American Journal of Engineering Research (AJER) 2021
American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-10, Issue-02, pp-149-157
www.ajer.org
Research Paper Open Access

An Analysis of Adoption and Barriers to Implementation of Building Information Modeling in Ethiopian Construction Industry

Misgana Abebe Gutema
Assosa University, Asosa, Ethiopia
Corresponding Author: Misgana Abebe Gutema

Abstract: *This research aimed to study Building Information Modeling adoption and barriers to implementation in Ethiopia that may encounter while adopting. Four parties who are the critical stakeholders in the Building Information Modeling adoption and implementation were Ethiopian Construction Project Management Institute experts, Consultant, Contractor and Client having a total of 9(nine) participants those identified in a preliminary survey. The data collected was through records and reports from the file, interview as well as observations. The methodology used for this research was based on purely qualitative research techniques. The study findings are presented in three main thematic areas. Building Information Modeling Level of awareness and knowledge in the construction industry, Building Information Modeling adoption and barriers in the construction industry and the culture of Building Information Modeling application in construction work. Ethiopian Construction Project Management Institute adopted Building Information Modeling in the activities at the office level and is set the roadmap to implement on each construction industry in 2024 is mandatory. To improve the culture of using the Building Information Modeling system by implementing it in higher educational institutions and construction industries. Also, through awareness creation, training of all construction stakeholders will help to get better the culture of using Building Information Modeling in the construction industry. The study recommends the concerned bodies should be motivated to implement the Building Information Modeling in construction project activities without any confusion on the benefit.*

Keywords:-*Building Information Modeling, Adoption, Barrier, Implementation*

Date of Submission: 24-02-2021 Date of acceptance: 28-02-2021

I. INTRODUCTION

The Building Information Modeling as the process of generating and managing building data during its life cycle using three-dimensional, real-time, dynamic building modeling software to decrease wasted time and resources in building design and construction. This process produces the building information model, which encompasses building geometry, spatial relationships, geographic information, and quantities and properties of building components, including the life-cycle processes of construction and facility operation.

Currently, the modeling industry in developed countries can support not only 3D models but also, the construction management areas of scheduling, cost control, estimating, safety training and sustainability.

The focus of this study is to investigate the adoption and what issues/problems one may face to implement Building Information Modeling in the construction industry of Ethiopia. Prior knowledge of potential issues/problems could be the difference between successful adoption and a failure to adopt Building Information Modeling in a timely and cost-effective manner and the barriers of implementation lead to failing the successful adoption.

To describe it clearly, Current Building Information Modeling software technology provides interoperability between the 2D paper drawings, Excel spreadsheets, construction schedules, and other 2D information and the Building Information Modeling model. If the design is changed in the 3D model, the 2D information is automatically updated. Similarly, if the design is changed in the 2D document, the 3D model is also automatically updated. This interoperability saves time, reduces errors and can provide an advantage to the designers while ensuring consistency between all types of information documenting the project. The second section of this paper shows three methods for monitoring systems of solar plants. The third section discusses

communication and monitoring system for wind turbines, and finally the conclusion is discussed in the fourth section.

II. LITERATURE REVIEW

Building Information Modeling has gone beyond being just a drawing and documentation tool; and it is not solely about software, but represents a more collaborative method of working (NBS, 2015); most importantly, it remains the most potential development in the world of construction industry (Chan, 2014).

There is significant adoption of Building Information Modeling at design and construction stages in countries like United Kingdom (UK), United States (US), Germany, Australia and New Zealand. On the other hand, UK's Building Information Modeling uptake could be seen as not meeting the expectations with the present alternating adoption rate (Chan, 2014).Building Information Modeling, the process began as a common name for a variety of activities in object-oriented computer-aided design (CAD) that support the representation of building elements in terms of their 3D geometric and non-geometric (functional) attributes and relationships (Laine T., et al., 2010).

Due to the contemporary sophistication in construction contracts, building design and the resulting demand for the construction of quality infrastructure, the constructability challenges many construction companies face are very sophisticated and cannot be addressed and solved easily without the help and application of technology. (Laine T., et al., 2010) One technology that has emerged over the last decade and a half is Building Information Modeling. This technology has enabled designs to become more sophisticated as the technologies supporting Building Information Modeling have evolved.

Building Information Modeling in Ethiopia

The cost and time overruns, quality and design related problems, inefficient productivity as compared to the international norm, luck of proper project integration are the critical challenges that hinders the Ethiopian Construction industry's performance. Apart from the aforementioned critical challenges, the Industry is rapidly booming at the double digit rate of progress.

It is noted that one of the reason for such inefficiency is the industries character of being non proactive in using appropriate technologies. Among the reputable state of the art technologies that could create a real difference in the performance of the Construction Industry, Building Information Modeling takes the leading role as revealed in many developed and developing countries.

Researcher states that integration of Building Information Modeling into the curricula of Academic Institutions is useful. Government should assist the construction Firms by arranging Building Information Modeling training programs for construction Firms. Moreover, should insist integration of Building Information Modeling courses in the university undergraduates' syllabus to have a satisfactory number of Building Information Modeling operators with full and real awareness of Building Information Modeling to fill the gap in the construction projects.

On the other hand mandating Building Information Modeling in construction projects should be taken. To accelerate this process, the government should take the necessary actions to assist the organizations to change smoothly to Building Information Modeling. Dires, (2018)

Another researcher said that possible remedial solution for better adoption of Building Information Modeling as; it should be included in Ethiopian Building code as one of the integrated design modality for all stakeholders, as an integral design approach. Belay (2016)

Currently, study attempt to explain the role of Building Information Modeling in sustainable infrastructure design and delivery and it investigates the preparedness of Architecture, Civil Engineering and Construction Technology and Management undergraduate students to implement Building Information Modeling in the construction industry to attain sustainable infrastructure in Ethiopia. The research tried to identify the possible challenges faced by higher education institute in Ethiopia to offer Building Information Modeling in these programs. (Belay, 2016)

III. RESEARCH DESIGN

This research aims to examine Building Information Modeling adoption, barriers of implementation, lived experiences to identify potential issues and trends a construction company in Ethiopia that may come across while adopting Building Information Modeling. The lived experiences of adopters appear to be the best data source for this type of study which seeks to identify potential problems in Building Information Modeling adoption and barriers of its implementation in the country based on actual experiences.

Key Informant Interview (KII) and Focus Group Discussion (FGD) were used to collect qualitative data. Ethiopian Construction Project Management Institute practitioners and construction stakeholder professionals Architect, Consultant and contractor were the major participants in FGD and KII.

A multi-stage sampling technique was used to select sample professionals. The first stage was stratification of the office concerning in the country in order to accommodate the software application process. Then, professionals were divided into two experts (public and private) organization. In the second stage, one sample professional was selected from each stratum by using purposive sampling technique. The reason behind taking only professionals from each stratum is that experts can only describe about Building Information Modeling. Accordingly, Ethiopian Construction Project Management Institute and Construction industry sample professionals from the construction industry were included for the study, each representing public and private experts respectively. Thus, the total samples of 9 experts were used for the study.

These lived experiences are invaluable to a construction company in a developing country as they may help to identify and mitigate a problem before the adoption of Building Information Modeling related software. According to Creswell (2013) the problems for which the understanding of individuals' lived experience and phenomena are essential, are the best-suited problems for phenomenological research.

Industry professional interviews are as a primary data source and the data from any written material is the secondary data. Professional interviews are used broadly as a direct source of information, a qualitative approach to content analysis is considered as a suitable approach to this exploratory study.

Generally, exploratory studies are based on non-probability/purposive/ sampling of respondents; while its analyses are frequently used to create hypotheses for further study. And, it is focused on fewer respondents on the bases of single case qualitative methodology.

Qualitative content analysis is a process of utilizing textual data systematically in the development of emergent themes. Thus, the concepts to be used are driven and generated through an interpretation of respondents' statements. Qualitative research includes in-depth interviews, direct observation, and written documents. To collect these types of data for a study, a target population, community, or study area is identified first. (Creswell, 2013)

Before starting this research there was a preliminary survey study to identify the participants to conduct this qualitative research first. Then, the data was gathered from the identified participants; Architects, Engineers, Contractors and Ethiopian Construction Project Management Institute experts and project experts as a sample of the population.

The interview transcriptions were tabulated according to the answers given to the specific questions to compare the overall experiences and ideas of the interviewees for each question. As suggested by Creswell (2013), once the data organization is completed, performing a continuous analysis was done to gain an in-depth understanding of the data in hand.

Following this process helped me in the coding process as having a general understanding of the data to index the data in a more comprehensive manner. During this process, I was able to pre-identify comprehensive themes and indexes that were later used for the data in hand. After a full understanding of the data and all the essential notes taken, the answers from all interviews to each specific question were coded.

Qualitative Findings

This section is focused on the analysis of collected data that are generated through semi-structured interviews with consultant, contractor and the clients/authority who are the industry's stakeholders/experts. These interviews are carried out face to face for transcription. It is mainly to explore the inside of the industry in the key area of Building Information Modeling.

Qualitative research is a systematic inquiry into social phenomena in natural settings. These phenomena can include but are not limited to, how people experience aspects of their lives, how individuals and/or groups behave, how organizations function, and how interactions shape relationships. In qualitative research, the researcher is the main data collection instrument. The researcher examines why events occur, what happens, and what those events mean to the participants studied. (Denzin NK et al, 2011)

The method allowed the interviewees to interact freely, express their views and comment on the general aspect of the key area i.e. Building Information Modeling, hence provides an opportunity to the interviewer for generating direct, relevant and additional information.

Data Collection Methods and Tools

The study sample involves four parties who are the critical stakeholders in the Building Information Modeling adoption and implementation. This sample of four is selected by considering their importance in the industry's decision making as well as a priority by the preliminary survey.

The sample consists of three parties (Consultant, Contractor, and Client) each having one representative plus additional one from government body who representing a development control body, Ethiopian Construction Project Management Institute experts. The data collected is through records and reports from a file as well as observations.

The methodology used for this research is based on purely qualitative research techniques. The qualitative research paradigm demands an in-depth understanding of a phenomenon, an individual or a situation. (Merriam S., 2002)

In this paradigm, the qualitative research technique is more to know how people do things and what meaning they give to their lives rather than on people's surface opinions as in survey research. Hence, samples were selected from the public and private organizations that are experienced in Building Information Modeling adoption and in the construction industry to use Building Information Modeling in their projects.

Semi-structured interviews were conducted among nine respondents from the public (5 respondents) and private sectors (4 respondents) for the preliminary data collection. The face-to-face interviews were designed to gather preliminary data on Building Information Modeling application in construction projects. The interviews were recorded and transcribed verbatim for content analysis.

Data Sampling and Quality Control

The questionnaire was formed and distributed in July - September 2019. The target population was identified by the preliminary survey and the data were collected from engineers, architects, contractors, and Ethiopian Construction Project Management Institute practitioners who have some information about Building Information Modeling adoption and applications in the construction industry in the Ethiopian construction industry.

The selection of the participants is one of the initial steps taken towards data gathering and sampling. Determining the proper sample size for this research was the first step. Englander argues that small sample sizes, probably no more than 10 participants, are most suitable for this type of research while the minimum number of participants is limited to three (Englander, 2012).

Large samples may become unmanageable therefore, in this study a total of nine (9) participants were selected for data gathering purposes. Five participants contributed to the study are all currently working in the Ethiopian Construction Project Management Institute, one as directorate and four as practitioners while the other four respondents are working with AEC construction firms.

All the participants have the first-hand knowledge and experience of Building Information Modeling adoption and applications in their job and going back to the first iterations of Building Information Modeling type software. This process resulted in selecting informants that appear to be a representative sample of Building Information Modeling adopters from which to interview.

All of the respondents (R1, R2, R3, R4, R5, R6, R7, R8, and R9) were interviewed close enough to allow for a face to face interview. Simultaneously, all responses the closed-ended questions as well.

Developing the open-ended questions to start the interview was another important step in preparing for the study. The questions developed for this research were closed-ended structured and open-ended unstructured questions to start the conversation where the interviewee tells about their Building Information Modeling-related adoption experiences freely. They were also used to prompt additional information and detail as needed throughout the interview process.

IV. FINDINGS OF THE STUDY

The study findings are present in three main themes. The three thematic areas are; Building Information Modeling Level of Awareness and knowledge in the construction industry, Building Information Modeling adoption, and barriers in the construction industry and culture of Building Information Modeling application in construction works that means its implementation and promotion capabilities of the stakeholders in the construction projects. The questionnaires prepare to ask for the thematic areas of the analysis as applied in each theme and discussed.

The objective of the study are:

- To investigate the adoption and barriers to the implementation of Building Information Modeling in the Ethiopian construction industry.
- To get the awareness level of construction participants about BIM,
- To identify a barrier to Building Information Modeling (BIM) to be used in Ethiopia and
- To insight the culture of using BIM application in construction works.

BIM Level of Awareness and Knowledge in the Construction Industry

In Ethiopia, like in these developed countries, the preparation is on-going. There is little knowledge of Building Information Modeling, even at the awareness level. The practitioners' (R1, R2) point of view is that; the public has limited knowledge in terms of awareness of Building Information Modeling while talking about its adoption.

The knowledge on Building Information Modeling is good-looking below limited; it was almost heard in Ethiopia through the adoption movement by Ethiopian Construction Project Management Institute and it

appears quite stimulating. So it is at the starting level for the country. From the general point of view, primarily from any work, the knowledge is restricted to activities in the office today.

Through their experiences, the adopters can help those wishing to adopt Building Information Modeling in their firms plan for and anticipate potential barriers they may encounter when adopting Building Information Modeling in their job/firm/project. The insight from the adopters with first-hand knowledge in Building Information Modeling adoption is a valuable resource for individuals and construction companies willing to adopt Building Information Modeling.

On the other hand, some of the stakeholders (R6, R7, and R9) shared their level of Building Information Modeling knowledge and they seem to lack a clear understanding of what 'Building Information Modeling' means in their activities to implement it before the introduction Building Information Modeling by ECPMI. Now, they are forming a relationship of working together with the adopters.

Moreover, after going deep into the conversation, Ethiopian Construction Project Management Institute practitioners mostly acknowledged having used some of the lower level Building Information Modeling tools (Level 2 systems). Hence, there is an indication of limited and lower level Building Information Modeling tools utilization: a little short while of 'file-based collaboration' with CAD for objects visualization and positive reception. (Table 4.2)

The Government can support construction companies by offering periodical sessions to promote awareness and the benefits of Building Information Modeling. Also, it should raise the Firms' awareness of the challenges that firms may face and the best way to respond to these challenges during the journey to change to Building Information Modeling. These sessions should be offered by specialized Building Information Modeling institutes; all these sessions should be under the support of the Administration.

Besides, some stakeholders are not aware of anything about Building Information Modeling in the field of the construction firm. Frankly, this is the first time they are hearing about building information modeling from this research questionnaire. This is the major case to adopt Building Information Modeling in the construction site to make it applicable and known in the construction industry.

Further investment and motivation towards the use of Information Technology in the construction sector will increase the quality of the project throughout all phases of the construction. To aware the stakeholders it requires funds and time to implement Building Information Modeling in all construction sectors in the country.

But, there is awareness of Building Information Modeling and using it via their consultant regarding R9. Thus using Building Information Modeling is coming from consultants; the consultants working with are using Building Information Modeling as an infant stage since its adoption is not far in Ethiopia.

Again, there is an indication of 'lonely Building Information Modeling' users especially from the highly multidisciplinary consulting firms (ZIAS Consultant Engineering) in the country; they are practicing collaborative Building Information Modeling concepts at an organizational level only with collaboration with Ethiopian Construction Project Management Institute.

On the other hand, Building Information Modeling can be aware through training, implementing in the curriculum in higher institutions of the country as a course, by sharing experience from other countries that had more knowledge on Building Information Modeling and adopted it earlier. The need to assess the current trend like Building Information Modeling in higher educational institutions in regards to training and building the capacities of Architectural, Engineering and Construction Technology and Management students are vital to solving the sector's problems in the country.

Contractors associated lack of Building Information Modeling tools utilization with the type of training received by graduates of higher institutions (university). A new innovative way of working is not taught in schools that is why the old curriculum remains. Also, the trend of the adoption should start from training in schools to designers and subsequently the contractors.

The best way to adopting this system is marketing, and marketing must start from school. Because whatever training to get from school will be what to be using until the training with this Building Information Modeling; the marketing will start from schools, link with the construction company.

Additionally, many organizations, clients and government bodies are promoting the use of Building Information Modeling due to its advantages over prevalent methods. Building Information Modeling gives simple as well as complex solutions depending on the requirement for any party or stakeholder in a project. To add to these ideas, the professional AEC industry should contribute to the use of the Building Information Modeling program to make it the most known system in their activity.

The answer to the question 'Who promotes Building Information Modeling?' was set to be government, companies, and experts. (Table 4.2) So the ZIAS consulting firm is taking part to promote Building Information Modeling in collaboration with Ethiopian Construction Project Management Institute in the promotion of Building Information Modeling in the construction industry.

Building Information Modeling Adoption and Barriers in the Construction Industry

The professional organizations would have been the focal points for professional developments; centers where innovations are introduced, marketed and even trained. Consultants perceived the same idea of Building Information modeling adoption in Ethiopia where Ethiopian Construction Project Management Institute professionals lead its adoption before the private intervention. It's quite a good initiative; presented and accepted by the professions within the industry before the process of being legislated upon by the government. To adopt Building Information Modeling, the size of an organization has a significant influence. (Table 4.2)

To identify the Building Information Modeling Adoption and Barriers in the Construction Industry the questionnaire prepared accordingly. The following table 4.2 gives the answers to the closed-ended questions properly.

According to the above table 4.2, Lack of Senior Management Support, Cost of Implementation (Software and Training), Scale of Culture Change Required, Other Competing Initiatives, Lack of Supply Chain Buy-in, Staff Resistance and ICT Literacy, Legal Uncertainties, Ownership, and Intellectual Property, Contractual Arrangements, Product Liability Risks, Professional Indemnity Insurance and Authenticity are all the barriers to Building Information Modeling adoption in Ethiopia at moderate level. These are also described by many works of literature in chapter two.

There are several reasons why senior managers are reluctant to introduce new technologies and processes into their organizations. However, management support for the introduction of new technologies and processes is essential if the benefits are to be realized. This is also set as the barrier that senior management support brings new technology to the construction industry.

To implement Building Information Modeling, the culture of change resistance, lack of software supply chain, staff resistance and lack of legal framework is the main barrier in our country. The previous studies also identified these barriers and it was the same for this study as well. (Table 4.2)

Another factor that acts as a barrier to Building Information Modeling up-take is the number of ongoing initiatives that organizations are already engaged in. The opportunity exists for front end designers to collaborate with clients, main contractors, sub-contractors and fabricators, and other members of the supply chain for integrated project delivery. The lack of software supply chain in our country is another barrier for the implementation of Building Information Modeling in the construction industry. There is also Staff Resistance in the process of implementing Building Information Modeling in the construction industry of Ethiopia. (Table 4.2)

For this study, the various legal aspects of Building Information Modeling have been combined under the title "Legal Uncertainties" in chapter two. Thus there are concerns regarding legal issues discussed in the literature. However, there has been a legal case regarding Building Information Modeling and also there are legal issues in the construction industry as the primary and secondary data gathered shows.

Additional ideas were also asked to identify any further barriers to Building Information Modeling implementation. Five respondents gave additional comments on barriers to implementations. One suggested that there were no further barriers than those set in the questions.

The next suggested that a lack of knowledge was probably the main reason for not fully adopting Building Information Modeling to date. This was already investigated that there is a "Lack of Technical Expertise" barrier. The next comment related to ownership and liability which was investigated there is lack of "Legal Uncertainties".

Two firms suggested that "Procurement Routes" and the speed of procurement on fast track Design and Build schemes were additional barriers. They considered that this resulted in using "tried and tested" methods rather than having to take time and rethink the process. Fear of the unknown, anticipated learning curve length and the ability to take a project through from inception were the last three barriers identified.

Also, Building Information Modeling was adopted in Ethiopia by the Ethiopian Construction Project Management Institute who is leading the implementation regarding the government body. The other question was to identify whether the experts adopt or not Building Information modeling in their job. (Figure 4.1)

However, the adoption of Building Information Modeling in the country is at an infant stage, Ethiopian Construction Project Management Institute adopted it in their activity at the office level and Ethiopian Construction Project Management Institute prepared the roadmap to implement on construction industry.

The interviewees participated in Building Information Modeling adoption through the ECPMI. This can be seen as a clear lack of understanding and knowledge of the Building Information Modeling concept individually. However, a 'lonely Building Information Modeling' at modeling and collaboration stage can be noticed with the highly established consultancy firms and the Ethiopian Construction Project Management Institute Construction Management Technology Transfer practitioners.

Ethiopia has set up bodies that are involved in the setting up of guidelines and mainly used experience gathered by both private and public companies on various projects to set up these guidelines.

Therefore, in Ethiopia's Public institution, the Ethiopian Construction Project Management Institute is playing a big role in the establishment of guidelines and implementation of Building Information Modeling after adoption. Ethiopian Institute of Architecture, Building Construction Management and City Development started different research in Building Information Modeling.

For policy regarding the use of software, openly stated nothing when asking for a deep detail about Building Information Modeling until today except the roadmap preparation is by ECPMI, Construction Management Technology Transfer department.

As Construction Management Technology Transfer at Ethiopian Construction Project Management Institute precisely there is no kind of legislative backup and it is on progress to be prepared by Ethiopian Construction Project Management Institute in Ethiopia.

On the other hand, there is a need for an articulated proposal to the government regarding its potential benefits to the country's construction sector. Those who know it very well are expected to play a vital role in informing the government, while strong assurance is required by the government heads to adopting and implementing Building Information Modeling.

The government is more than ready and willing to do that there is no knowledge, no expertise along that area yet except it is being processed by Ethiopian Construction Project Management Institute. Building Information Modeling is when a proposal is articulated well and presented to the department of engineering. Ethiopian Construction Project Management Institute would work toward that line to make things much easier for them.

As they came across, Ethiopian Construction Project Management Institute concluded that achievement of Building Information Modeling needs a champion, personal effort; interest and involvement to tackle any barriers in the industry of construction industries in Ethiopia either in adoption or implementation.

The Culture of Building Information Modeling Application in Construction Works

Introducing new processes into an organization involves the shifting of the culture of the organization, which carries with it, risks and challenges that are not limited to financial considerations, but also include the flexibility of the organization’s people and systems.

The introduction of Auto CAD about thirty years ago paved a way for computer-assisted design in the construction industry. Currently, computer-based design courses are efficient and given in several undergraduate courses especially in developed and developing countries. Building Information Modeling should be taught in educational institutions as graduates with Building Information Modeling literate graduates have more advantages over Building Information Modeling illiterate graduates.

As it is seen, the scale of culture change required is one barrier of adoption and implementation of Building Information Modeling (Table 4.2) it is better to scale up the culture of using Building Information Modeling in the construction industry.

In Ethiopia, it was supposed that the consultants are relatively using Building Information Modeling tools (i.e. Auto CAD and Revit). However, not knowing them as Building Information Modeling tools and also not utilizing to their full potentials (i.e. integrating the tools in their activities).

BIM knowledge and proficiency play an important role in the use of Building Information Modeling within organizations.

The contractors are reliant on the kind of tool/software/ that their consultant uses at the design stage. They mostly adopt what the consultants are using because of their interdependence in the construction industry. Therefore, it is important to develop the culture of innovating new technology like Building Information Modeling to speed up the communication between the stakeholders of construction projects.

Construction education should keep itself updated with innovations and industry. Building Information Modeling should be integrated into Architecture, Construction and Engineering programs. Educational institutions should produce Building Information Modeling-enabled professionals for the adoption of Building Information Modeling in the construction industry.

Therefore, it is essential to implement Building Information Modeling in the graduate-level curriculum and in the construction industry, too. Thus, whatever the consultant uses and provided, Ethiopian Construction Project Management Institute with designers is the first line of adopters.

The government is a client for big projects in Ethiopia. Also, it was revealed that the Ethiopian Construction Project Management Institute is the leading organization for the adoption of Building Information Modeling as well as related innovations in the Construction industry.

But it should be known Ethiopian Construction Project Management Institute was using Auto CAD and harmonized it into a Building Information Modeling, but as isolated software for design, have used it severally for infrastructural design works.

One of the emerging project delivery methods called Integrated Project Delivery (IPD) is claimed to have many of the attributes of construction delivery systems very much compatible with Energy and

Environment certification systems in Ethiopia. Therefore, Building Information Modeling is the most important to fit the gap in the delivery method.

To improve the culture of using the Building Information Modeling system by implementing it in all higher educational institutions and all construction industries. On the other hand, through awareness creation, introducing the new technology, training all construction stakeholders will help to get better the culture of using Building Information Modeling in the construction industry.

Generally, in Ethiopia, the implementation of Building Information Modeling is really at the infant (beginning) stage and it is expected from the construction stakeholders and authority to make it grow soon to all construction industry. There is a strong indication that the knowledge of Building Information Modeling tools and the concept is more famous with the consultants (designers) than clients and contractors.

Therefore, it is better to train construction industries' stakeholders and make Building Information Modeling a well-known technology in the country to be ready for implementation then.

Finally, in construction industries, it is found that the issues of Building Information Modeling can address are reducing errors, decreased rework and waste, improved sustainable design and construction, improved risk management, more reliable facility and asset management, better coordination of clients' changes to the design and their effects and many other benefits of technology use within the construction technology and management field.

Using Building Information Modeling in Ethiopia is important to produce, manage and exchange building information's through planning, design, construction, and operations are to improve design coordination's, reduce cost for design and construction, reduce waste, early delivery(time), improve building performances, reduces operation costs, leads for volumetric constructions, prefabricated and manufacturing.

Building Information Modeling is also essential to Reduce project Risk, Delay, Cost overrun and Disputes in construction stages.

V. CONCLUSION

Building Information Modeling in the Ethiopian government strategy has been set a cut-off date of 2024 on the construction projects. Without implementing Building Information Modeling organizations will not be accepted onto the construction projects. With this increased pressure through the government strategy and in light of the many merits of Building Information Modeling adoption, such as its modern way of conceptualizing, managing, designing and constructing the project. In addition to managing it as an asset through to demolition, organizations are seeking to implement it in order to survive.

However, if champion implementation is to take place there are a number of barriers to be overcome. This study identified more than twelve barriers to Building Information Modeling adoption and implementation from literature and identified them in Ethiopia.

Building Information Modeling knowledge and awareness seem to lack a clear understanding of what it means in the activities to implement it before the introduction Building Information Modeling in Ethiopia. Now, some organizations are requesting to form relationship of working together with the adopter i.e. Ethiopian Construction Project Management Institute.

The barriers observed reflect a lack of understanding of the potential business benefits and risks associated with Building Information Modeling adoption and implementation. To implement Building Information Modeling in our country the collaboration between the public and private companies is necessary.

As the bright future and exciting possibilities in Ethiopia, construction industries will change the existing culture of Building Information Modeling by understanding the importance of it to use in all applications of Construction projects.

ACKNOWLEDGEMENT

First, thanks to the Almighty God for making this work possible. Next, I am very much grateful to the following individuals. Advisor Alemu Mosisa, Co-advisor Gemeda Etefa, My Dad Abebe Gutema, Mom Kabadu Banti, Brothers Mengistu with his family, Wondimu with his family, Kayo with his family, Yadina, Gadisa and a sister Ayantu for contributing in my thesis works.

REFERENCES

[1]. Abazid M. (2017) The Quality Control Implementation in the Construction Projects in Saudi Arabia.
[2]. Ahbab C., Rezaei, A. & Sistani, N. S., 2013, Integration of building information modeling into the undergraduate curriculum: case of Eastern Mediterranean University. Tirana, Albania
[3]. Ahmad I., Sein Maung, K. and Panthi, Kamalesh, (2010) Challenges of Integration and ICT's Potentials in the Globalized Construction Industry. Proceedings of PICMET '10: Technology Management for Global Economic Growth (PICMET), 18-22 July 2010, Phuket, Thailand, 1-7.
[4]. Aouad, G., Wu,S., and Lee, A. (2006), nDimensional Modeling Technology: Past, Present, and Future, Journal of Computing in Civil Engineering, 20(3): 151-153.

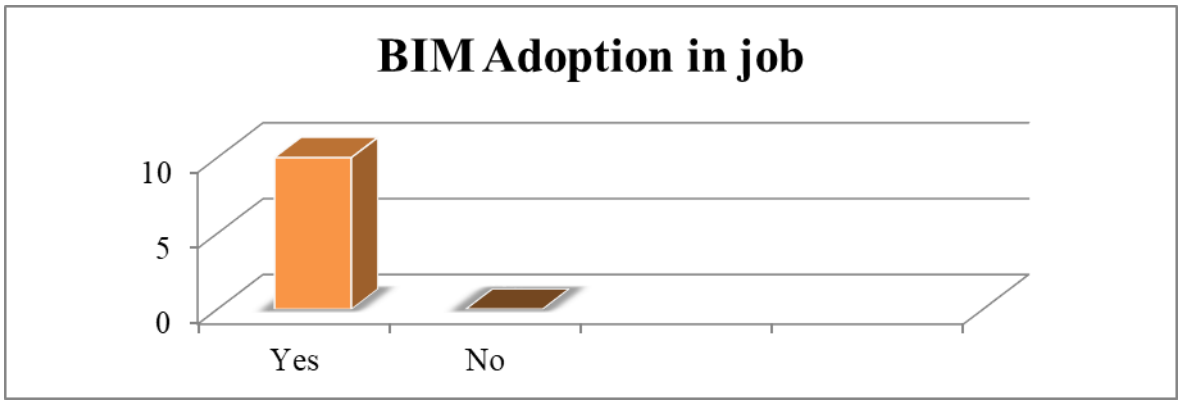

Figure V.1Building Information Modeling Adoption in job at Ethiopian Construction Project Management Institute

Table V.1 Responses for closed ended questions of the questionnaire

Questions	**Options**			**Answer**
Does the size of an organization have a significant influence on the adoption of Building Information Modeling?	Yes, No			Yes
If the answer for question number 1 above is no, why?				
Who promotes Building Information Modeling?	Government , Companies, Experts			ALL
Which level of Building Information Modeling is adopted in Ethiopia today?	Level 0,1,2,3...			Level 2
From the following statements in the table, which may be a barrier of Building Information Modeling implementation in Ethiopia (Mark all that may apply)				
	Low	Moderate	High	Moderate
Lack of Senior Management Support		X		X
Cost of Implementation (Software and Training)		X		X
Scale of Culture Change Required		X		X
Other Competing Initiatives		X		X
Lack of Supply Chain Buy-in		X		X
Staff Resistance and ICT Literacy		X		X
Legal Uncertainties		X		X
Ownership and Intellectual Property		X		X
Contractual Arrangements		X		X
Product Liability Risks		X		X
Professional Indemnity Insurance		X		X
Authenticity		X		X
Others(specify)				