**ADDIS ABABA UNIVERSITY**

**SCHOOL OF GRADUATE STUDIES**

# CHALLENGES OF TECHNOLOGICAL ADOPTION: IN THE CASE OF BIM IMPLEMENTATION IN OVID GROUP ADDIS ABABA, ETHIOPIA

**BY:**

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**ADDIS ABABA, ETHIOPIA**

**JUNE, 2024**

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**A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTERS OF ARTS IN MANAGEMENT**

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# DECLARATION

I, Feven Tesfaye, declare that this Research, entitled "**CHALLENGES OF TECHNOLOGICAL ADOPTION: IN THE CASE OF BIM IMPLEMENTATION IN OVID GROUP ADDIS ABABA, ETHIOPIA**", is my original work, and has not been printed, published and submitted as a research work or publication in any form by any University in Ethiopia or abroad. All the resources and materials used for this research have been appropriately cited and acknowledged.

Name <u>Feven Tesfaye</u>

Signature ____________________________

Date ________________________

# ENDORSEMENT

This thesis has been submitted to the School of Graduate Studies of Addis Ababa University for examination with my approval as an advisor at the title of "**CHALLENGES OF TECHNOLOGICAL ADOPTION: IN THE CASE OF BIM IMPLEMENTATION IN OVID GROUP ADDIS ABABA, ETHIOPIA**".

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Advisor

Addis ababa

Signature and Date

June 17/2024

**ADDIS ABABA UNIVERSITY**

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**APPROVED BY**

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| **Internal Examiner** | **Signature and Date** |

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*ABSTRACT*

*This paper discusses challenges of technological adoption: the case of implementation in ovid group Addis Ababa, Ethiopia. The specific objective is to define the barriers to BIM implementation, determine the benefits of using BIM, and how it can be adopted. The study was deployed a descriptive research design to examine the barriers and implementation of BIM usage for architects. In this research primary data collection methods were used. The primary data was obtained through a questionnaire prepared for the construction project employees. The total population of the study was 916 as a sampling frame. The data collection instrument was pilot-tested on 30 employees within the intended sample then the results of Cronbach's Alpha test were reliable. Using a stratified sampling technique self-administered questionnaire was distributed to 185 employees. SPSS version 24 was used to analyze descriptive statistics of the data collected. This examination has become necessary because BIM needs to be practically used for fast progress in the construction industry by taking advantage of modern technological innovation. According to the research findings, BIM has not been practiced in OVID group, and recommendations were made accordingly.*

*Organization barriers have the strongest correlation; Technology barriers have the lowest correlation with BIM adoption in the OVID Company. Strong and statically significant relationship between the chosen obstacle of BIM adoption regions were shown by the correlation study: "Operation barriers, Technology barriers, Organization barriers, Human/stakeholder barriers and Standard, policies and guideline-related barriers" in the case of OVID group with Pearson Correlation Coefficient value of 0.085**, 0.078**, 0.074**, 0.063** and 0.003** respectively.*

***Keywords**: building information modeling (BIM), Barriers, technology adoption, and Architecture*

**Contents**

## List of Acronyms and Abbreviations

BIM – Building Information Modeling

MEP – Mechanical Electrical Plumbing

BDS – Building Description System

CAD – Computer Aided Design

AEC – Architecture, Engineering and Construction

IT – Information Technology

GDP – Growth Domestic Product

RICS - Royal institution of chartered surveyors

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# CHAPTER 1
# INTRODUCTION

In this chapter, the definition of BIM, its benefits, and its application in the architecture, engineering, and construction industry will be discussed.

## 1.1 Background of the Study

In the last decade, digital transformation has changed a wide range of industrial sectors, resulting in an amazing increase in product quality, product variety, productivity, and product variety. In the Architecture, Engineering, and Construction (AEC) business, digital tools are highly adopted for designing, constructing, and operating buildings and infrastructure assets. However, the continual use of digital information on the whole method chain falls considerably behind different business domains. All too often, valuable information is lost because information is still predominantly handed over in the form of drawings, either as physical printed plots on paper or in a digital but limited format. (Borrmann et al., 2018)

Such disruptions in the information flow occur across the entire lifecycle of a built facility: in its design, construction, and operation phases as well as in the very important handovers between these phases. The planning and realization of built facilities is a complex undertaking involving a wide range of stakeholders from different fields of expertise. For a successful construction project, a continuous reconciliation and intense exchange of information among these stakeholders is necessary. Currently, this typically involves the handover of technical drawings of the construction project in a graphical manner in the form of horizontal and vertical sections, views, and detail drawings. The software used to create these drawings imitates the centuries-old way of working using a drawing board. However, line drawings cannot be comprehensively understood by computers. The information they contain can only be partially interpreted and processed by computational methods. Basing the information flow on drawings alone therefore fails to harness the great potential of information technology for supporting project management and building operation. A key problem is that the consistency of the diverse technical drawings can only be checked manually. This is a potentially massive source of errors, particularly if we take into account that the drawings are typically created by experts from different design disciplines and across multiple companies. Design changes are particularly challenging: if they are not continuously tracked and relayed to all related plans, inconsistencies can easily arise and often remain undiscovered until the actual construction – where they then incur significant extra costs for solutions on site. In conventional practice, design changes are marked only through revision clouds in the drawings, which can be hard to detect and ambiguous. The limited information depth of technical drawings also has a significant drawback in that information on the building design cannot be directly used by downstream applications for any kind of analysis, calculation, and simulation, but must be re-entered manually which again requires unnecessary additional work and is a further source of errors. The same holds for the information handover to the building owner after the construction is finished. He must invest considerable effort into extracting the required information for operating the building from the drawings and documents and enter it into a facility management system. At each of these information exchange points, data that was once available in digital form is lost and has to be laboriously re-created. (Borrmann et al., 2018b)

The BIM approach emphasizes knowledge exchange. It forms a single repository that evolves throughout the lifecycle of a construction project. BIM is considered one of the most suitable platforms for the architecture, engineering, and construction industry, providing cross-organizational and multidisciplinary solutions to improve construction performance challenges during planning, design, and construction operations. BIM is a technology that can enhance society in terms of design and construction concerning the building environment. This can be achieved by avoiding human errors, decreasing project costs, increasing the productivity and quality of work, and reducing the project delivery time, moreover, BIM can assist the management team in maintaining and operating different facilitates. (Smith & Tardif, 2012)

Many research and development efforts have been undertaken to minimize these performance challenges in the construction industry.

In developing countries, the challenges are compounded by the fact that the construction industry faces various performance challenges such as low productivity, poor information management, delays, cost overruns, waste, and rework become noticeable. (Radosavljevic & Bennett, 2012)

Multiple challenges exist in the AEC sector in Ethiopia, including: Slow construction industry development (CID), policy implementation and corruption, weak capacity of contractors and consultants, lack of cooperation and professionalism, lack of benchmarking, and the nature of the construction industry are identified as key challenges in Ethiopia. (Arayici et al., 2017)

## 1.2. Background of the Company

Ovid Kling Consult Plc (OKC) was established as a joint partnership between Ovid Group and Kling Consult International Gmbt to deliver high-value solutions. OKC the regional office for Kling Consult International provides design, engineering, and project management services here in Ethiopia, Djibouti, East Africa, Iraq, KSA, UAE and India. Ovid Kling Consult is involved in Megaprojects Local and international, providing Architectural, Structural & MEP Designs, Master Planning, Infrastructure, Landscape, Project Management, Site supervision, and Specialist Expertise

OVID Group is a corporate holding comprising seven member companies, namely OVID Construction, OVID Real Estate, OVID Manufacturing, OVID Trading House, OVID Venture Capital, OVID IT, and OVID IHG. OVID Group is a company that is led by a set of principles. The company gives services that deliver on time by applying original and creative ideology and proven methods with outstanding quality. The company has a vision with exceptional leadership that can set a transformative work culture. Ovid Construction is a Design and Build (DB) company with a Grade 1 construction license. It is legally registered and operates in Ethiopia, Djibouti and Kenya having over 7,000 permanent and temporary employees on production and construction sites, including highly experienced staff from different areas of specialization.

## 1.3. Statement of the Problem

Researchers and management professionals tried to identify gaps in the AEC industry such as teamwork fragmentations, ineffective coordination, poor communications, buildings low performance, energy overconsumption, and unsustainable buildings (Latham, 1994; Egan, 1998). In addition to design errors and clashes, project overrun, low productivity, low building quality, poor satisfaction of stakeholders /client/users, and shortage or unauthenticated data for Facility Management (FM) during the maintenance stage (Eastman, et al., 2008; Arayici, et al., 2012).

On the other hand, according to a recent study at the London School of Economics (LSE) in the UK, the management practice in Africa is poor as compared to Europe and North America. According to this report, Ethiopia is the second from the last followed by Mozambique which indicates that the management practice in Ethiopia is even far behind those poor performing developing countries in Africa.

It is an exclusive truth that the emergence of BIM has significantly enhanced the overall construction practices of the companies that have adopted it in industrialized countries while the barriers to its implementation are still persistently inhibiting the adoption process. Understanding the barriers to its adoption is the most important step toward the successful usage of this technology. To find the barriers and the opportunities it is important to apprehend the construction practice in Ethiopia.

The most important feature of BIM is that it is not generic. Issues found in one country might not necessarily resemble the Ethiopian context or any other country's context. Many countries have studied their respective adoption barrier towards BIM. Each of them has found distinct results and is moving toward the next step. It is also very important to study the situation in the Ethiopian context. BIM in Ethiopian architectures and engineers of the construction industry is not that applicable to improve the communication and coordination among stakeholders, architects, structural designers, MEP designers, and contractors.

The international BIM implementation guide shows that the global status of BIM adoption is 71% for North America, 44% for Europe, 54% UK, and 40% for Australia. With these driving facts that North America and Europe have a better project management practice and relatively high BIM adoption rates, there is an urgent need to adopt the latest technologies and management strategies to eradicate the recognized problems and to improve the performance of the AEC industry (Alhumayn, et al., 2017). This research will try to illustrate the benefits and barriers of BIM adoption in Ovid group.

## 1.4. Research Question

This investigation will be driven by three main research questions, which are:

- ✓ What are the barriers to adopting Building Information Modeling (BIM) in architectural companies, in Ethiopia?

**Small research questions**

- ✓ How Building Information Modeling (BIM) will be implemented in an architectural firm, in Ethiopia?
- ✓ What are the benefits of Building Information Modeling (BIM) adaptation in architectural companies, in Ethiopia?

## 1.5. Objective of the Research

### 1.5.1. General Objective

The main objective of this research is to find out the barriers to BIM technology adoption in architectural companies and its implementation process in Ethiopia. Furthermore, the research will express the benefit of BIM adoption for individuals and organizations in technical aspects.

### 1.5.2. Specific Objective

- Do operations affect BIM adoption?
- Does technology affect BIM adoption?
- Do Organizations affect BIM adoption?
- Do Human/stakeholders affect BIM adoption?
- Do standards, policies, and guidelines affect BIM adoption?

## 1.6. Significance of the Study

This research contributes additional knowledge on the usage of BIM that will benefit architects and engineers. It addresses real-world problems and seeks to find practical solutions or improvements specifically in Addis Ababa, Ethiopia. The research findings can positively influence policymakers to make informed decisions based on data evidence. Implementing BIM will improve the time and cost efficiency contributing to the overall well-being of a project.

Furthermore, this research contributes to the academic community by enhancing the understanding of the benefits of BIM usage and its implementation. It also helps to build a foundation for future research.

## 1.7. Scope of the Study

The application of the research will be on the Ethiopian construction industry and more specifically in Addis Ababa, which right now is booming in the architectural design and construction sector. The study is focused on three recent years starting from 2013 to 2016 E.C. This market is lagging in BIM adoption and implementation as compared to the other parts of the world even though it is rapidly growing.

## 1.8. Delimitations

In this thesis, only the architectural design industry will be studied by questioning participants from specific architectural companies operating in Addis Ababa. Other cities in Ethiopia will not be investigated because of the time and financial limitations of the researcher. The construction industry will be mentioned but not investigated

## 1.9. Organization of the Study

This study is divided into five main parts. The first part introduces the background of the research, the problem being studied, the general and specific objectives, the research questions, and the study's scope and limitations. The second part reviews theoretical and empirical literature from various sources, presenting a conceptual framework at the end. The third part discusses the research design and methodology, covering the sample design, data sources, and description of data collection instruments. The fourth part focuses on data analysis, presentation, and interpretation, touching upon reliability and validity, demographic characteristics, and providing a brief descriptive analysis. Lastly, the conclusion and recommendations are presented at the end of the paper, based on the research findings.

# CHAPTER 2

# LITERATURE REVIEW

The theoretical concepts in this chapter provide context for the study outcomes. It goes over comprehending the present situation and examines on BIM technology. This chapter also includes a survey of several empirical literatures.

## 2.1. Theoretical Review

### 2.1.1. Definition of BIM

BIM is a shared digital representation of a built asset to construction, facilitate design, and operation processes to form a reliable basis for decisions (ISO 19650-1:2018).

(The US National Building Information Model Standard Project Committee, 1990) BIM is a digital representation of the physical and functional characteristics of a facility (ISO 19650-1:2018). BIM is a include knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition**.**

According to Mastin et al. (2019), building information modelling (BIM) is a knowledge shared resource that provides information about a facility and serves as a dependable basis for decisions made throughout its life cycle. BIM is unique in that it emphasizes stakeholder collaboration at various stages of the project, from its conception to its demolition. BIM is defined as specialized technology used in conjunction with a collection of related procedures to create and evaluate building models.

According to (Mastin,et,al. 2019) BIM is as an knowledgeable 3D model-based process that gives engineering, architecture, and construction expertise the feedback and tools to too wise plan, design, construct and manage buildings and infrastructure.

According to (Mastin,et,al. 2019), expertise may demonstrate BIM from a different area. For this study, BIM is defined as a digital sample of the physical and functional characteristics of a resource. SMART international Building defines BIM from a different area; a new way to define and display the information needed for the design, construction, and operation of developed facilities.

## 2.1.2. Evolution of BIM

The concept of BIM dates back to 1975(Sacks et.al, 2011). The install system that closely resembled modern BIM was the Building Description System (BDS), which was begun by architectural professional Charles Eastman. BDS designed to create a paperless design documentation process that delivered several benefit, including simplified design input for complex building components, reuse of existing elements, and automated generation of building views, renders, schedules, and surveys (Sacks et.al, 2011)

A significant milestone in the examiner of BIM was the identified Building of Virtual by Graphisoft Archicad concept in 1987 (Sacks et.al, 2011). To generate models of 3D building with immediately emanated views and support advanced parametric 3D shapes (Sacks et.al, 2011). The paper emphasized the importance of workflow on a reference model based and the benefit for a well-organized relation between engineering and architectural information systems. (Sacks et.al, 2011)

But it wasn't until 2002—when Autodesk noticed the company behind Revit4 BIM software and released a white paper on the subject—that the word BIM became well-known (Sacks et al., 2011). The BIM software firms Graphisoft and Bentley Systems, in conjunction with industry experts such as Jerry Laiserin, contributed to the popularisation of the word BIM by standardising its usage for digital representation of the building process. (Sacks and others, 2011)

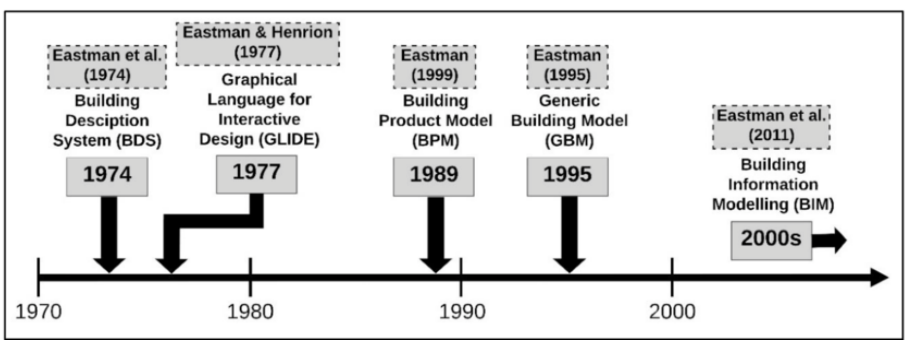


Figure 2. 1: Evolution of BIM from the 1970s to the present day

### 2.1.3. Why BIM

Digitalization has changed far too many industrial sectors in the recent several decades, leading to varied increases in output productivity and product diversity. Borrmann and the caliber of the goods A. and others (2018) However, due to the consistent digitalization of information, the construction industry's whole process lags behind that of other businesses Borrmann, A. et al. (2018)

Construction executives find that BIM is crucial for evaluating the methods and resources employed throughout a project's lifespan. Finch, R., and S. Mordue (2019). Furthermore; BIM has power to developed wise use of construction, increase association and sharing of knowledge to team members, and support construction-related tasks, different countries developed respective construction industries for BIM Casini, M. (2021).

#### 2.1.3.1. BIM dimensions

BIM is the relationship between data kinds in an information model. By adding more data dimensions, it is much easier to understand the construction venture and its many aspects, such as how it will be delivered, how much it will cost, and how it should be maintained etc. Hosseini, M. R.et, al. (2021).

**i.) 3D BIM models**

According to Antonopoulou, S. (2017b), a 3D BIM model offers more than just three-dimensional model geometry as it may assist with numerous perspectives of the data contained for a drawing set, including 2D and 3D geometries. In addition to offering comprehensive data on building and infrastructure design elements including geometry, size, and materials, 3D BIM models are advantageous for interdisciplinary cooperation, integration, and coordination Antonopoulou, S. (2017b).

**ii.) 4D BIM Models**

The term "4D" refers to the fourth dimension of information, which includes schedule (time) plus a 3D BIM model. This fourth dimension of information can also include scheduling data from a project information model. As the project moves along, this data is added to components that will get more intricate.

### iii.) 5D BIM Models: Cost

Quantities of materials are developed immediately changes are taken in the model. The model of 5D allows the owner and designer to make better informed conclusion, cost constraints resulting in higher-quality construction and therefore, BIM highly adopted the development of interim estimates Antonopoulou, S. (2017b).

### iv.) 6D BIM Models: Sustainability

Project management uses 6D BIM (automatic building certification, thermal analysis, and environmental analysis).6D is classified as Facility management Antonopoulou, S. (2017b). Hence, 6D BIM is interpreted as energy analysis or continuous analysis in this study Antonopoulou, S. (2017b).

### v.) 7D BIM Models

In BIM models, the 7D refers to all asset information, including functional and graphical data. 7D in BIM models for usage in operation and maintenance after the building stage Antonopoulou, S. (2017b). 7D is a database BIM record model that is used to support the use of planning and decision-making relevant to facility management. It contains all the information that the owner needs to know about using and maintaining the building. Antonopoulou, S. (2017b).

## 2.1.4. The Applications of BIM

Throughout a building's development and lifespan, BIM is applied extensively. The following are applications of BIM that are applicable to all phases of the development process, including design, planning, and construction stages. (De Wilde et.al, 2019)
**Development Scheduling**: The specific time can be planned fairly and partially with accuracy in order to accommodate contract workers and other individuals. (De Wilde et.al, 2019)

**Site Utilization Planning**: To disregard onsite challenges during the building phase, expand the construction area and allocate room for different temporary situations, such as a materials storage and construction equipment (De Wilde et.al, 2019). Given those conditions, the materials are situated in a power within the construction. (De Wilde et.al, 2019)

**MEP (Mechanical-Electrical-Plumbing) BIM coordination and conflict detection**: MEP design was related to a number of disciplines, including (De Wilde et.al, 2019). To save more time and money, it is critical to identify both internal and external challenges from the whole association in 10 (De Wilde et.al, 2019). In order to hide the pipes, the architect must locate them (using BIM) and create more durable ceilings and coverings. (De Wilde et.al, 2019)

**Recognizing time-based conflicts**: BIM dictates the method of execution of a given task together with its estimated cost and duration. According to BIM, there are no conflicts or overlaps between the jobs and the times in which they are assigned. As a result, nothing interferes with any work, even the building of temporary structures like material storage facilities. (De Wilde et.al, 2019)

**Energy efficiency**: Energy utilization is optimized throughout the building development and lifespan process. When adopting energy efficiency, sustainability considerations are made. (De Wilde et.al, 2019)

**Cost Estimation**: BIM permits indicate development actions together with the money raised. Furthermore, compared to outdated approaches, cost assessment is more accurate when using BIM technology. (De Wilde et.al, 2019)

## 2.2. Empirical Review

### 2.2.1. Barriers to BIM adoption in AEC Firms

Numerous academics have attested to the benefits of BIM in the AEC industries; yet, depending on the environment in which the methodology is to be implemented, the adoption process may encounter one or more difficulties or impediments. Shirowzhan, S., Tan, W., & Sepasgozar, S. M. E. (2020). Consequently, there are obstacles in the way of properly implementing BIM, especially in the least developed nations that are attempting to adopt global best practices. Shirowzhan, S., Tan, W., & Sepasgozar, S. M. E. (2020).

The five main categories of barriers to BIM adoption identified in this study are: operation-related, technology-related, organisational, human/stakeholder, and standard/policy. These categories are based on maturity measurement tools provided by various bodies, such as owner's CAT BIM characterization framework, NBIM, CMM, IU BIM proficiency index quick scan, DC scorecard, BIM assessment profile, and BIM cloud score. Arayici,et, al. (2017).

Smith, D. K., & Tardif, M. (2012c) After BIM is created in a particular industry, it is vital to analyses the maturity level of the technology by focusing on the standard measuring instruments of BIM implementation in every category. This means analyzing the hurdles to BIM development.

**i.) Operation-related barriers to BIM adoption**

An operation within the framework of this study is referred to as the modelling process coordination among different disciplines and documentation processes and information flow of BIM and the Mordue, S., Swaddle, P., & Philp, D. (2015c)

As Mordue, S., Swaddle, P., & Philp, D. (2015c) the obstacles connected to operations, such the procedures for acquiring, building manufacturing usage, planning, managing, and maintaining buildings, as well as how they interact with one another. Operation-related obstacles are those that oppose the process of establishing, overseeing, and documenting BIM-related operations Mordue, S., Swaddle, P., & Philp, D. (2015c).

BIM obstacles include the following: challenging initial setup of BIM; absence of industry collaboration efforts; lack of information exchange in BIM high initial cost, few concrete advantages, intangible business benefits, the construction industry's disruption, difficulty dividing and sharing BIM-related risks and expenses, a lack of well-defined procedures or workflows for using BIM technology, and a shortage of subcontractors with BIM proficiency
Mordue, S., Swaddle, P., & Philp, D. (2015c).

**ii.) Technology-related barriers to BIM adoption**

According to Mordue, S., Swaddle, P., & Philp, D. (2015c) technology-related equipment and networking systems required to boost AEC industries' productivity, profitability, and efficiency. Conversely, it encompasses the choice of hardware, software, and infrastructure that are critical to the technical side of implementing new technology within an enterprise.

As Mordue, S., Swaddle, P., & Philp, D. (2015c) currently distinguished technology-related BIM barriers are, complex software programs, ICT infrastructures insufficient, and not easy to use, problems of incompatibility and interoperability, High costs for BIM software and technology/high-cost investments, recurring needs for extra resources, high economic costs, the requirement to maintain complex data at the model examination level, and the longer time needed to adapt new technologies (BIM).

**iii.) Organization-related barriers to BIM adoption**

The primary element influencing the adoption of BIM in the AEC sector is organizational motives Mordue, S., Swaddle, P., & Philp, D. (2015c). Features including corporate scale, IT prowess, senior management backing, and organizational motivation are examples of organizational factors. Mordue, S., Swaddle, P., & Philp, D. (2015c) Organizational BIM planning, encompassing goals, tactics, and leadership support, is the subject of organizational barriers.

Some of the organization-related BIM obstacles that are most commonly found are limited funding, limited support and limited interest, limited senior management support and attention, A significant change in present workflow, protocols, practices, and cultural advancement is necessary for BIM, limited workflow of BIM-based, new responsibilities requires by BIM among projects engagement about BIM model Mordue, S., Swaddle, P., & Philp, D. (2015c)

**iv.) Human/stakeholder-related barriers**

Human or stakeholder barriers connected to the capabilities, mentalities, and BIM staff training. Human-related BIM barriers are: lack of client awareness and BIM of knowledge, lack skilled personnel, change resistance attitude, staff training higher cost, introduce new technology reluctance, universities weak education and training and government centers, and client demand lack Mordue, S., Swaddle, P., & Philp, D. (2015c).

**v.) Standards, policies, and guidelines-related barriers**

As Mordue, S., Swaddle, P., & Philp, D. (2015c) Standards are formal guidelines followed during the production process. The standard category assesses how well contracts, specifications, guidelines, and standards are being implemented Mordue, S., Swaddle, P., & Philp, D. (2015c). Written guidelines known as policies serve as a framework for decision-making in the AEC sector. These include training practitioners, dispersing rewards, spreading risks, conducting research, and reducing disputes Mordue, S., Swaddle, P., & Philp, D. (2015c).

Standards, policies, and guidelines barriers are BIM national standards lack and guidelines, safety of private information in BIM models and ownership, licensing, insurance, and cybercrime absence of a legislative framework for the use of BIM, the requirement to create contracts, relationships, and conflicts pertaining to BIM, absence of BIM law enforcement by local authorities, absence of industry norms Mordue, S., Swaddle, P., & Philp, D. (2015c).

### 2.2.3. BIM implementation

BIM Implementation is the process of technology in place of putting. Four the most important steps of BIM implementation and was presented list below Sacks, R., Liston, K., (2011b).

1. **Evaluation**

Analyzing BIM implementation is a smart place to start when deciding on a strategy to get to Sacks, R., (2011b). Examining the organization's present BIM capabilities and requirements is necessary for this step. Sacks, R., (2011b). The creation of an internal strategy plan for BIM approval is the most guarded task. During the first stages of deployment, some best practices that are helpful are Sacks, R., (2011b).

- The team's equipment, techniques, and operational capabilities analyze.
- The organization collect feedback
- Implications any legal assess.
- Complete support assurance from higher authority for BIM implementation.

2. **Project Planning**

Beginning a BIM project requires completing a few specific preparatory activities in order to ensure its success Sacks, R., Liston, K., Eastman, C., & Teicholz, P. (2011b). Developing a BIM execution plan, develop a BIM coordination model and identified the suitable software and hardware Sacks, R., (2011b). This can be work appropriately qualified internal team standardized techniques Sacks, R., (2011b).

3. **Design and Construction**

The design and construction of an architectural project can be displayed as a single, related system (Sacks, et.eal. 2011b). This phase's 3D models will be used as a template for the real building process all the time. To bring the design to life, tasks and additional resources need to be identified Sacks, R., (2011b).

4. **Operations and Maintenance**

When using BIM, operations and maintenance are the final stages. Sacks, R., (2011b). This procedure includes activities like asset management, preventative and corrective maintenance, and other things that help make sure the facility runs well and on a regular basis. Virtual platforms are among the BIM technologies that are strongly advised for a more seamless transition during handover and commissioning Sacks, R., (2011b).

### 2.2.4. BIM Adoption in Developing Countries

Numerous government agencies, professional groups, and construction organizations have promoted the use of BIM in the AEC sector in an effort to enhance project management and simplify collaboration among stakeholders in building projects (Smith & Tardif, 2012). While there are differences in the level of BIM application around the globe, industrialized nations such as the US, Australia, and several European countries have accelerated the spread of BIM within the AEC sector. In order to guarantee successful adoption in the public and private sectors in these nations, research programs and strategies in specific knowledge domains made use of many in-depth (Smith & Tardif, 2012)

Previous research has also indicated obstacles and difficulties in low-income nations adopting BIM, in spite of the endeavors of the relevant construction industry players and governments(Ifma, 2013). These obstacles include issues with inadequate IT infrastructure, building companies' financial stability, inadequate teamwork, a dearth of BIM courses at colleges, and cultural hurdles. In developing nations, the majority of BIM empirical research has concentrated on three main themes: Benefits of BIM, its readiness, and its obstacles (Ifma, 2013)

Thus, studies evaluated the important BIM characters such that the across the construction sectors pre and post-adoption stages (Hendrickson & Au, 1989). Concurrently, there is an increasing interest in the application of BIM in the government infrastructure construction industry, namely in relation to the planning, building, and asset management of water and road projects. Under such circumstances, the public infrastructure sector's areas of concentration include project data utilization and management related to the project life cycle(Hendrickson & Au, 1989). Therefore, this study goal to continue the continues efforts toward the investigation of the key BIM characters to increase BIM working in the public sector (Hendrickson & Au, 1989)

### 2.2.5. BIM in Ethiopia

Ethiopia began implementing the Integrated Housing Development program (IHDP), a massive government-led low- and middle-income housing initiative, in 2005. The program's initial objectives were to build 400,000 condominium units, generate 200,000 jobs, support the growth of 10,000 micro-and small-scale businesses, strengthen the construction industry's capacity, revitalize inner-city slum areas, and encourage low-income households to become homeowners.

In order to meet the increasing demand for affordable housing brought on by the rapidly increasing pace of urban growth, particularly for households with low and medium incomes, the Ethiopian government now runs a housing program.(French, 2011). The Ministry of Works and Urban Development (MWUD) launched the Integrated Housing Development Program (IHDP) in 2005 as a notable contemporary government response to the problem of low-income housing. The Addis Ababa Grand Housing Program, which aided the Ethiopian government in putting the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) into practice, is being carried out by the Program. The Goals of the IHDP (French, 2011)

a) Increase housing supply for the low-income population
b) Recognize existing urban slum areas and mitigate their expansion in the future
c) Increase job opportunities for micro and small enterprises and unskilled laborers, which will in turn provide income for their families to afford their housing
d) Improve wealth creation and wealth distribution for the nation

The Ethiopian government intends to apply new technology in the GDP that improves the whole management system in preconstruction, construction, and postconstruction in one model in order to fulfil the aforementioned goals and improve the construction sector (French, 2011). By using a single model, this type of collaboration design solution enables us to send extremely precise information to all stakeholders fast. Businesses must concentrate on Implementation while implementing BIM(French, 2011). Any successful BIM deployment requires a detailed implementation strategy that goes much beyond a basic rollout and training plan. The implementation plan must also take into account how the new solution will work with currently installed 2D or 3D modelling programs. (French, 2011). Businesses want to consider how relevant applications like energy analysis, cost estimation, and requirements may access the building information model. (French, 2011)

People that are progressive, have a broad perspective, and will promote BIM should make up the team. (French, 2011). The process of planning, developing, and managing a building may be drastically changed by using building information modelling. As is evident, businesses wishing to use BIM have both benefits and drawbacks to consider (Sheil et.al, 2016)

The significance of public sector support in the execution of Building Information Modelling is evident across all the nations under analysis. (Bulletin of the Atomic Scientists, 1961). The private sector has also made a large contribution to the implementation of BIM, and a cooperative effort is required between public and private companies to establish guidelines for the implementation of BIM in industry (Bulletin of the Atomic Scientists, 1961). This university's research project uses Autodesk Revit software as part of a revolutionary effort to digitize and make the nation's architectural heritage widely accessible.(Bulletin of the Atomic Scientists, 1961)

The ambitious research is being carried out by the chair of CAD and geo-informatics at the Ethiopian Institute of Architecture, Construction Management and City Development (EiABC) (Ayele Bedada, 2010). According to Principal study Conductor at the Chair, Ayele Bedada (2010), "We intend to look back at our architectural heritage and trace its significance to the development of the local industry through conducting this research." Numerous characteristics of our historical design may be used to forecast future changes in Ethiopia's design environment.

Beyond documenting the past, the primary objective of the project is to enable broad digital accessibility to Ethiopia's distinctive architectural and construction elements (Ayele Bedada, 2010). This access is made possible by a free, open-source Autodesk Revit plug-in that has the following features:

- Two-dimensional and high-quality pictures of Ethiopian construction material textures, construction technique patterns, and background images.

- Three-dimensional and parametric models of Ethiopian construction material details, Ethiopian house design types and indigenous plants (including a selection of trees and landscape elements).

"By making these objects available to emerging Ethiopian professionals in precise and practical ways, we will assist in advancing the Ethiopian architecture and construction industry," according to (Bedada, 2019). Three years ago, Bedada started the initiative by preparing the preliminary research. Now, a few academic staff members and a few eager students are involved. "During the modelling phase of the research, inspiration came from the Building Information Modelling (BIM) methodology" (French, 2011). The use of this stage produced parametric models of traditional Ethiopian architectural features with outstanding success because Autodesk Revit is a pioneer in this sector (French, 2011).

## 2.3. Conceptual Framework

The nature of the study's aim is specified in the conceptual framework. Adoption of BIM technology is the dependent variable, and process, technology, organization, human/stakeholder, standard, policy, and guidelines are the independent factors, according to the model. The variables were divided into five primary categories after a variety of literature types were reviewed in order to provide measuring metrics for its ongoing progress. BIM technology adoption is affected by understanding the benefits of BIM technology usage, the barriers to adopting BIM, and the ways to implement BIM. A examination of the literature provides evidence for the relationships between these factors.

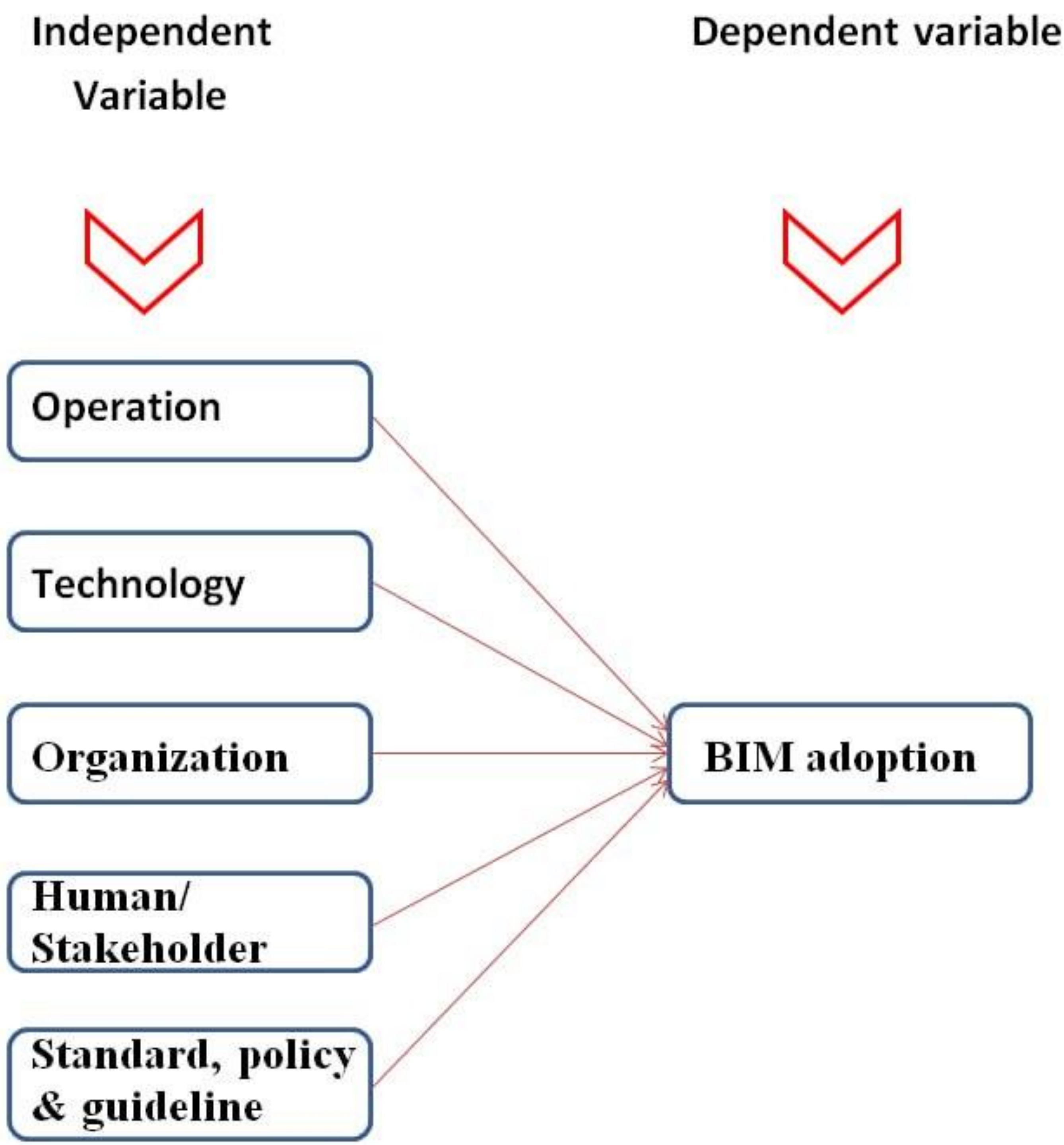


**Figure 2. 2: Conceptual framework**

# CHAPTER THREE

# RESEARCH DESIGN AND METHODOLOGY

In this chapter, descriptive research is carried out. The research design, data sources, data collection strategies, sample and sampling methodologies, and data analysis methods were all covered in this chapter.

## 3.1. Research Design

In order to separate the perceived significance and difficulty of BIM implementation from global literature, this study created a review of the literature. A structural questionnaire was given to professionals involved in the use of BIM in a specific building project.

This research design was structured within a descriptive research design, aligning with the specified objectives. It focused on exploring the interplay between dependent and independent variables, drawing data from a selected sample (Cresswell et al., 2003).

The data collection process involved the active participation of managers, contractors, engineers, and architects. Due to constraints in time and resources, a systematic selection method was applied. The research includes the independent variables as the BIM usage benefits, BIM adoption obstacles and BIM implementation methods. This structured method aimed at unraveling the changing environments BIM within the construction sector (Cresswell et al., 2003).

## 3.2. Research Approach

In order to accomplish the study's goals, a quantitative methodology was applied. Researchers can collect data on the opinions and attitudes of various respondents using the quantitative technique, and the findings are then applied to a population. Since quantitative approach was used in different similar studies survey instruments are also acceptable.

## 3.3. Target Population

A precise description of the study area's population is necessitates to effective research. Company under study was successfully concluded various projects in Addis Ababa, including federal housing corporate projects.

To focus on ongoing construction projects is strategic, driven by the researcher's aim to examine the contemporary application of Building Information Modeling (BIM) by architects. Consequently, the study's target population encompasses individuals employed in OVID group, where the workforce comprises 833 employees. Defining the target population ensures that the research investigates the recent and pertinent aspects of BIM usage by architects within the designated area of study.

## 3.4. Sampling Technique and Sample Size Determination

A sample is a portion that has been chosen to symbolize the total population. All the features of the population should be present in the sample that is taken. Among probability sampling design methods, the stratified sampling technique was employed in this research. This sampling method is selected because the population is heterogeneous i.e. persons with different sex, age, educational background, and occupation exist in the population. Geographically wise, samples were taken from each project site. Target population for this study was 833. Therefore, sample size of this study was 270 employees were taken using Slovin's sample size determination formula. 95% of confidence level assumptions.

$$n=\frac{N}{1+Ne^2}=\frac{150}{1+(150).05^2}=\underline{\underline{270}}$$

Where,

n = the size of sample

N = the size of population

1 = designates the probability of the event occurring.

e= the level of precision (Sampling error).

## 3.5. Source of Data

This study utilized primary sources of data. Primary data collection was the administration of a comprehensive questionnaire. Complementing this primary data, an array of supplementary information was drawn from various reputable journals, articles, literature, and the company's portfolio, collectively constituting invaluable secondary data.

### 3.5.1. Primary Data Source

To meet the target of the study, a questionnaire was developed with the best approach. It is designed specifically for this thesis purpose which aligns with the research objective, ensuring that the collected data is precisely what is needed for analysis. The questionnaires were filled out by selected participants including structural designers, architects, electrical engineers, mechanical engineers, office engineers, project managers and other inhabitants who are estimated to have a basic understanding of BIM usage in building construction projects. The researcher applied primary sources of data for the following reasons:

- to get quality data directly from stakeholders and maintain high standards of accuracy and reliability,
- to get the most up-to-date information as primary data is often more current than secondary data,
- To get insights into participants' perspectives, opinions, and experiences that may not be available through secondary data sources.

## 3.6. Collection Methods of Data and Instruments

The researcher used tools for gathering data from primary and secondary sources. This study implemented a quantitative research method by collecting information from professionals using questionnaires in the area of architectural design. The selected type of primary data tool for this research is a well-designed questionnaire, carefully constructed to explore the research objectives. The questionnaire drew its essence from the literature review conducted before the research initiation where it adapted from the knowledge of existing body.

In the survey a five-point Likert scale has been employed. From 'Strongly Disagree' at point one to 'A Strongly Agree' at point five, each response carried a numerical weight, rendering the data collected. It is aimed to facilitate a simplified expression for respondents to articulate their viewpoints. The Likert scale, chosen for its inherent ability to capture opinions, lent a continuous and scalable nature to the research. The questionnaire's layout was crafted with precision – a testament to simplicity and clarity.

The questionnaire, summarized in the English language, comprised a sum of 22 questioners group into two sections. Group I navigated the demographic respondents characteristics, in contrast. Group II explored BIM technology usage by architects and building construction stakeholders. The inclusion of secondary sources further enriched explorations. Journals, reports, research findings, and case studies became guiding instruments for this research.

## 3.7. Reliability and Validity

In research design and methodology Validity and reliability are critical aspects. Validity declared that the findings and conclusions of study are credible and meaningful. Validity addresses the question of whether a study measures what it claims to measure whereas Reliability measures efficiency, demonstrating how the same effects are repeated with the repeatability of the measurement.

To enhance the credibility of the findings, the researcher adopted begin-test on the questionnaire. Adjustments were made to clarify questioners, ensuring greater comprehension by the respondents. The initial phase of evaluating validity involved a face validity test. Validity test was done to experts by analyzing their responses qualitatively.

Consequently, the researcher showed the instrument to an academic advisor. For reliability, the researcher utilized the Cronbach alpha coefficient, where a high coefficient indicates that the items comprising the scale are cohesive and measure the same underlying construct. 0.70 a threshold was considered acceptable indicator of scale reliability (Gaur & Gaur, 2009). Subsequently, the instrument goes through a pilot test involving 30 employees from the targeted sample within the company. Reliability was assessed based on the respondents' scores using Cronbach's Alpha, and the outcomes of each scale are detailed as follows.

**Table 3. 1: Cronbach's alpha result**

| Variables | Number of Items | Cronbach's Alpha | Internal consistency |
|---|---|---|---|
| Operation-related barriers | 6 | .513 | Acceptable |
| Technology-related barriers | 5 | .605 | Acceptable |
| Organization-related barriers | 5 | .728 | Acceptable |
| Human/ stakeholder-related barriers | 6 | .631 | Acceptable |
| Standards, policies, and guidelines-related barriers | 4 | .596 | Acceptable |
| BIM adoption | 1 | .754 | Acceptable |
| **All variables** | **27** | **.675** | **Acceptable** |

Source: SPSS Result, 2024

## 3.8. Methods of Data Presentation and Analysis

This research is used quantitative analyses methods. Quantitative analysis was applied. Statistical techniques of Social Science 27 SPSS version 20 statistical software was used for descriptive analysis and regression analysis, ANOVA and correlation coefficients. Descriptive statistics measures the frequency, percentages, mean and standard deviation of the variables.

# CHAPTER FOUR

# DATA ANALYSIS, PRESENTATION AND INTERPRETATION

The study's conclusions are presented in this chapter according to the study's design. With this aim, the chapter presents both the tool used to get the descriptive statistics of all the variables used in this study as well as the respondents' response rate.

## a. Response Rate

Table 4.1 demonstrates that of the 185 questionnaires that were sent, 150 (82%) were fully completed, and the data that was returned was sufficient for reporting and analysis.

**Table 4. 1: Rate of Response**

| | Number of respondents | Percent |
|---|---|---|
| Questionnaire Distributed | 185 | 100% |
| Questionnaire Returned | 160 | 86.4% |

Source: SPSS Result, 2024

## 4.2. Descriptive Statistics

Data collection, analysis, interpretation, and presentation are all included in descriptive statistics. Descriptive statistics' main objective is to define and understand the research variables' mean and standard deviation.

### 4.2.1. Demographic Characteristics

Demographic analyses give background information of the respondents that collected to identify the future of the respondents. This includes gender, age, educational background, current occupation, and work experience.

**Table 4. 2: Characteristics of Respondents**

| No. | Variables | Type | Frequency | Percentage |
|---|---|---|---|---|
| **1** | Gender | Male | 96 | 60% |
| | | Female | 64 | 40% |
| | | Total | 160 | 100% |

| | | | | |
|---|---|---|---|---|
| **2** | Age | 18-30 years | 92 | 57.5% |
| | | 30-40 years | 68 | 42.5% |
| | | Total | 160 | 100% |
| **3** | Educational background | 1st degree | 112 | 70% |
| | | 2nd degree | 48 | 30% |
| | | Total | 216 | 100% |
| **4** | Current occupation | Structural engineer | 12 | 7.5% |
| | | Architect | 72 | 45% |
| | | Electrical engineer | 8 | 5% |
| | | Mechanical engineer | 12 | 7.5% |
| | | Project manager | 36 | 22.5% |
| | | Office engineer | 20 | 12.5% |
| | | Total | 160 | 100% |
| **5** | Experience | Below 1 year | 12 | 7.5% |
| | | Between 2-5 years' | 68 | 42.5% |
| | | Between 5-10 years' | 48 | 30% |
| | | above 10 years' | 32 | 20% |
| | | Total | 160 | 100% |

Source: SPSS Result, 2024

The table summarizes the characteristics of 160 participants across various variables. In terms of gender, 60% of the participants are male, while 40% are female. Regarding age distribution, the majority (57.5%) fall within the 18-30 years range and 42.5% in the 30-40 years range. In educational background, 70% hold a 1$^{st}$ degree, and 30% hold a 2$^{nd}$ degree. Current occupation reveals that 7.5% are structural engineer, 45% are architects, 5% are electrical engineers, 7.5% are mechanical engineers, 22.5% are project managers and 12.5% are office engineers. Lastly, in terms of experience, 7.5% have below 1 year of experience, 42.5% have 2-5 years, 30% have 5-10 years, and 20% have more than 10 years of experience. Most of respondents are male (60%), aged between 18-30 were (57.5%), holding 1$^{st}$ degree (70%), work as architects (45%), and have 2-5 years of experience (42.5%).

### 4.2.2. Descriptive Analysis of Variables

The descriptive analysis serves to discover existing facts on the extent of employee agreement regarding the utilization of BIM technology at OVID group. This is accomplished through the examination of five key challenge of BIM development: operation-related challenge to BIM development, BIM development of technology-related challenge, BIM development of organization-related challenge, BIM development of human/stakeholder-related challenge and BIM development standard, policies and guideline related challenge. This part presents the perspectives of the participants on both variables of the independent and dependent. Participants were endorsed or opposed statements of variables being investigated. A five-point Likert scale (ranging from 1 is Strongly Disagree to 5 is Strongly Agree). This investigation aims to identify difference among the variables; standard deviation is the square root of the extent of variance. The standard deviation is the mean reflects the dataset.

**Table 4. 3: Range of quantitative data for interpreting**

| Range | Interpretation |
|---|---|
| less 1.49 | Strongly disagree |
| Between 1.50-2.49 | Disagree |
| Between 2.50-3.49 | Neutral |
| Between 3.50-4.49 | Agree |
| greater 4.5 | Strongly agree |

Source: Upgade and Shende (2012)

#### 4.2.2.1. Descriptive Statistics on Operation-related barriers to BIM adoption

Respondents were asked to score their degree of agreement with each statement using six questions. The purpose of the proposed questions is to ascertain the degree of operation-related difficulty within the OVID group. Respondent’s level of agreement displays as follows.

**Table 4. 4: Summary of Response to Operation-related barriers**

| | Operation-related barriers | | Level of agreement | | | | | Total | Mean | SD |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Strongly disagree | Disagree | Neutral | Agree | Strongly agree | | | |
| 1 | Absence of industry collaboration, efforts, and knowledge sharing in BIM | N(f) | 4 | 8 | 12 | 52 | 84 | 160 | ***4.28*** | ***.977*** |
| | | % | 2.5% | 5% | 7.5% | 32.5% | 52.5% | 100 | | |
| 2 | Lack of proven benefits | N(f) | 40 | 40 | 48 | 20 | 12 | 160 | ***2.53*** | ***1.208*** |
| | | % | 25% | 25% | 30% | 12.5% | 7.5% | 100 | | |
| 3 | The fragmented nature of the construction industry | N(f) | 11 | 45 | 52 | 93 | 15 | 160 | 3.90 | 1.029 |
| | | % | 0% | 5% | 32.5% | 30% | 32.5% | 100 | | |
| 4 | Allocating and sharing BIM-related risks and costs difficulty | N(f) | 0 | 15 | 26 | 97 | 78 | 160 | 3.85 | .919 |
| | | % | 0% | 5% | 32.5% | 35% | 27.5% | 100 | | |
| 5 | BIM technology workflow lack detailed process | N(f) | 0 | 45 | 48 | 108 | 15 | 160 | 4.13 | .885 |
| | | % | 2.5% | 7.5% | 5% | 45% | 40% | 100 | | |
| 6 | BIM technology lack subcontractors | N(f) | 7.4 | 24 | 55 | 85.6 | 41.8 | 160 | ***4.28*** | ***.983*** |
| | | % | 2.5% | 5% | 7.5% | 35% | 50% | 100 | | |
| | Mean of operation-related barriers to adopting BIM | N(f) | | | | | | | **3.82** | **0.536** |
| | | % | | | | | | | | |

Source: SPSS Result, 2024

Table 4.4 outlines the perceptions of operation related challenge regarding (BIM) developed in projects of building construction. According to Upgade and Shende (2012), the mean or the average response of the respondents about the degree of agreement they had about the operation related challenge to developed BIM obtained to have (M 3.82, SD=0.536) on a 5-point scale.

**"Absence of industry collaboration and Lack of subcontractors using BIM"** has a higher mean value is obtained at 4.28 with a standard deviation of 0.983 on the variables and a lower mean value is obtained at 2.53 with a standard deviation of 1.208 on the variable **"Lack of proven**

**benefits".** Therefore, high standard deviation means the data are not closely around the mean, respondents scored on the range of 1.2 - 0.8. Thus, the participant perception is heterogeneous.

#### 4.2.2.2. Descriptive Statistics of BIM adoption on Technology-related barriers

Participants were asked to score how much they agreed with each of the five statements. Technology-related barriers in OVID group are designed the questions. The following table displays the participants' level of agreement.

**Table 4. 5: Technology-related barriers response**

| | **Technology-related barriers** | | **Agreement Level** | | | | | **Total** | **Mean** | **SD** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Disagree Strongly** | **Disagree** | **Neutral** | **Agree** | **Agree Strongly** | | | |
| 1 | Insufficient ICT infrastructure | N(f) | 4 | 8 | 40 | 64 | 44 | 160 | ***3.85*** | ***.966*** |
| | | % | 5% | 2.5% | 25% | 37.5% | 30% | 100 | | |
| 2 | Complex and not easy to use the software programs | N(f) | 24 | 36 | 36 | 36 | 28 | 160 | ***3.05*** | ***1.326*** |
| | | % | 22% | 25% | 22.5% | 22.5% | 8% | 100 | | |
| 3 | Incompatibility and capability problems | N(f) | 12 | 16 | 48 | 60 | 24 | 160 | 3.43 | 1.096 |
| | | % | 10% | 10% | 30% | 37.5% | 12.5% | 100 | | |
| 4 | High investment costs and expense of BIM software and technology | N(f) | 12 | 16 | 56 | 32 | 44 | 160 | 3.50 | 1.208 |
| | | % | 7.5% | 10% | 35% | 20% | 27.5% | 100 | | |
| 5 | Adapt to new technology (BIM) Longer time is required | N(f) | 12 | 36 | 36 | 48 | 28 | 160 | 3.28 | 1.208 |
| | | % | 7.5% | 22.5% | 22.5% | 30% | 17.5% | 100 | | |
| | Mean of technology-related barriers to adopting BIM | N(f) | | | | | | | **3.42** | **.743** |
| | | N(f) | | | | | | | | |

Source: SPSS Result, 2024

Table 4.5 outlines the perceptions of technology related barriers regarding (BIM) development in building construction projects. According to Upgade and Shende (2012), the mean of respondent for the degree of agreement about technology related barriers to developed BIM have a mean value of 3.42 (SD=0.743) scale of a 5-point.

**“Insufficient ICT infrastructure” has** a higher mean value at 3.85 with a standard deviation of 0.966 on the variable and **“The software programs are complex and not easy to use”** a lower mean value at 3.05 with a standard deviation of 1.326 on the variable. Therefore, high standard deviation is data are not clustered tightly around the mean, respondents scored on the range of 1.2 - 0.9 which is express indifference. Therefore, the participants’ perception is heterogenous.

#### 4.2.2.3. Descriptive Statistics of BIM adoption on Organization-related barriers

Participants were asked to rate each of the five statements. The questions are examined in an OVID group based on the level of organization-related impediments. The organization-related obstacles of the respondents' agreement level are shown in the following table.

**Table 4. 6: Summary of Response to organization-related barriers**

| | **Organization-related barriers** | | **Level of agreement** | | | | | **Total** | **Mean** | **SD** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Disagree Strongly** | **Disagree** | **Neutral** | **Agree** | **Agree Strongly** | | | |
| 1 | Lack support and interest of government | N(f) | 4 | 8 | 24 | 56 | 68 | 160 | 4.10 | .998 |
| | | % | 5% | 5% | 15% | 35% | 40% | 100 | | |
| 2 | Universities and government centers are weak education and training | N(f) | 4 | 4 | 12 | 40 | 100 | 160 | ***4.43*** | ***.922*** |
| | | % | 2.5% | 2.5% | 10% | 25% | 60% | 100 | | |
| 3 | Lack of senior management support and attention | N(f) | 4 | 0 | 16 | 72 | 68 | 160 | 4.25 | .832 |
| | | % | 2.5% | 0% | 10% | 45% | 42.5% | 100 | | |
| 4 | BIM requires radical changes in current workflow, practices, procedures, 5and culture change | N(f) | 8 | 8 | 20 | 68 | 56 | 160 | ***3.98*** | ***1.064*** |
| | | % | 5% | 5% | 12.5% | 42.5% | 35% | 100 | | |
| 5 | Project participants requires BIM new responsibilities | N(f) | 4 | 8 | 20 | 60 | 68 | 160 | 4.13 | .983 |
| | | % | 2.5% | 5% | 15% | 37.5% | 40% | 100 | | |
| 6 | Mean of organization-related barriers to adopting BIM | N(f) | | | | | | | **4.17** | **.655** |
| | | % | | | | | | | | |

Source: SPSS Result, 2024

Table 4.6 outlines the perceptions of organization related barriers regarding (BIM) development in projects of building construction. According to Upgade and Shende (2012), the mean response of the participants is the degree of agreement for technology related barriers to developed BIM a mean of 4.17 (SD=0.655) on a scale of 5-point.

"Weak education and training in universities and government centers" is higher mean value is obtained at 4.43 with a standard deviation of 0.922 on the variable whereas "BIM requires new responsibilities among project participants" is a lower mean value is obtained at 3.98 with a standard deviation of 1.06 on the variable. Therefore, high standard deviation of data are not tightly to the mean, respondents scored on the range of 1.064 - 0.832 means express indifference. Thus, the participant's perception is heterogenous.

#### 4.2.2.4. Descriptive Statistics on barriers of Human

Participants were given questions to rate each assertion. The purpose of the questions is to assess the degree of human-type obstacles within the OVID group. The degree to which the responder agreed is shown in the following table.

**Table 4. 7: Summary of Response to** barriers of human

| | **Barriers of Human** | | **Level of agreement** | | | | | **Total** | **Mean** | **SD** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Disagree Strongly** | **Disagree** | **Neutral** | **Agree** | **Agree Strongly** | | | |
| 1 | Client awareness and knowledge of BIM lack | N(f) | 0 | 0 | 20 | 64 | 76 | 160 | 4.35 | .693 |
| | | % | 0% | 0% | 15% | 40% | 45% | 100 | | |
| 2 | Skilled personnel lack | N(f) | 0 | 24 | 16 | 60 | 60 | 160 | 3.98 | 1.04 |
| | | % | 0% | 15% | 10% | 37.5% | 37.5% | 100 | | |
| 3 | Changing attitude resistant | N(f) | 0 | 16 | 20 | 68 | 56 | 160 | ***4.03*** | ***.938*** |
| | | % | 0% | 10% | 12.5% | 42.5% | 35% | 100 | | |
| 4 | Higher cost of staff training | N(f) | 4 | 40 | 64 | 40 | 12 | 160 | ***3.10*** | ***.946*** |
| | | % | 2.5% | 27.5% | 40% | 22.5% | 7.5% | 100 | | |
| 5 | Learn new technology is Reluctant | N(f) | 4 | 12 | 32 | 72 | 40 | 160 | 3.83 | .975 |
| | | % | 2.5% | 7.5% | 22.5% | 45% | 22.5% | 100 | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Lack of client demand | N(f) | 4 | 12 | 32 | 68 | 44 | 160 | 3.85 | .992 |
| | | % | 2.5% | 7.5% | 20% | 42.5% | 27.5% | 100 | | |
| | Mean of Human/stakeholder -related barriers to adopting BIM | N(f) | | | | | | | **3.85** | **.5394** |
| | | % | | | | | | | | |

Source: SPSS Result, 2024

Table 4.7 outlines the perceptions of company related barriers regarding (BIM) adoption in projects of building construction. According to Upgade and Shende (2012), the mean response of the participants about the technology types of barriers to adopting BIM a mean of 3.85 (SD=0.539) on a scale of 5-point.

"Lack of client awareness and knowledge of BIM" is a higher mean value is obtained at 4.35 with a standard deviation of 0.922 on the variable and "Higher cost of staff training" is a lower mean value is obtained at 3.10 with a standard deviation of 0.946 on the variable Hence, high standard deviation is tightly for the mean, respondents scored on the range of 1.04 - 0.693 is express indifference. Thus, the participant perception is heterogenous.

#### 4.2.2.5. Descriptive Statistics barriers of standards, policies, and guideline

Questions were presented to participate to rate each statement. The questions are developed to evaluate standards, policies, and guidelines-related barriers in OVID group. Participates agreement displays as follows.

**Table 4. 8: Summary of Response to Standards, policies, and guidelines-related Barriers**

| | **Barriers of Standards, policies, and guidelines** | | **Level of agreement** | | | | | **Total** | **Mean** | **SD** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Disagree Strongly** | **Disagree** | **Neutral** | **Agree** | **Agree Strongly** | | | |
| 1 | lack national standards and guidelines of BIM | N(f) | 4 | 8 | 32 | 76 | 40 | 160 | 3.88 | .93 |
| | | % | 2.5% | 5% | 25% | 42.5% | 25% | 100 | | |
| 2 | BIM application lack legal framework | N(f) | 0 | 8 | 32 | 52 | 68 | 160 | 4.13 | .902 |
| | | % | 0% | 7.5% | 20% | 32.5% | 40% | 100 | | |
| | | N(f) | 0 | 8 | 44 | 76 | 32 | 160 | **3.83** | **.805** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | BIM need to formulate BIM-related contracts, contractual relationships, and related disputes | % | 0% | 5% | 27.5% | 47.5% | 20% | 100 | | |
| 4 | Local authorities on BIM lack of law enforcement by | N(f) | 0 | 4 | 28 | 68 | 60 | 160 | **4.15** | **.795** |
| | | % | 0% | 2.5% | 17.5% | 42.5% | 37.5% | 100 | | |
| 5 | Mean of standards, policies, and guidelines-related barriers to adopting BIM | N(f) | | | | | | | **3.99** | **.5479** |
| | | % | | | | | | | | |

Source: SPSS Result, 2024

Table 4.8 outlines the perceptions of company types barriers regarding (BIM) developed in projects of building construction. According to Upgade and Shende (2012), the mean or the response of the participants of technology related barriers to developed BIM has a mean of 3.99 (SD=0.5479) on a scale of 5-point.

Variable "Lack of law enforcement by local authorities on BIM" is a higher mean value is obtained at 4.15 with a standard deviation of 0.795 on the and "The need to formulate BIM related contracts, contractual relationship and BIM related disputes" is a lower mean value is obtained at 3.83 with a standard deviation of 0.805 on the variable. Hence, low standard deviation is for the mean, participants scored below 1, is express opinion. Thus, Participants in the responder survey are all the same.

#### 4.2.2.6. Descriptive Statistics on BIM Adoption

One question was presented to respondents to rate their level of agreement with each statement. The questions are designed to examine the level of BIM adoption in OVID group. Respondent's level of agreement displays as follow.

**Table 4. 9: BIM Adoption Summary of Response**

| | **BIM adoption** | | **Level of agreement** | | | | | **Total** | **Mean** | **SD** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Disagree Strongly** | **Disagree** | **Neutral** | **Agree** | **Agree Strongly** | | | |
| | Is BIM practiced in your company | N(f) | 0 | 0 | 9 | 21 | 130 | 160 | 3.78 | .893 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | % | 0% | 0% | 5.63% | 13.12% | 81.25% | 100 | | |
| | BIM adopting mean | N(f) | | | | | | | **4.75** | **.5465** |
| | | % | | | | | | | | |

Source: SPSS Result, 2024

Table 4.7 outlines the perceptions of Building Information Modeling (BIM) adoption in building construction projects. According to Upgade and Shende (2012), the mean response of the respondents for technology related barriers to adopting BIM have a mean of 4.75 (SD=0.5465) on a scale of 5-point.

Hence, clustered tightly around the mean is low standard deviation, respondents below 1 is express close opinion. Thus, participants' perception is homogenous.

**Table 4. 10: Summary of mean and SD value of variables**

| | BIM adoption variables | N | Mean | Standard deviation |
|---|---|---|---|---|
| 1 | Operation related barriers | 160 | **3.82** | **0.536** |
| 2 | Technology related barriers | 160 | **3.42** | **.743** |
| 3 | Organization related barriers | 160 | **4.17** | **.655** |
| 4 | Human/stakeholder related barriers | 160 | **3.85** | **.5394** |
| 5 | Standards, policies and guideline related barriers | 160 | **3.99** | **.5479** |

Source: SPSS Result, 2024

Table 4.10 outlines the summary of mean and SD value of (BIM) developed variables in projects of building construction. Mean can be regarded as a measure of `central location' of a random variable.

"Organization related barriers" is a higher means value is obtained at 4.17 with a standard deviation of 0.655 on the variable and "Technology related barriers" is a lower mean value is obtained at 3.42 with a standard deviation of 0.743 on the variable

## 4.3. Correlation Analysis

Relations between two variables are the subject of correlation analysis. Correlation is defined as the degree and direction of a linear relationship between two variables. Pearson The link between the independent and dependent variables' factors is analyzed using the correlation coefficient. Coefficient of correlation is always between -1 to +1. The sign indicates whether there is are perfectly linear positive correlation (+1) or a related negative correlation (-1)

**Table 4. 11: Strength measurement of Coefficient**

| coefficient (r) | Strength of the relationship |
|---|---|
| Between e±0.1 to ± .29 | relationship weak |
| Between ±0.3 to ±0.49 | relationship medium |
| Between ±0.5 to ± 1.0 | relationship strong |
| +1 | positive relationship perfect |
| -1 | perfect relationship negative |

Source: Field (2005)

**Table 4. 102: Analysis of Correlation**

| Correlations | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| **Operation-related barriers** | Pearson Correlation | 1 | | | | | |
| | Sig. (2-tailed) | | | | | | |
| **Technology-related barriers** | Correlation Pearson | .429** | 1 | | | | |
| | Sig. (2-tailed) | .000 | | | | | |
| **Organization-related barriers** | Pearson Correlation | .446** | .460** | 1 | | | |
| | Sig. (2-tailed) | .000 | .000 | | | | |
| **Human/stakeholder-related barriers** | Correlation Pearson | .286** | .369** | .201* | 1 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Sig. (2-tailed) | .000 | .000 | .011 | | | |
| **Standard, polices and guideline-related barriers** | Correlation Pearson | .221** | .272** | .185* | .426** | 1 | |
| | Sig. (2-tailed) | .005 | .001 | .019 | .000 | | |
| **BIM adoption** | Correlation Pearson | .078** | .003** | .085* | .074** | .063 | 1 |
| | Sig. (2-tailed) | .324 | .972 | .287 | .351 | .428 | |

Source: SPSS Result, 2024

Concerning the relationship between (dependent variable) and (independent variable) in projects of building construction, analysis report of Pearson correlation is .078 at a significance level of .324. This operation-related challenge to develop BIM has a weak and positive relationship with dependent variable of BIM adoption. Therefore, it can be conclude that the variables have a linear relationship with each other.

Relationship between the BIM adoption dependent variable and organization-related barriers to adopting BIM independent variable in building construction projects, Pearson correlation analysis reported has .085 at a significance level of .287. Organization-related barriers to develop BIM have a weak and positive relationship with BIM adoption (dependent variable). Therefore, it can be conclude that the variables have a linear relationship with each other.

Relationship between the BIM adoption dependent variable and human/stakeholder-related barriers to adopting BIM independent variable in building construction projects, Pearson correlation analysis is.074 at a significance level of .351. Human/stakeholder-related barriers to Taking BIM have a weak and positive relationship with BIM adoption dependent variable. Therefore, it is possible to conclude that the variables have a linear relationship.

Relationship of the BIM adoption dependent variable and standard, policies and guideline-related barriers to developing BIM independent variable in building construction projects, Pearson correlation analysis is .063, a significance level of .428. Standard, policies and guideline-related barriers to developing BIM have a weak and positive relationship with BIM adoption (dependent variable). Therefore, it can be conclude that the variables have a linear relationship.

# CHAPTER FIVE

# SUMMARY OF FINDING, CONCLUSION AND RECOMMENDATION

This study tackled the research topic and concluded with conclusions regarding the study's aims, followed by suggestions.

## 5.1. Summary of Findings

A study of Correlation Analysis and descriptive statistical analysis were employed to evaluate the research topics and achieve specific study objectives.

- ❖ Organization barriers have the strongest correlation; Technology barriers have the lowest correlation with BIM adoption in the OVID Company. Strong and statically significant relationship between the chosen obstacle of BIM adoption regions were shown by the correlation study: "Operation barriers, Technology barriers, Organization barriers, Human/stakeholder barriers and Standard, policies and guideline-related barriers" in the case of OVID group with Pearson Correlation Coefficient value of 0.085**, 0.078**, 0.074**, 0.063** and 0.003** respectively.
- ❖ "Organization related barriers" is a higher means value is obtained at 4.17 with a standard deviation of 0.655 on the variable and "Technology related barriers" is a lower mean value is obtained at 3.42 with a standard deviation of 0.743 on the variable.

## 5.2 Conclusions

The researcher concluded that to determine and investigate the barriers to BIM adoption, as applied to OVID group in Addis Ababa.

- ❖ According to this study, there is a significant positive correlation with most of the hurdles in the OVID group's instance. the managers of that organization should emphases the barriers of BIM adoption area on their operational activities.

## 5.3 Recommendations

In regard to the study's findings the researcher has suggested that OVID group focus on the important user of BIM for enhancing overall project outcomes. BIM facilitates cost savings, energy efficiency, and time optimization through its collaboration. The integrated approach of BIM streamlines communication, minimizes errors, and improves project coordination, ultimately contributing to increased productivity and successful project delivery.

Based on the results, the research proposes the following recommendations:

- ❖ The study suggested that there are many opportunities for misinterpretation since technical information predominates in BIM adaptation. However, there are fewer unknowns in the implementation process when strategies and methods are described, and planning is elevated.
- ❖ All asset users must be included in the process, and the asset's potential changes or needs for adaptation over time must be carefully considered, in order for BIM adaptation to be effective throughout the team and organization. If assumptions are not sufficiently evaluated at an early stage, costly repercussions may result.
- ❖ The BIM transition requires a deep understanding of the team's current skill set and anticipated future skill demands, in addition to new skills and ways of operation. Putting together an evaluation of a team's BIM maturity level will help with this understanding.
- ❖ BIM enforces change and will impact current associations and agreements among stakeholders; thus, it is necessary to update legal and contractual emphases to guarantee a seamless transition to BIM. BIM-enabled coordinates represent a significant departure from outdated procedures. While it is crucial to strengthen working connections with the team and other stakeholders, it may also bring out new difficulties that require resolution. It is crucial to clearly define roles, responsibilities, risks, and liabilities so that all parties involved may understand the significance of BIM transformation.
- ❖ Your transition must take place gradually and be closely monitored in order to be deemed effective in adapting and reducing risk.
- ❖ The last, but not the least recommendation is to encourage barriers of BIM adoption area on their operational activities effect applied to OVID group researches. Hence, both academicians and practitioners are advised to conduct work- life balance factors effect on employee performance studies in different areas.

## Reference

[1] Borrmann, A., (2018). Building information modeling: *Technology Foundations and Industry Practice. Springer.*

[2] Borrmann, A., (2018c). Building information modeling: *Technology Foundations and Industry Practice. Springer.*

[3] Smith, D. K., (2012). Building information modeling: A Strategic *Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers. John Wiley & Sons.*

[4] Radosavljevic, M., (2012). Construction Management Strategies: A Theory of *Construction Management. John Wiley & Sons.*

[5] Arayici, Y., (2017). *Heritage building information modelling. Taylor & Francis.*

[6] Mastin, J. M., (2019). *Smith, Currie & Hancock's Common Sense Construction Law: A Practical Guide for the Construction Professional*. John Wiley & Sons.

[7] Borrmann, A., (2018). *Building information modeling: Technology Foundations and Industry Practice*. Springer.

[8] Mordue, S., (2019). *BIM for Construction Health and Safety*. Routledge.

[9] Casini, M. (2021). *Construction 4.0: Advanced Technology, Tools and Materials for the Digital Transformation of the Construction Industry*. Woodhead Publishing.

[10] Hosseini, M. R., (2021). *BIM Teaching and Learning handbook: Implementation for Students and Educators*. Routledge.

[11] Antonopoulou, S. (2017b). *BIM for Heritage: Developing a Historic Building Information Model*.

[12] Sanchez, A. X., (2016). *Delivering Value with BIM: A whole-of-life approach*. Routledge.

[13] Smith, D. K., (2012b). *Building information modeling: A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers*. John Wiley & Sons.

[14] Shirowzhan, S., Tan, W., (2020). *Spatial Big Data, BIM and advanced GIS for Smart Transformation: City, Infrastructure and Construction*. MDPI.

[15] Arayici, Y., (2017). *Heritage building information modelling*. Taylor & Francis.

[16] Smith, D. K., (2012c). *Building information modeling: A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers*. John Wiley & Sons.

[17] Mordue, S., (2015c). *Building information modeling for dummies*. John Wiley & Sons.

[18] Sacks, R., (2011b). *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors*. John Wiley & Sons.

[19] French, M. (2011). Condominium housing in Ethiopia: The Integrated Housing Development Programe.

# Appendix

Questionnaire

ADDIS ABABA UNIVERSITY

MANAGEMENT DEPARTMENT

SCHOOL OF GRADUATE STUDIES

Dear respondent,

I am a graduate student at Addis Ababa University, specializing in management. I am undertaking a research project titled "Barriers of Building Information Modeling (BIM) Adoption in the Case of Ovid Group Addis Ababa, Ethiopia." This research is being conducted to fulfill the requirements for the Second Degree of Management partially. The enclosed questionnaire is divided into two sections. Section I focuses on gathering demographic information about the respondents, while Section II delves into five barriers influencing BIM adoption. In this section, you will be asked to provide your insights and experiences, specifically related to the project site where you are currently employed.

This questionnaire is intended for completion by management staff, contractors, employees, and other individuals associated with the company operating at OVID group in different project sites. Your participation in this survey is crucial for the success of my research, as it aims to collect valuable data for the proposed study. The findings of this research have the potential to contribute to a better understanding of BIM usage in building construction projects, and your input is invaluable in achieving this goal. I sincerely appreciate your willingness to take the time and provide the necessary information. Your participation will significantly contribute to the success of this study.

Thank you once again for your cooperation and attention.

Sincerely,

Feven Tesfaye

Graduate Student Department of Management

Addis Ababa University

**Section I**: Please, mark (X) in the provided box based on your personal information.

1. Sex: Male ☐ Female ☐

2. Age: 18-30 years ☐ 30-40 years ☐ 40-50 years ☐ above 50 years ☐

3. Educational Background: Diploma ☐ 1st Degree ☐ 2nd Degree ☐ PhD ☐

4. Current Occupation: Structural Eng. ☐ Architect ☐ Electrical Eng. ☐ Mechanical Eng. ☐
   Sanitary designer ☐ Project manager ☐ Office Eng. ☐

5. Work experience: Below 1 year ☐ 2-5 years ☐ 5-10 years ☐ above 10 years ☐

**Section II**: "Please mark (X) in the appropriate cell for the following Likert-scale questions, indicating your level of agreement regarding your experience on the construction project site. Use the scale below, where 1 corresponds to 'Strongly Disagree,' 2 to 'Disagree,' 3 to 'Neutral,' 4 to 'Agree,' and 5 to 'Strongly Agree.'

| No. | Measurement Item | Score | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **Operation-related barriers to BIM adoption** | | | | | | |
| 6.1 | Absence of industry collaboration, efforts and knowledge sharing in BIM | | | | | |
| 6.2 | Lack of Proven benefit of BIM | | | | | |
| 6.3 | The fragmented nature of the construction industry | | | | | |
| 6.4 | Difficulty in allocating and sharing BIM-related risks and costs | | | | | |
| 6.5 | Lack of detailed processes or workflow to apply BIM technology | | | | | |
| 6.6 | Lack of subcontractors who can use BIM technology | | | | | |
| **Technology-related barriers to BIM adoption** | | | | | | |
| 6.7 | Insufficient ICT infrastructures | | | | | |
| 6.8 | The software programs are complex and are not easy to use. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6.9 | Incompatibility and capability problems | | | | | |
| 6.10 | High-cost of BIM software and technology / high cost of investment | | | | | |
| 6.11 | Longer time required to adapt to new technologies (BIM) | | | | | |
| **Organization-related barriers to BIM adoption** | | | | | | |
| 6.12 | Lack of government support and lack of interest | | | | | |
| 6.13 | Weak education and training in universities and government centers | | | | | |
| 6.14 | Lack of Senior Management Support and attention | | | | | |
| 6.15 | BIM requires radical changes in current workflow, practices, procedures, and culture change | | | | | |
| 6.16 | BIM requires new responsibilities among project participants about the BIM model | | | | | |
| **Human/stakeholder-related barriers** | | | | | | |
| 6.17 | Lack of client awareness and Knowledge About BIM | | | | | |
| 6.18 | Lack of Skilled personnel | | | | | |
| 6.19 | Resistance to change attitude | | | | | |
| 6.20 | Higher cost of staff training | | | | | |
| 6.21 | Reluctant to introduce new technology | | | | | |
| 6.22 | Lack of Client demand | | | | | |
| **Standards, policies, and guidelines related to barriers** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6.23 | Lack of BIM National Standards and Guidelines | | | | | |
| 6.24 | Lack of legal framework for BIM application | | | | | |
| 6.25 | The need to formulate BIM-related contracts, contractual relationships, and BIM-related disputes | | | | | |
| 6.26 | Lack of law enforcement by local authorities on BIM | | | | | |