Current Status of Awareness and Readiness Towards Building Information Modelling (BIM) Among Sri Lankan Quantity Surveyors

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Abstract

BIM gets people and information working together effectively and efficiently through defined processes and technologies. Therefore, BIM is widely promoted in both developed and developing countries as an emerging enabling technology. BIM has the potential to influence everyone's professions in the construction industry in different ways. For Quantity Surveyor (QS), BIM has the potential to remove many mundane elements of traditional quantity surveying, such as manual quantity taking off (QTO) replacing automate QTO, which increases the efficiency and collaboration.

Hence, several authors have stated in their work that BIM is a Buzzword for the Sri Lankan construction industry. Nevertheless, there are no statistical figures regarding the application and implementation of BIM among the construction players. Therefore, the aim of this paper is to investigate the current status of BIM awareness and readiness of QS's and large-scale quantity surveying firms in Sri Lanka. The research engaged with a questionnaire survey and semi-structured interviews among Sri Lankan quantity surveyors and quantity surveying organizations. The data was analyzed statistically using statistical analysis. This research will be limited to large-scale quantity surveying firms in Sri Lanka.

The results indicated that BIM is not a buzzword for the Sri Lankan construction industry anymore, as there are organizations who have already adopted BIM. Most of the large-scale quantity surveying organizations have already started using BIM and experiencing the benefits of it. Therefore, it can be concluded that Sri Lanka has reached BIM level one. The organizations who are using BIM, seeking to develop it furthermore by achieving BIM level 2. However, the majority of quantity surveying organizations are still not using or not in the process of implementing BIM. Unidentified barriers buried the acceptance of BIM into their organizations. Therefore, identified barriers and BIM adoption framework will accelerate the adoption of BIM into quantity surveying firms in Sri Lanka.

Keywords: BIM Awareness, BIM Readiness, Quantity surveyors, Quantity surveying organizations, Sri Lanka.

1.0 Introduction

Sri Lanka is going through major urbanization and economic development with the end of the civil war in 2009. As a developing country (IMF, 2012), the construction industry plays a major role in the development and achievement of the goals of the society (OBG, 2016). Therefore, the construction industry is a measurement tool for Sri Lanka, which indicate the economic situation (Langford et al., 2000).

In the modern construction industry, Quantity Surveyor plays an emergent role due to the rapidly changing and increasing nature of the industry. Therefore, demand for the Quantity Surveying profession is growing day by day in Sri Lanka (Withanagamage and Senevirathne, 2016). Preparing bills of quantities, estimating and pricing, cost planning are the most performing roles among Sri Lankan quantity surveyors as illustrated in table 1. The traditional practice of Sri Lankan quantity surveyors has become one of the major challenges (Perera et al, 2010; De Silva et al 2014; Gunasekara & Jayasena, 2013 and Weddikkara 2013) due to use of 2D drawings, poor communication, poor coordination, manual quantity take-off, etc. However, most of the developed countries which faced the same problems, have improved the role of Quantity surveyor by adopting BIM, into their practice. As BIM has gained much reputation and importance in the global context, this could be one of the solutions for Sri Lanka as well.

Table 1. RII value and the rank of the level of involvement of Sri Lankan quantity surveyors;

(Withanagamge and Senevirathne, 2016)

Level of Involvement	RII value %	
	Assistance Quantity surveyor	Quantity surveyor & Senior Quantity Surveyor
Preparation of Bill of Quantities (BOQ)	92.50	85.88
Estimating and Pricing	87.50	84.12
Cost Planning	75.00	84.12
Variation and Extra Work Processing and Approvals	76.25	84.12
Preparation of Rates	81.88	83.53
Interim Bill Processing	80.00	82.35
Preparation of Tender Documents	86.88	81.18
Level of Involvement	**Rank**	
	Assistance Quantity surveyor	Quantity surveyor & Senior Quantity Surveyor
Preparation of Bill of Quantities (BOQ)	1	1
Estimating and Pricing	2	2
Cost Planning	7	2
Variation and Extra Work Processing and Approvals	6	2
Preparation of Rates	4	5
Interim Bill Processing	5	6
Preparation of Tender Documents	3	7

According to Jayasena & Wedikkara (2012), BIM is relatively a new "Buzzword" for the Sri Lankan construction. However, recent publications show that the waves of BIM have already hit the construction industry, therefore BIM is not a BUZZ word for the Sri Lankan Construction industry anymore. Implementation of BIM in the construction Industry is not an easy task as the Sri Lankan Construction industry in the infancy stage of BIM implementation. Nevertheless, there are no statistical figures regarding the application and implementation of BIM among the construction players. Therefore, the aim of this paper is to investigate the current status of BIM awareness and readiness of QS's and large-scale quantity surveying firms in Sri Lanka.

1.1 The Characteristics of the Sri Lankan Construction Industry

With the Mahaweli project in the 1970s, the construction industry boomed in Sri Lanka. With that, mega irrigation projects like Victoria, Randenigala, and Kothmale were completed at the same time. The Sri Lankan construction industry consists of Building Construction, Highway Construction, Bridge Construction, Water Supply & Drainage, Irrigation & Land Drainage, Dredging & Reclamation and Other Constructions (OS, 2016).

The total value of the construction output in Sri Lanka is currently 90bn which is approximately 8% of the country GDP (Central Bank of Sri Lanka, 2015). As a proportion of GDP, the output of the Sri Lankan construction

industry is comparatively stable at about 8%. The industry offers direct employment over 681,000 people which is 7.4% of total employment (Central Bank of Sri Lanka, 2015), to support different occupations such as civil engineering, architecture, quantity surveying, mechanical, electrical and plumbing (MEP), renewable energy solutions, electronic security systems and ICT infrastructure (EDB, 2015). Most laborers worked for one or more than 2500 contracting firms and these domestic firms are 51% owned by a Sri Lankan national as required by law (Finco Enginnering, 2017).

However, the industry is changing shape with the ending of 30 year's civil war 2009 (ICRA, 2011). It is being found that many constructions work need to be done within the country, especially in the north and east areas of the country (ICRA, 2011). As a result of that many major foreign players have also stepped into the marker and this includes Chinese state-owned China Communications Construction Company, China Merchant Holdings International, a Hong Kong-based conglomerate and Indian state-owned company, National Thermal Power Corporation. Many foreign firms that are working in Sri Lanka have a joint venture with a local or domestic entity or contractor (Finco Enginnering, 2017). As such, it is clear that the construction industry of the Pearl of the Indian Ocean is booming. Therefore, it is important to be aware of where the industry stands right now, so we can have an idea of where it will be heading in the near future.

The latter especially will continue boosting the industry through such upcoming projects such as the Shangri La mixed-use development, the Phase 2 of the Havelock City figure 2.2, the ITC Colombo One Hotel & Residences, Keells Waterfront Project. Few others to mention would be the Capitol Twin Peaks, scheduled to be ready for occupation by end-2020, as well as Capital Heights by Access Engineering PLC commencing its construction on the 18th September 2017. Furthermore, the industry will be further stimulated by infrastructure projects such as Construction of Central Expressway – Section II –Package A or the Rehabilitation Improvements to Peradeniya – Badulla-Chenkaladi Road

1.2 What Direction Could the Local Construction Industry Take in the Future

Governments key plans are to develop mega cities designed to transform the Western Region's urban areas into a high-income economy generator, the project also targets the reduction of urban sprawl, traffic congestion, and waste, as well as prioritizing the increase of affordable housing and urban services. Moreover, real estate segments were in high demand in 2016 in terms of buildings including grade-A office space, luxury residential space, commercial space, and hotels. Considerable work is currently ongoing in many of these areas and some projects such as affordable housing is yet to get underway (figure 2).

Master plans have also been drawn up to open up 50,000 acres of land for economic zones in Hambantota, Trincomalee and Kandy to foreign investment and the private sector. In the eastern region, a Singaporean urban planning firm, Surbana Jurong is in charge of creating a master plan to include the construction of a new refinery, a natural port and an airport. Surbana Jurong's plan will develop the major port city of Trincomalee into an economic hub and incorporate a concept plan for the Trincomalee metro area that will take in transportation, infrastructure, and environmental and implementation proposals. In 2010 China financed the projects with $8bn in soft loans with an eye towards weaving Hambantota, Colombo South Port and Colombo Port City (figure 1), now CICF, into its Maritime Silk Road strategy, which aims to connect Chinese-invested and managed infrastructure and connectivity across Asia, Africa and Europe.

The government has made a significant move for the development and growth of the construction industry by introducing the new Act VIZ "Construction Industry Development Act" which has been approved by the Parliament in September 2014. This Act has made provisions for the establishment of a National Advisory Council on Construction, a Construction Industry Development Fund, the well-being of the industry related professionals, manufacturers, suppliers, contractors and craftsmen and some other policy and progressive measures to ensure the continuous and sustainable development of the industry. The construction sector is uniquely situated to assist the country in easing some of its debt burdens and helping drive growth.

Fig. 1. Upcoming Hyatt Regency in Colombo, San piling, 2016

Fig. 2. Port city project in Colombo, Source: Qin, 2017

1.2.1 Challenges faced by the Sri Lankan construction industry today

Factors seriously impairing the Sri Lankan construction productivity are related to project conditions, design, and procurement construction management, government policy and training of industry personnel (ICRA, 2011), & Balachandra (2014). Also, such factors as weather variation, material shortage, and lack of experienced design and project management personnel, many scope changes during construction, slow approvals and issues of permits also impair the construction industry. Therefore, the sector must first overcome these significant obstacles lying its way. Moreover, Sri Lanka is hesitant about going beyond traditional construction boundaries such as a continuation application of the traditional practices has prevented and delayed the use of technology innovations and created a stagnant environment (LMD, 2017). To overcome this situation, the Construction Industry Development Authority (CIDA) should adopt modern technology to alleviate problems related to the construction process (Galagoda, 2017).

Time, quality and cost are becoming key factors in any production cycle including in the construction process. In the modern construction industry, Quantity Surveyor plays an emergent role in terms of managing cost (Withanagamage et al, 2016). Therefore, in order to achieve predetermined objectives mentioned in the above reports, the whole design and construction process, including the work of quantity surveyors needs to be re-engineered (Ashworth and Hogg, 2007).

1.3 Quantity Surveying Profession

Before considering the role of QS, it is worth to review the background of the quantity surveying profession and how it evolved. It is believed that the ancient Egyptians used a system of quantity surveying (AIQS 2017 May 15), hence the first reference to a Quantity Surveyor is found in the Bible in the book of Luke 14:28 which says "Suppose one of you wants to build a tower, will he not first sit down and estimate the cost to see if he has enough money to complete it (NIQS, 2015).

Before 1666, masons, carpenters, and other craftsmen were paid by the day, but because of a large amount of labour needed to reconstruct the city after the fire at Westminster UK, it was decided that each craftsman is paid for the quantity of his trades work. This meant that instead of being paid a wage, the tradesmen were paid for the amount of masonry, carpentry or any other craft ship contained in the building. In essence, one had to study the drawings and measure the quantity of work of each trade contained in the building and at the same time prepares an estimate of the total cost of the building. Hence, from that humble beginning, the Quantity Surveying profession evolved. Notwithstanding, with the decision taken by architects to divorce themselves from surveyors to establish RIBA in 1834 and the fire that destroyed the palace of Westminster were the main reasons for the birth of QS profession in the UK (Cartlidge, 2009).

QSBC (2009), stated that: “Quantity surveyor is the profession developed during the 19th century from the earlier "Measurer," to a specialist tradesman (often a guild member), who prepared standardized 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” QSBC (2009). Moreover, “A Quantity Surveyor (QS) is a professional person working within the construction industry. The role of the QS is to manage and control costs within construction projects and may involve the use of a range of management procedures and technical tools to achieve this goal” QSBC (2009). Simply the main role of the quantity surveyor is to manage project costs within the agreed budget to accomplish employers specified projects goals. Therefore, quantity surveyors are also identified as financial managers of the construction team who add value by managing the functions of cost, time and quality (Seely, 1997, p.40).

A quantity surveyor is professionally trained, qualified, experienced and have expert knowledge of costs, values, labour and material prices, finance, contractual arrangements and legal matters in the construction filed (Chung, 2000), on behalf of the employer. The employer could be either the client or the contractor. Refer to RICS (1983) which stated that “In the 1971 report, the role of the Quantity Surveyor was defined as “ensuring that the resources of the construction industry are utilized to the best advantage of society by providing, inter alia, the financial management for projects and a cost consultancy service to the client and designer during the whole construction process”. This helps the client to forecast, analyse, plan, control and account measurements and valuation during the project process.

Quantity surveyors perform many roles throughout the project life cycle from inception to execution of the project as illustrated in figure 3. The role of the Quantity Surveyor can be divided into three main categories such as traditional, Evolved and developing role (Ashworth and Hogg, 2007). QS’s perform these roles in building work, building engineering services, civil engineering and heavy and industrial engineering (Ashworth and Hogg, 2007) within the construction industry. Traditionally, the role of quantity surveyors has been mainly associating with the functions of estimating and cost planning, procurement advice, measurement, preparation of Bills of Quantities (BOQ) and tender documentation, construction cost control, and preparation of valuations, payments, contractual claims and final accounts (Ashworth and Hogg, 2007).

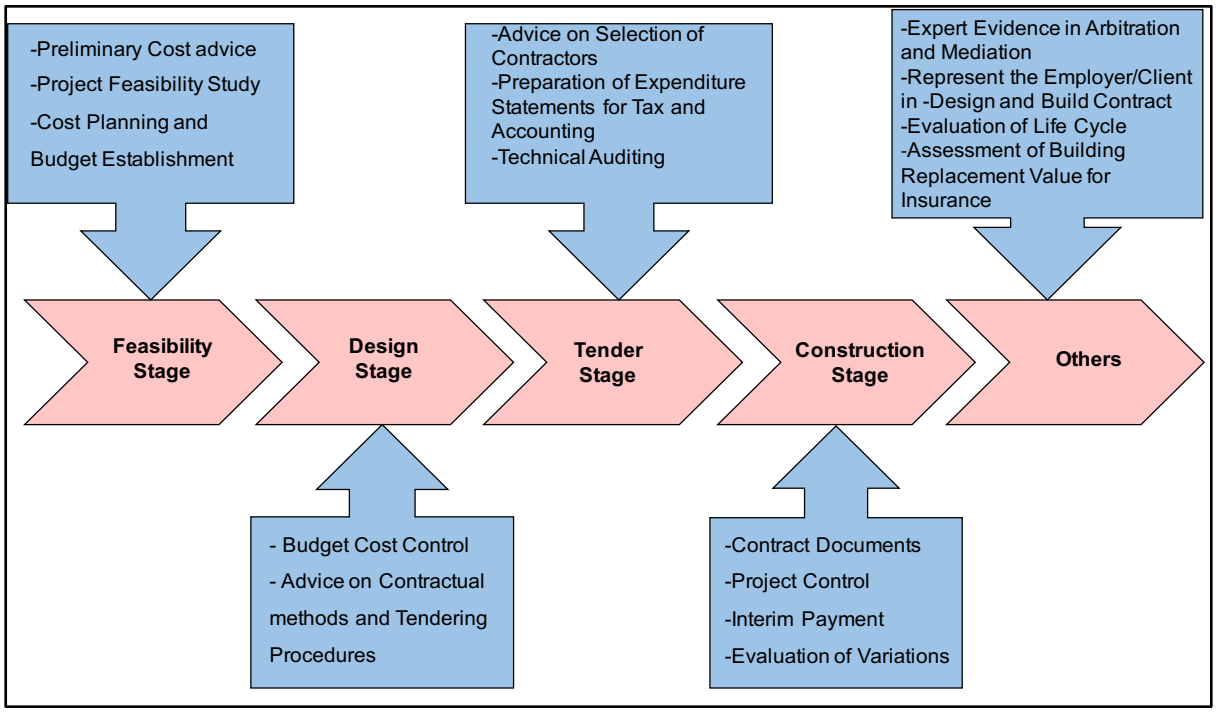

Fig. 3. Quantity surveyor duties and responsibilities; Constructiontuts,2015

2.0 Building Information Modelling (BIM)

The benefits of BIM motivate contractors and construction professionals alike to re-arrange their organizations to utilize BIM. The demand of the construction industry depends on project stakeholders that how effectively they introduce BIM into their organizations. The construction industry can utilize BIM for visualization, design appraisal, project management, information storage and retrieval, cost estimating, structural analysis, on-site management, facilities management and contract preparation (Sun et al, 2008), hence What exactly BIM is?

Abbreviation of BIM stands for three common translations namely Building information model, building information modelling and building information management (Lindstrom 2013). According to Aranda-Mena et al. (2008), for different professionals, BIM carries vague definitions. Therefore, there has been much debate over the need to have consistent definitions and terminology. Arenda-Mena et al. (2009), Goucher and Thurairajah (2013), Brewer et al (2012) and Building Smart (2012) have all argued for consistency in describing BIM, its systems, processes, and technologies, in order to reduce the misinterpretation in this field. However, there is no universally accepted definition of BIM, but most sources reveal a similar theme (Sawhney, 2014).
Initially, most of the professionals define BIM as a software or a technology, with BIM being "increasingly considered as an Information Technology (IT)- enabled approach that allows design integrity, virtual prototyping, simulations, distributed access, retrieval and maintenance of the building data" (Fischer et al 2004, p4). However, Smith (2014) and Taylor & Bailey (2011) argue that BIM is just not a software application, hence it brings a different way of thinking to deliver the project with new approaches within a different culture. At early stages of BIM, it was able to represent objects by eliminating lines, arcs, curves etc. hence now it has become a more advanced tool that is capable of performing "model analysis, clash detection, product selection and whole project conceptualization". BIM can be said an integrated database which contains a complete set of design information of the entire building. The changes made to the model at any stage of the project will be instantly reflected in the entire project process automatically, because of the information in the model is parametric and thereby interconnected (Krygiel et al, 2008).

According to Eastman et al (2011), BIM is both a technology change and a process change. A widely cited definition for BIM as defined by the US National Institute of Building Sciences (NIBS-Building SMART alliance, 2012) is: "A digital representation of physical and functional characteristics of a facility and a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life cycle". Therefore, BIM technology improves the visualization of a project, represented by intelligent objects which contains information about themselves and are capable of recognizing their relationships with other objects within the model. Moreover, technology is the catalyst for significant change in process and contracts as it allows for changes to be made to key processes that are involved in putting a building together, thereby supporting the move towards Integrated Project delivery (IPD) and a collaborative way of working. Therefore, it encourage construction industry stakeholders to move away from the traditional silo approach mentality where each stakeholder works independently from the other. Through defined processes and technology BIM gets people and information working together effectively and efficiently (RICS, 2013).

The quality of the construction works highly depends on the availability of quality information provided. Traditionally information was shared and managed using paper-based systems and verbally. Hence, BIM provides the opportunity for this information to be digitally represented. Wu et al. (2014) note, therefore, BIM is sometimes defined as "Building Information Management" ...in order to encompass the bigger picture of BIM". Moreover, the model and modelling technology provide the means whereby there is a smooth flow of information throughout the design and construction life cycle, facilitating simultaneous work by multiple design disciplines on common platforms (where participants can share work seamlessly) (Ajibade & Venkatesh, 2012; Goucher & Thurairajah, 2012; Smith, 2014). More recently Dave Philp (2013) defined BIM in terms of collaboration, clear open communication, high-quality information linked to business outcomes and modelling that created better outcomes.

2.1 Development of QS Practice with BIM

In 1971 the RICS defined the role of quantity surveyor as being associated with measurement and valuation (Nkado and Meyer 2001). Traditionally, when estimating project cost, estimators do manual take-off or alternatively digitize architects paper drawing or import CAD drawings into a cost estimating software package to enable quantity take-off. These methods are fraught with human errors and often lead to inaccuracies in estimates. Quantification errors may arise in the form of mistakes, arithmetic errors, processing errors, data extraction errors from drawings and databases, and double or multiple counting (Olatunji, 2011). Inaccurate estimates have been identified as one of the major underlying sources of project failure in construction (Aibinu

and Pasco, 2008). Even though, many statistical/mathematical and intelligent models using historical data of completed projects to reduce inaccuracies in estimates, they are unable to perform well due to the uniqueness of buildings.

Theoretically, BIM can offer many benefits to the quantity surveyor, with its computable information and single information- sharing model driven by a collaborative environment because of its quantity automation capabilities – important because when preparing cost estimates, quantity surveyors perhaps spend 50-80% of their time on quantity take-off (Autodesk, 2012). Other potential benefits include: help provide cost information consistent with the design, better visualization of design for costing purposes and overall time savings, to mention a few. In a project development cost is one of the most important elements. Cost information is a feature of most of the role played by QS. Meanwhile, accurate cost estimating depends on accurate quantification. Thus technology (such as BIM) that potentially improves accuracy in quantification would impact cost estimating in a significant way and would impact all other services provided by the quantity surveyor and in turn, would have positive implications for a project as a whole in terms of better outcome and value for money. Therefore, the RICS authored a guidance note to inform the QS/cost manager in the performance of their measurement role in a BIM environment and advised the QS to utilize the model data rather than traditional manual measurement in the production of quantities (RICS, 2014). It follows, therefore, that BIM can directly benefit cost management by rapid and accurate automated quantity take-off; facilitating cost planning and Bill of Quantity (BQ) production. The automated quantity-take off also facilitates cost control and analysis, as the building model progresses, and allows easier pricing of alternative design solutions (Klashka, 2006, Eastman et al 2011).

Consequently, now many countries drive towards BIM adoption into the construction process. A recent Australian study conducted in 2010 has indicated that the use of BIM by the construction industry would provide potential economic benefits to the country and that it is being used by various industry players. Therefore, QS must develop their skills to meet current needs and refine their knowledge to understand that they possess the necessary skills to apply BIM into cost management in practice. However, it is not clear whether or not quantity surveyors find BIM a useful concept and whether they perceive a great benefit in the adoption of BIM-based quantity surveying services. Therefore, the following section will discuss the benefits and drawbacks of BIM adoption into the cost estimate process.

2.2 BIM and the Quantity Surveying, Why now?

As an emerging enabling technology, Building Information Modelling (BIM), is widely promoted in the UK (Zhou et al, 2012). With the recently announced BIM mandate in the UK, have highly impacted on the work practices of project stakeholders. Its pushing stakeholders to adopt BIM technologies and processes on all publicly procured projects. QS as one of the major stakeholders in construction also seeking to change their working practices towards BIM. According to the UK Government Building Information Modelling (BIM) Strategy paper for the Construction Industry Council (CIC) meeting (BIS, 2011), level 2 BIM integrated with 4D program data and 5D cost elements which QS should familiar with BIM the ways in which processes can be made more cost-effective and add value. In any construction project, cost management is a fundamental element. Quantity surveyors are responsible for this function manages cost throughout the project.

In the UK, 73% of surveying firms see the non-adoption of BIM, among them, 68% of respondents said that they don't think there is enough information available for small companies in order to aid them with adoption (RICS, 2015). In addition, 31% of surveyors claim that there is not a need to use the technology in their organization, while over a quarter (26%) stated that they don't feel their firm has the technical skills in place to implement the technology. Interestingly, over half (55%) of those members interviewed said that they are currently working with architect's firms that are using BIM. In addition, half of these respondents said that the architects they have collaborated with have been encouraging them to adopt BIM within their own organization (RICS, 2015).

Muse (2015) stated that "BIM is the future, not just of the surveying industry, but the entire construction sector. It has the power to unlock cost and time efficiencies which will enable the UK industry to become more efficient and competitive on a global scale". With this in mind, surveyors – particularly quantity surveyors – need to lead the charge when it comes to BIM and ensure that they have the right skills in place to implement it across their organisation. However, according to BCIS (2011), in the UK it claimed that only 4% of QS firms regularly invest in BIM training and only 10% were actively assessing BIM tools for potential adoption. These results indicate that not fully adoption of BIM by QS is likely to have a negative impact on the industry as a whole.

In Denmark, the use of BIM has grown in quantity surveying organizations has grown considerably according to the results of BIPS (BIPS survey,2008). In general, the companies have moved from 'heard of BIM' to actually working with it. In 2008, every fourth respondent often used building models. By 2014, this number has doubled. As far as disciplines are concerned, 15% are using BIM on all projects, 36% are using BIM on most of their projects, 20% have used BIM on some projects, 11% have used BIM on a few projects 18% have never implemented or used BIM. The use of models has become relatively advanced and BIM-oriented. During the last year 75% have performed clash detection by cooperating with others through the use of digital models, 75% have extracted quantities from digital models, 60% have performed analysis within digital models, 60% have shared models with design partners outside of their organisation, 50% have exchanged models through open standards. The survey results also illustrated that respondents clearly expect to expand their use of BIM over 65% of respondents who use BIM expect their company to use it on all projects, five years from now. Over 65% of respondents whose companies do not use BIM expect that BIM will be implemented to some degree, five years from now. It can also be added that the IFC format is used by over 65% of respondents, and it now seems to have a foothold within the Danish Construction Industry.

The survey in **Japan** was conducted by the Institute of International Harmonization of Building and Housing (IIBH). This is the first International BIM Survey held in Japan and the respondents numbered up to 244. 60% of them work in the field of design, 16% in construction (including technical development, quantity surveying and product planning), 8% are students or researchers, 3% work in estimating or planning, and 13% work in fields other than these. Classification by employer shows that 36% are from design firms, 34% are general contractors, 8% subcontractors or suppliers, 9% from research institutes, 6% consultants and 3% quantity survey consultants. The survey reveals that 46% have experience in BIM, which is higher than expected.

A recent survey conducted in **Australia** indicates Australian quantity surveyor's involvement with BIM-based projects. According to the results, 37% of the respondents have been directly involved in a BIM-based project in Australia. 63% have not been involved in any. A respondent indicated that they have just been appointed to their first BIM-based project. 19% of the BIM users have been involved in the past 3-5years while 36% of the BIM users became involved in the past 2 years another 36% in the past 1 year. Hence it appears that QS involvement in BIM projects has increased in the past 2 years. Only a few 9% have been involved for more than 5 years.

New Zealand's only national BIM survey recently found that the proportion of BIM users increased from 34 % (2015) to 57 % (2016), with a year-on-year increase in overall BIM awareness in the construction industry, from 88 % (2015) to 98 % (2016) (Masterspec, 2016; Masterspec, 2017). BIM is expected to provide endless opportunities to the quantity surveying profession and their clients, allowing them to streamline their workflows and increase the quality of the cost services they provide (Boon & Prigg, 2012).

The adoption of 5D BIM within a construction project provides an expanded range of possibilities to not only to the quantity surveyor but to many different project stakeholders. These possibilities are attributed to the significant amount of information that can be encapsulated from the BIM models and the efficiencies that can be gained (Forgues et al, 2012). Current practice in New Zealand is for BIM models to be "live linked" to estimating software tools, in order to automatically extract the quantities (Boon & Prigg, 2012).

Above discussion indicates that most of the countries have already in a process of adopting BIM into quantity surveying profession especially for cost estimating due to its capabilities to improve the overall cost estimation process enabling a faster and more cost-effective project delivery process, higher quality buildings, and increased control and predictability for the owner (Forgues et al, 2012). Hence, For the Sri Lankan construction industry, BIM is totally a Buzzword yet. None of the construction projects have been adopted BIM so far. According to Jayasena and Wedikkara (2015), the awareness of BIM has been increased within the last few years and BIM has become one of the foremost topics in professional gatherings. Therefore, there's a need for investigating the current status of BIM awareness and readiness of QS's and large-scale quantity surveying firms in Sri Lanka.

3.0 Methodology

This research has been undertaken as a pilot study that is incidental to PhD research. The data were collected both quantitatively and qualitatively. Therefore, the fieldwork essential the use of both questionnaire survey and semi-structured interviews to interrogate the issues in the subject area.
The questionnaire was sent through emails and hand-delivered to more than 50 Quantity surveyors in the Sri Lankan quantity surveying industry. Therefore, the sample compromised with,

A. Quantity surveyors registered with RICS
B. Quantity surveyors registered with IQSSL
C. Industry practitioners
D. Academic practitioners.

30 responses were received at the moment of writing this paper. The collected data was analysed quantitatively using statistical analysis.

Semi-structured interviews have been conducted as cases studies. All level of staff was invited to interviews they are Managing Director; Director Associate Director; Senior Quantity Surveyor; Assistant Quantity Surveyor; Trainee Quantity Surveyor. The above 6 interviewees have been purposely selected given their individual roles and varied level of experience, which should be reflected by their responses to the interview.

As BIM is currently becoming the buzzword among the construction industry, an assumption was made prior to the research investigations that a few organizations are taking BIM as potential business marketing, which led to the claims of implementing BIM, although their statuses were arguable. Many publications recognize as the primary technology for BIM the use of 3D parametric tools (Construction Project Information, 2009; Eastman et al., 2011; Elvin, 2007; NIBS, 2007; Smith &Tardif, 2009). Therefore, organizations were selected based on the use of BIM tools such as Revit, Costx.
To identify the company which at least, has started implementing BIM / engaged in a BIM-based process, a few techniques were engaged:

A. Direct communication with QS organizations in Sri Lanka
B. Attachment and collaboration with ICTAD and IQSSL (Institute of quantity surveyor's Sri Lanka)
C. Direct communication with Construction professionals in Sri Lanka

Nine companies were identified through the above techniques, contact numbers and email addresses were obtained. Applications for conducting preliminary interviews were then requested via phone calling and emails. Out of Nine companies, 5 positively responded to the request. A preliminary interview is a process where the researcher attempts to get a brief picture regarding the current involvement of BIM within the company.

Following questions were asked during the preliminary interviews, which are:
A. As part of the screening process: To make sure the company has fully/partially incorporated BIM into their business.
B. As part of refining the interview question: To get a brief picture of the company. This information helps to identify related questions that suit the company level of BIM usage.
c. As part of the research strategy: To develop trust and credibility so that the researcher could gain access to carry out data collection.

4.0 Discussion

4.1 Awareness of BIM

The questionnaire was mainly focused on the awareness of BIM and its benefits of quantity surveyors in Sri Lanka. According to the findings, 88% of respondents have at least heard about BIM. Whereas, 12% of them are not aware of what BIM is as shown in figure 4. Moreover, most of the respondents got to know about BIM mainly from websites (59%).
Apart from websites, seminars (47%), professional in the industry (41%), conferences (24%) and workshops (12%) also have increased the awareness of BIM of quantity surveyors. These results indicate that the awareness of BIM within Sri Lankan QSs is at an extensive level.

Respondents were asked to indicate "How would you describe your level of experience with BIM?" to get an idea about their current position of BIM. According to Table 2, 53% of them are in intermediate level in terms of experience on BIM. Whereas, 47% of them Novice to BIM and none of them weren't in advanced knowledge or experience about BIM. This result indicates that, even though the BIM awareness is there, most of the respondents don't have proper experience in BIM.

Respondents were also asked to indicate their awareness of BIM benefits. 88% respond was “Yes”, which means they aware of what sort of benefits can gain by adopting BIM. Also, 12% of them responded as “NO” which means they don’t have proper knowledge about BIM and its benefits. However, it can be concluded that a majority of respondents are aware of BIM and its benefits.

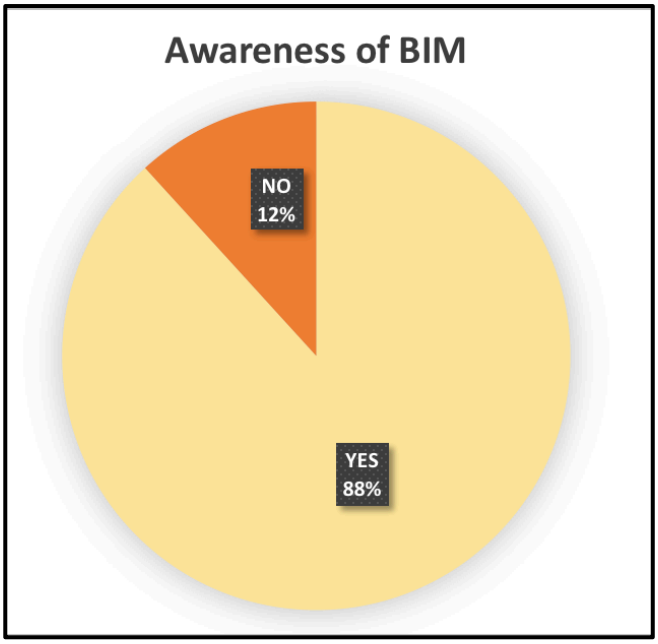

Fig. 4. BIM awareness among Sri Lankan quantity surveyors

Respondents were also asked: “Do you believe that the following benefits can be obtained by adopting BIM to improve the QS profession?” All the given BIM benefits in the questionnaire were identified through the literature by the researcher. According to figure 5, the major benefit of BIM for quantity surveyor is, it allows to have a quick cost check by capturing all items (2.47). Respondents have ranked this one in the highest position among the list of benefits given. Apart from that BIM is capable of quick alternative generations (2.00), generating design changes (1.94), clash detection (1.94), Automatically QTO (1.94), extracting quantities directly from the models (1.88), Improves the information management (1.82), improves visualization (1.59). These results indicate that a majority of the weaknesses identified in traditional cost estimating process, can be eliminated by adopting BIM.

Table 2. BIM knowledge of Sri Lankan QS

Novice	47%
Intermediate	53%
Advanced	0%

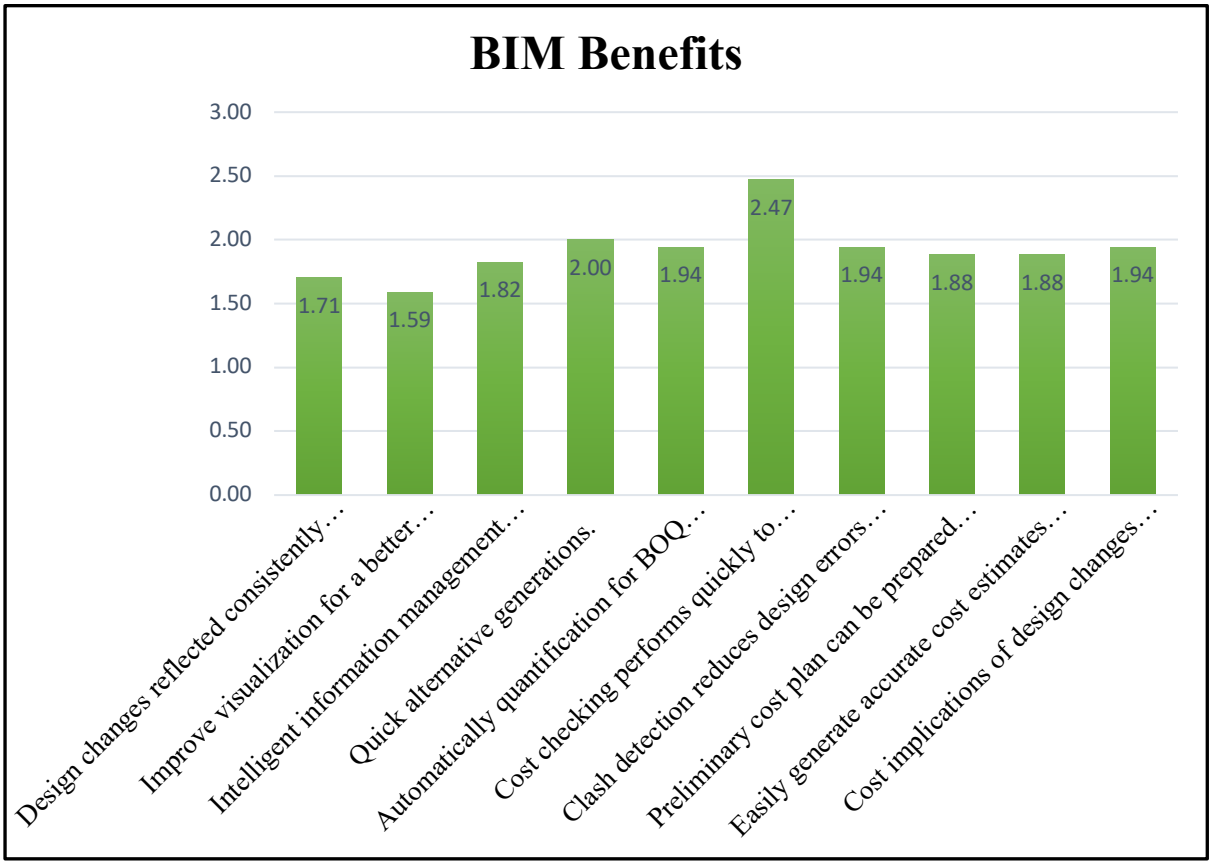

Fig. 5. BIM Benefits to cost estimate process

4.2 Readiness of Sri Lankan Quantity Surveyors and Large-Scale Quantity Surveying Organisations for BIM Adoption.

According to figure 6, out of nine BIM organizations, there were only 3 quantity surveying organizations (33%) which are currently using BIM or engaged in a BIM-based process. Rest of the organizations (67%) are not using or not in a process of adopting BIM. Organization A is the first Sri Lankan Organization who started using BIM four years ago. The organization has acquired few licenses of Revit Structure, Revit architecture, Costx-5D estimating, CATO, MS Project and AutoCAD. Most importantly, they are the first Sri Lankan organization who's dealing with the First BIM-based project going on in Havelock town, Colombo. Other two organizations also using above-mentioned BIM related tools. Moreover, they do operate in international markets such as Oman, Qatar, United Arab Emirates.

These organizations offer BIM-based services such as,

A. Author of the 3D model (Revit)
B. Extract drawings from the 3D model
C. Determine associated information such as the Material Taking Off, Weight, Surface Area and Centre of Gravity (Costx)
D. Prepare cost estimates using Costx
E. Conduct Automated Clash Check
F. Deliver Walkthrough Review

Moreover, more than 88% of quantity surveyors agreed that BIM enabled cost estimation process in more effective than the traditional cost estimation process. As BIM tools capable of improving rich three-dimensional (3D)

context by aiding QS to identify significant cost-sensitive design features (by overcoming significant limitations of 2D drawings. 3D models created by using BIM technology is capable of providing more transparency on the design for the quantity surveyors. Moreover, BIM has further helped estimators to visualize real-world conditions through a virtual 3D construction, which is a particular benefit in complex designs that are not easily represented in floor plans. Therefore, visualization is one of the basic applications of BIM through 3D models, which gives a clear picture of the project scope and characteristics, for quantity surveyors to take accurate measurements from the drawings.

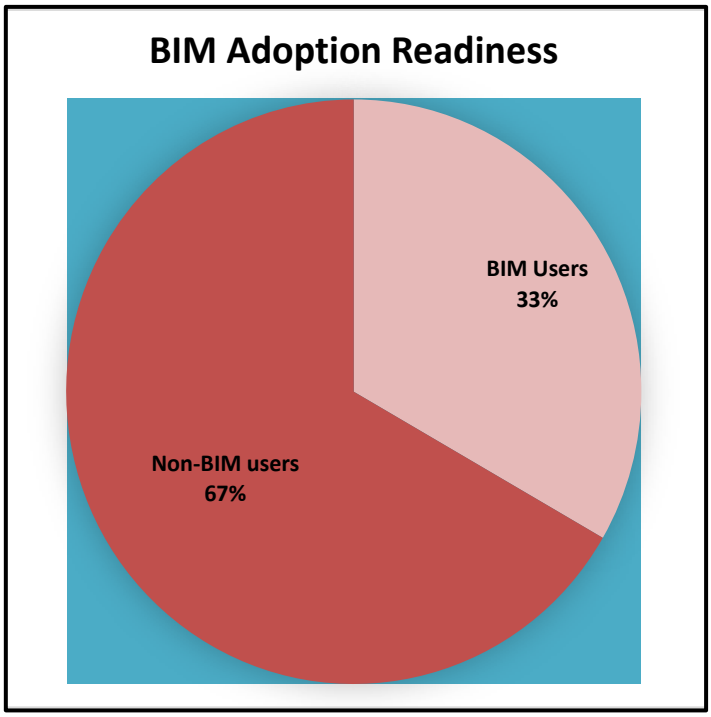

Fig. 6. Current BIM adoption rate by Sri Lankan quantity surveying organiz

Therefore, it has eliminated time-consuming tasks such as double counting, re-measurements, and missing elements. Therefore, quantity surveyors have more time to consider other aspects of the estimate rather counting on elements. Moreover, many quantity surveyors mentioned that it is very beneficial for them where the QS can carry out a 3D virtual walk-through and make sure everything in the model is factored in the QTO. Any changes made to the model such as editing of plans, sections, elevations or 3D view within the model automatically made to all other documentation, drawings, and outputs, by saving time for the manual revisions. Consequently, design errors caused by inconsistent 2D drawings are eliminated. From the QS perspective, if clashes can be addressed in the design stage, there is a better chance a variation will not occur on site.

Also, BIM allows them to identify these conflicts from the federated model before they materialize in the field and this can exclude costly variations during construction. Due to earlier clash detection, it has increased the cost efficiency of the project and reduces the risk of running behind schedule. Moreover, it has reduced errors and omissions in the design drawings by helping quantity surveyors to make correct assumptions and decisions to prepare accurate cost estimates. Apart from that, due to the rich nature of data within BIM objects, QSs allowed to extract and distinguish information from the 3D model beyond traditional measurements, such as the number of columns within a particular material characteristic. Quantity surveyors can upload or download any information at any stage of the project from these models. Moreover, information can be easily picked from the model to perform an order of magnitude and elemental estimates, even if the geometry from BIM at early stages of design comprises in few quantities. Most importantly the most useful tasks that can be automated through BIM use is quantity take-off (QTO). A BIM-based model is an assembly of objects defined by specific properties, some of which are the element's geometric attributes. Most BIM tools contain routines to perform calculations using the element's geometric properties and provide spatial quantities like area and volume in text form. BIM-based QTO is reported to provide simpler and yet more detailed and accurate cost estimates of the project, reducing time and expenses.

5.0 Conclusion

Even though most of the recent publications stated that BIM is a Buzzword for the Sri Lankan construction industry, this study indicates that it's not a buzzword for the Sri Lankan construction industry anymore. According to the findings Sri Lankan quantity surveying organizations already started using BIM, and it can be categorized as BIM level 1 according to the Bew & Richards BIM Wedge diagram 2008. They've improved the accuracy of cost estimation process after using BIM and experiencing the other sides of BIM benefits as well.
These organizations have future plans to improve the use of BIM by achieving BIM level 2.
However, a majority of QS based organizations (67%) are still not using BIM. The major reasons behind this would be unidentified BIM adoption drives and barriers. Also, a nationally developed BIM adoption framework will be a key requirement for BIM adoption.
Therefore, it is recommended to developed BIM adoption framework by identified BIM adoption drives and barriers. Moreover, government intervention will also successfully lead BIM implementation within the Sri Lankan construction sector.

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