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A STUDY ON CONSTRUCTION COST MANAGEMENT USING BIM

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Abstract—The growth and development of IT (Information Technology) in construction leads to steep incline in advanced construction management. Building Information Modeling (BIM) is a technology and an intelligent model based process to manage construction projects. The traditional methods of manual quantity takeoff and cost calculations, where the designers use 2-D diagrams are the cause for 60-70% of errors that occur in construction management. Using BIM in construction management minimizes such errors. In this paper, BIM and its role in construction cost management are studied by having Revit Architecture software as a tool. This is followed by a study on the current scenario of BIM in construction industry all over the world.

Keywords—Building Informational Modeling (BIM), Cost Management, Revit Architecture.

I. INTRODUCTION

The development of computer technology promotes reform of information technology. Building information modeling (BIM) is thus applied in cost management of large engineering projects. Thus, some shortcomings of traditional project cost management are solved and improved. BIM leads building industry to enter a higher level. It brings convenience for managers to predict, analyze and solve various problems in the initial design stage. BIM can vividly confirm the material mobilization time and resource consumption within schedule scope, reduce storage cost and unnecessary material loss to the largest extent, and carry out dynamic project cost management. BIM technology has an important position in cost management of large engineering projects. (ICETIS 2014)Buildings consume huge proportions of scarce resources. Resource allocation and reduction are major drivers toward BIM implementation, whether it be using renewable or recycled materials or reducing energy consumption. Stakeholders hope that BIM will be a key in reducing construction resource consumption. In 2004 the Construction Industry Institute estimated that 57% of money spent on construction is non-value-added, which is WASTE. With the U.S. construction market estimated at US$1.288 trillion for 2008, at 57% waste, over $600 billion per year is being wasted. A large portion of the money spent in the construction industry is wasted as shown in figure 1. (InfoComm International, 2011)

WASTAGE IN CONSTRUCTION INDUSTRY

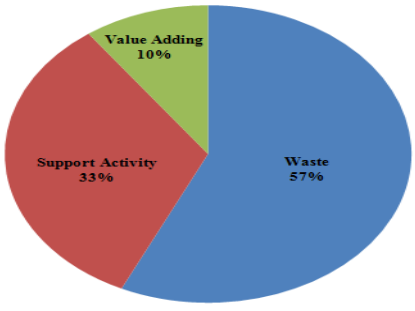

Figure.1Survey Review

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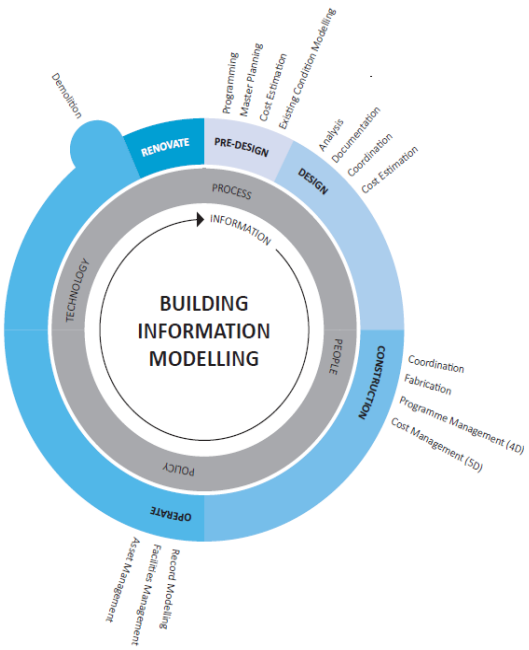

Figure 2.Building Information

The key principal is that BIM is not any single act or process. It is not creating a 3D model in isolation from others or utilising computer-based fabrication. It is being aware of the information needs of others. A BIM model can contain information/data on design, construction, logistics, operation, maintenance, budgets, schedules and much more. The information contained within BIM enables richer analysis than traditional processes. Information created in one phase can be passed to the next for further development and reuse (New Zealand BIM Handbook, 2014). The BIM is used for the complete life cycle of any construction project. The life cycle of construction project is described in figure 2.

II. REVIT ARCHITECTURE

After one decade in the architecture, engineering, and construction (AEC) space, the Autodesk Revit Architecture software continues to be unique in its holistic building information modeling (BIM) approach to design integration. Sure, there are other BIM-ish tools that allow to design in 3D. Revit Architecture provides the unique ability to design, manage and document project information from within a single file. Because all data resides in a single project file and can work in virtually any view to edit your model (plan, section, elevation, 3D, sheets, details, and even a schedule). The user interface (UI) of Revit Architecture is similar to other Autodesk products such as the Autodesk AutoCAD, Autodesk

III. BUILDINGINFORMATION MODELING

BIM is the sharing of structured information. There are many definitions of BIM (Building Information Modelling). The focus will vary from designers to constructors and operators. BuildingSmart defines “BIM is a digital representation of the physical and functional characteristics of a building. As such, it serves as a shared knowledge resource for information about a building, forming a reliable basis for decisions during its life cycle from inception onward.”.

THE LIFE CYCLE OF CONSTRUCTION PROJECT

Source:NewZealandBIMHandbook,

Inventor, and Autodesk 3ds Max products. You might also notice that it’s similar to Windows-based applications such as Microsoft Word and Mindjet’s MindManager. All of these applications are based on the “ribbon” concept: toolbars are placed on tabs in a tab bar, or ribbon. (Autodesk Revit Architecture 2014 – Essentials)

Revit is the best-known and current market leader for BIM in architectural design. It was introduced by Autodesk in 2002 after Autodesk acquired the Revit program from a startup company. Revit is a completely separate platform from AutoCAD, with a different code base and file structure. Revit is a family of integrated products that currently includes Revit Architecture, Revit Structure and Revit MEP. It runs on Windows OS and on Macs, using the Windows BootCamp plug-in. it runs on both 32- and 64-bit processors and versions of the OS. (BIM Handbook, 2011).

IV. BIM AND COST MANAGEMENT

Building Information Modeling (BIM) is becoming a comprehensive collaborative process in the construction industry. Despite its short history, BIM has had an increasing growth during the last decade. This is happening mainly due to its capabilities on construction projects. BIM can create a common language between all parties and system divisions in a project and make them an integrated team. The approach of BIM strongly matches with integrated project delivery systems. The role of BIM as a coordinator of project system is quite similar to the duties of a project manager. BIM integrates different disciplines by effective communication, analyzes the project systems for constructability, estimates the cost and time of projects at any time using quantity takeoffs, draws a big picture of projects using visualization and builds collaborative teams. All these are what a project manager does in a different scale during a project life

cycle. BIM fosters collaboration in the early phases of a project between team members through the use of consistent and more complete information more effectively than do traditional approaches. This allows design decisions to be made that optimize the whole building at a stage when they are far less expensive to analyze, rather than the traditional approach of optimizing individual components. This should minimize the need to make changes later in the design or during the construction process when even.

construction cost and life-cycle cost of the building. Figure 3 illustrates this concept. (ASHRAE, 2009)

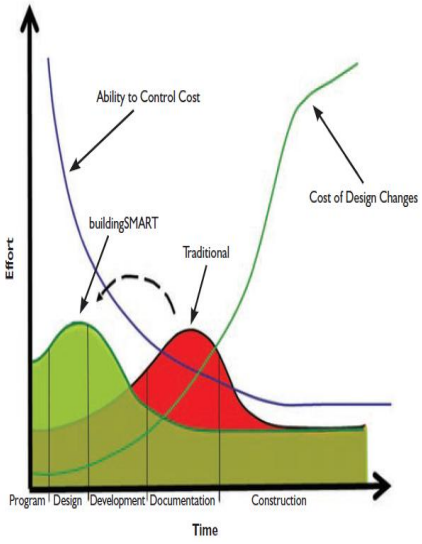

Figure 3: Ashrae

guidelines and models. The 'buildingSmart' organisation (previously called the International Alliance for Interoperability) continue to play a major leading role in BIM development and implementation in Australia that includes establishing an 'Open BIM Alliance of Australia' that involves an alliance with a number of software vendors to promote the concept of 'Open BIM' (CIBER 2012).

North America and the Scandinavian regions are generally regarded as the construction industry leaders in BIM development and implementation (Wong et al. 2009). McGraw Hill Construction (2013) found that BIM adoption by project team professionals in the North American industry had grown from 17% in 2007 to 71% in 2012 which demonstrates that BIM is now in the mainstream in the industry. This indicates that this region is leading the way on a global scale. A major catalyst for this dates back to 2003 when the General Services Administration (GSA) established a National 3D-4D-BIM program through its Public Buildings Service (PBS) Office. As a major public sector client with approximately 8700 buildings across the United States this program has had a tremendous influence on BIM adoption thus demonstrating the importance of major client and government leadership for the industry (Building Smart 2012). Brown (2008) found that there was a significant increase in support for BIM in the United States following the publication of two major reports by the National Institute of Standards and Technology (NIST) that measured the cost consequences of inadequate interoperability in the capital facilities sector of the US construction industry. They estimated the annual cost burden to US$15.8 billion. The Scandinavian region also has a strong BIM development and implementation track record.

Government mandates for the use of BIM on government projects have provided further impetus in countries such as Finland, Norway, and Denmark. The Finnish Government has invested heavily in IT research in the construction industry since the 1970s (Granholm 2011). They recently released a Universal BIM Guide for the industry which is being heavily supported. The Finnish public sector is the key driver in BIM adoption with Senate Properties, a major government entity with a property asset portfolio of approximately 6 billion Euros, a major leader requiring BIM on their projects and undertaking many pilot and research projects. Across the industry BIM is used on 20-30% of government projects with predictions that this will increase in the near future to 50% (Koppinen & Henttinen 2012).

In Denmark, the Danish Enterprise and Construction Authority established a Digital Construction Program in 2007 that has been implemented by major government entities. The program requires that BIM is used on all projects over 5.5 million Euros with information exchanged using the Industry Foundation Class (IFC) format. A number of reports and guidelines have been produced to assist firms in meeting these requirements (Building Smart 2012).

In Norway, Statsbygg is the Norwegian government's construction and project management representative and requires the use of BIM on all public projects. The Norwegian government is a strong supporter of BIM and invests heavily in research and development (Granholm 2011).

In the United Kingdom the government has introduced a BIM implementation strategy for the UK construction industry that is considered by many to be the most ambitious and advanced centrally driven BIM implementation program in the world (HM Government 2012). The objective is to transform the UK industry into a global BIM leader in a relatively short space of time (Withers 2012). In May 2011, the UK Government Construction Strategy was published which detailed the government's intention to require BIM on all of

its projects by 2016 through a 5 year staged implementation plan. BIM is seen as central to the government's objective in achieving a 20% saving in procurement costs (Cabinet Office 2011). This strategy has had a dramatic impact on the UK industry as firms scramble to develop the necessary technological capabilities to meet these requirements. This strategy has the potential to influence BIM implementation on a wider global scale as other countries take note of these developments standards.

Singapore is also emerging as a world leader in BIM implementation. The Singapore Building and Construction Authority (BCA) have developed a strategy to have BIM widely implemented on public projects by 2015 (Granholm 2011). The government has also established a Construction Productivity and Capability Fund (CPCF) of $250 million with BIM a key target. In 2000, the Construction and Real Estate Network (CORENET) program was established as a strategic initiative to drive transformation in the industry through the use of information technology. CORENET provides the infrastructure for the exchange of information amongst all project participants. The CORENET e-Plan Check system for development applications is a further initiative to encourage the industry to use BIM. The system enables architects and engineers to check their BIM designed buildings for regulatory compliance through an online 'gateway'. Singapore has adopted the Industry Foundation Classes (IFC) as the standard for BIM implementation (Building Smart 2012). (Dr. Peter Smith, 2014)

A. In India

India's AEC industry creates enormous employment opportunities across various sectors related to the construction field. The national Gross Domestic Product (GDP) increased by $70 billion in the year 2014-15 (approximately 13% growth in GDP). The Indian construction sector is very big and has a large scope for new implementation. The major companies are sub divided into small, medium, large companies and we have a very high practicing of contracting. Further it is sub-divided into many divisions where nearly 40 million people are working in daily basis for fewer amounts. After the general election 2014 India has planned for more investments on construction and infrastructure development of the country. The planning commission has been ready to take the Indian construction industry to next leap. New development technologies have to be implemented and should be adapted by Indian AEC industry sector. For the fast growing Indian construction sector, by adapting and accepting new technology the amount of time taken for the work will be immensely reduced.

BIM is widely used and custom-made within the developed countries, into developing countries it's not in an exceedingly massive scale. In India, BIM technology is still in a developmental stage. India is a complete distinction to its alternate western countries in terms of BIM technology. We've less recognition to BIM in Republic of India compared to alternative countries. The most important purpose is that the price of implementing any new BIM computer code. Furthermore, the accessorial price of upgrading the hardware and educating the workers for BIM usage on the development is quite high. In India, implementing such a pricey technology may appear non-satisfying to the AEC businesses, considering the very fact that, the masterful and unskilled labour is cheap, and without delay accessible. Although we tend to see a gradual rise of implementing BIM in AEC business in next 4-5years the expansions are in an exceedingly massive scale. Main reason for slow growth is lack of masterful folks and investments. Once, several businesses see full implementation of BIM full-fledged project and its output in India. The Republic of India will have an enormous impact for the tutorial and analysis fields through collaboration between the governments and therefore the industries thereby causing parallel sectors and rising economies to develop BIM implementation methods.

The awareness of BIM within the Indian business is growing in great way however examination to international business, would like a faster development of growth and acceptance of BIM everywhere in India. Prime AEC businesses ought to begin shifting to BIM for a better future and growth on company as wells the construction industry everywhere in India, the amount data ought to be improved and plenty of business ought to begin adopting to the new technology. (ICASCE, 2016)

BIM AWARENESS IN INDIA

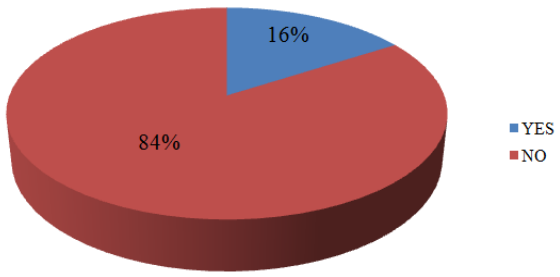

Figure 4

Source: ICASCE, 2016

LEVEL OF BIM KNOWLEDGE IN INDIA

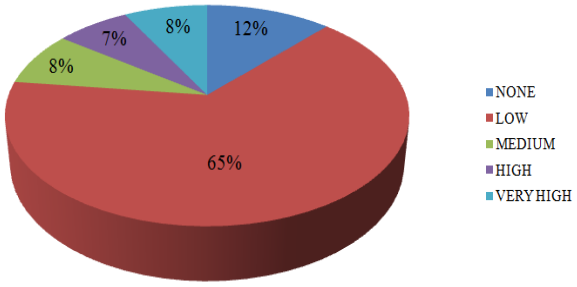

Figure 5
source: ICASCE, 2016

CONCLUSION

From the study made above, it is clear that BIM is the fast growing technology in the construction industry worldwide. Implementing BIM in construction project will lead to better cost management and reduction in wastage. The information obtained from BIM process can be used effectively in various construction processes. The errors occurring in the cost calculation while using traditional methods are minimized to a maximum rate while implementing BIM technology. Thus the usage of BIM in the construction projects leads to the better cost management with less time and effort.

REFERENCES

[1] Dr. Peter Smith (2014), "BIM & the 5D Project Cost Manager", Procedia - Social and Behavioral Sciences 119 (2014) 475 – 484, DOI: 10.1016/j.sbspro.2014.03.053.

[2] Lei Lan (2014), "BIM-based cost management of large engineering projects", International Conference on Education Technology and Information System (ICETIS 2014), China.

[3] Padmini. R (2016), "Scope of Implementing Building Information Modeling In Architecture Engineering Construction (AEC) Firms of India", International Conference on Architecture, Structure and Civil Engineering (ICASCE'16), London (UK), 26-27 March 2016, ISBN 978-93-84422-62-2.

[4] American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE, 2009), "An Introduction to Building Information Modeling (BIM)", 3 November 2009, American Society of Heating Refrigerating and Air-Conditioning Engineers Inc., Georgia.

[5] [5] Autodesk Building Industry Solutions (2002), "Building Information Modeling", Autodesk Inc., USA.

[6] [6]BIM Acceleration Committee (2014), "New Zealand BIM Handbook", July 2014, ISBN 978-0-473-29223-2.

[7] [7]Chuck Eastman, Paul Teicholz, Rafael Sacks and Kathleen Liston (2011), "BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors", 29 March 2011, ISBN: 9781118021675.

[8] [8]InfoComm International (2011) "Building Information Modeling (BIM)", Guide February 2011.

[9] [9]Ryan Duell, Tobias Hathorn and Tessa Reist Hathorn (2013), "Autodesk Revit Architecture 2014 – Essentials", John Wiley & Sons Inc., Hoboken, ISBN: 978-1-118-57508-6.

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