

**HOW A QUANTITY SURVEYOR IN SOUTH AFRICA CAN USE BUILDING
INFORMATION MODELING (BIM) TO STAY RELEVANT IN THE CONSTRUCTION
INDUSTRY**

By

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November 2012

Declaration by students

I, the undersigned, hereby confirm that the attached treatise is my own work and that any sources are adequately acknowledged in text and in the bibliography.

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Abstract:

Title of treatise : How a Quantity Surveyor in South – Africa can use Building Information Modeling (BIM) to stay relevant in the construction industry

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Building Information Modeling is a term representing a new process or approach that is being widely implemented in the architecture, engineering and construction industry. If one works in this industry and has not yet heard the term, it is reasonable to expect it will not be the case much longer. The adoption of this approach to designing and managing projects is catching on at a phenomenal pace in the US and in Europe and it will not be long before it takes over the South African building industry. The firms that have been early adopters of BIM are realizing its benefits and enjoying a competitive advantage as they work to secure and perform new projects in a much more efficient manner, from the conceptual design stage through project completion, and the operation and maintenance of the building. BIM continues to overcome the initial hesitancy among architects, designers, engineers, contractors and owners, by proving it to be a powerful data management system and time saver. BIM is in its early stages of development and the tools that support BIM are being improved each year. The building industry will continue to reap the rewards as the tools and processes of BIM are fine-tuned.

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CHAPTER 1

1. Research Proposal

1.1. Introduction

The three words: 'Building Information Modeling' (BIM) brings fear to a lot of Quantity Surveyors around the world. Being a Candidate Quantity Surveyor myself, one of the very first things Quantity Surveyors hear about Building Information Modeling is about its potential to facilitate multiple functions i.e. preparing bills of quantities automatically from BIM data. Preparing bills of quantities is only one of many duties of a Quantity Surveyor, but it is seen as the most important and time consuming function. It also forms the biggest source of income for quantity surveying companies. Hearing that there may be a major disincentive to innovation as it straddles professional boundaries which currently exist is not something that a Quantity Surveyor wants to hear.

To better understand the significant changes that BIM introduces, this paper includes a description of current paper-based design and construction methods and the predominant business models now in use by the construction industry. It then describes various problems associated with these practices, outlines what BIM is, and explains how it differs from 2D and 3D computer-aided design (CAD). A brief description of the kinds of problems that BIM can solve and the new business models that it enables is given.

The research include a presentation of the most significant problems that may arise when using the technology, which is now only in its early phase of development and use. The unanswered questions of this paper are: what opportunities and challenges does BIM present to the quantity surveying profession and should Quantity Surveyors embrace or compete with Building Information Modeling? Quantity Surveyors want to know what they should do to stay relevant in the building industry and not be replaced by BIM and finally the Quantity Surveyors want to know if they have a future in the building industry or is quantity surveying a dying profession?

1.2. Main statement:

How can a Quantity Surveyor in South Africa use Building Information Modeling (BIM) to stay relevant in the construction industry?

Quantity surveying as a profession has been around since the 1820's. Since the beginning the roles and duties of a Quantity Surveyor have changed a lot. There have been many challenges that the profession had to face and overcome in the past. The latest challenge that the profession of quantity surveying are facing is an acronym consisting of three letters: BIM. Building Information Modeling is most likely the biggest challenge that Quantity Surveyors had to face since the beginning of the profession. If BIM threatens to replace the Quantity Surveyor, how should Quantity Surveyors in South Africa handle the embrace of BIM? Do you fight or join?

1.3. Sub-problems and Hypothesis

1.3.1 How do BIM influence the building industry in South Africa?

Hypothesis

BIM is relatively new and still unknown to greater part of South Africa, especially to the medium to small quantity surveying companies. It has been used for years in countries like USA, UK and Canada and will be compulsory for all government projects in the United Kingdom within five years. It is likely that BIM will have the same influence on the construction industry in South Africa as it has had in the other countries. The end of BIM is less waste and a better product. The actual profit of BIM is that once the building is completed, the management of the building can adopt the model and exercise better management throughout its life exercise.

1.3.2. Can the functions of a Quantity Surveyor be replaced by BIM?

Hypothesis

The main function of a Quantity Surveyor that is likely to be replaced by BIM is the preparation of bills of quantities through BIM's potential to facilitate multiple functions from BIM data. This can be catastrophic for smaller quantity surveying companies which main source of income is the preparation of bills of quantities. Services that a Quantity Surveyor offer that is not likely to be replaced by BIM include: preparation of preliminary estimates, feasibility studies, and evaluations for financial advice for the client. A computer does not have a brain like humans have and therefor will never be able to replace Quantity Surveyors as a whole. Therefore it can be expected that some, but definitely not all of the current functions of a Quantity Surveyor will be replaced by BIM.

1.3.3. What changes will BIM bring to the Quantity Surveyor and project manager profession?

Hypothesis

It is expected that a lot of work is required initially to develop the skills and processes needed to integrate BIM and Quantity Surveyor processes, but the results will justify the investment.

Once the skills and processes are in place, both Quantity Surveyors and Project Managers will save a lot of time and the extra time will enable them to perform their duties more accurate and thoroughly.

1.3.4. How can a Quantity Surveyor stay relevant in the changing industry?

Hypothesis

The role of the Quantity Surveyor has always been to be the financial advisor of the client. Seeing that the Quantity Surveyor will have more time on his hand he will be able to focus on ways to save the client money, time and effort.

Quantity Surveyors may be in a good position to assist the parties and professionals in this manner, because of their knowledge and skills in relation to determining costs, tariffs, rates, prices, certification, contract terms and contract related communication.

1.4. Assumptions

Quantity Surveyors around the world play an important part in the construction industry. Without the Quantity Surveyor the construction industry will not be able to operate as efficient as it does at the moment and a lot of time and money will be wasted through inefficient management. The Quantity Surveyor acts as the financial advisor to the client.

1.5. Definition of terms and Abbreviations

AI	-	Artificial Intelligence
AIQS	-	Australian Institute of Quantity Surveying
ASAQS	-	The Association of South African Quantity Surveyors
BIM	-	Building Information Modeling
BOQ	-	Bill of Quantities
CAD	-	Computer-Aided Design
CBR	-	Case-Based Reasoning
IFC	-	Industry Foundation Class
PA	-	Principal Agent
PM	-	Construction Project Manager

QS	-	Quantity Surveyor
RICS	-	Royal Institution of Chartered Surveyor
ROI	-	Return on Investment
SMM	-	Standard Methods of Measurement
VE	-	Value Engineering
VFM	-	Value for Money
2D	-	Two-dimensional
3D	-	Three-dimensional

1.6. Limitations

This paper will mainly focus on how Building Information Modeling influences the role of the Quantity Surveyor in South Africa. How BIM influenced the United States of America, United Kingdom, Canada and Mozambique will only be touched on. The rest of the world and therefore the rest of Africa will not be investigated. The paper further will only focus on the influence of Building Information Modeling on the construction industry and it will not look at the influence that CAD or any other system will or have had in the past. Time will also be a limitation as research will only be done for the next six months. Thus it will not be possible to see a pattern form in the South African building industry.

1.7. Importance of study

It present BIM brings uncertainty to most Quantity Surveyors in South Africa. This study will provide Quantity Surveyors with more knowledge about BIM, how it works and exactly what it is capable of doing. This study will provide Quantity Surveyors with enough knowledge to know how BIM will influence their future and what they as Quantity Surveyors need to know and do in order to stay relevant in an ever changing built environment. Knowledge will enable them to plan in joining type of functions or collaborating with other built

environment professionals. If it is not a threat, the conversion can be undergone more fluent.

1.8. Research methodology

The data collection on BIM is to be achieved through studying studies done on BIM.

There is a book on the market that will form the base of the research.

The Director of Virtual Construction of Emcor Construction Services in the United Kingdom has been contacted via email. He answered every email and is very keen to helping where he can. Consequently, his knowledge and experience BIM will be used.

As BIM is becoming a more and more popular tool in the South African market, studies are freely available and will be obtained through the universities internet portal and through web sites dedicated to BIM. Journals regarding BIM are available on the World Wide Web. These journals will form a big part of the research.

CHAPTER 2

Building Information Modeling and Quantity Surveying Practice

The construction industry is widely acknowledged as unique and conservative. Building Information Modeling (BIM) systems have the potential to revolutionize current practices and to automate the measurement of quantities from construction drawings. However, there are fears that such developments could threaten the viability of the quantity surveying profession. This study explores the relationship between BIM systems and the roles of Quantity Surveyors in the construction industry. It is argued that BIM challenges traditional roles of Quantity Surveyors and their relevance to the construction industry. We recommend the development of revised curricula for Quantity Surveyors and further research into standard systems of measurement (Olatunji, Sher and Gu, 2010).

2.1. Introduction

The construction industry has considerable potential to drive economies. There is robust evidence to show that an innovative and efficient construction industry contributes to a stable global economy. However, the construction industry is notoriously conservative and slow to adapt to change as illustrated by the following examples:

- The construction industry has made several attempts to eliminate wastage, cost overruns, mismanagement, and disputes. These failures have undermined public enthusiasm and support for the industry.
- The industry has remained one of the slowest adopters of innovative technologies despite strong evidence of the correlation between investment in Information Technology (IT) and improved performance.
- The industry is, by and large, ineffective in fostering harmonious work environments. One of the single largest determinants of project failure may be that construction professionals expose themselves to conflicts of interest. For example, a professional discipline may decide to protect their own professional interest rather than accept a duty of care to protect the industry. Interestingly, such failures have increased the

erosion of discipline boundaries, largely as a result of an increasing demand for multi-skilled professionals (Olatunji, Sher and Gu, 2010).

New technologies have the potential to provide competitive advantages by increasing opportunities and lowering costs. Evolutionary developments in the construction industry can be viewed as a function of Technology, Process and People. Technology refers to improved soft and hard methodologies. The construction process involves operational flows through which construction development processes permeate (including project planning, design, construction, maintenance, management and disposal). Critical to these development processes are human resources that formulate, maintain, manage and implement the development processes. Figure 1 illustrates the anatomy of construction.

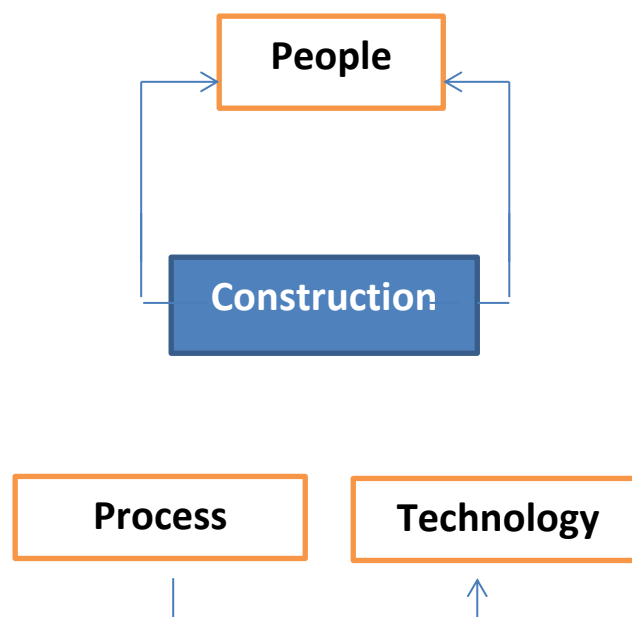


Figure 1. The anatomy of the construction development process

It has had a significant impact on the construction industry. It has initiated improvements in design and project monitoring and has lowered costs, and improved accuracy, speed and safety. Arguably IT provides the catalyst necessary to address some of the challenges of uncertainty, mismanagement and disputes. Interestingly, there is empirical evidence which shows that IT applications for construction professional service delivery are continually being encouraged by the public through their high expectations for professionalism and improved ethical behaviour. Quantity surveying is an important discipline within the

construction industry. A service underpinning quantity surveying practice is the measurement buildings and preparation of bills of quantities. The Australian Institute of Quantity Surveying (AIQS) identifies measurement or quantification as a basic ability required of a Quantity Surveyor. This service remains an expectation of the quantity surveying profession regardless of the technologies and approaches used to achieve it. Measurement relies on coordinate data which are usually provided in the form of construction drawings. Advances in drawing technology have the potential to impact on the ways in which bills of quantities are prepared. Since the advent of computer aided drawings (CAD), researchers and practitioners have been working to exploit CAD data to generate bills of quantities. Whilst this Holy Grail has been realised in research environments (for example, Cooperative Research Centre for Construction Innovation projects 2002-056- C and 2005-008-C), commercial opportunities and challenges are still to be addressed. From a layman's perspective, Building Information Modeling (BIM) may be considered as the current state of art in CAD developments. It is currently being implemented by a significant number of architectural and engineering practices, and has the potential to revolutionise the quantity surveying profession.

An effective definition of BIM is provided by Schwegler (2001) as the process of creating an information database for a project in which lifecycle information is expressed in an interoperable manner to create, engineer, estimate, illustrate and construct a construction project. BIM opens opportunities for multiple disciplines to share and exchange data. Gao and Fischer report extensively on the dramatic growth in relevance, use, value and commercial opportunities of BIM in contemporary construction. Apart from the usual barriers which constrain change, an additional factor impeding BIM adoption is an inherent conflict of interest within and between discrete construction disciplines. BIM's potential to facilitate multiple functions (e.g. preparing bills of quantities automatically from BIM data) may be a major disincentive to innovation as it straddles professional boundaries which currently exist (Olatunji, Sher and Gu, 2010). This is the crux of this paper—what opportunities and challenges does BIM present to the quantity surveying profession?

2.2. The traditional Quantity Surveyor

The profession developed during the 19th century from the earlier "measurer", a specialist tradesman (often a guild member), who prepared standardised schedules for a building project in which all of the construction materials, labour activities and the like were quantified, and against which competing builders could submit priced tenders. Because all tenders were based on the same schedule of information, they could be easily compared so as to identify the best one. As a profession quantity surveying emerged around the 1820s with one of the earliest Quantity Surveyors being Sir Henry Arthur Hunt who was involved in work on the Houses of Parliament. After the fire in 1834 that destroyed the old Palace of Westminster Henry Hunt came up with an estimate cost of £724,984 (changes by Parliament put it up to £1.5m).

A Quantity Surveyor, they can be referred to as Chartered Quantity Surveyors, a construction cost consultant or a commercial manager. The contracts and cost on the construction project, including the beginning start-up work to the final figures to complete the project is what the Quantity Surveyor's job traditionally consists of.

A Quantity Surveyor may work for either the client or the contractor, working in an office or on-site. They are involved in a project from the start, preparing estimates and costs of the work.

HKIS (2000) noted that practice surveyor's duty is investigation to discover the facts and relevant transactions because they can be appointed to act as experts in property rent review (Buildings Construction, 2010).

McDonagh (1992) stated that civils, housing, repairs and maintenance had grown in the past few years. Quantity Surveyors are required to take more responsibility and a cradle to the grave approach by clients. The environmental impact studies are more and more mandatory. The single person practices are more and more popular.

Chung (2000) recognized that the duties of Quantity Surveyors are preliminary cost advice, cost planning and value management, contractual methods, tendering, choice of contractor, valuation of construction work, project management and increased efficiency.

RICS (1999) pointed out some services of Quantity Surveyor should be provided during different stage of the project. In the pre-contract stage, Quantity Surveyor should prepare and develop preliminary cost plan, advise on cost of design team's proposals, monitor cost implications during detailed design stage, maintain and develop cost plan. For the tender stage, the Quantity Surveyor should advise on the contractual documentation to clients. Moreover, the Quantity Surveyor also needs to prepare recommendations for interim payments, post-contract cost control and final account. Furthermore, the Quantity Surveyor should provide and price bills of quantities, prepare cost analysis, advise on financial implications, advise on use of areas and provide measurement of areas, provide advice on contractual matters (Masterbuilders, 2012).

2.2.1. Traditional duties of Quantity Surveyor:

According to Buildings Construction (2010) the traditional duties of a Quantity Surveyor are:

- The preparation of bills and schedules of quantities of materials, labour and services required in the construction and equipment of building or engineering works.
- Visit building sites to monitor progress.
- Preparing tender and contract documents, including bills of quantities with the architect and/or the client.
- Preparation of specifications when required so to do.
- Undertaking costs analysis for repair and maintenance project work.
- Assisting in establishing a client's requirements and undertaking feasibility studies.
- Performing risk and value management and cost control.
- Preparing and analysing costing for tenders.
- Advising on procurement strategy.
- Identifying, analysing and developing responses to commercial risks.
- Allocating work to subcontractors.
- Providing advice on contractual claims.
- Analysing outcomes and writing detailed progress reports.
- Valuing completed work and arranging payments.
- Maintaining awareness of the different building contracts in current use.

- Understanding the implications of health and safety regulations.

2.2.2. Areas requiring more specialised knowledge include:

- Offering advice on property taxation.
- Providing post-occupancy advice, facilities management services and life cycle costing advice.
- Assisting clients in locating and accessing additional and alternative sources of funds.
- Enabling clients to initiate construction projects.
- Advising on the maintenance costs of specific buildings (Malone, 2012).

The Quantity Surveying Profession has developed a long way since it was first conceived over two centuries ago. Then, it was a post-measurement and accounting discipline only. Over the years the role of the Quantity Surveyor increased in its importance due in part to the rapid development and urbanisation of cities and towns and with increased emphasis placed upon costs of building.

In order to accurately forecast and control costs the profession began to develop various methods. Only initial costs in use were taken into account. The importance and work of the Quantity Surveyor expanded during the 1980s due to the interest in whole life cycle costing.

The availability of limited resources associated with the continued importance of economic choices has assured the Quantity Surveyor a prominent future in the construction industry. However, the Quantity Surveyor needed to expand their skills, expertise and client base in order to survive.

Various challenges faced the profession by the end of the twentieth century. The Profession has been able to develop and utilise their skills more fully due to the increased activities associated with information technology which removed some of the repetitive tasks associated with their work. In addition to solely considering initial costs of construction emphasis has shifted to identifying and adding value to the development process.

All over the world Quantity Surveyors are now involved in a variety of projects ranging from homes, airports, power stations, highways, ports, stadiums to offshore oil rigs. They are

involved at all levels of the process, starting with advising on the initial proposal for a project to meeting the client's needs, right through its working life and even how to recycle the building.

They provide complex solution based services on a scale that few have imagined. Although Quantity Surveyors do still provide traditional services, they now service new industries and offer a wider spread of services to a wider spread of clients. This is opening new commercial possibilities for Quantity Surveyors whether working for companies, client groups, contractors or other advisory and consulting firms.

As if the above mentioned challenges are not enough of a challenge for the quantity surveying profession, there is now a new kid on the block that threatens to change the future of Quantity Surveyors forever. The name of the kid is BIM or in full: Building Information Modeling. The word BIM brings fear to most Quantity Surveyors around the world and more relevantly in South Africa. BIM have a lot of advantages to offer the construction industry as a whole, but threatens to eliminate or at the very least minimize the role of Quantity Surveyors as we currently know it (Masterbuilders, 2012).

2.3. Building Information Modeling

Notwithstanding Schwegler (2001) definition of BIM (as the process of creating an information database for a project in which lifecycle information is expressed in an interoperable manner to create, engineer, estimate, illustrate and construct a construction project), BIM means different things to different people. A more all-encompassing description is provided by Succar in Figure 2.

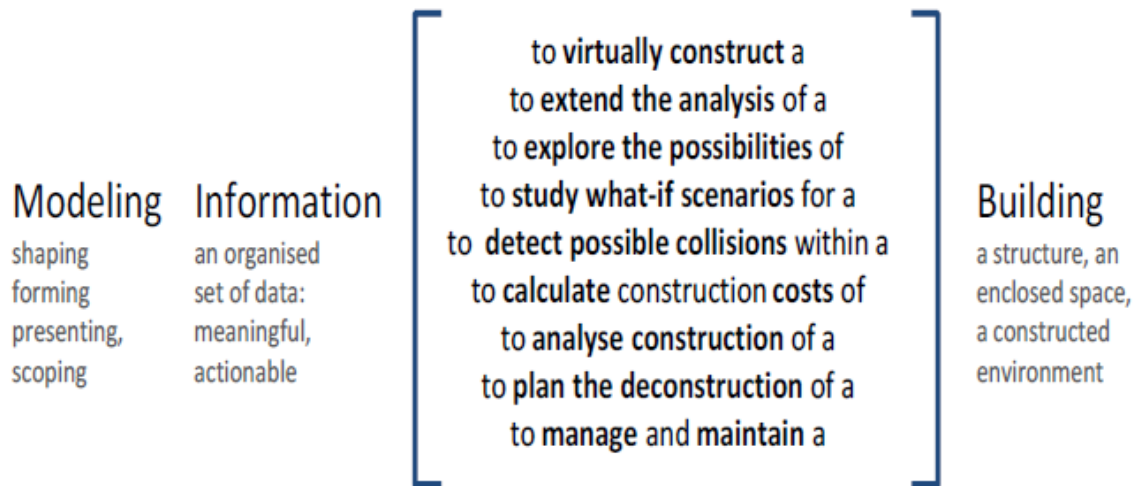


Figure 2. Some common interpretations of BIM

Relevant literature highlights BIM as three- or four-dimensional drafting applications that generate data - intensive plans. In contrast to two dimensional drawings where sets of lines and surface areas are rendered through soft and hard intelligent features, BIM systems store data related to each 'object'. The implication of this on the construction process is that construction designers and constructors are able to model real life situations before moving to site. Tse et al note that this presents significant opportunities for the construction industry. Latham reports that design deficiencies and associated constructability constraints are the single largest factors responsible for the poor performance of the construction industry. It is likely that conflicts in design and construction may be favourably impacted upon by BIM. BIM has the potential to automate measurement and facilitate the preparation of accurate estimates. The Cooperative Research Centre for Construction Innovation has reported successful attempts to produce Bills of Quantities automatically using Industry Foundation Class (IFC) data. There are many possibilities for applications of BIM in the Architectural, Engineering and Construction (AEC) industries, but a hallmark of BIM is that it should allow contractors to receive design documents which incorporate accurate quantities and specified materials in electronic format.

With Building Information Modelling now carrying out many traditional Quantity Surveyor functions, are Quantity Surveyors and their slide rules about to meet a sticky end? Or can man and machine live and work happily alongside each other?

In May 2011, chief construction adviser, Paul Morrell, announced that within five years all government construction projects, in the United Kingdom, would have to use building information modelling, a way of working that involves the entire project team using a 4D model that can do many of the traditional number-crunching functions of a Quantity Surveyor - automatically. This announcement confirms the seriousness of BIM and proves that it cannot be ignored. BIM is only the latest assault by machines on the Quantity Surveyor profession: AutoCAD systems have been doing more and more calculations automatically over the past 20 years. The traditional Quantity Surveyor is being terminated.

Quantity Surveyors do not like hearing the above statement and instead of just accepting the inevitable they are fighting back with the one weapon the computers don't yet have: brains. Taking on the corporate lingo of McKinsey and Deloitte, Quantity Surveyors such as EC Harris and Turner & Townsend have tried to transform themselves into "cost consultants" or "built asset consultants" and are now trying to offer strategic advice on investment, energy use, carbon emissions and running costs to clients in a way that a computer never can. Yet, as BIM removes even more of the traditional work of a Quantity Surveyor, small firms will find it harder and harder to rely on producing bills of quantity to survive (Malone, 2012).

2.4. Out with the old

The basis of the quantity surveying fortunes lies in procurement work in addition to a range of high-end services. Over the last 50 years services offered by Quantity Surveyors has changed.

50 Years Ago	Today
Pre Contract Work:	
Measuring work to defined rules	Sector-specific design advice
Analysis and scheduling of work	Early stage comparative cost planning
Preparing Cost Estimates	Advising on cost of design options
Preparing tender documents (BQ)	Analysis and scheduling of work
	Measuring work to define rules
	Preparing Cost Estimates
	Preparing tender documents
	Drafting Contracts
	Assembling frameworks
	Benchmarking and Value Management
	Funders/mergers and acquisitions due diligence
Post –Contract Work:	
Valuation of work in progress	Acting as Contracts Administrator
Valuation of variations	Valuation of work in progress
Evaluation of claims for additional cost	Valuation of variations
Settling final accounts	Contractual advice
	Evaluation of claims for additional cost
	Settling final accounts
	Setting capital allowances calculations
	Acting as adjudicator or mediator
	Acting as expert witness or arbitrator
	Risk Management
Other Services:-	
	Project and Facilities Management
	Program Management
	Development Management
	Supply chain Management
	Construction Management
	Project Monitoring
	Strategic development and Portfolio advice
	Insurance Valuations
	Building Surveying

Table 1. .Changes in services offered by Quantity Surveyors over the last 50 years

BIM will mean that the entire design team is working on the same plans, so it should remove the need to digitise drawings. And as the whole supply chain is involved, materials manufacturers will be able to input their own costs, says Richard Brinley, group director of membership and professional groups at the RIBA. “You won’t need a human hand to add up the numbers,” he says.

This isn’t anything new. The actual number-crunching work of Quantity Surveyors has been declining over the past few decades, Brinley says, and BIM is only the latest part of the mechanisation of the profession. “Already loads of measuring are automated in the current

generation of CAD systems,” he says. What BIM will do is remove entirely the remaining vestiges of traditional quantity surveying. “The old task of Quantity Surveyors measuring quantities has been going for the past 20 years and BIM will end it,” Brinley asserts.

As a result, Quantity Surveyors could end up with a lot more time on their hands. “Typically, it takes one of our team on a project two days to measure something,” says Erland Rendell, head of thought leadership at Davis Langdon. “Whereas with BIM its point and click, or drag and drop, and it takes half an hour.” He says that this kind of time-saving will be made on the cost planning stages (Masterbuilders, 2012).

2.5. The roles of Quantity Surveying in construction

Quantity Surveyors are ubiquitous in the construction industry. Conventionally, Quantity Surveyors’ services include the preparation of preliminary estimates and feasibility studies, cost plans and schedules, and bills of quantities. Quantity Surveyors draft and compile documentation for construction contracts, and prepare and analyse construction contract tenders. They also provide advice on contractor selection and financial management of all construction works and allied reporting, including auditing, planning cost and indexing. They provide construction project management services as well as value management, facilities management, management contracting, construction dispute resolution, research, and other forms of consultancy services.

The appeal of quantity surveying services depends largely on the ability of professionals to address core client expectations and the manner in which such services are marketed. Masidah and Khairuddin (2005) argue that some of the professional services rendered by Quantity Surveyors might be unnecessary and undesirable. However, measurement and pricing of construction works are important functions provided by Quantity Surveyors. This is central to the contention that BIM’s potential to automate quantity measurement might threaten clients’ requirements for quantity surveying services. Notwithstanding this, a number of quantity surveying services transcend measurement and an assessment of costs—they are facilitated by such data. Clearly the potential for BIM to influence the quantity surveying profession is considerable.

2.6. What does BIM mean for the Quantity Surveying profession?

Conventional construction estimating practices have been criticized because there is hardly an estimate without its own peculiarities and current estimating processes are seen by some as too rigid. However, BIM measurement represents an approach that could have a marked impact on preconstruction processes. Such measurement and its link with estimating are very real possibilities, but there are considerable challenges still to be overcome.

Chief amongst these is the need to filter BIM data so that they comply with the rules prescribed in relevant Standard Methods of Measurement (SMM). SMMs proliferate throughout the world, and more than one may operate within a single country. For example, in the UK measurement of building works is governed by SMM7, whilst measurement of civil engineering works is under CESSM3. Similarly in Australia measurement of building and civil works are governed by separate SMMs. Multiple SMMs mean that the financial returns to software developers from country-specific BIMSMM filters are limited. This is a major issue – the market required to support the development of such filters is modest, and the investment required to develop robust filters is considerable. As already mentioned, the development of such filters has so far been restricted to research projects. Arguably there is a case for re-engineering measurement procedures and there are precedents for maverick approaches which disregard SMMs. For example, in the US in the 1980's Timberline Software provided facilities which integrated CAD data with their house-building estimating software. The approach they adopted was to construct estimating performance data that aligned with the quantities generated by the CAD software used. Could this approach be extended to current practice? In other words, could BIM objects effectively generate alternate SSMs? This approach is simple but, to the authors' knowledge, such approaches have only been used in discrete market sectors where SMM-based bills of quantities are rarely used.

Clearly BIM presents opportunities and challenges. BIM remains a nascent ideal whose realization is probably many years off. However, the rewards are high as the time taken to measure buildings will be markedly reduced, leaving more time for estimating calculations (Agustsson, 2007).

2.6.1. Measuring up

Not everyone thinks it's quite as clear cut as this. "All it does is taking the grunt work out," says Richard Steer, senior partner at Gleeds. This kind of work has already been outsourced to Quantity Surveyors in India and the Philippines, he says. "Our London office hasn't produced a bill of quantities for some time." Still, this isn't necessarily true of smaller Quantity Surveyor firms across the country. "There's already segmentation in the market where the bigger firms are offering the higher level consulting and the small firms doing bills of quantity production," says Steer.

Even though from May 2016 all government construction projects in the United Kingdom will have to use building information modelling, the quantity surveying and project management students at all universities in the United Kingdom including Oxford Brookes University, still gets taught essential measurement skills. Employers around the world still need employees to have basic measuring skills.

Even so, the new way of working will cut traditional Quantity Surveyor work. This could send fees diving, just as the profession limps out of recession. But it could free up Quantity Surveyors to use their grey matter to advise clients where and how to invest their money, and how to cut carbon emissions, energy and running costs.

The larger outfits have been doing this for years, if not decades. In 2008, EC Harris rebranded itself as a "built asset consultancy". Phillip Youell, its chief executive, oversaw the change. "We struggled with trying to describe what we do," he explains. The mission of the firm was this: "A better outcome for the investment in your built asset." But Youell says the rebranding occurred after many staff had already changed how they worked, thinking more about what clients want - for example, if they even needed a new building at all.

"It took us a long time to get 3,000 people thinking in these terms," Youell says. "We had a series of training programmes. We took people offline (not working on projects) and talked to them about client management and client empathy."

EC Harris tried to mould employees into consultants that had a much wider knowledge of the markets their clients would be working in, and even of areas only vaguely connected with business. "Most books on the advised reading list aren't about other sectors: some are

about F1, football and rugby,” Youell says. “We encourage people to form a view of the world.” They are exhorted to read quality newspapers and magazines and become non-executive board members for charities.

2.7. Conclusion

BIM is a major challenge to the services conventionally provided by Quantity Surveyors and other construction disciplines. The adoption of BIM may redefine traditional professional boundaries in construction (not just for quantity surveying). By the year 2020 these boundaries may have shifted. Given this possibility, it is prudent to review quantity surveying curricula, and it will interesting to see how two independent surveys of quantity surveying tertiary education currently under way in Australia make reference to this. Is the current trend to adopt BIM sustainable? Will the perceived potential of BIM be realised in the future? Will the construction industry have the stamina to confront traditional barriers and adopt technological innovations that challenge existing industry practices? The answers to these questions may become apparent over time, or they may be informed by further studies, based on robust research methodologies and empirical data analysis. We trust the latter approach will prevail.

CHAPTER 3

How BIM influences the building industry in South Africa

BIM is not a thing or a type of software but a human activity that ultimately involves broad process changes in construction. A wider and wider variety of owners is starting to demand BIM use. Many large owners have developed contract terms and detailed guides for their design and construction service providers. New skills and roles are being developed. Almost universally positive return on investment values have been reported by both design firms and construction contractors, with those actively measuring return on investment reporting that it exceeded their initial estimates. A survey conducted in early 2007 found that 28 percent of the U.S. AEC industry was using BIM tools; that number had grown to 49 percent by 2009. In 2007, only 14 percent of users surveyed considered themselves to be expert or advanced. By 2009, 42 percent did. In the period from 2007 to 2010, contractors were the fastest adopters of BIM.

BIM standard efforts, such as the National BIM Standards in the United States, are gathering steam; and the public is increasingly demanding greener buildings. BIM tools are becoming common in construction site offices. The lack of appropriately trained professional staff, rather than the technology itself, is still the current bottleneck for most companies. The greatest demand is for people who have experience both in modeling and in construction (Autodesk, 2007).

3.1. Introduction

BIM is changing the way buildings look, the way they function, and the ways in which they are built. Throughout this paper, the term BIM will intentionally and consistently be used to describe an activity (Building Information Modeling), rather than an object (as in building information model). This reflects beliefs that BIM is not a thing or a type of software but a human activity that ultimately involves broad process changes in construction around the world and so also in South Africa. In this chapter, the aim will be to provide two perspectives on the future of building using BIM: where BIM is taking the AEC industry, and where the

AEC industry is taking BIM. It begins with a short introduction describing the conception and maturation of BIM until the present (2012). Perspectives on what the future holds will then be provided. The forecast is divided into two timeframes: a fairly confident forecast of the near future that looks ahead to the next three years (until 2015) and a more speculative long-term forecast looking ahead to the year 2020. The near-term forecast reflects current market trends and then reviews current research. The long-term forecast relies on analyses of likely drivers and a fair amount of intuition. Beyond 2020, potential advances in hardware and software technologies as well as business practices, make it impossible to predict anything reliably, and so we refrain from speculation.

After 2020, construction industry analysts will reflect, with the benefit of hindsight, on the process changes that will have occurred by 2020. They will likely find it difficult to distinguish definitively between such influences as BIM, lean construction, and performance-driven design. In the absence of each other, these techniques could, theoretically, flourish on their own. Their impacts, however, are complementary in important ways, and they are being adopted simultaneously (buildingSMART, 2012).

3.2. The development of BIM up to 2012

BIM technology crossed the boundary between research concept and viable commercial tool in the first years of the past decade, and it is well on the way to becoming as indispensable to building design and construction as the proverbial tee square or hammer and nail. The transition to BIM, however, is not a natural progression from computer-aided drafting (CAD). It involves a paradigm shift from drawing to modeling. Modeling provides different abstractions and model development processes, leading to new ways of designing. These are still being sorted out. BIM also facilitates, and is facilitated by, a concurrent shift from traditional competitive project delivery models to more collaborative practices in design and construction. The concept of computer modeling for buildings was first proposed when the earliest software products for building design were being developed (Bijl and Shawcross 1975; Eastman 1975; Yaski 1981). Progress toward BIM was restricted first by the cost of computing power and later by the successful widespread adoption of CAD. But idealists in academia and the construction software industry persisted, and the research

needed to make BIM practical continued to move forward. The foundations for object-oriented building product modeling were laid throughout the 1990s (Gielingh 1988; Kalay 1989; Eastman 1992).

Parametric 3D modeling was developed both in research and by software companies for specific market sectors, such as structural steel. Current BIM tools are the fulfilment of a vision that has been predicted, by many, for at least three decades. BIM technology will continue to develop rapidly across the world and therefor in also in South Africa. Just as the concepts of how BIM tools should work drove their technological development, a renewed vision of the future of building with BIM, emphasizing workflow and construction practices, is now needed. Readers who are considering the adoption of BIM tools for their practices and educators teaching future architects, civil engineers, contractors, building owners, and professionals, should all understand not only the current capabilities but also the future trends and their potential impacts on the building industry (Masterbuilders, 2012).

3.3. Building Information Modeling rolls out in South Africa

This paper will look at how architectural firms in South Africa, a country known for its ability to effect change, have adopted Autodesk Revit building information modeling. I explore the reasons for their easy transition to the new technology and what lessons we can learn from their success.

3.3.1. Situation on the Ground

South Africa's economy is climbing back from the worldwide slowdown and strengthening in the post-apartheid era. Inflation there is down, property values are soaring, and the country's architectural and building industry is enjoying healthy growth (Autodesk, 2007).



Figure 3. Glynnwood Hospital expansion project

A3 Architects, Johannesburg, South Africa, used Autodesk Revit for the \$5.45 million Glynnwood Hospital expansion project.

The South African building industry traditionally is an early adopter of technology, propelled by independent thinkers and doers who can make IT work to suit their needs. An open regulatory process encourages investigating new approaches for building design. The country's dynamic political and social environment creates a can-do atmosphere that energizes the business sector, freeing it from the constraints of established and perhaps outdated, ways of doing things (Constructech, 2012).

3.3.2. Straight to production

Many firms in South Africa already use AutoCAD, so they saw little risk in trying out Revit, which integrates with AutoCAD, on a working project. As a result, designers elected to use Revit on sizable projects right out of the gate, foregoing the traditional approach of proving the technology on a small, trial project.

A3 Architects in Johannesburg is a good example of this. The company's first experience with Revit was on a \$5.45 million hospital expansion project.

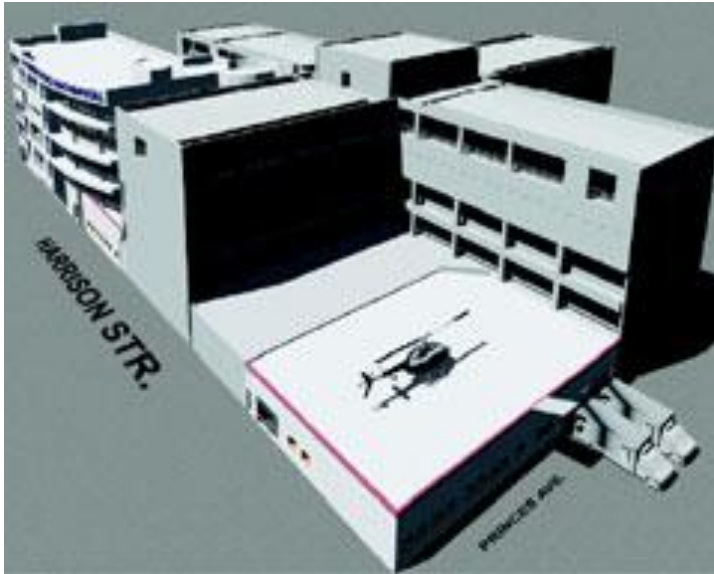


Figure 4. Glynnwood Hospital, courtesy A3 Architects

Designers were adding a new wing to a four-story structure and enlarging the existing ground-floor emergency room and lobby. The firm completed the project in three weeks, delivering 3D images, plans, sections, and multiple elevations. According to A3 partner William Ackerman, "We've put Autodesk Revit through its paces on a very large project and it's come through with flying colours."

Smaller firms have also embraced building information modeling, implementing Revit directly into production to increase their residential project capacity without increased staffing. Johannesburg firm Sheer Architectural & Interior Design used Revit to design eleven residential projects in two months. Sheer architect Sean Couzyn reports, "Often people are concerned about the drop in productivity after introducing a new program. Autodesk Revit is very easy to use. I was producing acceptable working drawings a few days after my first training day" (Constructech, 2012).

3.3.3. Technology's Promises Delivered

Another Johannesburg firm, *Bentel Associates International*, first used Revit on a new building design project - the 1-million- ft² Thalia Galleria retail complex in Saudi Arabia. According to Edmund Batley, Bentel's director for Middle East projects, the vast Galleria

demanded much more spatial exploration and 3D manipulation than other retail projects, which are usually more planning and layout oriented. "Autodesk Revit provided a digital environment that enabled us to view all spaces from any point, and for the very first time allowed us to explore the scale and nature of the design as a true 3D entity."



Figure 5. 250-unit apartment building in Johannesburg

Autodesk Revit building information modeling is used on a variety of South African residential and commercial projects, such as this one from *Site Architects*, a firm that has used Revit to design this 250-unit apartment building in Johannesburg.

Firms using Revit for residential projects echoed this theme. Jurie van Dyk from *Archilution*, a practice in St. Francis Bay, is using Revit to design luxury vacation homes for his clients. "Financial and time constraints prevent architects specializing in residential projects from creating physical models," says Jurie. "With Autodesk Revit I can quickly create an electronic model, which allows me to fully explore the design options" (Constructech, 2012).

3.3.4. Lessons Learned

Architectural firms and resellers around the world can learn from the experiences of their South African peers.

For many of these early adopters, Johannesburg-based *Cadplan*, a registered Autodesk dealer and developer since 1988, was a crucial element in their implementation. *Cadplan's*

CEO Marek Brandstatter credits the enthusiasm and implementation expertise of his staff, and the software itself, for the success of its Revit customers in South Africa. "Revit has handled everything we've thrown at it," states Brandstatter. "It's immensely rewarding to work with software that consistently exceeds your expectations."



Figure 6. Autodesk Revit image of 250-unit apartment building in Johannesburg, South Africa

Firms that have been frustrated in the past by architectural design software, particularly model-based software, will be pleasantly surprised by the Revit building information modeler. The system is intuitive to learn and use, so staff training is minimal and implementation costs are significantly decreased. For firms already using AutoCAD, the move to Revit is a low-risk, natural progression.

And don't wait for a small side project to pilot Revit. Cadplan's Brandstatter offers this analogy: Using conventional CAD and geometry-based modelers for architectural design is like using a spread sheet with the formulas disabled. Turn on the formulas and everything just works. That is Revit (Constructech, 2012).

3.3.5. More BIM success stories in South Africa

Other enhancements include improved performance for publishing and filtering large catalogs in SmartBIM Library. SmartBIM QTO allows for early cost estimating with Revit, which can help project participants refine the costs early in the project (Constructech, 2012).

Some professionals in the construction industry in South Africa still see the topic of BIM (Building Information Modeling) as being a lot of hype but little action. But the truth is there are a lot of real world examples out there - from sports stadiums to hospital projects - where contractors, trades, and owners are finding more practical uses for Building Information Modeling.

Take for example, sports stadiums. These arenas are typically unique structures, with complicated rooflines, curved beams, and heavy structural steel design. Recently, a total of five new stadiums were built for the FIFA World Cup, and two were modeled using BIM techniques and software.

The Nelson Mandela Bay Stadium has a unique roof structure - made of teflon-coated fiberglass, held up with 36 steel girders, and a total weight of 2,500-tons of futuristic curved beams.

According to Tekla, the project required seamless coordination of 4,200 drawing between multiple party participants. However, with the use of technology, the tight schedule and unique details were completed on time.

Additionally, Tekla was used on the renovation of Royal Bafokeng stadium and the creation of the Mbombela Stadium—in both cases to model the steel structure of other stadiums for the FIFA World Cup.

While contractors, trades, and owners are using BIM to help improve coordination in the field, providers are working to release the latest in updated technology solutions.

For example, Reed Construction Data, www.reedconstructiondata.com, Norcross, Ga., announced new versions of its SmartBIM Library 4.0 and SmartBIM QTO 2.0, which include support for Revit 2011 from Autodesk, www.autodesk.com, San Rafael, Calif., among other new features.

3.4. Conclusion

It is time to embrace BIM.

The African built environment industry is playing catch-up with BIM adoption worldwide, and it's high time to embrace full BIM. There are positive network effects, such that the benefits increase as the number of users' increase, with the aim being fully integrated BIM from design to construction to operation.

There is a steep BIM learning curve because full adoption requires much more than buying some software and hardware. BIM is fundamentally a process, the adoption of which requires significant changes to internal workflow (and, indeed) company culture. This talk is about what these challenges are and how to overcome them.

What to expect when you're expecting (to adopt BIM):

- Common initial challenges and being realistic about productivity issues.
- The need to build a library of BIM objects and to establish a BIM protocol, and the necessary internal structures needed to make these happen.
- Setting up workflow to ensure effective and efficient internal and external communication and collaboration.
- The vital importance of early collaboration among the design team

CHAPTER 4

Changes that BIM will bring to the Quantity Surveyor and project manager profession

This chapter is about the issues over the involvement of Quantity Surveyors and Project Managers in using BIM. In this day and era, everyone in the construction industry should start learning this new language of BIM and no matter how small, should start making contribution in BIM development. So far most of the development has been coming through the software vendors and a very little involvement is seen by the professionals.

As already mentioned; by 2016 all public construction projects in UK will have to adopt the processes of BIM and each type of procurement methods will be affected by this adoption.

The implications of which particularly for Quantity Surveyor and Project Manager will be:

- To immerse in understanding the BIM processes.
- To adopt one of the BIM compatible application or software to do the daily professional cores.
- As maturity is reached in using the BIM applications, the construction and especially the quantity surveying will be in the position to develop BIM modeling template which will form a seamless connection between architectural or engineering models and Quantity Surveyor or Project Manager working methods.
- The above will help establish a common platform to produce compatible models for seamless flow from one application to other.
- Gradually contribute to BIM Standards which so far in common language is restricted to the use of model authoring software mostly to streamline architectural and engineering outputs.

As another implication and in relation to the third point above, it may also be vital for Quantity Surveyors or Project Managers to have a working knowledge of BIM authoring tools. The importance of this is manifested in the fact that while architectural or engineering firms gear up to incorporate the modeling requirements from other stakeholders, Quantity

Surveyors or Project Managers have enough knowledge to edit or modify the model to make it workable on quantity surveying or estimating applications such as CostX or Vico (Autodesk, 2007).

On academic front, many institutes of higher education are rolling out BIM specific courses to train future Project Managers and Quantity Surveyors. For instance University of Glamorgan has just validated MSc in BIM and Sustainability.

The Unitec Institute of Technology in New Zealand is trying to incorporate elements of BIM in all their current courses in Construction Management (Agustsson, 2007).

4.1. The improvements that BIM offer the quantity surveying profession

4.1.1. BIM & Quantity Surveying

BIM (Building Information Modeling) is now liable for executing many traditional Quantity Surveyor functions automatically with its 4D modeling capabilities.

A Building Information Modeling (BIM) system can computerize the measurement of quantities from construction drawings. This will facilitate contractors to have design documents which include exact quantities and specified materials in electronic format.

With the utilization of a correctly configured Building Information Model, an exact bill of quantities (BOQ) can be generated automatically. The BOQ is then applied to create reports in the essential format. This is performed with any phase of the Quantity Surveyor dispatch ranging from estimating, tendering and construction control.

By utilizing BIM the contractors will be able to keep a visual record of what has been measured where. This will help contractors to detect clashes and co-ordination errors (Eastman, Teicholz, Sacks and Liston, 2011).

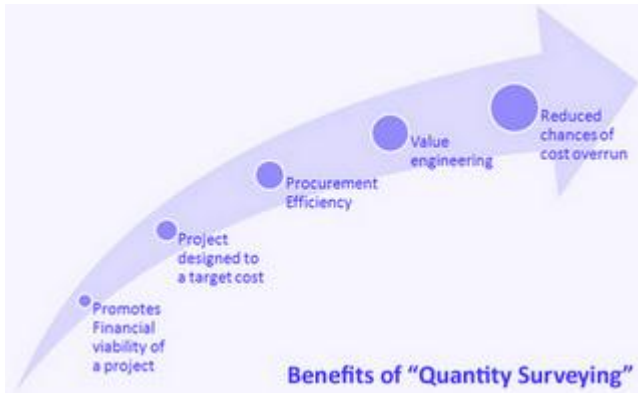


Figure 7. Benefits of Quantity Surveying

The importance of BIM from a measurement and costing viewpoint:

- It will form the geometry of what has been or might be designed.
- Identify the work scope in Bills of Quantities and colonize the Bills with quantities from the model
- Specification, auto-annotating the 3D and 2D drawings from the model including dynamically linking the Bill descriptions to the specification.

BIM allows the entire design team to perform on the same plans eliminating the requirements to digitize drawings. In a BIM process the entire supply chain is involved and the material manufacturer will get the ability to contribute to their own costs. The huge time saving is possible on the cost planning phases. Besides BIM also provide better cost models to fulfil the demand for VFM (value for money) all through the sustainable building development (National Institute of Building Sciences, 2007).

4.2. End of an era

BIM will mean that the entire design team is working on the same plans, so it should remove the need to digitise drawings. And as the whole supply chain is involved, materials manufacturers will be able to input their own costs, says Richard Brinley, group director of membership and professional groups at the RIBA. "You won't need a human hand to add up the numbers," he says.

This isn't anything new. The actual number-crunching work of Quantity Surveyors has been declining over the past few decades, Brinley says, and BIM is only the latest part of the mechanisation of the profession. "Already loads of measuring are automated in the current generation of CAD systems," he says. What BIM will do is remove entirely the remaining vestiges of traditional quantity surveying. "The old task of Quantity Surveyors measuring quantities has been going for the past 20 years and BIM will end it," Brinley asserts.

As a result, Quantity Surveyors could end up with a lot more time on their hands. "Typically, it takes one of our team on a project two days to measure something," says Erland Rendell, head of thought leadership at Davis Langdon. "Whereas with BIM its point and click, or drag and drop, and it takes half an hour." He says that this kind of time-saving will be made on the cost planning stages (BIM Mandate, 2003).

4.3. Measuring up

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Franco Cheung, who teaches quantity surveying as an undergraduate degree and project management at masters' level at Oxford Brookes University, still teaches essential measurement to his students. "Employers say they still need basic measuring skills," he says.

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remove the need to digitise drawings. And as the whole supply chain is involved, materials manufacturers will be able to input their own costs, says Richard Brinley, group director of membership and professional groups at the RIBA. “You won’t need a human hand to add up the numbers,” he says.

The larger outfits have been doing this for years, if not decades. In 2008, EC Harris rebranded itself as a “built asset consultancy”. Phillip Youell, its chief executive, oversaw the change. “We struggled with trying to describe what we do,” he explains. The mission of the firm was this: “A better outcome for the investment in your built asset.” But Youell says the rebranding occurred after many staff had already changed how they worked, thinking more about what clients want - for example, if they even needed a new building at all.

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4.4. Having to re-brand

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Whether the big consultants are transforming themselves fast enough is an open question. In 2001, 46% of EC Harris’ fee-earning staff was Quantity Surveyors. By 2005, that figure was down to 42% and last year it was a third. The rest include facilities managers, project

managers and strategy consultants. Davis Langdon is 49% “cost management”, which, it emphasises, is not just “traditional quantity surveying” but “cost modelling and planning and general pre-contract cost advice”. Meanwhile, 31% are consultants. The big firms are changing, then, but quantity surveying still makes up a large chunk of their businesses.

But for Quantity Surveyors who are not part of a large organisation, with their large training budgets, moving away from bills of quantities will be more difficult. David Blake, chairman of 42-strong, Darlington-based consultant Blake Newport, thinks remaining as traditional, measuring Quantity Surveyor is no longer viable. “They can’t demand enough of a fee,” he says. Instead, more traditional Quantity Surveyors will follow Blake Newport’s example and specialise in dispute resolution, project management, risk management and other services. “A lot of it is legally based,” he says.

So is there a value in being trained as a Quantity Surveyor any more, if graduates will need to carve out a niche? Rendell of Davis Langdon says his firm now often takes on graduates without a Quantity Surveyor degree, assessing them on their “personal traits” in addition to qualifications. But Blake thinks a Quantity Surveyor degree is still a good starting point. “The skill set that a Quantity Surveyor learns at university is generally very good,” he says, and adds that the firm still has strong links with Leeds University. “But you have got to have continued professional development.”

Undergraduates at Oxford Brookes do have to take a module in “financial appraisal”, which is weighted as much as their dissertation, says Cheung. The module teaches them how to assess a development from a developers’ perspective. “It takes time to develop the level of sophistication to deal with clients,” he argues. “The industrial placement year of our undergraduate programme helps students to acquire the skills through actual practice.”

It’s hard to argue that the introduction of BIM will be anything other than a good thing for Quantity Surveyors, argues Neill Morrison, former Davis Langdon partner and now head of cost consultancy at Deloitte, simply because it will eliminate so many mistakes and clashes of plan on site. “No Quantity Surveyor worth his salt can argue that it is bad for the industry,” he says.

But it will hit the small firms while making it easier for the large ones. “For the Quantity Surveyor profession, it will accelerate from its roots as a measuring profession to a value-added service. It will be a nail in the coffin of these small practices that make money from producing bills of quantities,” he says. “But for Davis Langdon and EC Harris it will not reduce fee income and will reduce the number of jobs that go wrong.”

BIM moves quantity surveying as a profession even further away from number crunching, slide rules and measurement. Today’s Quantity Surveyors have to now shine their shoes, think about “strategy”, read the Financial Times more diligently, and maybe even study for an MBA. The bigger firms have already shown how, but whether the traditional firms can adapt quickly enough and escape the rise of the machines remains to be seen.

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“This is the future. It’s what contractors and owners want consultants to be using now and so times have to change.

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“There can be a very happy coexistence between Quantity Surveyors and BIM. It is not a replacement but a tool - a tool that will cut the amount of time you have to spend on analysis right down and give you the opportunity to direct your talents towards being more creative. In the UK, we started using BIM on London Bridge House, next to the Shard, eight months ago. We discussed our plans with Mace, the contractor, and now everything has been converted into 3D. We want this project to become one of the first in this country to go all the way to the end under BIM, as an example of what can be done on future schemes.

“The benefits so far for us include having a fully coordinated project with a lot less conflict, a more sustainable building in the final instance and also throughout the process, as less time is spent on each stage. That’s the major advantage, it cuts unnecessary work out. Some Quantity Surveyors have responded well to BIM - EC Harris and Davis Langdon want to use it. My advice to firms who are still not sure would be to take advantage of the larger firms who are more experienced, because they will help. Any small firm we work with, we’d be more than happy to help them get used to the system and become familiar with it. There is no reason why the industry can’t be more collaborative when it comes to this; working together will mean creating better buildings.

“The other thing to remember is that BIM has actually been around for a while in the US and so we should feel reassured by that. We have been involved long enough to know that BIM will work and does work - it’s not a complete unknown.

“Change is always difficult for people in the beginning. Nobody likes having to adapt the way they do things. But in this case, once people get into it and see all the advantages of working with BIM, it will become second nature. It’s just a question of which consultants and Quantity Surveyors get into it sooner rather than later to see the benefits” (BIM Mandate, 2003).

4.5. Integrating BIM and Quantity Surveyor

This part of the research paper looks at how Building Information Models can be integrated with common software to reduce the time and errors associated with traditional quantity surveying processes.

Traditional Quantity Surveyors processes are extremely time consuming and prone to error during the creation of BOQ’s. However, time issues can be addressed and errors eradicated by automating the process. There are two steps required to achieve this, the first being the production of a properly configured Building Information Model (Eastman, Teicholz, Sacks and Liston, 2011).

4.5.1. Quantification using the BIM process

'Properly configured' is a very important phrase to understand. It is a common misconception to think that a building information model is simply a 3D representation of 2D plans and elevations used to visualise a design and locate overlapping or clashing components. Whilst both of these outputs are of great value to the construction process, they are only two of the myriad benefits that can be derived from such a model.

When produced correctly, a building information model assigns construction data to each element modelled. This means that those elements can be interrogated to provide details such as dimensions, locations and material composition.

Put simply, the model's in-built intelligence knows what each building element is, where it is located, what it is made of and how much there is of it. In other words, the model can automatically create a BOQ.

Yet, to derive a meaningful BOQ, the model has to be created in such a way as to deliver a BOQ that is configured to construction methodology. It is not enough to just to 'count' the building elements, because in reality the construction process groups activities together and the model must understand this.

It is therefore necessary to have a framework in place to define the design protocols for the model – such a framework is commonly described as a work breakdown structure (WBS) or standard method of measurement (SMM). Once this has been defined, the model can instantly create a BOQ that is 100% accurate and moreover, every time a design change is made in the model, the BOQ is updated.

Therefore using the BIM process, all of the manual work associated with traditional take off methods is eliminated along with the associated errors of measurement, missed elements and double counting (Agustsson, 2007).

4.5.2. Using the BOQ to create reports

The second step in the process is use the BOQ to produce reports in the required format. This can be done at any stage of the Quantity Surveyor remit.

For Estimating – there are a number of software that integrate directly with BIM technology to produce seamless interoperability between the two platforms. It is usually only necessary to ensure that the BOQ is produced using the same WBS or SMM as the estimating tool.

For Tendering – it is normally sufficient to provide a detailed BOQ to enable creation and submission of bids. As most BIM tools can produce BOQs in standard formats (Excel, 123 etc.), there is little work required other than formatting.

For construction control – it is necessary to develop a workflow based on the prevailing Quantity Surveyor system in use, in order to match the required process for issue, approval and revision of drawings. As the resulting periodic reports are usually created using standard platforms (MS, Lotus etc.), it is reasonably simple for an experienced programmer to create the required utilities to drive the process automatically (Eastman, Teicholz, Sacks and Liston, 2011).

4.6. Summary

The cost of not using interoperable technology is colossal. Clearly, when interoperable solutions do not exist options are limited. Where they do, it makes total business sense to deploy them. Building Information Modeling is here and it is here to stay. It has changed the entire building industry and will continue to do so whether the industry wants to accept it or not. BIM must be seen as an opportunity and not as a threat.

Everyone in the construction industry should start learning this new language of BIM and no matter how small, should start making contribution in BIM development. So far most of the development has been coming through the software vendors and a very little involvement is seen by the professionals. In order for BIM to reach its full potential some professionals of

the industry will have to join forces with the software vendors and sort out all of the last problem areas that BIM still have (Eastman, Teicholz, Sacks and Liston, 2011).

4.5.3. In conclusion

Although work is required initially to develop the skills and processes needed to integrate BIM and Quantity Surveyor processes, the resulting benefits undoubtedly justify the investment. There are numerous case studies available, including 'The Dubai Mall', that demonstrate financial savings and ROI.

Once the skills and processes are in place, on-going benefits increase with every project.

CHAPTER 5

How a Quantity Surveyor can stay relevant in the changing industry

5.1. Introduction

As we have already established the traditional Quantity Surveyor will not be around much longer. Producing bills of quantities, which is a time consuming task, will be done with BIM automatically. This fact brings fear to the most Quantity Surveyors. With the right attitude this change can be seen as an opportunity. Not having to produce a complete bill of quantity manually will mean that Quantity Surveyors will all of a sudden have much more time on their hands. Time; the one thing a Quantity Surveyor never have enough of. What the Quantity Surveyors decide to do with this time will now determine whether they will stay relevant in the building industry or not.

In future the proactive and effective manage of cost, contracts, communication and claims - the four C's- will consistently become more important to developers and facilitators involved in physical structures and properties.

The Quantity Surveyor should understand the challenges and opportunities presented by the needs of client in relation to cost, contracts, communication and claims and perhaps focus their development on the important links between the functions.

Changes and developments in the industry and market will also influence the way in which these functions are managed. For those professionals who deliver these services to the industry, the focus should be on client satisfaction and a positive experience for all concerned. Establishing a link in effectively managing the process to ensure success should be the primary aim of the manager. This should be done in close partnership with all functionaries, engaged in the process.

Planning, controlling and co-ordinating budgets and cost plans, as well as communicative results will limit claims and facilitate the process of contract management. The contract

should also facilitate partnerships and the system should be aimed at satisfying needs, seeking opportunity and perusing growth.

The main objective of this chapter is to study the subject of value engineering (now known as value management) from Quantity Surveyor perspective. Based on the parameters; cost, contracts, communication and claims the value engineering study is done and the challenges faced by the Quantity Surveyor is also discussed. According to (Eastman, Teicholz, Sacks and Liston, 2011) the objective of the study can be summarized as follows.

- To study the subject of value engineering and its methodology.
- To study the value engineering importance in cost management and the Quantity Surveyor's role.
- To study how the selection of contracts can add value to the project and the Quantity Surveyor's contribution to that process.
- To study the Quantity Surveyor's communication strategies to achieve the expected value and client's objectives.
- To study how the knowledge of Quantity Surveyor can add value (in terms of money, time and effort) during disputes.

5.2. Value engineering theory & methodology

5.2.1. Methodology

Value engineering methodology evolved in the 1940s when the transition was made from the search for an alternative to the search for means of fulfilling the functions of an alternative. Shortly afterwards it was observed that function-oriented alterations in working methods often result in improving quality along with eliminating unnecessary cost (Palmer et al., 1996). Since its introduction, the methodology has been well developed to be applied in construction industry, as it enables realization of life cycle cost and cost effectiveness of projects (Omigbodun, 2001). VE in the construction industry is mainly an organized effort to challenge the design and construction plans of projects to provide the required facility at

the lowest overall costs, consistent with requirements for performance, reliability and maintainability (Dell'Isola, 1988). Delays in construction projects may be due to lack of meticulously devised plans (Ghorbani and Shokri, 2005) and consequently budget deficit (Mirmoham madsadeghi and Aghdami Thani, 2005). Through all-pervasive utilization of the VE methodology such obstructions may be avoided. This judgement is made on the grounds that VE can improve plans and designs along with thriftiness in budget expenditures. According to *Mirmoham, Madsadeghi and Aghdami Thani, 2005* research show that this negligence is often due to limited access to experts and lack of knowledge about the method and its benefits. One may realize that these two factors may predispose VE teams towards other obstruction factors (Mirmoham, Madsadeghi and Aghdami Thani, 2005).

This obstacle may be surmounted with recourse to artificial intelligence (AI) models. Case-based reasoning (CBR) from AI may be utilized to enhance efficiency of VE study through outlining a model of the expert knowledge for a VE workshop. The inherent analogical nature of a CBR model would facilitate access to more comprehensive and systematically classified information during a VE workshop. Inasmuch as VE in the construction industry encompasses a cognitive process, such a reasoning method could be indispensable and could affirm promising results. Furthermore, classified background knowledge of the knowledge base may enhance the creativity of the VE study team, and transform their creativity to capability from an instinctive behaviour of mind.

5.2.2. Value Engineering Theory

VE may be defined as a creative, organized approach whose objective is to optimize cost and/or performance of a facility or system (Dell'Isola, 1988). The focal points of the notion are function analysis and creativity. Through defining functions and classifying them, it spots functions with more potential of increasing value. Thereafter with the creative approach alternative ideas would be recommended to replace original design. An established framework for fulfilling assigned tasks of the methodology has been defined as the VE job plan. The job plan is defined through special phases ranging from five to eight in various versions, all following the same concept (Assaf et al., 2000).

A typical version, comprising five phases, is selected in this study (Phillips, 2003):

1. Information phase: information acquisition, function analysis and selecting areas with poor value for detailed study.
2. Creative phase: generating ideas as an alternative to meet the requirements of an understudied function.
3. Analytical phase: evaluation of ideas and selecting the best practical ideas.
4. Development phase: developing prominent ideas and selection of the best idea.
5. Presentation phase: recommending a VE change and improvement proposal in a most challenging format.

Teamwork is an essential phenomenon in the VE job plan, resulting in crossing organizational lines (Dell'Isola, 1988). The ideal groups for VE should embrace different disciplines (Phillips, 2003):

- Design groups comprising project engineers, designers, draftsmen and mainly engineers who are responsible for construction.
- Operators groups comprising supervisors and construction engineers.
- Experts in costs groups with e.g. cost evaluators and accountants.
- Development groups comprising construction experts, commercial and financial experts.
- Organizer groups such as trouble-shooters or construction managers.

5.3. Management of cost

5.3.1. Aims & Goals of cost management

The basic goals of cost management and pricing of a project or product relate to the link between price and intrinsic value, affordability in relation to needs or investment, and managing the procurement process. The cost managers should therefore understand that they need to work with clients from the very inception of a project, even earlier and then

throughout the process to ensure the best results. This does not mean that a cost planner or cost manager is a cost cutter, far from it a cost manager should take responsibility (with designers, client and other roll players) to ensure the interest of the client, community and environment are served (Ferry and Brandon, 1991).

Grover Cleveland cited in Nel (1992) stated the following about the property investment: " No investment on earth is so safe, so sure, so certain to enrich its owner". However, one also has to take best value into account as well as to put available funds to best use. This includes gearing, cost design or design to cost, cost planning, cost control, architecture, location environment etc.

Sound investment has proven its value, been a safe guard against ill fortune, produced income, provided security and shown itself to be away of producing wealth (Nel, 1992). Utilizing funds to best effect will improve these benefits even further.

The cost manager needs to understand that the type of construction required for a building will also influenced the performance of the building over time, including the functional performances of the user's environment mole, cited in Venmore- Rowland, Brandon and Mole, 1991.

The cost managers should be continuously involved from the design to the co-ordination and auditing, to ensure best cost results, specifically in commercial property, where investment is required to yield the best financial returns.

Other areas of cost management that need attention are cash flow, the timing of payments, interest rates and the availability of funds at specific times. These aspects also influence the total financial outlay and eventual returns on a property investment.

Kenley (2003) stresses the potential value of improved and strategic cash flow to enhance the profitability of the construction industry, with the further potential to offer reduced costs to the client and improved contractor performance.

Cash flow forecast and management should therefore be part of the cost manager's service to ensure that the developers receive the full benefits of pro-active attention.

The cost managers (Quantity Surveyor's) involved must go beyond a re-active service. It should also include a service that takes the following aspects of value into account:

- Physical: a quality building
- Psychological: a pleasant looking building which is good to live in," places of the soul"
- Real quality: cost effective but with specifications that fit the purpose.
- Durability: taking life cycle costs and whole life cycle costs into account.
- Design: design to cost, cost design and appearance.
- Affordability: budget and returns are important.
- Timelessness: short term fashions as opposed to design that will withstand the pressures of current whims.

The cost manager, while communicating alternatives and options to the designers and the client should remember the role of relative quality, affordability, returns, as well as the latter's link to design and specification.

5.3.2. Quantity Surveying and cost management methods and tools

Although cost management may be seen as an obvious and simple process, in reality it is not. All aspects associated with a project have a direct impact on costing and how it is managed (Knipe et al., 2002).

The Quantity Surveyor is ideally placed to manage this complex process. If the methods are followed correctly and the tools used effectively, cost management may produce exceptional results.

5.3.2.1. Cost Design

This process is based on design aimed at satisfying the parameters dictated by cost, cost of acquisition, operation and management. The process may also be described as cost design where such design is defined as designing a project in economic terms, taking into account

the cost and cost benefits of each element of the project in an effort to balance the interrelationship of all cost elements and the reason for its existence (Knipe, 2002) (Verster and Berry).

5.3.2.2. Value Management

Value management is a systematic approach and process earlier referred to as value engineering, to ensure delivery of a function or product at the lowest cost without detriment to quality, performance or reliability (Ashworth, 2004).

Value management is a continuous process that should occur throughout the project but is most effective when implemented right from the inception of the project. Moreover, it should also include the following aspects:

- Orientation: Understanding the issues
- Information: Identification of functions, needs, budgets, project constraints and timing.
- Speculation: The creative development of ideas and alternatives
- Analysis and evaluation: Elimination and filtering of ideas.
- Development: Examination in detail
- Selection: The final proposal
- Conclusion: Presenting the findings to the client.

Value management is one of the effective tools available to Quantity Surveyors who are in a position to play an important role in ensuring that the client and designers actually consider all value and cost related aspects of construction, design specification and development options.

5.3.2.3. Cost Planning

Cost planning is used to ensure that the developer knows in the early stages of a project what the anticipated final cost of the total development may be, including the cost of land, legal issues, demolitions, buildings, professionals, furniture, connections, tax, financing and management. Building cost is only of the items, but the Quantity Surveyor should include all costs in the cost plan of the final cost. The cost planner should have a clear understanding of cost and budget targets to enable him to adjust the developer about possible future over-runs and pro- actively to provide alternative solutions (Ferry and Brandon).

One of the most effective tools that the Quantity Surveyor uses to assist with the planning and design process is the elemental cost plan. The theory behind the analysis of building costs per element is that the total cost is a sum of the cost of individual so- called elements such as walls, roofs, foundations, etc. (Morton and Jaggard, 1995).

5.3.2.4. Cost Control

Linked to auditing, cost control is an activity that is aimed not only at reactive reporting of decision results, but also at accounting for the decisions and visions of the client and advising the client how best to achieve desired outcomes (Knipe et al., 2002). Cost control happens throughout the deployment process, from the briefing stage to completion.

5.3.2.5. Cost Checking

This process is necessary to ensure that the client is always informed about the actual performance of the building in cost terms in relation to the budget or cost plan." The actual cost of each element or section of the building as the detailed designs are developed is checked against the cost target or cost plan, or specific elements in the cost plan" (Seeley, 1983).

5.3.2.6. Cost Analysis

Cost analysis supports the Quantity Surveyor's service to the client and can provide the Quantity Surveyor with useful cost information and data. The forms of cost analysis are identified by Ashworth (2002), namely:

- Identification of major cost items
- Analysis of the annual user cost of building ownership
- Identification of those groups of items(elements) of cost importance

5.3.2.7. Cost benefits analysis

The aim of cost benefit analysis is to establish the real benefit of expenditure not only in financial terms, but also in terms of time and energy expended by human resources, and the social benefits (Ferry and Brandon, 1991).

5.3.2.8. Life cycle costing

The life cycle costing also known as cost-in- use describes the modelling techniques aimed at coping with the mixture of capital and running cost of buildings and effect on ownership of a building. The Quantity Surveyor must be very sensitive to the influence of all cost factors so that the client receives advice that is practical, applicable, timely and effectively.

5.3.2.9. Cost reporting

The Quantity Surveyor must ensure that continuous, accurate cost information, analysis, cost results and cost influences are reported to the client and design team.

5.3.4. Conclusion

Using the above tools, techniques or methods and implementing them effectively will result in a better product at a better price with lower maintenance cost and an increased return potential over a long period of time.

Money is the most limited resource and the challenge is to utilize it optimally. Though the Quantity Surveyor is ideally positioned continuously to play an active role, he should also be more involved in strategic decisions to empower clients even more.

5.4. Contracts and the Quantity Surveyor

5.4.1. Aims and goals of construction contract

A contract is a document that spells out the rights and obligations of parties and the administration of this interaction while protecting the parties against the risks that emanate from various relationships, actions and production.

Many alternative ways to procure contracts exist, but experience has shown that a partnership approach as opposed to a two-sided procurement method is preferable. The secret of success may be in the organization of rights, obligations and administration, in such a manner that mutual support by the parties and effective professional service to the contracting parties are important factors to be included in the contract (UK Dissertations, 2011).

Although the legal systems in countries are very specific to each country, there are important aspects that need to form part of any construction contract in any country ensure harmony, the parties understanding of duties and the effective administration of obligations:

- Objectives: Offer acceptance and performance
- Preparation: Documents

- Design responsibility
- Agents
- Site representation
- Regulations
- Works risk
- Indemnities
- Insurances
- Securities, guarantees etc.

- Execution: Preparation
 - Access to the works
 - Access to the works
 - Setting out of the works
 - Assignment
 - Nominated and selected sub-contractors
 - Direct contractors

- Completion: Practical, works and final completion
 - Defects liability periods
 - Sectional completion
 - Revision of dates
 - Penalties

- Payments: Interim payments to the contractor
 - Adjustments
 - Recoveries
 - Final accounts

- Cancellation: By the employer or the contractor and the rights related to
 - Default and disaster

- Disputes: Litigation, arbitration, adjudication and mediation.

The above headings taken from an agreement show the general terms that should be included in a construction contract, but one needs to remember that many project-specific variables also need to be included in the agreement. The contract documents, apart from drawings and specification, should also include the following:

- Preliminaries - the management of the contract
- Trade preambles - basic standard specifications
- Bills of Quantities - depending on the method of procurement used, but compiled in accordance with an acceptable and agreed standard.
- Guarantees.

5.4.2. Procurement options

Although the Quantity Surveyor's service is traditionally linked to the production of bills of quantities, the profession has evolved to play a pro-active role in any procurement alternative and contractor selection process. Once the Quantity Surveyor's service, in relation to pre-contract cost advice, is concluded, the very important next service phase of procurement advice and action should be addressed.

Basically, procurement can be divided into two main alternatives, these are:

- Price-in-advance methods
- Cost-reimbursement methods

Various other procurement methods for diverse needs and reasons are used, such as cost plus, construction management, design and manage, and measured term contract. The primary considerations for contractor selection or procurement, however, are the following: the influence of cost, time and design as well as the client's needs and budgets. For this reason, the Quantity Surveyor may promote the multi-procurement method to enable the client to control the effects of time and cost, continuing to allow space for sustained design, development, effective professional service and contractor involvement. The method relies on producing procurement documents timely, on a provisional basis, based on provisional design information. This enables the procurement of a main contractor who will manage

many other selected or nominated sub -contractors who will be procured during the development of the building, as detailed information becomes available. The secret of this method is that mutual understanding and a very close working relationship between all role players must exist. The Quantity Surveyor performs a very important task in the execution of the project (Ashworth, 2004).

5.4.3. Conclusion

The proper selection of an appropriate procurement method and the introduction of effective contract terms that will enable the contracting parties to focus on the work at hand should derive from pro-active, knowledge -based advice to the client, taking all aspects and circumstances of the proposed project into account

Contracts, ensuring a partnership approach and imposing order on the rights and the obligation in proper manner, generally cover all risks and ensure effective contributions by the client, contractor and professionals (UK Dissertations, 2011).

5.5. The management of communication

5.5.1. The goals of a communication strategy

5.5.1.1. Contract communication

Contract terms should be communicated to parties and people involved so that they have no or little doubt about the meaning of words or terms. For this reason, the following aids are used by courts to interpret contracts:

- Avoidance of absurdity
- Upholding the contract or clause as opposed to ineffectual or void interpretations
- Equitable interpretations

- The intentions of the parties
- The recitals are subordinate to the operative part of the contract
- The grammatical meaning of the words used
- The contract will be interpreted as a whole in respect of the purpose and scope
- The technical meaning of words
- The written contract itself as opposed to verbal explanations

It is clearly understood that the contract guides the official communication related to rights, obligations and administration of the contract and by all the parties involved. It is therefore important that the Quantity Surveyor should understand all issues related to contract communications.

5.5.1.2. General communication

"In the information era, however, the strategic resource is information, knowledge and creativity. There is only one way a corporation can gain access to these valuable commodities through people its most important resource" (Naisbitt and Aburdene in Puth, 1994)

The above quotation illustrates how important it is to work with people, not only informally but also formally by means of contract documents, and in the process communicate well with them. People are the most important resource and thus the most important aspect and source of success.

5.5.2. Communication using management and leadership methods

While contract communication is generally used as a formal and official communication method to ensure that the rights and obligations of parties are protected and enforced, management and leadership communication, as an approach or method, are very important elements in ensuring results.

5.5.2.1. Management communication

Management communication is the number one problem in business today. While technology has advanced in leaps and bounds, managers and academics understanding of the substance of the process.

Communication is seen as the life-blood of organizational management; therefore, the manager and professional must have an adequate knowledge of the nature and role of communication although it is difficult to do well or understand the influence of communication (Ewing, 1994).

The effective communicator should have a well-founded understanding of substantive transformation as a basic approach. Management is inherently a problem-solving job (Whetten and Cameron in Puth, 1974), indicating the importance of communication while obvious criteria for solving problems are expertise, knowledge, skills and experience , using sound management principles to transmit function -and- outcome expectations.

5.5.2.2. Leadership communication

Leadership is based on communication. Leaders communicate not only information, but also attitudes and assumptions (Emshoff and Denlinger in Puth, 1994).

Since professionals often find themselves in leadership positions where clients and other parties rely on their expertise and skills, the professional must also be able to communicate and be concerned with:

- Coping with change
- Understanding competition and markets
- Be able to inspire followers
- Be a good example and influence people to achieve goals

Emshoff and Denlinger in Puth (1994) suggest that many corporations today are over-managed and under-led. Professional leadership is needed and should be the concern of all professionals.

Autry and Mitchell (1998, pp214) suggest that a wise leader should embrace the paradox of:

"By not forcing, he leads

By not dominating, he leads

By not leading, he leads"

Leadership asks for communication with subordinates, partners, professionals and other functionaries. Leadership is expected of any professional because of his position, knowledge and pro-active service. The lessons to be learned from the above are that communication is not forceful, not dominating, but accommodating.

5.5.3. Conclusion

Colin Bower warns against a specific form of leadership, in his words:

"Leadership is never a neutral value; far from it, it polarizes and divides" he continues "the cult of leadership is not more than the most thinly and inept disguised cloak of tyranny". He argues that we do need leaders in battles and expeditions, but because of these times, it should not mean that they are always needed and that "leaders fudge issues and paper over cracks by substituting evangelical qualities for good organization, agreed objectives and rational propositions". He concludes with an idealistic picture of competent individuals acting as his or her own leader (Bower, 2005).

It remains clear that leadership could be all of the above, but that effective communication and partnerships with individuals may lead to success (UK Dissertations, 2011).

5.6. Management of claims and disputes

5.6.1. The goals of claims and dispute resolution

The goals of claim and dispute resolution are firstly to establish the right of any party to submit a claim, and secondly to enable the other party to consider the claim in terms of its validity, contractual terms and possible outcome.

Lodging or considering a claim does not mean that a dispute exists, but should the rejection of a claim occur, a different interpretation of a claim exist, a difference of opinion obtain, one has to note that a dispute may then be lodged. Dispute resolution should then assist the parties in resolving such an impasse in a cost effective, satisfactory and timely manner (Ashworth, 2004).

5.6.2. The methods used to resolve disputes

For the purpose of this paper, the methods to be discussed are cancellation, adjudication, mediation and arbitration.

5.6.2.1. Conciliation

In an effort to resolve a dispute, satisfactory results are never guaranteed, not even in a court of law. It is therefore perhaps important to use inexpensive ways and methods to try and resolve a dispute.

Results have shown that conciliation does have a remarkable measure of success in regard to solving differences before they can become disputes.

The parties decide who the conciliator will be. The conciliator should, however, be a person with good communication skills and knowledge. The objective is to bring the parties together in a forum to investigate their contentions and assist the parties to formulate their own settlement, by indicating the consequences. Improved communication should be ensured through joint and separate meetings. The conciliator may also be requested to

formulate an own opinion. In the end, parties are still left with the option to continue with litigation or arbitration. Conciliation, however, has the following foci and advantages:

- Control - the parties control the process
- Consensus - the parties aim at the best commercial solution
- Continuity - the relationship will continue
- Confidentiality- no harmful public exposure

The following diagram illustrates the difference between litigation and all ADR (Alternative Dispute Resolution) processes:

The Quantity Surveyor, with good communication skills is ideally positioned to play an important role in respect of conciliation because disputes usually revolve around payments, valuations, certificates and penalties (UK Dissertations, 2011).

5.6.2.2. Adjudication

Adjudication is an accelerated form of dispute resolution in which a neutral, impartial and independent third party deals with the dispute as an expert and not as an arbitrator, and whose determination is binding unless and until invalidated or overturned by an arbitration award.

The adjudicator shall not give advice to the parties or their representatives concerning any aspect of the Agreement in respect of which he has been appointed other than in accordance with stated Rules (Joint Building Contracts Committee (JBCC) 2005 4.1 Adjudication rules, cl. 1.1, 3.2)

The procedure may be as follows:

- Either party shall submit full details of a dispute arising in terms of the agreement, together with copies of all relevant documents
- The other party may submit a written response
- The adjudicator shall:

- act as an expert and not as an arbitrator
- adopt the most cost - and time -effective procedure
- The adjudicator may also:
 - convene and conduct a hearing
 - determine the payments and costs of the dispute on the basis of the submitted documents only
 - meet with the parties
 - decide on his own jurisdiction
 - make use of specialist knowledge
 - open up documents related to the dispute
 - refuse admission to any persons other than the parties

It is important to note that an adjudication award is not binding on the parties, but is most definitely a process that will limit the costly processes of arbitration and litigation. Quantity Surveyors and cost engineers are ideally positioned to play a very active role in adjudication (UK Dissertations, 2011).

5.6.2.3. Mediation

Mediation means different things to different people, but in the construction industry, it usually denotes a procedure in which a neutral third party seeks to resolve a dispute between contracting parties, by conducting an enquiry, similar to arbitration, but less formal and by giving a non -binding opinion. The parties represent themselves without calling in legal professionals. The mediator should know the details of the dispute and should give each party the opportunity to state their case. The mediator should decide which procedure is the best, based on circumstances.

Quantity Surveyors often perform mediation tasks for clients or other parties, be it informal as a Quantity Surveyor - mediator or formal by appointment. However, in terms of many contracts (JBCC series 2000, Ed. 4.1), the parties shall agree on the appointment of a mediator and meet with the mediator in an effort to reach a settlement. If a settlement is

reached, the mediator shall record such an agreement which shall become binding on the parties on the signing (UK Dissertations, 2011).

5.6.2.4. Arbitration

In some countries, arbitration is a process provided for by an act of law, adopted by parties through mutual agreement stipulating that they will submit any dispute that may arise between them to the impartial judgement of some third party of their choice and that the award by this impartial person will be final and binding. Arbitration is not a new process; in fact, it was known to the Romans, used by the Dutch and English in the days of colonial expansion and is currently widely used in the construction industry and further afield.

Arbitration is a more formal process than the dispute-resolution processes mentioned earlier, but arbitration has many advantages. Some of these are:

- Expert knowledge of a selected arbitrator possible savings in legal representation costs
Flexibility of the process
- The decision is final and binding
- Time and money are saved
- Arbitration is a private matter

Quantity Surveyors perform or can perform an important role in arbitration, as cost advisor, expert, representative, witness or even arbitrator (UK Dissertations, 2011).

5.6.3. Conclusion

A knowledgeable professional, utilizing the claim- and dispute -resolution methods available to best effect, may assist the parties by means of these methods, to save money, time and effort.

Quantity Surveyors may be in a good position to assist the parties and professionals in this manner, because of their knowledge and skills in relation to determining costs, tariffs, rates, prices, certification, and contract terms and contract related communication (UK Dissertations, 2011).

CHAPTER 6

Conclusion

6.1. What BIM is and why is it different?

BIM will mean that the entire design team is working on the same plans, so it should remove the need to digitise drawings. And as the whole supply chain is involved, materials manufacturers will be able to input their own costs. You won't need a human hand to add up the numbers.

BIM involves representing a design as objects – vague and undefined, generic or product-specific, solid shapes or void-space oriented (like the shape of a room), that carry their geometry, relations and attributes. The geometry may be 2D or 3D. The objects may be abstract and conceptual or construction detailed. Composed together these objects define a building model. If an object is changed or moved, it need only be acted on once. BIM design tools then allow for extracting different views from a building model for drawing production and other uses. These different views are automatically consistent - in the sense that the objects are all of a consistent size, location, specification - since each object instance is defined only once, just as in reality. Drawing consistency eliminates many errors.

Modern BIM design tools go further. They define objects parametrically. That is, the objects are defined as parameters and relations to other objects, so that if a related object changes, this one will also. Parametric objects automatically re-build themselves according to the rules embedded in them. The rules may be simple, requiring a window to be wholly within a wall, and moving the window with the wall, or complex defining size ranges, and detailing, such as the physical connection between a steel beam and column (Eastman, 2009).

6.1.2. Why BIM is Important?

Because 3D objects are machine readable, spatial conflicts in a building model can be checked automatically. Because of this capability, at both the design and shop drawing levels, errors and change orders due to internal errors are greatly reduced. Pieces can carry attributes for selecting and ordering them automatically, providing cost estimates and well

as material tracking and ordering. Thus as a building representation, BIM technology is far superior to drawings. This is very clear for contractors and fabricators.

The larger implications of BIM are not just consistent drawings, cost estimation and bills of material and clash detection. Because building models are machine readable, it becomes practical to use the data they carry in many other ways: for energy, lighting, acoustic or other analyses - not as post facto checking if an almost finished design is "OK", but rather to provide feedback while designing, informing the designer of the effects of changes or to explore the relative effect on alternatives. Thus building models allow for better integration of design processes, allowing the kind of exploration that is equivalent to having a team of analyst consultants assessing your design as you make explorations. The result is that designers taking advantage of BIM can develop and demonstrate design trade-offs in ways that have been impossible in practice until now, and providing better services. Many of the uses of BIM data are waiting to be discovered and developed.

These capabilities also facilitate much improved coordination and collaboration. Designing a building once for contract drawings, then developing a set of detailed drawings for shop fabrication is recognized as involving much waste and inefficiency. Design-build and other forms of architect-contractor teaming have been recognized as more efficient - in terms of cost, time, and for reducing the potential for litigation. Building models tremendously facilitate this process. A 3D model is easier for all parties to interpret and visualize. Design or fabrication work can be coordinated in person or at a distance using web conferencing tools such as Webex and GoToMeeting and virtually walking through the 3D model (Eastman, 2009).

6.1.3. What changes will BIM bring to the Quantity Surveying Profession?

BIM is a major challenge to the services conventionally provided by Quantity Surveyors and other construction disciplines. The adoption of BIM may redefine traditional professional boundaries in construction (not just for quantity surveying). By the year 2020 these boundaries may have shifted. Given this possibility, it is prudent to review quantity surveying curricula, and it will be interesting to see how two independent surveys of quantity surveying tertiary education currently under way in Australia make reference to this. Is the

current trend to adopt BIM sustainable? Will the perceived potential of BIM be realised in the future? Will the construction industry have the stamina to confront traditional barriers and adopt technological innovations that challenge existing industry practices? The answers to these questions may become apparent over time, or they may be informed by further studies, based on robust research methodologies and empirical data analysis. We trust the latter approach will prevail.

6.1.4. The Mind shift required for full BIM adoption

It is truly not an exaggeration to say that adopting BIM fully and properly requires enormous changes both at the individual and company-level. We heard in the previous talk about the challenges in general, but this talk is an in-depth case study, complete with hard earned lessons learnt.

6.1.5. How BIM influences the building industry in South Africa

It is time to embrace BIM.

The African built environment industry is playing catch-up with BIM adoption worldwide, and it's high time to embrace full BIM. There are positive network effects, such that the benefits increase as the number of users' increase, with the aim being fully integrated BIM from design to construction to operation.

There is a steep BIM learning curve because full adoption requires much more than buying some software and hardware. BIM is fundamentally a process, the adoption of which requires significant changes to internal workflow (and, indeed) company culture. This talk is about what these challenges are and how to overcome them.

What to expect when you're expecting (to adopt BIM):

- Common initial challenges and being realistic about productivity issues.
- The need to build a library of BIM objects and to establish a BIM protocol, and the necessary internal structures needed to make these happen.
- Setting up workflow to ensure effective and efficient internal and external communication and collaboration.

- The vital importance of early collaboration among the design team

6.1.6. Changes that BIM will bring to the Quantity Surveyor and project manager profession

Although work is required initially to develop the skills and processes needed to integrate BIM and Quantity Surveyor processes, the resulting benefits undoubtedly justify the investment. There are numerous case studies available, including 'The Dubai Mall', that demonstrate financial savings and ROI.

Once the skills and processes are in place, on-going benefits increase with every project.

6.1.7. How a Quantity Surveyor can stay relevant in the changing industry

Using the above tools, techniques or methods and implementing them effectively will result in a better product at a better price with lower maintenance cost and an increased return potential over a long period of time.

Money is the most limited resource and the challenge is to utilize it optimally. Though the Quantity Surveyor is ideally positioned continuously to play an active role, he should also be more involved in strategic decisions to empower clients even more.

The proper selection of an appropriate procurement method and the introduction of effective contract terms that will enable the contracting parties to focus on the work at hand should derive from pro-active, knowledge-based advice to the client, taking all aspects and circumstances of the proposed project into account

Contracts, ensuring a partnership approach and imposing order on the rights and the obligation in proper manner, generally cover all risks and ensure effective contributions by the client, contractor and professionals (UK Dissertations, 2011).

Colin Bower warns against a specific form of leadership, in his words: "Leadership is never a neutral value; far from it, it polarizes and divides" he continues "the cult of leadership is not more than the most thinly and inept disguised cloak of tyranny". He argues that we do need leaders in battles and expeditions, but because of these times, it should not mean that they are always needed and that "leaders fudge issues and paper over cracks by substituting evangelical qualities for good organization, agreed objectives and rational propositions". He concludes with an idealistic picture of competent individuals acting as his or her own leader (Bower, 2005).

It remains clear that leadership could be all of the above, but that effective communication and partnerships with individuals may lead to success (UK Dissertations, 2011).

A knowledgeable professional, utilizing the claim- and dispute -resolution met holds available to best effect, may assist the parties by means of these methods, to save money, time and effort.

Quantity Surveyors may be in a good position to assist the parties and professionals in this manner, because of their knowledge and skills in relation to determining costs, tariffs, rates, prices, certification, and contract terms and contract related communication (UK Dissertations, 2011).

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