

# INTEGRATION OF EMERGING TECHNOLOGIES IN CONSTRUCTION INDUSTRY

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**Abstract** - In today's digital economy, integration of technologies plays a crucial role in the successful delivery of major construction and infrastructure projects. The construction industry has been adjudged to be at the verge of a technological revolution, with many technologies promising innovative solutions to the industry's age-old problems of coordination and delivering projects on time, on-budget and to client's specifications, through what has come to be known as integrated project delivery. The step-change in construction practice envisaged has, however, largely remained limited in scope, with variations from one project or firm to another. The systematic review of the evidence in this paper shows how technologies are being used in the delivery of building and infrastructure projects at various stages in the project life cycle and into the life of the assets. The review is focused on the problems, challenges and potentials of various technologies, such as Information and Communication Technology, Building Information Modelling (BIM), Mobile technology. Lastly, the ways in which the literature theorized various phenomena in the field were analyzed and the implications for construction practice were explained.

**Keywords**— *Integration, technologies, Building information modelling, Information technology.*

## I. INTRODUCTION

Traditionally the construction industry is known to have passive reaction for emerging technology. In recent years, the technology available to increase productivity has seen rapid adoption and advancement. The recent development in the computational tools and hardware has correspondingly enhanced the construction methodology also to keep pace with the developments in design developments. For example, the development in concrete technology has led to the use of automated batching plants, temperature controlled transit mixers and placer booms. In an identical manner, Project management, Estimation and Building Information Modelling technologies are now commonly found in construction. The need for efficiency in managing the construction process and emerging technologies is the result of best opportunities to improve the construction process through better integration and efficiency.

The growth of new technologies in the construction industry is expected to have impact on the way construction is performed in future. With any new

methodologies, there are expected to be changes in the composition of workforce. In the recent past emerging technology in the construction industry has focused on communication and collaboration, as the benefits to the construction process by improvement in these areas is obvious. Two types of technology have dominated in these areas, building information modelling (BIM), which has established a solid reputation for collaboration and cloud computing, which has emerged more recently as a solution for collaboration.

## II. REVIEW OF LITERATURES

### A. Application of Building Information Modelling in construction projects

Building Information modelling (BIM) tool provides extensive information about the nature & magnitude of work, documentation, specification, design, planning and scheduling construction resources, workmanship, quality, safety, energy analysis, life cycle costing etc. In the past, few decades, there have been growing interests of the construction sector using BIM due to many benefits & effective utilization of resources during design, planning & construction of new buildings. The BIM is mainly focused on developing different models by adding time, cost and energy analysis in existing 3D model. It has potential to increase efficiency of the project, minimize waste and increase sustainability across construction projects. Although, studies in the past reported the application of BIM mostly in building construction; however, limited studies have been reported in infrastructure.

### B. Application of Information Technology in construction management

IT has considerable influence in the field of construction and plays important role in the management of construction Industries. From the planning to the implementation and controlling, IT helps on every stage of the construction and its management, by enhancing the Work-ability with the advancement in the methodology. Many researchers have presented new ideas for supporting the construction management using IT. With every new construction technology, the working process enhances and gives new methodology

of construction. The main use of information technology is to automate and integrate the functions of construction project aiming increased productivity. IT has decisive impact on every stage of construction management such as planning, scheduling, implementation, controlling and monitoring. It also helps the decision maker to avoid/overcome the delays and wastage of the time, material and assets by providing real-time data.

### III. TECHNOLOGICAL ADVANCEMENTS IN CONSTRUCTION INDUSTRY

#### A. Building Information Modelling

Building Information Model is primarily a three-dimensional digital representation of a building and its intrinsic characteristics. It is made of intelligent building components which includes data attributes and parametric rules for each object. BIM provides consistent and coordinated views and representations of the digital model including reliable data for each view. This saves a lot of designer's time since each view is coordinated through the built-in intelligence of the model. Building Information Modelling is the process and practice of virtual design and construction throughout its lifecycle. It is a platform to share knowledge and communicate between project participants. CAD is no longer just about drafting. Autodesk BIM solutions allows to explore and evaluate a project's constructability before it's built, improve cost reliability, visualize construction processes through 4D simulation and clash detection, increase coordination between stakeholders throughout the design and construction process, and better predict, manage and communicate project outcomes.

#### B. Information and Communication Technology

Information Technology describes technologies and equipment that can be used to store, retrieve, transmit and manipulate data. Information and Communications Technology is a specialist application of Information Technology that has some aspect of communication. It includes areas such as; software development, mobile devices, cloud computing, data centers, cyber security, research networks, support and so on. Design and construction are information intensive activities, involving a large number of people collaborating to produce complex, one-off developments. Whilst historically, information may have been managed and communicated using paper-based systems and verbal instructions, the integration of the supply chain, the introduction of computer aided design (CAD) and building information modelling (BIM) and the development of mobile computing means that ICT is becoming a fundamental part, not just of the design office, but also of the construction site.

### IV. RESEARCH DESIGN

Research design refers to the conceptual structure within the study conducted. A research design indicates a plan of action in connection with the proposed study. The steps involved are:

1. Data collection
2. Questionnaire survey
3. Analysis

#### A. Data Collection

The Data collection is the most important step in this project. Various technologies that are used in the construction industry are collected from various literatures. Four major technologies were identified and were put into a questionnaire. The technologies identified are listed below:

1. Information and Communication Technology
2. Building Information Modelling
3. Mobile Technology
4. Construction related software

#### B. Questionnaire survey

The questionnaire is the key element of this thesis. Respondents were asked to fill the questionnaire based on their experience and knowledge. Questionnaire was prepared comprising of five sections. The first section dealt with some of the questions related to the respondent's experience, organization and they were administered to three groups of respondents, viz., contractor, consultant and engineer. The second section comprised of questions related to Information and Communication Technology in their projects and the skills of IT staff. The third section consists of questions related to Building Information Modelling. The fourth section comprised of questions about the use and benefits of construction related software. The next section was related to the use of mobile technology.

#### C. Analysis

After the survey is completed, the data is analyzed. This also gives a statistical output in the form of charts which represent the percentage of respondent for each question.

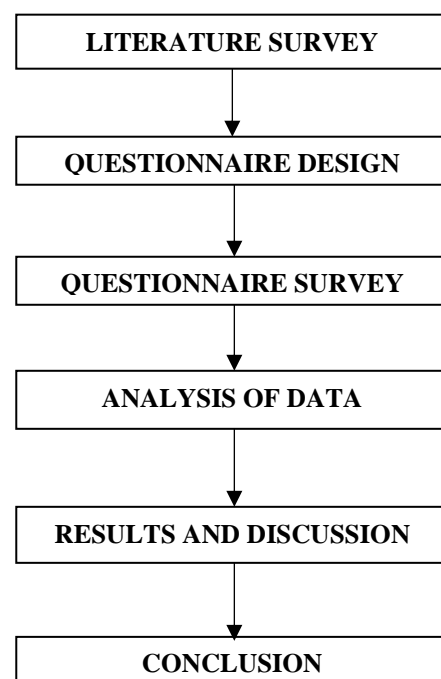


Fig 1. Methodology

**V. RESULTS**

The questionnaire was distributed among Contractors, Consultant and Engineers. Totally 25 respondents duly completed the questionnaire survey. The statistical representation of each of the questions included in the questionnaire in all the sections were represented below in the form of pie chart.

**A. Organization Information**

The survey respondents are from many industries including residential, commercial, industrial and manufacturing. The majority, over 50%, build in residential construction and 40% in commercial construction. Most of the organization were medium sized and they undertake residential projects.

**B. Information and Communication Technology**

Over 43% of survey respondents do not have a dedicated IT department at their companies. The likelihood of having an IT department increases the larger the company size and the more the sales volume. However, just because a company lacks an IT department doesn't necessarily mean no employees are dedicated to IT.

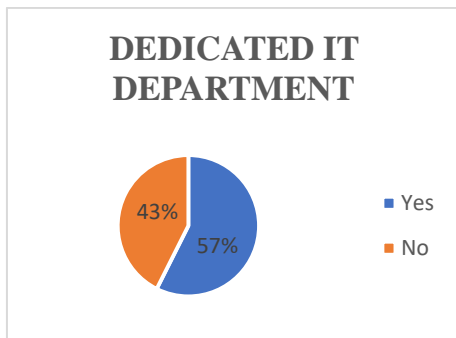


Fig.2 Dedicated IT Department

When asked how their companies determine the number of IT department staff needed, over 47% said it is a function of the number of total employees on staff. 30% said IT staffing depends on the number of technology solutions needing support and 19% said IT staff depends on the size and scope of upcoming projects. Only 4% said IT staff is dependent on budget allowances.

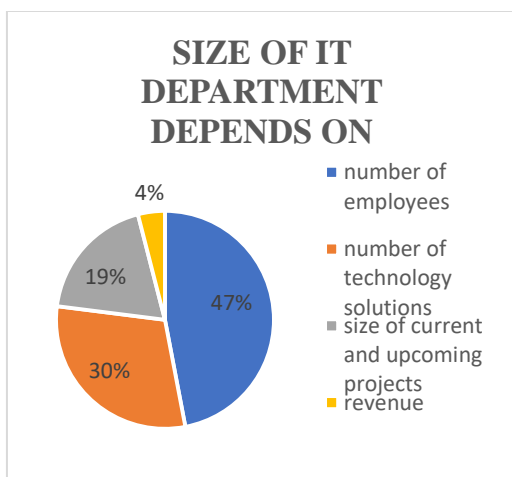


Fig.3 Size of IT Department

About 60% of the respondents said that the level of Information and communication technology awareness in their organization is medium, 30% respondents said ICT awareness in their organization is high and 10% said poor ICT awareness in their organization.

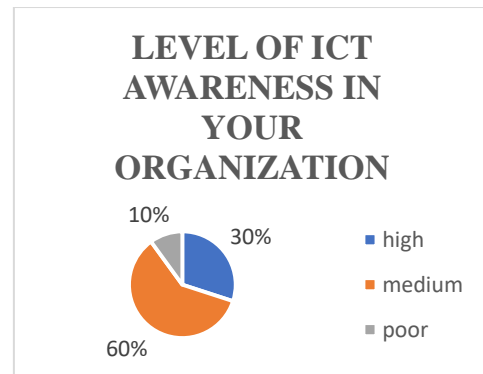


Fig.4 ICT Awareness

**C. Building Information Modelling**

About 45% of the respondents said that the current use of BIM tools in their organization were 50% to 75%, thirty percent of respondents said the use of BIM tools in their organization were about 25% to 50%. Only five percent respondent selected the use of BIM tools above 75%.

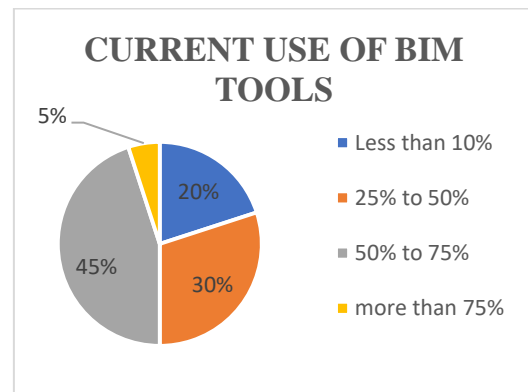


Fig.5 Current use of BIM tools

For the factors controlling the use of BIM, about 45% of the respondents have chosen inexperienced users, 30% respondents selected lack of sufficient time to evaluate, 15% said too expensive software.

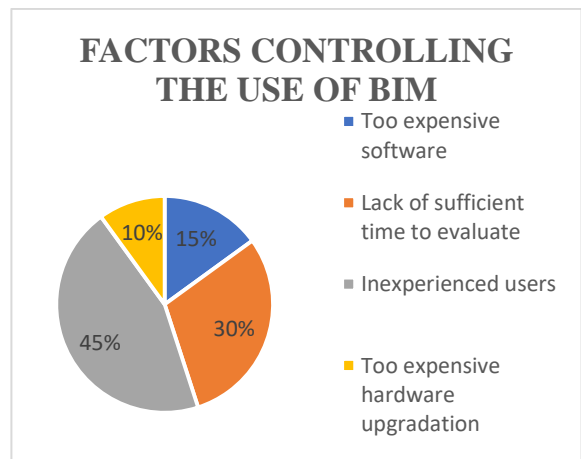


Fig.6 Factors controlling use of BIM

**D. Construction related software**

About 60% of the respondents have chosen Microsoft Excel for estimating purposes whereas 20% use spreadsheets. 10% of respondents prefer onscreen take off and 8% use sage estimating software.

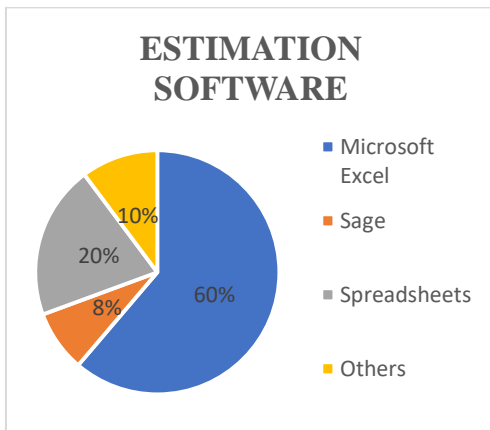


Fig.7 Estimation software

Both Microsoft Project and Primavera P6 continue to hold their rank as the two most popular scheduling tools for construction companies.

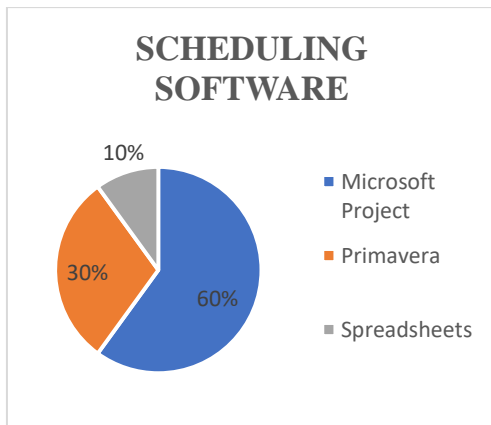


Fig.8 Scheduling software

The respondents chose Skype as their most preferred conferencing and communications software, jumping ahead of WebEx by 30%. Other conferencing and communication software preferred by the respondents were GoToMeeting and Microsoft Lync. About 10% of the respondents prefer facetime as conferencing and communication software.

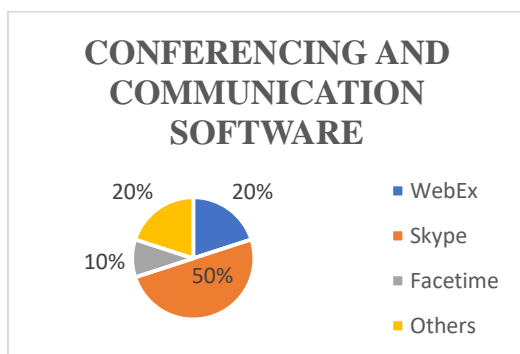


Fig.9 Conferencing and Communication software

File storage and collaboration solutions, showed Dropbox as a clear favourite. Many builders commented that they also use it for personal reasons, and sometimes use their personal Dropbox at work if their company does not have an account.

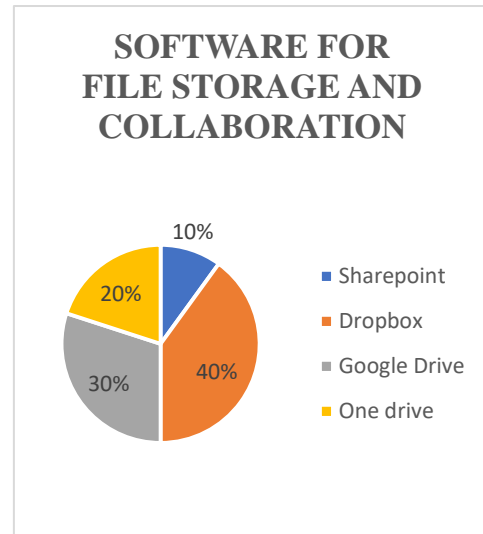


Fig.10 File storage and collaboration software

**E. Mobile Technology**

When it comes to mobile operating systems in use for construction, the most widely used operating system selected by many respondents is Windows followed by Android and ios respectively. About 35% respondents selected Windows operating system and 30% respondents selected Android and ios respectively. Only 5% respondents selected blackberry operating system.

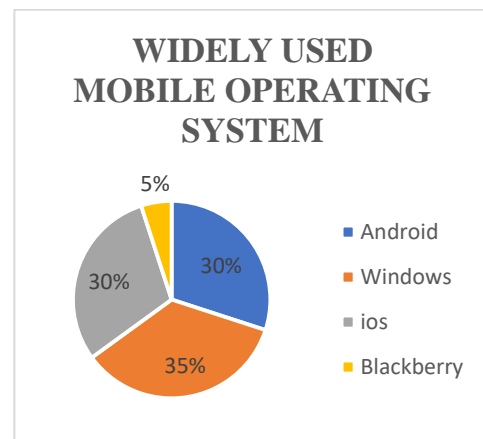


Fig.11 Mobile Operating system

**F. Limiting factor for the adoption of new technology**

After establishing a strong comfort with trying new technology, survey respondents were asked to identify the most limiting factors in their companies adopting new technology. Lack of staff to support the technology was the most common answer at 45%, followed closely by budget at 35% and employee hesitance at 20%.



## LIMITING FACTOR IN ADOPTING NEW TECHNOLOGY

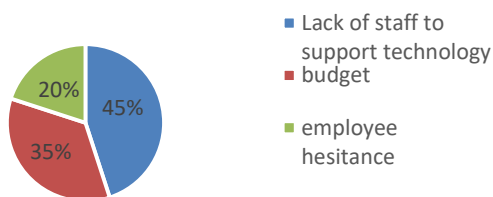


Fig.12 Limiting factors in adopting new technology

## VI. CONCLUSION

Construction Management is the art of bringing the project on time and within budget despite all the variables and specialties. To achieve the perfectness in the construction, IT helps allot in the same. Rapid evolution of ICT offers opportunities to enhance communication between participants in construction projects and to enable more effective and efficient communication. ICT applications also aid operational improvement through communication of construction information for effective decision-making and coordination. IT plays an important role in the construction management and support at almost every stage, such as planning, execution, monitoring, controlling, resource levelling, equipment management, costs and assets management, etc. From the use of IT in construction industry, the working ability enhances highly and gives the more accurate results. Information technology has been positively impacting construction productivity and will likely continue to do so in the future.

There is limited introductory BIM training available and, if available, training is at the professional high end of BIM, aimed at Architects, Engineers etc. In response to the survey question, "Are you aware of BIM", 60% of respondents answered No, among those sixty percent respondents 50% of them interested in a short practical introductory course. This appears to indicate that there may be a need for this type of training for employers and employees unfamiliar with BIM. The introductory course would enable them to obtain a basic understanding of BIM and to decide if they would like to engage in further training. The survey explores the BIM potentials when used in the field to better communicate and integrate construction information across different trades, allowing for efficient work processes and better decisions.

This study provides a proof that technological devices have impact on information and communication technology (ICT) acceptance for construction site management. These reveals the need for assessing the effectiveness of the technological devices is vital to both contractor's companies and the ICT providers. There is a need to assess the character of a technological device, because it helps in making a right choice, and enhance its acceptance for the construction site management

## ACKNOWLEDGMENT

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