
# ADDIS ABABA UNIVERSITY, SCHOOL OF COMMERCE

## SCHOOL OF GRADUATE STUDIES

# ASSESSMENT OF THE USE OF DIGITALIZATION TO MANAGE CONSTRUCTION PROJECTS AND ITS PERCEIVED EFFECT ON PROJECT SUCCESS

BY : MUNA BESHIR

B. SC. ( ARCHITECTURE, ADDIS ABABA UNIVERSITY, 2018)

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JUNE, 2021

ADDIS ABABA, ETHIOPIA

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A PROJECT WORK SUBMITTED TO ADDIS ABABA UNIVERSITY SCHOOL OF COMMERCE IN PARTIAL FULFILLMENT OF THE REQUIRMENTS FOR THE DEGREE OF MASTER OF ARTS IN PROJECT MANAGEMENT

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APPROVED BY BOARD OF EXAMINERS

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## *STATEMENT OF DECLARATION*

I, Muna Beshir, declare that the thesis entitled "Assessment of the use of digitalization to manage construction projects and its perceived effect on project success" is my own work and has not been presented for any Degree or Master program in this or any other institution. All sources of materials used for this thesis have been properly acknowledged. It is offered for the award of Degree of Master of Arts in Project Management with guidance and support of the research advisor Teklegiorgis Assefa.

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| Candidate's Name | Signature | Date |

Advisor's approval

This project work has been submitted for examination with my approval as a university advisor.

_____

Advisor's Name

_____

Signature

_____

Date

## *STATEMENT OF CERTIFICATION*

This is to certify that Muna Beshir has conducted this research work on the topic entitled "Assessment of the use of digitalization to manage construction projects and its perceived effect on project success" under my supervision. This work is original in nature and it is sufficient for submission for the partial fulfillment for the award of Degree of Master of Arts in Project and Management.

Teklegiorgis Assfa (Assistant Professor)

Signature_____

Date _____

## *ACKNOWLEDGMENT*

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My special thanks goes to my husband, Ato Mahfuz Muhammednur for being understanding and supportive in every aspect.

Thank You.

# ACRONYMS/ ABBREVIATIONS

PM : Project Management

PMBOK : project management body of knowledge

BIM : Building information model

IPD : Integrated project deliver

GDP : Gross Domestic Product

HR : Human Resource

PM : Project Management

WBS : Work Breakdown Structure

MOUD : Ministry of Urban Development

GC : General Contractor

BC : Building Contractor

SPSS : Statistical Package for Social Science

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## ABSTRACT

*Any country's socioeconomic growth is aided considerably by the construction industry. Due to the interdependencies of various diverse stakeholders, Construction projects are getting more complicated and harder to manage. The state of the building construction sector demands increased efficiency and digitalization, yet it is resistant to technological change, particularly in developing nations. In addition, how many companies are now using it and what areas have a high impact but low use are not thoroughly explored in Ethiopia. This study evaluates the current use of digital medias in managing the 10 knowledge areas of project management in Addis Ababa's building construction projects. It also examines how building contractors (BCI) view the positive and negative impacts, benefits, and drawbacks of digitalization, as well as identifying high-impact areas with low use for improvement. This was done by using both descriptive and explanatory methods of research. A total of 94 building contractors where selected by using stratified random sampling technique, which used Government division of building contractors in to grades as a strata. Data were then gathered through questionnaire and interviews. Based on the assessment conducted, the general use of digitalization was found to be 1.84, which is moderate. In areas like project-integrated management, project schedule management and project communication, the use of digitalization is relatively high. While in areas like project quality management and project risk management, the application is very low. The data also indicated that project closing phase is the area were high use of digitalization was recorded, while project initiation phase is the area with low use. Finally, strong perceived effect was observed on project communication management, project integrated management and project scope management while on areas like project stakeholder management and project procurement management, the opposite was observed. Based on the data collected, priority areas for improvement were selected, those areas are project scope management, project quality management and project communication management. The researcher finally recommends the identified areas to be improved and further research be conducted in the area.*



*Key words: Project management, Project management knowledge areas, Digitalization, Use of digital medias, construction projects, construction project management, Digitalized construction project management.*

# CHAPTER ONE : INTRODUCTION

## 1.1 Background of the study

Any country's socioeconomic growth is aided considerably by the construction industry. (Olugbenga and Akure, 2012). Most emerging countries, according to Jekale (2004), spend 10% of their GDP on construction projects and about 50% of their wealth on fixed assets. It also employs up to 10% of the workforce and accounts for about half of total gross fixed capital formation. (Lopes, 2012).

Ethiopia's building industry has grown rapidly and is given a great deal of attention. By establishing the physical structures essential for the production and distribution of goods and services, it lays the groundwork for other industries to expand. According to information gathered from Ethiopia's Ministry of Construction, Ethiopia allocated 9.5 percent of its entire Gross Domestic Product (GDP) on construction in 2016.

According to data acquired from Ethiopia's Planning and Development Commission, the sector has made a significant contribution to economic growth. The sector contributed to the country's economic growth by a minimum of 10.9 percent in 2009/10 and a maximum of 38.7 percent in 2012/13, according to ten-year data. The industry employs the second-largest number of people in the country. (Construction Industry Development Policy, 2014).

Despite this importance, several academics claimed that the construction industry's performance in developing countries is still poor. Every construction project presents its own set of difficulties. On nearly one-third (29%) of lost projects, poor communication is recognized as the primary cause of failure. According to the PMI professional survey, only approximately half (52%) of projects are completed within the originally anticipated timeframe (Mark, 2018). These problems necessitate a better understanding of the construction process as well as tactical knowledge of the concerns that arise at each project phase. The complexity and turbulence of the project will increase as the project's size and number of employees grow. Traditional project management methods, such as paper-based records and approaches, make this difficult to handle. There needs to be a better approach to deal with it.

Digital technology will, without a doubt, become more vital for construction industry in the future. It improves the management process and boosts a company's efficiency, productivity and output. Technology, in general, and information technology (IT) in particular, have been employed and regarded as tools to minimize time and enhance performance and efficiency in numerous industries over the past 40 years. (Berlak, 2003). It’s important is even higher with our current situation, COVID-19.

COVID-19 is a global epidemic unlike any other, with comparisons to the Second World War and the Great Depression in terms of human behavior. Physical separation and quarantine were required to suppress the COVID-19 pandemic. Various forms of human activity changed from

manual to digital in order to fulfill this mandate while attempting to maintain the status quo. (Zheng, 2021).

Digitalization is the process of leveraging digitization and digital technologies to improve corporate processes, create innovative business models, and identify and deploy new revenue streams for value addition and value-adding opportunities. (Osterwalder, 2010).

Digital project management is a process of managing online/offline projects using digital media such as mobile apps, websites, e-commerce solutions, events, social media, advertising, etc. It starts from the concept and ends with the total project completion, within the defined budget and using a certain amount of resources. It contains planning, tracking, reviewing, delegating and measuring outcomes. Digital construction management through Building Information Modelling (BIM) and a networked data environment offer both broad and comprehensive views of all phases of a project, assisting in the mitigation or avoidance of difficulties that can cause a project to stall. (Azihar et al 2015)

The project management knowledge areas are all you need to know about project management in order to be successful in managing the project. These knowledge domains in project management cover a lot of ground. The majority of the time, knowledge areas are used on most projects. The project management team is responsible for determining the proper depth of implementation for each project. Knowledge areas also allow us to review project management practices by separate and distinct siloes.

The construction business has come to be associated with "inefficiency," resulting in low productivity and profit margins. Non-value-added activities take up a lot of time on building sites, increasing waste and decreasing efficiency. This demand forces the sector to shift away from older, more traditional communication techniques and toward more modern digital ones. (Stefanakis, 2019)

In this research, the general construction project management trend in Ethiopia from concept to completion and all ten-project management body of knowledge with respect to digitalization was assessed. How much of the construction management processes are currently digital and its perceived impact of that digitalizing in the overall construction success were also studied.

## 1.2 Statement of the problem

Most project failures, according to PWC (2004), are caused by organizational project management deficiencies, which account for 59 percent of the issues. As a result, competent project management is essential.

Construction projects, due to the interdependencies of various diverse stakeholders, are getting more complicated and harder to manage. The site management process is still dominated by paper, resulting in considerable expenses, errors, and waste for construction organizations, and a significant amount of time is spent on construction sites performing non-value-added activities, raising waste and inefficiency rates.

The most essential themes that the construction industry is attempting to accomplish today are increasing efficiency, effectiveness, productivity, and project quality, as well as lowering project cost and delivery time. The digital construction transformation has begun to emerge as a fundamental strategy for achieving these goals and meeting the demands of modern building projects. This forces the sector to shift away from older communication channels and toward modern digital ones. (Stefanakis, 2019)

The construction industry has been exposed to digital transformation for some time, but it has yet to fully accept it and exploit its potential (Becerik & Rice, 2010). The state of the building construction sector demands increased efficiency and digitalization, yet it is resistant to technological change, particularly in developing nations like Ethiopia. How many companies are now using it and what areas have a high impact but low use are not thoroughly explored in Ethiopia.

Therefore, the purpose of this study is to evaluate the current use of digital medias in managing the 10 knowledge areas of project management in Addis Ababa's building construction projects. It also examines how building contractors (BCI) view the positive and negative impacts, benefits, and drawbacks of digitalization, as well as identifying high-impact areas with low use for improvement.

## 1.3 General and specific objectives

### 1.3.1 General objective

The general objective of this research is to assess the use of digitalized management in the Ethiopian building construction sector in relation to the ten-project management body of knowledge and its perceived effect on overall project success and identify high impact areas with low use for improvement.

### 1.3.2 Specific objective

- To evaluate the use of digital systems in project management.
- To examine the perceived effect of digitalization on project success.
- To identify priority areas that has high impact areas with low use for future improvement

## 1.4 Research Question

1. How much of digitalization is being used to manage construction projects?
2. What is the perception of the effect of digitalization on project success?
3. What are the priority areas that have high impact with low use and need improvement?

## 1.5 Hypothesis of the Research

H1. Digitalization has effect on project success
Ho : Digitalization doesn't have effect on project success

## 1.6 Significance of the Research

This study acknowledges that various published research on digital technology and information and communication technology (ICT) in building construction have been conducted in countries all over the world. However, How many companies are now using it and what areas have a high impact but low use are not thoroughly explored in Ethiopia.

The significance of the research is to show how much of digitalization is currently being used to manage construction projects in Ethiopia and how are its positive effects, negative effects, benefits and shortcomings are being perceived. It also identifies priority areas that have high effect on construction projects for future improvement, which can serve as a benchmark for future research aiming to improve the use of digitalization on construction projects in Ethiopia.

## 1.7 Research Scope

The study's scope is limited to the topic assessing the use of digitalization to manage construction projects located in Addis Ababa. The research is limited to contractors that work in the construction industry (BCI). According to the Ministry of Construction, As of 2013 E.C., there are 1,600 large building construction enterprises in Addis Ababa, with ten different grades.

The study's geographical scope was set in Addis Ababa, Ethiopia, because it is the country's capital city and home to several development projects. Theoretically, this research was limited by 10 knowledge areas provided by the Construction Extension of PMBOK's Guide

## 1.8 Research Limitation

The major limitation for this research was poor data recordings on the construction sites. The construction processes are either not recorded at all or poorly recorded due to this; the impact of digitalization can only be measured subjectively.

The research has been hampered by poor project management practices and a project

management knowledge gap. Most companies don’t apply the ten-project management body of knowledge. In addition to this, the respondents' unwillingness, reluctance and busyness were also a limitation.

## 1.9 Organization of the research report

This paper was divided into five major chapters. The first section of this paper depicts the study backgrounds such as construction management and digitalization, statements of the problem, basic research questions, objectives, significance, scope and limitation of the research. The second section takes an in-depth and elaborative look at relevant and related literature; Theoretical, Empirical and conceptual frame work, while the third section explains the research design and methodology of the study as well as the analysis used. The fourth section will go over the findings and discussions. The final section will cover the research summary, conclusion, and recommendations.

# CHAPTER TWO : REVIEW OF RELATED LITERATURE

## 2.1 Introduction

This chapter is organized into three sections; theoretical review, empirical review of related literature and conceptual framework. Under the theoretical review section, definition of terms is discussed. Under empirical review section, related literatures on the importance, effect and general use of digitalization are discussed. Under the conceptual framework section, the theoretical relationship between Digital medias usage, Impact of digitalization and the knowledge areas of PM with project success is discussed.

## 2.2. Theoretical Review

### 2.2.1 Project and project management

A project, according to Passenheim, 2004 is a short-term endeavor that results in a one of a kind product, service, or outcomes. A project is made up of pre-defined processes and tasks that will achieve business and/or technical goals, run for a set period of time, and have a budget and resources.

A project is a collection of distinct, interconnected operations with a single aim or purpose that must be completed on time, on budget, and according to specifications (Wysocki, 2018). Within a program, a project is defined as an effort with a defined start and finish date, and which usually has a primary goal (Kerzner, 2003).

PM is described in a variety of ways. PM, according to Kerzner (2003), is the activity of planning, organizing, directing, and regulating project activities (and resources) in order to fulfill an organization's objectives within the given time, cost, and scope in order to fulfill the customer's expectations.

Managing a project is a challenging and complex process that requires the identification and commitment of resources in order to ensure the project’s completion and, as a result, the accomplishment of organizational goals. (Soota, 2005). PMI (2003) defines project management as the application and integration of logically grouped processes divided into five categories: initiating, planning, executing, and monitoring & Controlling and Closing stages, all of which are carried out with in a given schedule, scope, quality, budget, resources and risk.

### 2.2.2 Construction project and its management

Construction is the act or process of building something. It entails a series of steps that result in either a new set of buildings and infrastructure or changes to existing structures and infrastructure (Radosavljevic and Bennett, 2012). A construction project is a piece of work that is being attempted or completed in the construction industry. A project is made up of a sequence of complex or interconnected activities and tasks that use resources to accomplish a certain

goal. It must be completed according to a set of requirements and within a defined budget (Munns and Bjeirmi, 1996)

Construction stages are:

**1. Preliminary Stage:** The first stage refers to the situation before the start of the tender or design of a project. It relates to the general situation and approach of the projects from the organizational perspective.
**2. Pre-Construction Stage:** This stage entails the initial set-up the project. More specific, the tendering, the planning and the design of an upcoming project.
**3. Construction Stage:** This stage is strictly focusing on what happens on-site during the construction activities.
**4. Post-Construction Stage:** The final stage is the post-construction stage. After the completeness of the construction and final handover to the client, there are certain actions that can be taken from the project team.

Construction projects differ from other types of projects in terms of their nature and characteristics. PMI (2016) highlighted the generally accepted principles for construction projects that are not common to all general project categories in the Construction extension to the PMBOK Guide. Construction projects are inherently more likely to take place in an ever-changing, complicated environment, with a high level of risk. PMI (2016) Construction projects, he continued, handle geography, physical environments, existing infrastructure, communities, site circumstances, and a diverse range of stakeholder requirements all at the same time. Furthermore, according to PMI (2016), late completion of building projects usually results in significant penalties or damages.

In construction projects, project management's main role is to organize diverse professionals working on the project so that they can make the most of their time there (Chartered Institute of Building, 2002). Construction project management, according to Hendrickson (2008), necessitates a comprehension of the design and construction processes in addition to general and project management skills. According to Kwak & Ibbs, 2000, the average cost of PM services is 6% of total project cost and 9.3% for construction enterprises.

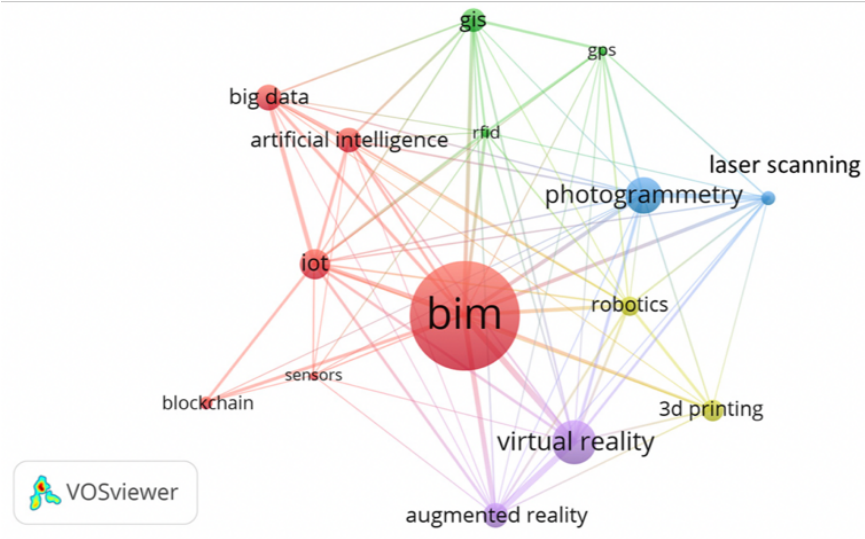
### 2.2.3 Digitalization and Digital Project Management

Digitalization is the process of leveraging digitization and digital technologies to enhance corporate processes, establish new business models, and uncover and implement new revenue-adding and value-adding opportunities (Osterwalder and Pigne, 2010). By transforming interactions, communications, corporate operations, and business models into more digital ones, digitalization implies a larger use and context for digitized data and digital technologies. When it comes to digitization vs. digitalization, the former is an action that may permit the latter, while the latter always necessitates the former (Valenduc and Vendramin, 2017). Digital transformation is the result of digitalization processes, which refer to digital strategies shaping and implementing, their transformation of business models into customer-driven business ones

that require organizational change at all levels, and the use of digital technologies (Frank et al, 2019).

Digital project management is a streamlined method of overseeing online projects from conception to completion while staying under budget and utilizing a limited number of resources. It entails planning, delegating, tracking, reviewing, and evaluating results, all of which are frequently accomplished with the aid of project management software. Every project has a particular goal, but the ultimate goal is to expand the firm and generate a positive return on investment. Digital projects come in a variety of sizes and formats. Websites, mobile apps, videos, games, events, content, e-commerce, social media, and advertising are all examples.

***Figure 1.*** *Visualization of keywords occurrences of digital technologies in the construction industry.*




(Source : Mudan and Cynthia, 2020)

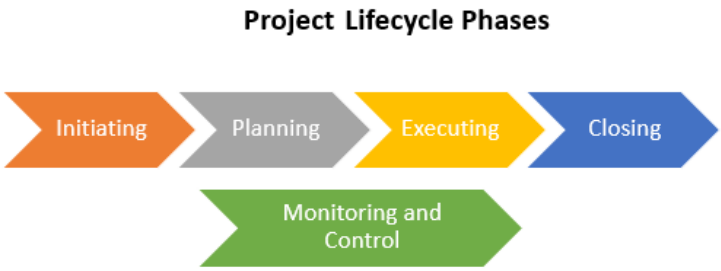
## 2.2.4 Construction Project Management Process

A Project Management Process Group is a logical collection of project management procedures that work together to achieve certain project goal. Process Groups are independent of project phases. Project management processes are grouped into the following five Project Management Process Groups:

*Initiating Process Group*: Those procedures for defining a new project or a new phase of an existing project, as well as gaining authorization to begin the project or phase.
*Planning Process Group:* Those processes for determining the scope of the project, refining the objectives, and determining the course of action were all necessary for achieving the project's goal.
*Executing Process Group*: Those processes performed to complete the work defined in the project management plan to satisfy the project requirements.

*Monitoring and Controlling Process Group*: Those processes that are required to track, review, and regulate the progress and performance of the project; identify any areas where adjustments to the plan are required; and implement those changes.
*Closing Process Group*: Those processes performed to formally complete or close the project, phase, or contract. (PMI, 2013).

***Figure 2.*** *Project lifecycle phase*




## 2.2.5 The Ten Project Management Body of Knowledge

A Knowledge Area is a specified area of project management that is described in terms of its component processes, practices, inputs, outputs, tools, and techniques and is defined by its knowledge requirements. Although the Knowledge Areas are interrelated, they are defined individually from the stand point of project management. They are:

I. Construction Project Integration Management

Within the Project Management Process Groups, project integration management includes the processes and activities for identifying, defining, combining, unifying, and coordinating the numerous processes and project management activities. Unification, consolidation, communication, and interaction are all features of integration in project management. These steps should be taken from the beginning to the end of the project. (PMI, 2013).

II. Construction Project Scope Management

Project scope management refers to the procedures that must be followed to guarantee that the project includes all of the work that is required, and only the work that is required, in order to be completed effectively. (Source: PMI, 2013). The work to be done on a project, how the workers should finish the job, and who on the team is responsible for completing the various duties on the project are all included in the scope of work for a construction project.

III. Construction Project Schedule Management

Project schedule management includes the procedures for managing the project's timely completion. (PMI, 2013). Ineffective time management in construction projects can result in extra expenses and delays, either by failing to account for the entire complexity of a project or by failing to efficiently manage scheduled work or unexpected events.

## IV. Construction Project Cost Management

The activities involved in planning, estimating, budgeting, financing, funding, managing, and controlling expenses so that the project can be completed within the allocated budget are all part of project cost management. (Source: PMI, 2013).

Cost Management of Construction Projects addresses essential factors that assist drive project success, such as measurement procurement, cost planning, contract administration, and project cost management, and focuses on the cost manager/quantity surveyor hired by the project client.

## V. Construction Project Quality Management

Project Quality Management includes mechanisms for implementing the organization's quality policy into project and product quality requirements planning, management, and control in order to meet stakeholders' expectations. (PMI, 2013). The policies, processes, and procedures put in place, by management, to improve an organization's capacity to offer quality to its clients are known as quality management in construction.

## VI. Construction Project Resource Management

Management of project resources includes the procedures for locating, acquiring, and managing the resources required to complete the project successfully. (PMI, 2013). Construction projects can fall behind schedule or become unprofitable if resource management is not properly managed.

## VII. Construction Project Communication Management

Project communication management, by definition, refers to the set of operations involved in the creation, collecting, presentation, distribution, and secure storage of information within a project and its surroundings. (PMI, 2013).

Construction project communication management is thus the backbone of effective decision-making throughout the project's existence. It encompasses the procedures that must be followed to guarantee that project information is planned, created, distributed, stored, retrieved, managed, controlled, monitored, and finally disposed of in a timely and suitable manner. (PMI, 2013).

## VIII. Construction Project Risk Management

Project Risk Management is a term that refers to the process of Risk management planning, identification, analysis, response planning, response implementation, and risk monitoring for a project are all covered. (PMI, 2013). To properly manage construction risk, you must first understand the many types of hazards that exist in building projects. These issues can arise

from both internal and external sources, and they might be financial, contractual, operational, or environmental in nature.

## IX. Construction Project Procurement Management

Management of project procurement includes the procedures for purchasing or obtaining products, services, or results from sources other than the project team. (PMI, 2013). By definition, procurement in construction management entails procuring all of the materials and services required to bring a construction project to a timely and satisfactory conclusion.

## X. Construction Project Stakeholder Management

"An individual, group, or organization who may affect, be impacted by, or perceive itself to be influenced by a project decision, activity, or outcome," according to the PMBOK Guide (PMI, 2013). Stakeholders in construction projects are persons, groups, or organizations who may influence or be influenced by a construction project's choice, activity, or outcome. (PMI, 2013)

A general overview of the basic construction project processes groups and the ten-project management body of knowledge are mapped as follow:

*Table 1: Knowledge area and construction management process groups mapping (PMI, 2013).*

| Knowledge Area | Project Management Process Groups | | | | |
|---|---|---|---|---|---|
| | *Initiating Process Group* | *Planning Process Group* | *Executing Process Group* | *Monitoring & Controlling Process Group* | *Closing Process Group* |
| *1. Project Integration Management* | *1.1 Develop Project Charter* | *1.2 Develop Project Management Plan* | *1.3 Direct and Manage Project Work*<br>*1.4 Manage Project Knowledge* | *1.5 Monitor and Control Project Work*<br>*1.6 Perform Integrated Change Control* | *1.7 Close Project or Phase* |
| *2. Project Scope Management* | | *2.1 Plan Scope Management*<br>*2.2 Collect Requirement*<br>*2.3 Define Scope*<br>*2.4 Create WBS* | | *2.5 Validate Scope*<br>*2.6 Control Scope* | |
| *3. Project Time Management* | | *3.1 Plan Schedule Management*<br>*3.2 Define Activities*<br>*3.3 Sequence Activities*<br>*3.4 Estimate Activity Durations*<br>*3.5 Develop Schedule* | | *3.6 Control Schedule* | |
| *4. Project Cost Management* | | *4.1 Plan Cost Management*<br>*4.2 Estimate Costs*<br>*4.3 Determine Budget* | | *4.4 Control Costs* | |
| *5. Project Quality Management* | | *5.1 Plan Quality Management* | *5.2 Perform Quality Assurance* | *5.3 Control Quality* | |
| | | *6.1 Plan Human Resource Management* | *6.3 Acquire Project Team* | | |

| | | | | | |
|---|---|---|---|---|---|
| *6. Project Resource management* | | *6.2 Estimate Activity Resources* | *6.4 Develop Project Team*<br>*6.5 Manage Project Team* | *6.6 Control Resources* | |
| *7. Project Communications Management* | | *7.1 Plan Communications Management* | *7.2 Manage Communications* | *7.3Control Communications* | |
| *8. Project Risk Management* | | *8 .1 Plan Risk Management*<br>*8.2 Identify Risks*<br>*8.3 Perform Qualitative Risk Analysis*<br>*8.4 Perform Quantitative Risk Analysis*<br>*8.5 Plan Risk Responses* | *8.6 Implement Risk Responses* | *8.7 Control Risks* | |
| *9. Project Procurement Management* | | *9.1 Plan Procurement Management* | *9.2 Conduct Procurements* | *9.3 Control Procurement* | |
| *10. Project Stakeholder Management* | *10.1 Identify Stakeholders* | *10.2 Plan Stakeholder Management* | *10.3 Manage Stakeholder Engagement* | *10.4 Control Stakeholder Engagement* | |

### 2.2.6 Importance of Digitalization on construction projects

The state of the building construction business demands increased productivity and digitalization, but it is resistant to technological change. De Soto et al. (2018) emphasized the importance of digital technologies in improving construction delivery through a digital building system that may assist in the successful delivery of projects from site selection to project handover.

Mesa et al. (2016) pointed out that when a significant number of people are involved in a construction project, the effectiveness of their cooperation is the most critical factor impacting the project's success. Due to a lack of cooperation, the construction process is divided into stages, there are many revisions and rework, and the project's duration and unanticipated costs increase. To solve difficulties, the building design and construction sector has to increase participant coordination and adopt more collaborative approaches (Mesa et al. 2016)

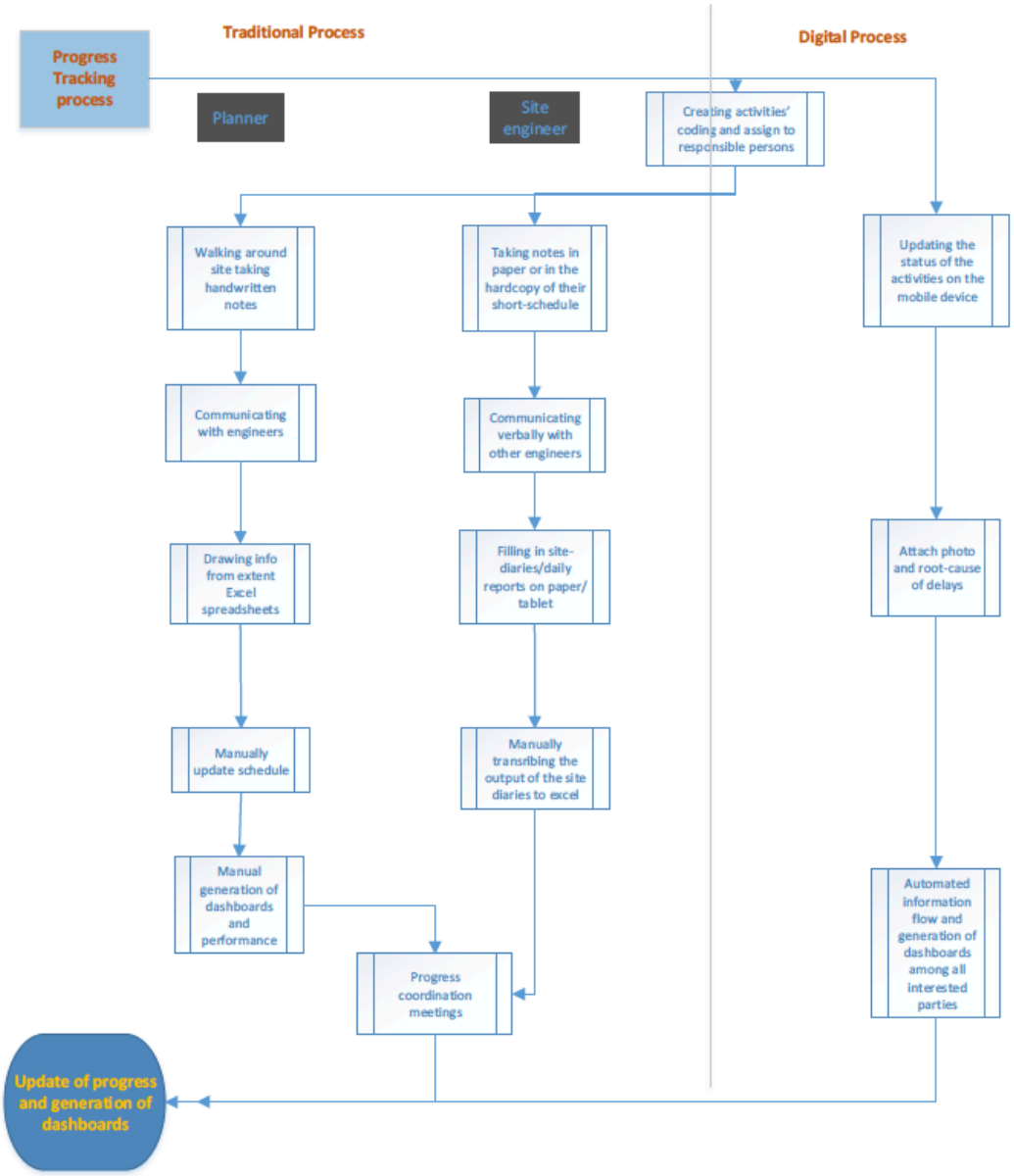
It may be said that BIM and IPD are widely employed in the construction industry. Many academics and practitioners recognize and appreciate the advantages of their use. BIM is a potential breakthrough in the architectural, engineering, and construction (AEC) industry. BIM technology creates a digitally created exact virtual representation of a building. Such a computer model incorporates the structure's exact spatial geometry as well as the necessary data for effective construction work planning and execution, as well as project management (Eastman et al. 2011).

### 2.2.7 Effect of Digitalization on construction projects

In traditional management, individual users, project teams, divisions, and corporations can use automated dashboards to develop analytics to better understand the dynamics of their work and increase productivity. However, it is not enough for the site team to submit information into

the planner; the planner must actually go out on site to ensure that the activities are running on time. This flowchart aids in visualizing the process of tracking construction activity progress in relation to the digital process.

***Figure 4*** *: Flowchart of progress tracking process. (Traditional vs. Digital)*




(Source : Stafanakis 2000)

According to Siniak, the use of BIM technology in Ukraine can result in a 20-50 percent cost savings at the design stage and up to a 40% cost savings at the construction stage due to labor and cost transparency, factory production of building components, elimination of potential errors, repairs and rework, and clear time schedules for construction investment (Siniak et al. 2019). The use of BIM in AEC projects over the last 10 years has demonstrated that digitization in the construction environment has a substantial impact on the optimization of all services and communication between all parties involved in a project (Azhar et al. 2015).

***Table 2 :*** *Influence of BIM on Project Management knowledge areas*

| PMBOK Knowledge Areas | Influence of BIM |
|---|---|
| Project Integration Management | Development of the project charter and project management plan in sync with the BIM Execution Plan; develop integrated change control with BIM |
| Project Scope Management | Integrate BIM Execution Plan with Scope Definition; develop a Scope Control mechanism |
| Project Time Management | Incorporate standard processes and practices of 4D simulation, phasing, and prototyping; interface of project schedule and the BIM implementation plan |
| Project Cost Management | Incorporate standard processes and practices of quantity takeoff, estimating; link cost assemblies with model objects to generate estimates |
| Project Quality Management | Interface of model quality management plan with the overall project quality plan |
| Project Human Resource Management | Coordination and communication protocols, training, and competency mapping about BIM |
| Project Communications Management | Collaboration, coordination and communication protocols |
| Project Risk Management | Accuracy and certainty in time, cost, and other project parameters |
| Project Procurement Management | Supply chain integration, Quantity takeoff, estimating |
| Project Stakeholder Management | Visualization, Collaboration, Information Sharing |

(Source : Dr. Eriksson and Isabelle, 2017)

### 2.2.8 General utilization of Digitalization

Despite the fact that the literature constantly emphasizes digitalization's efficiency and cost savings, the construction industry has been slow to adopt technology. The relationship between IT and productivity, according to Brynjolfsson (1993), is often debated but poorly understood. He underlines the disconnection between the need to increase company efficiency and the adoption and application of new digitalization technologies.

While other businesses have embraced this clearly beneficial trend, the construction sector has yet to fully embrace it in its service offering. This failure to capitalize on the inherent benefits of digitization has had a huge impact on the industry, particularly in poorer nations, where there has been no significant reform in the construction sector (Castagnino et al. 2016).

Ethiopia is no exception, with traditional delivery techniques still being used for the majority of building projects.

## 2.3. Empirical review

Despite the fact that the literature constantly emphasizes digitalization's efficiency and cost savings, the construction industry has been slow to adopt technology. The relationship between IT and productivity is often discussed but poorly understood, according to (Brynjolfsson, 1993). He underlines the disconnect between the need to increase company efficiency and the adoption and application of new digitalization technologies.

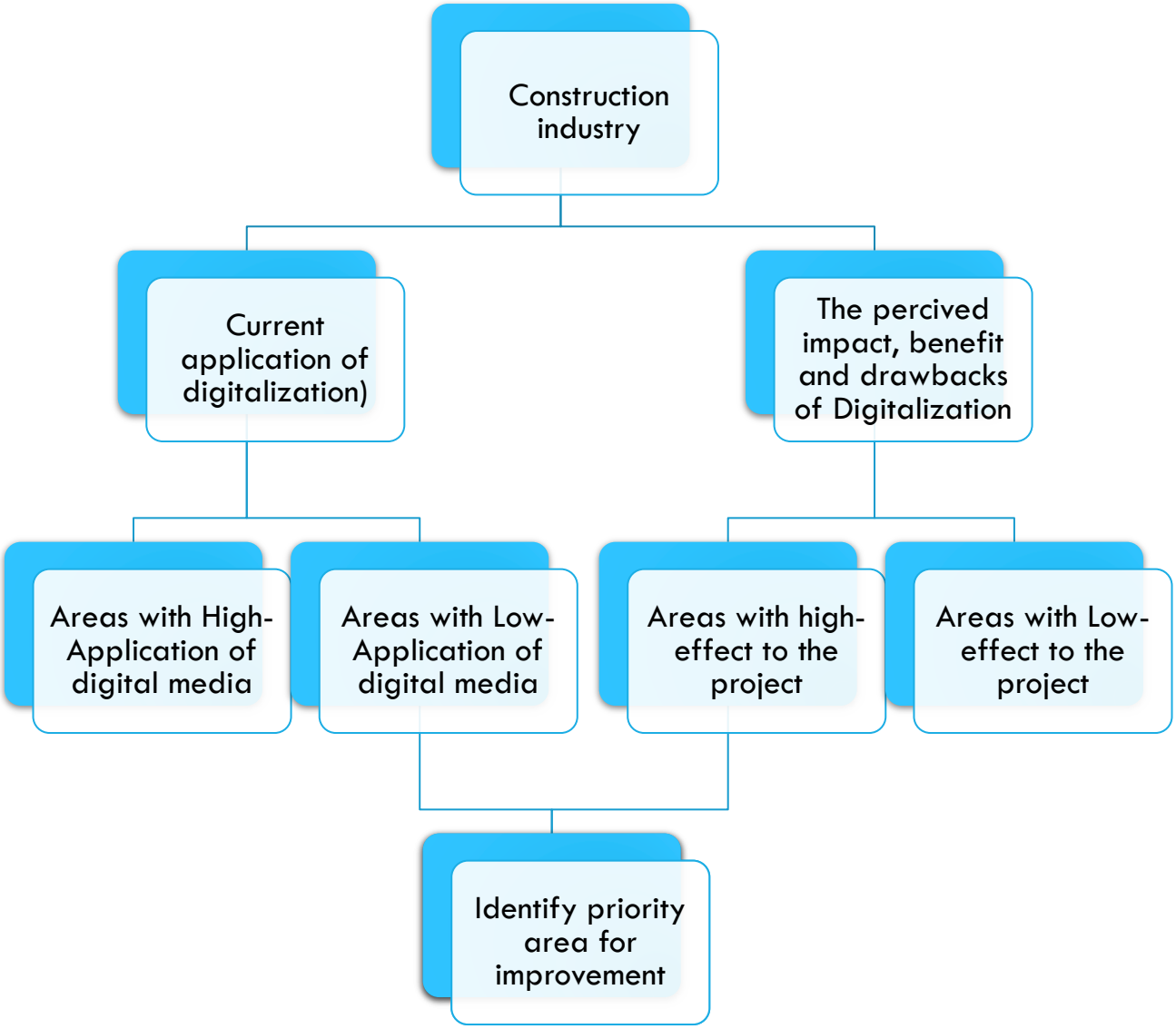
The study done in South Africa revealed that the major stages of construction where digitalization is evident are the design phase, and the feasibility phase. The major construction processes where it is mostly visible are, construction cost control, cost planning, preliminary cost estimate and building system analysis. In addition, the most significant benefits to be derived from digitalization in the industry includes time-saving in construction projects delivery, increase productivity, increase speed of work, increase document quality, speeding up of response time, and simpler working methods. (Shiau, 2018)

The most significant benefits to be derived from the digitalization of the industry includes time saving, increase productivity, increase speed of work, increase document quality, speeding up of response time, and simpler working methods. The least benefits of digitalization are, reduction of construction error, and the promotion of new work. (Stefanakis, 2019)

According to Aghimien (2018), the major stages of construction where digitalization is evident are the design phase, and the feasibility phase. The major construction processes where digitalization is mostly visible are, construction cost control, cost planning, preliminary cost estimate and building system analysis. It is, however, less evident in the maintenance schedule. In addition, the most significant benefits to be derived from the digitalization in the industry includes time-saving in construction projects delivery, increase productivity, increase the speed of work, increase document quality, speeding up of response time, and simpler working methods.

## 2.4.Conceptual Model

***Figure 5:*** *Conceptual Model*




(Source : Self Developed)

# CHAPTER THREE : RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter discusses issues that are related to methods and approaches of the research. Population size, sample size and techniques, data collection and analysis methods will also be discussed. This research generally assesses the use of digitalization for the ten-knowledge area of project management and the perceived impact.

## 3.2. Research Design

In this research, both descriptive and explanatory methods of research were used for the two parts.

The descriptive technique of research was employed for the first portion of the study because it focuses primarily on studying or assessing the existing use of digital medias in managing building construction projects management. The characteristics of the target population are explored in descriptive research. As a result, only the "how much" of the subject will be addressed in this section, not the "why." The purpose of the research is to better understand the existing management practices on construction projects in Addis Ababa, Ethiopia.

In the second section, explanatory research methodologies were developed to analyze the positive and negative effects, benefits, and drawbacks of digitalization. Due to lack of data, the result was analyzed subjectively.

## 3.3. Research Approach

In this research, the integration of both qualitative and quantitative research approaches was used. Quantitative approach was used to collect numerical data; questionnaire was used for this approach. And the qualitative approach was used as a support to strengthen the data and to prepare questionnaire; interview was used for this approach. Due to time restriction, a cross-sectional survey strategy was used.

## 3.4. Target Population of the study

The population for this research is the group of contractors that are registered in Addis Ababa. It is mandatory for contractors to register before undertaking any construction projects. They have an option to register in any one of the following categories.

*Table 3: Types of Contractors in Ethiopia*

| Types of contractors | Code | Qualification |
|---|---|---|
| General Contractor | GC | Qualified to work on wide range of construction projects including buildings, roads, railways, bridges |
| Building Contractor | BC | Qualified to work building construction projects and related works. |
| Road Contractor | RC | Qualified to work road construction and other related civil engineering projects. |
| Specialized Contractors | SC | Qualified to work in construction activities in specialized trades like electro-mechanical installation works, sanitary installation works, painting and decorations, landscaping and wood and metal works and other related activities. |

Building Contractors of all grades are selected to be the target population for this research. According to MOUD (2005), There are ten grade categories that are based on the construction cost of the project that the contractor is seeking to undertake.

*Table 4 : Contractors Grade Categorization in Ethiopia*

| Categories | Grade | Construction cost | No |
|---|---|---|---|
| BC | 1 | Above 210,000,000 | 84 |
| BC | 2 | Up to 210,000,000 | 54 |
| BC | 3 | Up to 160,000,000 | 81 |
| BC | 4 | Up to 110,000,000 | 393 |
| BC | 5 | Up to 54,000,000 | 582 |
| BC | 6 | Up to 27,000,000 | 23 |
| BC | 7 | Up to 11,000,000 | 38 |
| BC | 8 | Up to 5,400,000 | 268 |
| BC | 9 | Up to 3,000,000 | 72 |
| BC | 10 | Up to 1,000,000 | 6 |
| | | *Total:* | *1600 Contractors* |

## 3.5. Sampling Technique

There are many sampling techniques. This research used from random sampling design, stratified random sampling. The sampling frame is partitioned into uniform and non-overlapping subgroups, known as strata, and a simple random sample is selected within each subgroup in stratified sampling. (Bhattacherjee, 2012). The research used the MOUD (2005) grading as one sub group. From each stratum, a sample was drawn in proportion to its corresponding stratum sample frame. For the interview, I used convenience sampling to select 10 respondents.

## 3.6. Sampling Size

According to Taro Yamane's (1967) formula to calculate sample size was used to determine the appropriate sample size for the research. This formula was used to calculate a 90% confidence level and precision P =0.1 are assumed for this equation.

$$n = N/1+Ne^2$$

n = sample size
N = Population
e = margin of error (0.10)

$$n = N/1+Ne^2$$
$$= 1600/1+(1600 * (0.10)^2)$$
$$= 1600/1+(16)$$
$$= 1600/17$$

*Sample size is = 94 Building Contractors*

Sample size for each stratum was calculated by the following formula:

$$n\ (stratum) = N(stratum)/N(\ Total) * n\ (Total)$$

Where, n = sample size
N = sample frame

*Table 5: Summery of stratum sample size*

| Stratum (Grade) | Sample Frame | Sample Size |
|---|---|---|
| Grade 1 | 84 | 5 |
| Grade 2 | 54 | 3 |
| Grade 3 | 81 | 5 |
| Grade 4 | 393 | 23 |
| Grade 5 | 582 | 34 |
| Grade 6 | 23 | 1 |
| Grade 7 | 38 | 2 |
| Grade 8 | 268 | 16 |
| Grade 9 | 72 | 4 |
| Grade 10 | 6 | 1 |

## 3.7. Research Measurement instruments

Structured questionnaire and interview questions were issued to undertake this research. The ten project management knowledge areas and the five project phases were incorporated. The questionnaire was done on Google doc and it was filled online. It has 60 questions and takes 15-20 minutes to complete. The interview has 10 questions and it was conducted in person.

## 3.8. Data collection procedure

This research used from stratified random sampling, using grades as one stratum. A sample was drawn from each stratum in proportion to its corresponding stratum sample fra me. Then, Lottery method was used to select participants. Then, structured questionnaires were sent and collected via email and interviews were conducted physically.

## 3.9. Data analysis method

Descriptive research was used where the use of digitalization is depicted. The questionnaire was designed in a way you can't pass to the next level if you didn't finish the first to check Completeness. After that, the data was entered to EPI Data and transferred to SPSS version 25 for further analysis. Descriptive statistics was done and results were generated using tables and graphs.

## 3.10. Validity and Reliability

In research, reliability refers to whether the same findings will be obtained if the investigation is repeated at another time by another researcher. If this is the case, the instrument used can be considered reliable (Lincon and Guba, 1985). In order to maintain the reliability of the data, the researcher distributed the questionnaire for 94 randomly selected companies, only for one project manager from each company.

In this study's context, content validity is the extent to which the survey items (components) cover the application of digital management in a representative and comprehensive manner, Hence, the comprehensiveness and representativeness of the instrument to assess the application were assured.

## 3.11. Ethical Consideration

The information provided will be kept confidential and the response that key informants reply will not be used for any other purpose other than this research work and will have no effect on them. The respondents will be assured that the information they provide is confidential and used for academic purpose only. The respondents' anonymity was ensured since the research instrument did not include any sections that allowed participants' identities to be revealed.

# CHAPTER FOUR : RESULTS AND DISCUSSION

## 4.1 Introduction

The main purpose of this thesis is to evaluate the application of digitalized management in the Ethiopian building construction sector in relation to the ten-project management body of knowledge and its perceived impact on overall project success. This chapter discusses the analysis of the results. The discussion is presented by using tables and charts. Background of the respondents is also discussed. Knowledge areas with respect to application of digitalization are computed. Accordingly, the perceived effect on each knowledge areas are also discussed.

## 4.2. General information

94 Questionnaires were dispatched to a total of 94 Project Managers of Different Building Contractors. 85 of the project managers filled and returned back the questionnaires. According to the responses, 70 (82.4% ) are male and 15 (17.6%) of the respondents are females.

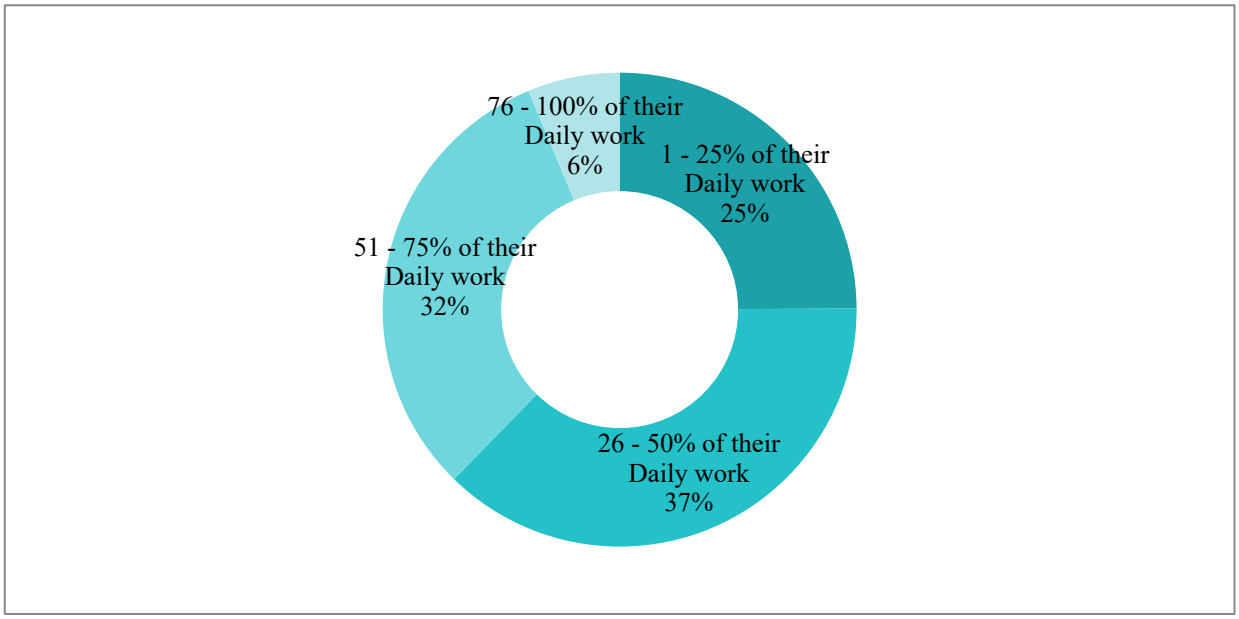
10 (11.8%) had diploma, 40 (47.1%) had bachelors degree, 25 (29.4%) had masters, 10 (11.8%) had PhD. 75 (88.2%) of the project managers (respondents) have training or educational background in project management. 30 (35.3%) had less than 5 years work experience, 30 (35.3%) 5 to 10 years of experience, 25 (29.4%) more than 10 years' experience.

Around 50% of the companies have 15 to 25 years of work experience in the field with 50 to 100 staff under them. Out of the 85 respondents, 5 (5.9%) of the companies have never used digital media in their work. The results below are the 80 companies that actually use digital media.

Out of the 80 respondents who use digital medias, 40 (50%) thinks digital medias are user friendly and 30 (37%) thinks it is adequate while 10 (12.5%) thinks it is poor. 60 (75%) are confident with the ability of digital medias while the rest 20 (25 %) are neutral.

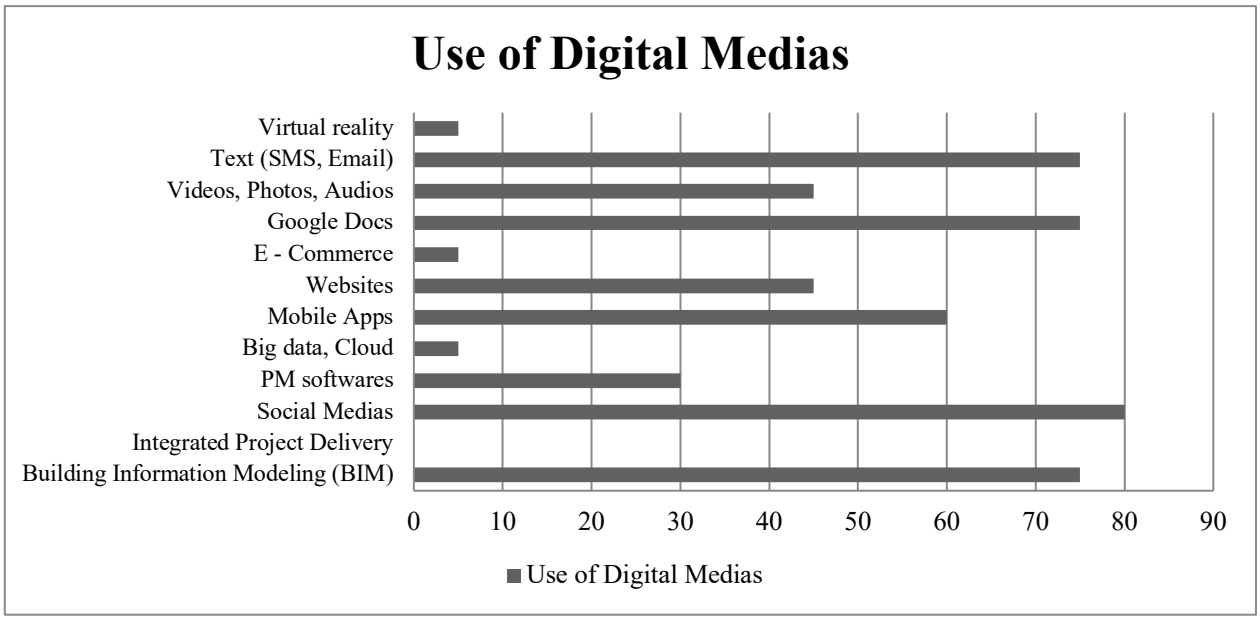
Digitalization has many benefits, especially for projects that are wide and complicated like construction. Questionnaires about the use of digitalization were distributed to 80 Building contractors with different grades and 38% of the respondents spent more that 50% of their daily work on digital medias while only 25% Spent less than 25% of their daily work. See Figure 6.

Figure 6 : Daily work and Digital Media Usage




Almost All companies use medias like BIM, Text, Social medias and Google docs to manage their projects. Integrated project management, Big data and E – commerce are not widely used, despite their several benefits. See figure 7.

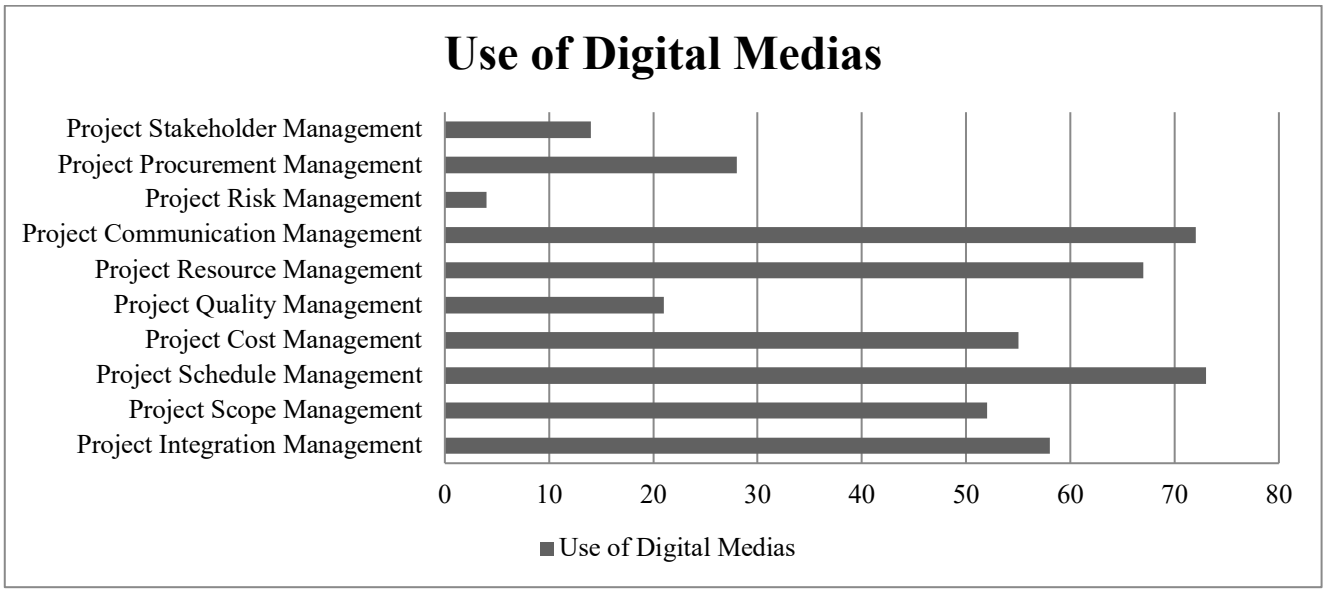
*Figure 7 : Types of digital medias being used*



## 4.3. Practice of digitalization in the Ethiopian construction industry

The use of digital media for project communication management, project schedule management and project resource management is relatively high, while the use for project risk management, project stakeholder management and project quality management is very low. See Figure 8.

*Figure 8 : Use of Digital Medias with respect to the knowledge areas*




The 10 Project Management body of knowledge ware assessed in this research. All the 47 processes with in them were also assessed and average of the assessment results are presented in this table. See

**I. Project Integration Management**

Integration management is all about unification, consolidation, communication, and interdepe ndence of PM processes, according to the PM body of knowledge guide. Senior management recognizes PM as a success factor.

The digital use in integration management of the selected companies was done using 7 questions assessing the initiation, planning, execution, monitoring and controlling and closing phases (see table 6). The average score in digital use was used to assess the overall digital use in this area. The total no of respondent is 80.

*Table 6 : Digital use for project integration management*

| Integration Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean *(SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To develop project charter (Initiation Phase) | 23(18%) | 0 (0%) | 17 (14%) | 32 (26%) | 8 (6%) | 2.03 (1.40) |
| 2 | To develop Project management plan(Planning Phase) | 6 (5%) | 0 (0%) | 14 (11%) | 33 (26%) | 27 (21%) | 2.94 (1.44) |
| 3 | To direct and manage project work (Execution Phase) | 4 (3%) | 0 (0%) | 6 (5%) | 45 (36%) | 25 (20%) | 3.09 (1.42) |
| 4 | To manage project knowledge (Execution Phase) | 5 (4%) | 3 (2%) | 17 (13%) | 34 (27%) | 21 (17%) | 2.79 (1.33) |
| 5 | To monitor and control project work (Monitoring and controlling Phase) | 5 (4%) | 5 (4%) | 17 (13%) | 29 (23%) | 24 (19%) | 2.78 (1.37) |
| 6 | To perform integrated change control (Monitoring and controlling Phase) | 12(10%) | 0 (0%) | 28 (22%) | 22 (18%) | 18 (14%) | 2.43 (1.33) |
| 7 | To close project or phase (Closing Phase) | 10 (8%) | 21(17% | 0 (0%) | 24 (19%) | 25 (20%) | 2.41 (1.52) |
| | | | | | **Average Integrated Management Digital Usage** | | **2.64/4 (1.40)** |

* The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for integration management is 2.64 (SD = 1.40) which is well use. The result of the survey showed execution phase of project has average usage of 3, which is relatively higher than the remaining phases.

## II. Project Scope Management

The process of scope management involves defining the specific work. It is also creating work breakdown structure, verifying the scope and finally controlling the scope. This activity ensures tracking of all activities, comparison of planned with what is executed.

The digital use in scope management of the selected companies was done using 6 questions assessing the planning, monitoring and controlling phases (see table 7). The average score in digital use was used to assess the overall digital use in this area. The no of respondent is 80.

*Table 7 : Digital use for project scope management*

| Scope Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean * (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To plan scope management (Planning Phase) | 13 (10%) | 12 (10%) | 10 (8%) | 19 (15%) | 26 (21%) | 1.40 (1.44) |
| 2 | To collect requirement (Planning Phase) | 11 (9%) | 24 (19%) | 21 (17%) | 38 (30%) | 6 (5%) | 1.44 (1.28) |
| 3 | To Define scope (Planning Phase) | 12 (10%) | 8 (6%) | 23 (18%) | 32 (26%) | 5 (4%) | 1.42 (1.16) |
| 4 | To create Work Breakdown Structure (Planning Phase) | 19 (15%) | 3 (2%) | 12 (10%) | 21 (17%) | 25 (20%) | 1.33 (1.58) |
| 5 | To validate scope (Monitoring and controlling Phase) | 14 (11%) | 14 (11%) | 12 (10%) | 19 (15%) | 21 (17%) | 1.37 (1.47) |
| 6 | To control scope (Monitoring and controlling Phase) | 13 (10%) | 12 (10%) | 24 (19%) | 26 (21%) | 5 (4%) | 1.33 (1.17) |
| | | | | | **Average Scope Management Digital Usage** | | **2.28/4 (1.35)** |

* The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for scope management is 2.28 (SD = 1.35) which is moderate use. The digital use in scope management is not satisfactory as change in scope can result in time variation and might increase the overall cost of the project.

### III. Project Schedule Management

Schedule management is relatively one of the areas with high digital medias. The purpose of schedule management is to identify activities in terms of duration, sequencing and resource estimation for successful project implementation.

The digital use in schedule management of the selected companies was done using 6 questions assessing the planning, monitoring and controlling phases (see table 8). The average score in digital use was used to assess the overall digital use in this area. The total no of respondent is 80.

*Table 8 : Digital use for project schedule management*

| Schedule Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean * (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To plan schedule management (Planning Phase) | 6 (5%) | 4 (3%) | 5 (4%) | 37 (30%) | 28 (22%) | 1.44 (1.49) |
| 2 | To define Activities (Planning Phase) | 4 (3%) | 11 (9%) | 0 (0%) | 43 (35%) | 22 (18%) | 1.28 (1.41) |
| 3 | To sequence Activities (Planning Phase) | 5 (4%) | 0 (0%) | 27 (22%) | 21 (17%) | 27 (22%) | 1.16 (1.36) |
| 4 | To estimate Activities Duration (Planning Phase) | 3 (2%) | 12 (10%) | 16 (13%) | 29 (23%) | 20 (16%) | 1.58 (1.29) |
| 5 | To develop Schedule (Planning Phase) | 5 (4%) | 3 (2%) | 6 (5%) | 42 (34%) | 24 (19%) | 1.47 (1.42) |
| 6 | To control Schedule (Monitoring and controlling Phase) | 4 (3%) | 5 (4%) | 10 (8%) | 36 (29%) | 25 (20%) | 1.17 (1.36) |
| | | | **Average Schedule Management Digital Usage** | | | | **2.86/4 1.39** |

***** The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for schedule management is 2.86 (SD = 1.39). The assessment revealed the overall use of digitalization for this area is “Well”.

### IV. Project Cost Management

Cost management plan is where the company performed less compared to other processes. Purpose of cost management in projects is ensuring costs are properly estimated and activities are completed within the estimates.

The digital use in cost management of the selected companies was done using 4 questions assessing the planning, monitoring and controlling phases (see table 9). The average score in digital use was used to assess the overall digital use in this area. The no of respondent is 80.

*Table 9 : Digital use for project cost management*

| Cost Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean * (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To plan cost management (Planning Phase) | 21 (17%) | 19 (15%) | 12 (10%) | 28 (22%) | 0 (0%) | 1.49 (1.28) |
| 2 | To estimate cost (Planning Phase) | 14 (11%) | 16 (13%) | 23 (18%) | 27 (22%) | 0 (0%) | 1.41 (1.07) |
| 3 | To determine budget (Planning Phase) | 21 (17%) | 15 (12%) | 14 (11%) | 24 (19%) | 6 (5%) | 1.36 (1.36) |
| 4 | To control cost (Monitoring and controlling Phase) | 23 (18%) | 16 (13%) | 5 (4%) | 31 (25%) | 15 (12%) | 1.29 (1.58) |
| | | | | | **Average Cost Management Digital Usage** | | **1.84/4 (1.32)** |

* The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for cost management is 1.84 (SD = 1.32) which is moderate use. The digital use in cost management is not satisfactory even though it is one the of essential factor.

## V. Project Quality Management

Project quality management is ensuring quality planning, quality assurance and controlling.

The digital use in quality management of the selected companies was done using 3 questions assessing the planning, monitoring and controlling phases (see table 10). The average score in digital use was used to assess the overall digital use in this area. The no of respondent is 80.

*Table 10 : Digital use for project quality management*

| Quality Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean * (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To plan quality management (Planning Phase) | 45 (36%) | 21 (17%) | 13 (10%) | 1 (1%) | 0 (0%) | 1.28 (1.59) |
| 2 | To manage quality (Executing Phase) | 44 (35%) | 17 (14%) | 15 (12%) | 5 (4%) | 0 (0%) | 1.07 (1.58) |
| 3 | To control quality (Monitoring and controlling Phase) | 41 (33%) | 16 (12%) | 8 (6%) | 11 (9%) | 4 (3%) | 1.36 (1.61) |
| | | | | | **Average Quality Management Digital Usage** | | **0.81/4 (1.59)** |

* The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for quality management is 0.81 (SD = 1.59) which is not well. The digital use in quality management is not satisfactory even though it is one the of essential factor. It has higher use for monitoring and evaluation phase, especially to control quality.

## VI. Project Resource Management

Resource management ensures project teams' planning, estimating, acquiring, developing, managing and controlling.

The digital use in resource management of the selected companies was done using 6 questions assessing the planning, execution, monitoring and controlling phases (see table 11). The average score in digital use was used to assess the overall digital use in this area. The total no of respondent is 80.

*Table 11 : Digital use for project resource management*

| Resource Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean * (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To plan resource management (Planning Phase) | 12 (10%) | 0 (0%) | 26 (21%) | 38 (30%) | 4 (3%) | 2.28 (1.06) |
| 2 | To estimate activity resource (Planning Phase) | 14 (11%) | 11 (9%) | 26 (21%) | 25 (20%) | 4 (3%) | 1.93 (1.16) |
| 3 | Acquire resource (Execution Phase) | 23 (18%) | 21 (17%) | 10 (8%) | 21 (17%) | 0 (0%) | 1.3 (1.30) |
| 4 | To develop team (Execution Phase) | 26 (21%) | 14 (11%) | 15 (12%) | 22 (17%) | 3 (2%) | 1.71 (1.38) |
| 5 | To manage team (Execution Phase) | 21 (17%) | 16 (13%) | 10 (8%) | 37 (30%) | 0 (0%) | 1.84 (1.31) |
| 6 | To control Resource (Monitoring and controlling Phase) | 9 (7%) | 5(4%) | 30 (24%) | 26 (20%) | 10 (8%) | 2.29 (1.16) |
| | | | | | **Average Resource Management Digital Usage** | | **1.89/4 (1.23)** |

* The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for resource management is 1.89 (SD = 1.23) which is not well. The digital use in resource management is not satisfactory even though it is one the of essential factor.

## VII. Project Communications Management

Communication management is ensuring project information is handled systematically. It also ensures a standard flow of information throughout the organization and mainly through the company's project portfolios.

The digital use in communication management of the selected companies was done using 3 questions assessing the planning, execution, monitoring and controlling phases (see table 12). The average score in digital use was used to assess the overall digital use in this area. The no of respondent is 80.

*Table 12 : Digital use for project communication management*

| Communications Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean * (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To plan communication management (Planning Phase) | 13 (10%) | 11 (9%) | 14 (11%) | 16 (13%) | 26 (21%) | 2.39 (1.51) |
| 2 | To manage Communication (Execution Phase) | 6 (5%) | 9 (7%) | 10 (8%) | 37 (30%) | 20 (16%) | 2.75 (1.37) |
| 3 | To monitor communication (Monitoring and controlling Phase) | 5 (4%) | 6 (5%) | 13 (10%) | 15 (12%) | 41 (33%) | 3.01 (1.6) |
| | | | | | **Average Communication Management Digital Usage** | | **2.72/4 (1.49)** |

* The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for communication management is 2.72 (SD = 1.49) which is moderate. The digital use in communication management is not satisfactory even though it is one the of essential factor. It has higher use for monitoring and evaluation phase, to monitor communication.

## VIII. Project Risk Management

The purpose of risk management is to foresee possible risks and entertain them as per the priority given based on their severity. It also requires keeping record of every adverse event to control future risks.

The digital use in risk management of the selected companies was done using 6 questions assessing the planning, execution, monitoring and controlling phases (see table 13). The average score in digital use was used to assess the overall digital use in this area. The no of respondent is 80.

*Table 13 : Digital use for project risk management*

| Risk Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean * (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To plan risk management (Planning Phase) | 50 (40%) | 21 (17%) | 8 (6%) | 1 (1%) | 0 (0%) | 0.5 (1.67) |
| 2 | To identify risk (planning Phase) | 36 (29%) | 25 (20%) | 13 (10%) | 5 (4%) | 1 (1%) | 0.88 (1.49) |
| 3 | To perform risk analysis (Planning Phase) | 42 (34%) | 25 (20%) | 16 (13%) | 5 (4%) | 2 (1%) | 1.0 (1.61) |
| 4 | To plan risk responses (Planning Phase) | 40 (32%) | 26 (21%) | 12 (10%) | 6 (5%) | 0 (0%) | 0.85 (1.32) |
| 5 | To implement risk response (Execution Phase) | 40 (32%) | 23 (18%) | 11 (9%) | 7 (6%) | 0 (0%) | 0.83 (1.54) |
| 6 | To monitor risk (Monitoring and controlling Phase) | 46 (37%) | 10 (8%) | 18 (14%) | 5 (4%) | 1 (1%) | 0.81 (1.59) |
| | | | | | **Average Risk Management Digital Usage** | | **0.8/4 (1.54)** |

* The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for risk management is 0.8 (SD = 1.54) which is moderate. The digital use in risk management is not satisfactory even though it is one the of essential factor. Furthermore, the comparative score of risk audit is at the lowest.

## IX. Project Procurement Management

Project procurement management is planning and controlling procurement & contract management and closing procurement process formally.

The digital use in procurement management of the selected companies was done using 3 questions assessing the planning, execution, monitoring and controlling phases (see table 14). The average score in digital use was used to assess the overall digital use in this area. The no of respondent is 80.

*Table 14 : Digital use for project procurement management*

| Procurement Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean * (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To plan procurement management (Planning Phase) | 21 (17%) | 20 (16%) | 13 (10%) | 15 (12%) | 6 (5%) | 1.44 (1.34) |
| 2 | To conduct procurement (Execution Phase) | 30 (24%) | 17 (14%) | 16 (13%) | 12 (10%) | 5 (4%) | 1.31 (1.45) |
| 3 | To control procurement (Monitoring and controlling Phase) | 16 (13%) | 15 (12%) | 28 (22%) | 15 (12%) | 6 (5%) | 1.75 (1.22) |
| **Average Procurement Management Digital Usage** | | | | | | | **1.5/4 (1.34)** |

* The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for procurement management is 1.5 (SD = 1.34) which is not well. The digital use in procurement management is not satisfactory even though it is one the of essential factor.

## X. Project Stakeholder Management

Stakeholder management is the process of identifying, engaging and monitoring the relationship between the company and its key stakeholders. The fundamental purpose of a project inception is to meet the expectations of major stakeholders at the end of the day.

The digital use in stakeholder management of the selected companies was done using 4 questions assessing the initiation, planning, execution, monitoring and controlling phases (see table 15). The average score in digital use was used to assess the overall digital use in this area. The no of respondent is 80.

*Table 15 : Digital use for project stakeholder management*

| Stakeholder Management | | Not At All | Not Well | Moderate | Well | Very Well | Mean * (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | To identify stakeholders (Initiation Phase) | 37 (30%) | 20 (16%) | 11 (9%) | 5 (4%) | 7 (6%) | 1.06 (1.58) |
| 2 | To plan stakeholder engagement (Planning Phase) | 40 (32%) | 8 (6%) | 29 (23%) | 3 (2%) | 0 (0%) | 0.94 (1.46) |
| 3 | To manage stakeholder engagement (Execution Phase) | 39 (31%) | 15 (12%) | 12 (10%) | 10 (8%) | 4 (3%) | 1.06 (1.56) |
| 4 | To monitor stakeholder engagement (Monitoring and controlling Phase) | 35 (28%) | 13 (10%) | 24 (19%) | 4 (3%) | 4 (3%) | 1.11 (1.47) |
| **Average Stakeholder Management Digital Usage** | | | | | | | **1.04/4 (1.52)** |

* The average use is the average score calculated using the frequency of usage (from not at all (0) to very well (4) ) and the respondent rate of the 80 companies.

As depicted in the above table, average digital use for stakeholder management is 1.04 (SD = 1.52) which is not well. The digital use in stakeholder management is not satisfactory even though it is could cause a lot of problems.

Table 16: Summary of the over all use of digitalization with respect to PM knowledge areas

| | Knowledge Areas | Not At All | Not Well | Moderate | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | Project Integrated Management | 11.6% | 5.4% | 17% | 40% | 25.9% |
| 2 | Project Scope Management | 17.8% | 11.5% | 19.7% | 33.3% | 17.8% |
| 3 | Project Schedule Management | 6.24% | 7.28% | 12.48% | 43.7% | 30.2% |
| 4 | Project Cost Management | 25% | 20.3% | 15.6% | 35.9% | 3.1% |
| 5 | Project Quality Management | 54.1% | 20.8% | 16.6% | 6.2% | 2.1% |
| 6 | Project Resource Management | 22.9% | 13.5% | 23.9% | 35.4% | 4.2% |
| 7 | Project Communication Management | 10.4% | 10.4% | 16.6% | 27% | 35.4% |
| 8 | Project Risk Management | 52% | 26% | 16.6% | 5.2% | 0% |
| 9 | Project Procurement Management | 29.1% | 20.1% | 27% | 16.6% | 6.2% |
| 10 | Project Stakeholder Management | 46.8% | 18.7% | 21.8% | 7.8% | 4.7% |
| | ***Over All use*** | ***42.99%*** | | ***18.74%*** | ***38.07%*** | |

Table 17: Summary of the average use of digitalization with respect to PM knowledge areas

| Knowledge Areas | | Not At All | Not Well | Moderate | Well | Very Well | Mean (SD) |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | Project Integrated Management | | | | 2.64 | | 2.64 (1.40) |
| 2 | Project Scope Management | | | 2.28 | | | 2.28 (1.35) |
| 3 | Project Schedule Management | | | | 2.86 | | 2.86 (1.39) |
| 4 | Project Cost Management | | | 1.84 | | | 1.84 (1.32) |
| 5 | Project Quality Management | | 0.81 | | | | 0.81 (1.59) |
| 6 | Project Resource Management | | | 1.89 | | | 1.89 (1.23) |
| 7 | Project Communication Management | | | | 2.72 | | 2.72 (1.49) |
| 8 | Project Risk Management | | 0.80 | | | | 0.80 (1.54) |
| 9 | Project Procurement Management | | | 1.5 | | | 1.50 (1.34) |
| 10 | Project Stakeholder Management | | 1.04 | | | | 1.04 (1.52) |
| | | | | | **The average Use** | | **1.84 (1.42)** |

Project integrated management, project schedule management and project communication management uses digital medias highly while the use of digital media for project quality management, project risk management and project stakeholder management are relatively low.

Table 18: Summary of the average use of digitalization with respect to PM phases.

| Project Phase | | Not At All | Not Well | Moderate | Well | Very Well | Mean |
|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | |
| 1 | Project Initiation Phase | | | 1.55 | | | 1.55 |
| 2 | Project Planning Phase | | | 1.95 | | | 1.95 |
| 3 | Project Execution Phase | | | 1.75 | | | 1.75 |
| 4 | Project Monitoring and controlling Phase | | | 2.04 | | | 2.04 |
| 5 | Project Closing Phase | | | | 2.41 | | 2.41 |
| | | | | | | **The average Use** | **1.84** |

The use of digitalization is high on project closing phase and project monitoring and controlling phase. The application is low for project initiation phase.

## 4.4. Perceived effect of digitalization on project Success

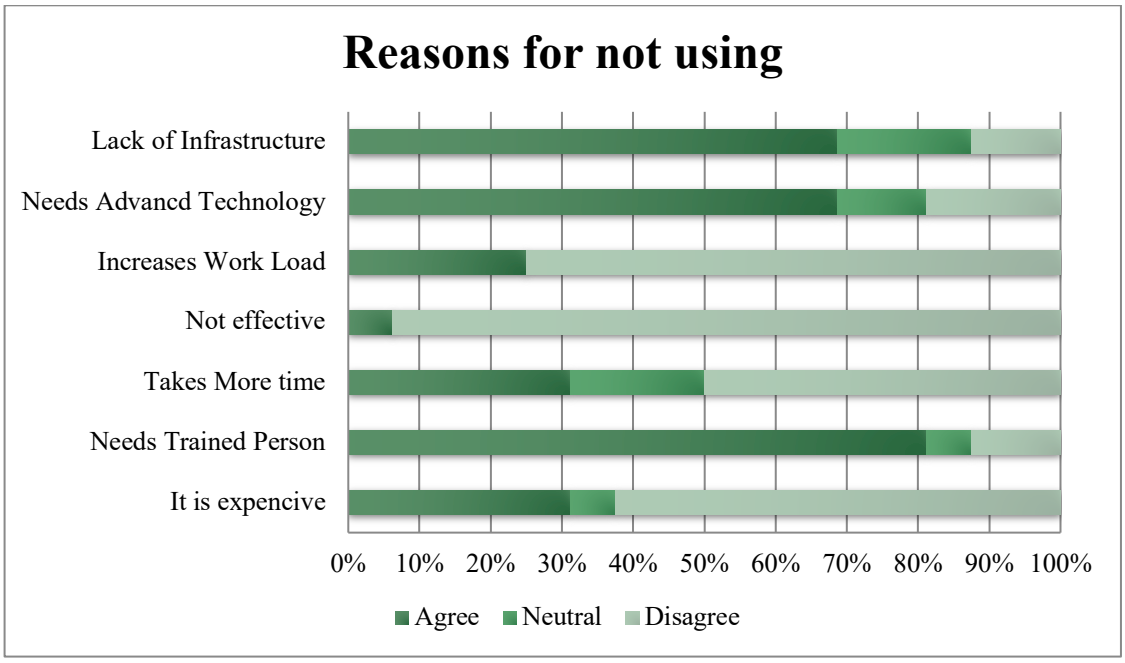
Table 19: Summary of the effect of digitalization on project success with respect to PM knowledge areas.

| | Knowledge Areas | Negative Effect | No Effect | Positive Effect | Strong Positive Effect |
|---|---|---|---|---|---|
| 1 | Project Integrated Management | 0% | 12.5% | 31.3% | 56.2% |
| 2 | Project Scope Management | 0% | 25% | 18.8% | 56.2% |
| 3 | Project Schedule Management | 0% | 0% | 56.3% | 43.7% |
| 4 | Project Cost Management | 0% | 18.8% | 68.8% | 12.4% |
| 5 | Project Quality Management | 0% | 62.5% | 12.5% | 25% |
| 6 | Project Resource Management | 0% | 18.8% | 56.3% | 24.9% |
| 7 | Project Communication Management | 0% | 0% | 31.3% | 68.7% |
| 8 | Project Risk Management | 6.3% | 50% | 31.3% | 12.4% |
| 9 | Project Procurement Management | 0% | 43.8% | 50% | 6.2% |
| 10 | Project Stakeholder Management | 6.3% | 18.7% | 25% | 0% |
| 11 | Work Load | 0% | 6.3% | 45.6% | 51.1% |

According to the respondents, digitalization has high effect on project communication, project integration and project scope managements, while it has low effect on project stakeholder, risk management and quality management.

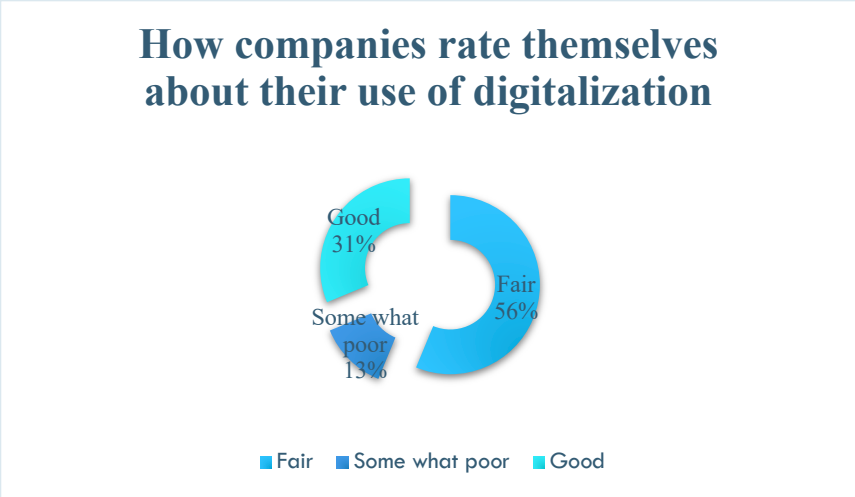
## 4.5. Challenges of digitalization

Figure 9: Summary of the reasons for not using digitalization




In developing countries like Ethiopia, the use of digitalization to manage projects is low. Of the many reasons, the respondents were asked why they don't use them. More than half of the respondents said it's because the need of advanced technology and lack of infrastructure. Lack of Skilled person was also one of the reasons, while they disagree that it is not because it is ineffective or expensive.

Figure 10: Companies' rate of the use of digitalization




Despite the results showing low use of digital media, 31% of the respondents thinks their use is good, and 56% thinks it is fair while only 13% of them thinks it is somewhat poor.

## 4.6. Discussion of Results

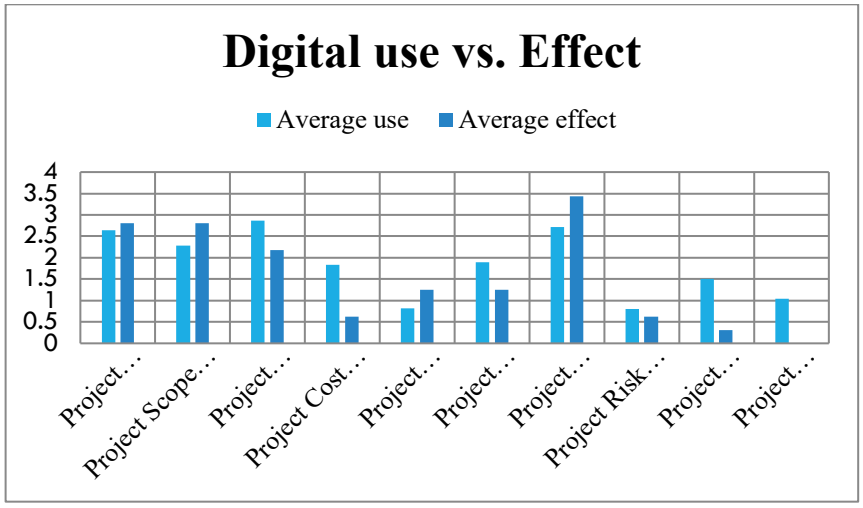
Organizations exist in a dynamic context, and most of their actions are challenged by a variety of circumstances, some of which can be regulated while others cannot. Organizational factors that can be managed can be discovered within the organization itself. These internal aspects influence (but do not totally determine) the project's success (organization). Project management makes an effort to address these manageable environmental factors. These factors are the PM knowledge areas.

The state of the building construction business demands increased productivity and digitalization, but it is resistant to technological change. De Soto et al. (2018) emphasized the importance of digital technologies in improving construction delivery through a digital building system that may assist in the successful delivery of projects from site selection to project handover. Ethiopia is not that different.

Based on the assessment conducted, the general use of digitalization is 1.84, which is Moderate. In areas like project-integrated management, project schedule management and project communication, the use of digitalization is relatively high. While in areas like project quality management, project risk management and project stakeholder management, the application is very low despite their significant impact on project success.

As per the data from the survey, project closing phase is the area were high use of digitalization was recorded while project initiation phase is the area with low use. Strong perceived effect was observed on project communication management, project integrated management and project scope management while on areas like project stakeholder management and project procurement management the opposite was observed.

Figure 11: Digital use vs. the perceived effect with respect to PM knowledge areas




Based on the data collected, areas with high impact and low use were selected as priority areas for improvement, those areas are project scope management, project quality management and project communication management.

# CHAPTER FIVE : SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

## 5.1 Summary of findings

- From the PM knowledge areas, areas with high and low use of digitalization were identified. Project integrated management, project schedule management and project communication management uses digital medias highly while the use of digital media for project quality management, project risk management and project stakeholder management are relatively low.
- From the PM processes, areas with high and low use of digitalization were identified. The use of digitalization is high on project closing phase and project monitoring and controlling phase. The application is low for project initiation phase.
- The perceived effect of digitalization with respect of PM knowledge area were collected. Digitalization has high effect on project communication, project integration and project scope managements, while it has low effect on project stakeholder, risk management and quality management.
- Priority areas that has low use and high effect were identified for improvement. Those areas are project scope management, project quality management and project communication management.

## 5.2. Conclusion

The construction sector has yet to fully embrace digitalization in its service offering, while other businesses have embraced this clearly beneficial trend. This failure to capitalize on the inherent benefits of digitization has had a huge impact on the industry, particularly in poorer nations, where there has been no significant reform in the construction sector (Castagnino et al. 2016).

This research has provided an assessment of the use of digitalization in the building Construction projects. The researcher of this study believes that this research has the possibility to create awareness about this important issue. In addition, the factors identified by this study to have an effect on the overall success in construction projects can serve practitioners in the project sector as well as at institution levels as a useful guide to the assessments use and effect of digitalization.

As per the findings of the survey, the current digital management practice in the building construction companies as perceived by project managers show that 1.84. 42.99% of the respondents said they don't use digitalization well and 18.74% is fair. 38.07% said they use digitalization well which is less than half.

In a similar note, almost all of the respondents think digitalization has high effect on the overall project success. Strong perceived effect was observed on project communication management,

project integrated management and project scope management while on areas like project stakeholder management and project procurement management the opposite was observed.

To conclude, most Project managers in the Ethiopian building construction sector are aware of the use of digital media and its significance to project success. But the general use of them to manage the projects are very low, according to the survey data. Since the construction sector usually uses traditional approach to implement endeavors, it is very rare to find companies with a well-structured documentation and system to manage them. There for; This topic needs proper attention and lots of improvement.

## 5.3. Recommendation

- To exist in this dynamic construction market and to compete with the local and foreign contractors the corporation has to implement advanced project management in its all construction sectors.
- Organizations, whether building companies in particular or any construction companies in general, are recommended that they should advance their use of digital medias in all ten knowledge areas to achieve the desired success of projects. According to the findings, priority areas for improvements are Project scope management, project quality management and project communication management.
- Project scope management is the method that must be followed to ensure that the project contains all of the work that is required and doesn't contain unwanted works in order to be completed efficiently. Therefore, advancing the use of digitalization in this area will have high effect on the overall project success.
- Project Quality Management includes mechanisms for implementing the organization's quality policy into project and product quality requirements planning, management, and control in order to meet stakeholders' expectations. Therefore, advancing the use of digitalization in this area will have high effect on the overall project success.
- A project work is teamwork. In teamwork, communication is perhaps one of the most important success factors since there is the need to build stronger cooperative relationship through continuous engagement and information sharing as well as coordination of stakeholder plans at all levels. So as to enable the fulfillment of this strong need well-designed and appropriate communication plan should always be in place. Therefore, advancing the use of digitalization in this area will have high effect on the overall project success.
- it is very rare to find companies with a well-structured documentation and system to manage their projects. The use of digitalization is also very low. There for; This topic needs proper attention and lots of research-based improvement.

### 5.3.2. Recommendation For future research

This study was undertaken focusing on only building construction companies. And due to constraint of time and many it was only conducted in Addis Ababa. Therefore, further research involving larger sample sizes from these types of organizations will help increase the generalizability of the findings.

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# Appendices

Appendix 1: Questionnaires

ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

SCHOOL OF COMMERCE

DEPARTMENT OF PROJECT MANAGEMENT

May 30, 2021

Dear Respondents,

I am a graduate student in Project Management at Addis Ababa University, School of Commerce. I am undertaking a research, titled "***Assessment of the use of digitalization to manage construction projects and its perceived effect on project success***" in partial fulfillment of the requirements for the degree of Master of Arts in Project Management.

You are one of the respondents who have been selected to participate in this research. I would like to kindly request you to take few minutes of your time and fill the following attached questionnaire.

The survey will take about 15 -20 minutes of your time. Your answers will be treated anonymously and will not end up in the hands of a third party. Only processed collective results will be presented in my report.

I thank you in advance for your time and effort. If you have any questions for clarification, you can contact me through:

Email: munbeshir@gmail.com

Tel.: +251920 53 90 98

Best Regards,

Muna Beshir
Addis Ababa, Ethiopia

## Part One: General Information

### I. About the project manager

1. Gender
   - ◯ Female ◯ Male
2. What is your highest education level
   - ◯ Diploma
   - ◯ Bachelor's Degree
   - ◯ Masters
   - ◯ Ph.D.
   - ◯ Other: _____
3. Do you have any project management training or education background?
   - ◯ Yes ◯ No
4. Working Experience
   - ◯ Less than 2 years
   - ◯ 2 – 5 Years
   - ◯ 5 – 7 Years
   - ◯ 7 – 10 Years
   - ◯ More than 10 Years

### II. About the Company

5. Grade of contractor
   - ◯ Grade 1 ◯ Grade 2
   - ◯ Grade 3 ◯ Grade 4
   - ◯ Grade 5 ◯ Grade 6
   - ◯ Grade 7 ◯ Grade 8
   - ◯ Grade 9 ◯ Grade 10
6. Company's Working Experience
   - ◯ Less than 5 years
   - ◯ 5 – 15 Years
   - ◯ 15 – 25 Years
   - ◯ 25 – 35 Years
   - ◯ More than 35 Years
7. Which of the following categories of staff size does your firm fall into?
   - ◯ Less than 25 Staff
   - ◯ 25 – 50 Staff
   - ◯ 50 – 99 Staff
   - ◯ 100 – 249 Staff
   - ◯ 250 – 500 Staff
   - ◯ More Than 500

### III. About the Digitalization

8. Do you use Digital Medias to manage your projects?
   - ◯ Yes ◯ No
9. Estimate the amount of your daily work which currently requires the use of Digital medias:
   - ◯ 1 - 25%
   - ◯ 26 - 50%
   - ◯ 51 - 75%
   - ◯ 75 - 100%
10. How user-friendly are digital Medias?
    - ◯ Very Poor
    - ◯ Poor
    - ◯ Adequate
    - ◯ Good
    - ◯ Very Good
11. How confident are you of the ability of the digital Medias to support successful projects?
    - ◯ No Confidence
    - ◯ Little Confidence
    - ◯ Neutral
    - ◯ Confident
    - ◯ Very Confident
12. Which of the digital Medias do you use?
    - ◯ Building Information Model, BIM (*Archi cad, Auto cad, Revit, Navis work…)*
    - ◯ Integrated Project Delivery, IPD
    - ◯ Social Medias *(Telegram, Facebook,, Whats up …)*
    - ◯ Project management softwares *(Click up, Team work, Proof hub, Jira, Podio… )*
    - ◯ Big Data, Cloud
    - ◯ Mobile apps
    - ◯ Web sites
    - ◯ E - Commerce
    - ◯ Google Docs (Word, Excel, Access ...)
    - ◯ Videos, Photos, Audios
    - ◯ Text (SMS, Email ….)
    - ◯ Virtual reality

## Part Two: Digitalized project management

13. In which Process do you use digital Medias in managing your projects?

### XI. Project Integration Management

| | Integration Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To develop project charter (Initiation Phase) | | | | | |
| 2 | To develop Project management plan(Planning Phase) | | | | | |
| 3 | To direct and manage project work (Execution Phase) | | | | | |
| 4 | To manage project knowledge (Execution Phase) | | | | | |
| 5 | To monitor and control project work (Monitoring and controlling Phase) | | | | | |
| 6 | To perform integrated change control (Monitoring and controlling Phase) | | | | | |
| 7 | To close project or phase (Closing Phase) | | | | | |

### XII. Project Scope Management

| | Scope Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To plan scope management (Planning Phase) | | | | | |
| 2 | To collect requirement (Planning Phase) | | | | | |
| 3 | To Define scope (Planning Phase) | | | | | |
| 4 | To create Work Breakdown Structure (Planning Phase) | | | | | |
| 5 | To validate scope (Monitoring and controlling Phase) | | | | | |
| 6 | To control scope (Monitoring and controlling Phase) | | | | | |

### XIII. Project Schedule Management

| | Schedule Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To plan schedule management (Planning Phase) | | | | | |
| 2 | To define Activities (Planning Phase) | | | | | |
| 3 | To sequence Activities (Planning Phase) | | | | | |
| 4 | To estimate Activities Duration (Planning Phase) | | | | | |
| 5 | To develop Schedule (Planning Phase) | | | | | |
| 6 | To control Schedule (Monitoring and controlling Phase) | | | | | |

### XIV. Project Cost Management

| | Cost Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To plan cost management (Planning Phase) | | | | | |
| 2 | To estimate cost (Planning Phase) | | | | | |
| 3 | To determine budget (Planning Phase) | | | | | |
| 4 | To control cost (Monitoring and controlling Phase) | | | | | |

### XV. Project Quality Management

| | Quality Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To plan quality management (Planning Phase) | | | | | |
| 2 | To manage quality (Executing Phase) | | | | | |
| 3 | To control quality (Monitoring and controlling Phase) | | | | | |

**XVI. Project Resource Management**

| | Resource Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To plan resource management (Planning Phase) | | | | | |
| 2 | To estimate activity resource (Planning Phase) | | | | | |
| 3 | Acquire resource (Execution Phase) | | | | | |
| 4 | To develop team (Execution Phase) | | | | | |
| 5 | To manage team (Execution Phase) | | | | | |
| 6 | To control Resource (Monitoring and controlling Phase) | | | | | |

**XVII. Project Communications Management**

| | Communications Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To plan communication management (Planning Phase) | | | | | |
| 2 | To manage Communication (Execution Phase) | | | | | |
| 3 | To monitor communication (Monitoring and controlling Phase) | | | | | |

**XVIII. Project Risk Management**

| | Risk Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To plan risk management (Planning Phase) | | | | | |
| 2 | To identify risk (planning Phase) | | | | | |
| 3 | To perform risk analysis (Planning Phase) | | | | | |
| 4 | To plan risk responses (Planning Phase) | | | | | |
| 5 | To implement risk response (Execution Phase) | | | | | |
| 6 | To monitor risk (Monitoring and controlling Phase) | | | | | |

**XIX. Project Procurement Management**

| | Procurement Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To plan procurement management (Planning Phase) | | | | | |
| 2 | To conduct procurement (Execution Phase) | | | | | |
| 3 | To control procurement (Monitoring and controlling Phase) | | | | | |

**XX. Project Stakeholder Management**

| | Stakeholder Management | Not At All | Not Well | Neutral | Well | Very Well |
|---|---|---|---|---|---|---|
| 1 | To identify stakeholders (Initiation Phase) | | | | | |
| 2 | To plan stakeholder engagement (Planning Phase) | | | | | |
| 3 | To manage stakeholder engagement (Execution Phase) | | | | | |
| 4 | To monitor stakeholder engagement (Monitoring and controlling Phase) | | | | | |

14. Please indicate the effect this form of digital work structure has had on the following criteria:

| | Strong Negative Effect | Negative Effect | No Effect | Positive Effect | Strong Positive Effect |
|---|---|---|---|---|---|
| Individual Workload | ○ | ○ | ○ | ○ | ○ |
| Overall Project Workload | ○ | ○ | ○ | ○ | ○ |
| Work breakdown str. | ○ | ○ | ○ | ○ | ○ |
| Scope Management | ○ | ○ | ○ | ○ | ○ |
| Integration Management | ○ | ○ | ○ | ○ | ○ |
| Schedule Management | ○ | ○ | ○ | ○ | ○ |
| Cost Management | ○ | ○ | ○ | ○ | ○ |
| Quality Management | ○ | ○ | ○ | ○ | ○ |
| Resource Management | ○ | ○ | ○ | ○ | ○ |
| Communication Management | ○ | ○ | ○ | ○ | ○ |
| Risk Management | ○ | ○ | ○ | ○ | ○ |
| Procurement Management | ○ | ○ | ○ | ○ | ○ |
| Stakeholder Management | ○ | ○ | ○ | ○ | ○ |

15. Please indicate why you don't use digital medias in all phases

| | Strongly Disagree | Disagree | No Effect | Agree | Strongly Agree |
|---|---|---|---|---|---|
| It is Expensive | ○ | ○ | ○ | ○ | ○ |
| It needs trained personnel | ○ | ○ | ○ | ○ | ○ |
| It takes more time | ○ | ○ | ○ | ○ | ○ |
| It is not effective | ○ | ○ | ○ | ○ | ○ |
| It increases work load | ○ | ○ | ○ | ○ | ○ |
| Advanced Technologies | ○ | ○ | ○ | ○ | ○ |
| Lack of infrastructure | ○ | ○ | ○ | ○ | ○ |

16. Who would you rate your company's success in using digital medias?

- ○ Excellent
- ○ Good
- ○ Fair
- ○ Somewhat poor
- ○ Poor

Thank you for your kind co-operation.

## Appendix 2: Interview questions

First, I would like to thank you and your good office for sparing your time to respond few questions concerning Project management digitalization in your organization/project.

My name is Muna Beshir. I am a graduate student of project management at AAUSC. The objective of this interview is to assess the level of digitalization in construction projects. Therefore, I sincerely request your utmost co-operation during our session.

1. Do you use digital Medias to manage your projects? If no, Why?
2. For which of the 10 PMBOK do you use digitalization the most and the least? Why?
3. For which of the 5 project phases do you use digitalization the most and the least? Why?
4. How do you describe your companies' use of digitalization?
5. Do you think digitalization has an effect on managing construction projects? (Both positive and negative effects).
6. What do you think is the benefits of digitalization?
7. What do you think is the short comings of digitalization?