quantity surveyors are mainly involved with the measurement of works, the tendering process and cost control. There are many potential uses of BIM, including automated quantity takeoff and BQ preparation, which will have a great impact to the QS profession. This has raised concern about the viability of quantity surveyors in construction projects and whether or not they are still required.

The impact of BIM to the QS profession will be related to the profession's working proves, and it will bring more benefits rather than disadvantages. The common argument is that other profession will be able to undertake quantity surveyor's job as BIM could potentially produce BQ with the 'click of a button'. However, this is an invalid argument as BIM software does not generate cost estimates automatically, it merely assist the cost estimating process. Cost estimating with BIM still requires basic measuring skills.

Architects might also not want to take the responsibility of costing the project, as their scope of work does not normally extend to quantity takeoff or cost information. The architects also wouldn't want to be liable if the building cost was inaccurate. Therefore, it would be more preferable to leave the responsibility of costing with the quantity surveyors.

The work of quantity surveyor requires an accurate interpretation of designs and numerical representations of drawings. The process typically starts with the quantity surveyor doing manual takeoff from the architect's paper drawing or importing their CAD drawings into a cost estimating software, which is prone to human error. BIM requires high quality, reliable and integrated information about the project. By using a building information model instead of drawings, quantity takeoff and measurements can be produced directly from the model. This means that errors that would normally be made during the cost estimating process can be reduced.

The BIM software also allows quantity surveyors to extract useful data for quantity takeoff at any stage of the project. When manual quantity takeoff is no longer required, the generation of schedules and cost estimates can be produced more quickly, and the potential for human error is reduced.

Quantity Surveyors can bring so much more expertise and experience to the project rather than simply counting or quantifying. The use of BIM means that the tedious task of quantifying can be automated, which provides quantity surveyors with extra time that can be used to focus on other tasks that can provide higher value for the project. This includes identifying construction assemblies, risk management, life cycle costing, price generation and others.

However, there are several factors that limit Quantity Surveyors to fully utilize the potential of BIM. This can be summarized into:

- Lack of interoperability
- Lack of training/education
- Lack of standards
- Liability issues

Like many other professional disciplines, the role of quantity surveyors will continue to evolve in order to meet the need of the ever-changing environment. It is nearly impossible to predict with 100% accuracy how the role of any profession will change. However, a key feature for the future is the need to continuously add value and enhance the professional service. This is especially true, as clients are demanding more for less.

The skills of a quantity surveyor that were important 5 decades ago still remains important today but their relative importance has declined and replaced by new skills. The relative importance of these new skills will also be changed as the industry continues to evolve and change. However, no matter what the future holds, it is important for the profession to understand their core competencies for them to develop further in the future.

ICT is one of the areas that will have a significant impact on how quantity surveyors carry out their work in the future. BIM has the potential to enable the profession to perform tasks such as material take off and preparation of BQ with more accuracy and less time. In the past, they would have to manually extract information from the CAD or paper drawings and put them in the estimating software and then prepare the cost documents. With BIM, costs and prices can be fully integrated into the model itself, which allows quantity surveyors to extract prices and create cost documents directly from the model.

The QS profession's future would depend more on how much of the changes they can influence rather how much they can resist them. If the profession refuses to change, they will become outdated and eventually become unemployed. It is not a question of what the future holds for quantity surveyors, but rather a question of how much they can control the future to their advantage. It is not "Why use BIM" anymore; it is "How to use BIM".