ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

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AGILE PROJECT MANAGEMENT IN MODERN ETHIOPIA'S CONSTRUCTION INDUSTRY- EXPLORE THE CASE STUDY OF APPLICATION OF POST-TENSIONING

Final project work submitted to the School of Commerce of Addis Ababa University in partial fulfillment of the requirements for the Degree of Master of Arts in Project Management

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SCHOOL OF GRADUATE STUDIES
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Statement of Declaration

I, Yeabtsega Tassew, declare that the work presented in this project work, titled "Agile project management in modern Ethiopia's construction industry- Explore the case study of application of post-tensioning" is my own original work. I have conducted the study independently, with the guidance and comments of my research advisor. All sources of information have been duly acknowledged and the project work has been submitted in partial fulfillment of the requirements for the Degree of Master of Arts in Project Management.

Yeabtsega Tassew **Signature_____**

Date_____

Letter of Certification

I hereby certify that Yeabtsega Tassew completed their project work, titled "Agile project management in modern Ethiopia's construction industry- Explore the case study of application of post-tensioning" under my supervision. The project work is original and meets the requirements for partial fulfilment of a Master of Arts Degree in Project Management.

Bahran Asrat (Ph.D.) **Signature_____**

Date_____

Approval Page

The research project titled " Agile project management in modern Ethiopia's construction industry- Explore the case study of application of post-tensioning" prepared and submitted by Yeabtsega Tassew in partial fulfilment of the requirements for the degree of Master of Arts in Project Management, has been approved and accepted.

Research Advisor: Bahran Asrat (Ph.D.) **Signature_____**

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Internal Examiner: Mesfin W. (Ph.D.) **Signature_____**

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External Examiner: Zelalem G. (Ph.D.) **Signature_____**

Date_____

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ABBREVATIONS/ ACRONYMS

ACI- American Concrete Institute

AFD- Agile Framework Development

APM- Agile Project Management

PT- Post- Tensioning

PTI- Post Tensioning Institute

RCC- Reinforced Cement Concrete

Abstract

This research paper investigated the adoption and effectiveness of agile project management (APM) in real-world construction projects within Ethiopia's post-tension industry. As a professional working in the post-tension industry, I'm interested in exploring new and effective project management methodologies that improve the industry's performance and competitiveness. The research focused on a pioneering Engineering firm that introduced post-tension technology in Ethiopia. Both qualitative and quantitative research approaches were employed to assess the current level of APM adoption, its impact on project outcomes, and best practices in the industry. The investigation encompassed all projects undertaken by the firm, including public, private, and bridge projects. Questionnaires were completed by 44 (forty-four) Engineering professionals, and interviews were conducted with technical, operations, and construction heads. The findings revealed a moderate level of APM adoption in Ethiopia, with PT subcontractors being the primary adopters, while other parties exhibited limited implementation. The research highlighted the positive impact of agile project management on project outcomes such as cost, schedule, and quality. To optimize APM in post-tension construction, the study proposed strategies including education, infrastructure development, collaboration, and impact measurement. The paper concludes with a summary of key findings, implications, suggestions for future research, and acknowledgment of study limitations.

Keywords- Agile project management, agile methodology, post-tensioning, construction, project management

Chapter One

1. Introduction

This chapter provides an overview of the research, including the study's background, problem statement, research questions and objectives, significance, scope, limitations, and organization of the paper.

1.1 Background of the study

Agile project management involves a repetitive and incremental process of carrying out a project throughout its complete life cycle. Its aim is to provide new products or services in an incremental manner, allowing for continual feedback and adaptation throughout the development process (Turner R. , 2014). Agile project management originated in the software development industry and has since been used as a solution for the challenges various industries face globally. APM values individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation, and responding to change over following a plan enabling teams to adapt to changes in project requirements and scope quickly (Agile Manifesto, 2001).

Agile methodologies that are commonly used in construction projects include scrum, lean construction, and kanban. Scrum is a framework that focuses on collaboration, iterative development, and delivery of products in short time increments called sprints. Lean construction is a project delivery approach that emphasizes the reduction of waste and maximizing value for customers. Kanban is a visual management tool that enables teams to manage and optimize their work processes. Each methodology has its unique approach and can be tailored to fit the specific needs of a construction project (Mark C. Layton, 2020).

Post-tensioning is a construction technique developed by Eugene Freyssinet in 1928 which is used to reinforce concrete structures such as buildings, bridges, and parking garages with high-strength steel cables or tendons (ACI Committee 423, 2014). Post-Tensioning allows for longer spans,

reduced material costs, and increased structural strength, making it an attractive option for construction projects. The use of post-tensioning can result in significant cost savings and improved durability of the structure (Post-Tensioning Institute, 2023)

Agile project management and post-tensioning practices share some commonalities in their emphasis on flexibility, adaptability, collaboration, and communication. One similarity is that both practices prioritize flexibility and adaptability. Post-tensioning allows for adjustments to be made to a concrete structure even after casting, which can be useful if the design needs to be changed or if unexpected conditions arise during construction which affects the strength and serviceability of a structure (Post-Tensioning Institute, 2023). Similarly, agile project management emphasizes the ability to adjust plans and processes as needed to respond to changing customer needs or project requirements (Agile Manifesto, 2001). Another similarity is the importance of collaboration and communication. In post-tensioning, engineers, architects, and construction teams need to work closely together to ensure that the design is executed properly and that any necessary adjustments are made in a timely manner. Similarly, agile project management relies on frequent communication and collaboration among team members, stakeholders, and customers to ensure that everyone is aligned and that the project is progressing as intended (Agile Manifesto, 2001).

The construction industry in Ethiopia is experiencing significant growth, with an increasing number of complex and large-scale projects being undertaken. One of the technologies that have been introduced in the sector is post-tensioning. As a professional working in the post-tension industry, the implementation of agile methodologies in the post-tension industry in Ethiopia is relatively new and unexplored. Although the introduction of post-tension technology is relatively new to Ethiopia, the industry is rapidly growing and gaining popularity as post tensioned slabs have increased structural strength, reduced material costs and construction time, and the allowance of lighter structures to be built as compared to the traditional RCC slabs (Ahmed, 2021). Hence, in order for these projects to succeed, there is a need for a more efficient and effective project management approach (Hailemarkos, 2020). This study aims to investigate the adoption and effectiveness of agile project management in real-world construction projects in the Ethiopian post-tension industry. The findings of this study are instrumental in increasing the awareness and understanding of agile methodologies among stakeholders as a means of improving project

management practices in the post-tension industry in Ethiopia and contributing to the country's economic growth and development.

1.2 Statement of the problem

According to Hailemarkos' research conducted in 2020, there is a strong correlation between the level of maturity in construction project management and the success rate of the project, indicating that the former can be used as a predictor of the latter. Hailemarkos' research found that organizations with higher project management maturity levels were more likely to complete their projects on time, within budget, and to the satisfaction of their stakeholders. This is because organizations with mature project management practices have established processes, tools, and techniques to identify and manage risks, communicate effectively with stakeholders, and monitor and control project progress.

Research conducted to assess the performance of the construction industry in Ethiopia concerning construction project management practices and challenges showed that the industry's application of general project management procedures, functions, tools, and techniques were unsatisfactory. Specifically, the industry's performance in safety, risk, and time management was found to be very low. Moreover, the study revealed a significant schedule slippage ranging from 61-80%, and other project variables such as cost, quality, resource utilization, and safety deviated by 21-40% from the predetermined requirements or anticipated at the outset of the project (Zelele, 2016). These findings indicate the urgent need for intervention to improve the construction industry's project management practices in Ethiopia.

Agile project management has been recognized as a contemporary project management approach that has demonstrated its efficacy in ensuring project success. APM and its methodologies have been shown to bring about significant benefits in construction projects. Agile methodologies can have a substantial impact on minimizing expenses related to project implementation. Additionally, the utilization of agile methodology can have a substantial impact on improving the overall quality of the final product. By following the steps outlined in agile methodology, project implementation can adhere to certain standards that are crucial in producing a high-quality end product. Furthermore, agile methodology offers a well-defined framework of processes for project managers to follow, which can help prevent costly errors during project implementation. The

different stages of agile project management, such as design, can effectively mitigate unforeseen issues that could otherwise drive-up project expenses (Rashina Hoda, 2008).

The construction industry is a vital sector for economic growth in Ethiopia. According to the World Bank, the construction sector in Ethiopia has been growing steadily over the past few years and is a significant contributor to the country's economy. The industry (including construction) share of Ethiopia's GDP was estimated to be around 21.9% in 2021. In the context of Ethiopia's growing construction industry, the use of post-tension technology and agile management practices can significantly enhance the sector's efficiency and productivity. By incorporating post-tensioning into construction projects, builders can improve the structural integrity and durability of buildings and infrastructure, resulting in safer and more reliable structures (Ahmed, 2021). Additionally, implementing agile management techniques can help construction teams adapt quickly to changing conditions and ensure projects are completed on time and within budget. As agile management practices involve a flexible and iterative approach to project management, it allows for continuous adaptation and improvement throughout the project lifecycle (Rashina Hoda, 2008). This approach is particularly useful in the third world context, where project constraints such as limited resources, tight schedules, and unpredictable weather conditions are common.

With the construction industry's share of Ethiopia's GDP expected to remain significant, it is essential for the construction sector to embrace innovative technologies and management practices to maintain their competitive edge. By adopting post-tensioning and agile management, Ethiopia's construction industry can continue to thrive and contribute to the country's economic growth.

Despite the growing acceptance of agile project management as a method for managing complicated projects, and leading projects to success (Agile Manifesto, 2001), there is a lack of research on the application of agile project management methodologies and their effectiveness in managing construction projects that involve post-tension technology in Ethiopia's context.

The application of agile project management has been a topic of interest in various industries in Ethiopia, including social enterprises, software, and banking. Researchers such as (Fekadu, 2021), (Zelalem Regassa, 2017), and (Debebe, 2019) have investigated the use of agile project management in these industries.

While agile project management methodologies have been investigated in other industries of Ethiopia, there is a lack of literature that specifically addresses the application of agile project management in Ethiopia's post-tensioning industry. Therefore, there is a need to investigate the use of agile project management in Ethiopia's post-tension construction industry to determine its effectiveness and identify best practices for project managers. Hence, the problem addressed by this research paper was the lack of literature exploring the adoption and effectiveness of agile project management in real-world construction projects in the Ethiopian post-tensioning industry. This gap in the literature presents a challenge for project managers and practitioners in the industry who seek to improve project outcomes and increase efficiency. By addressing this gap, this research paper aims to contribute to the knowledge base of agile project management in the post-tension construction industry in Ethiopia.

1.3 Research questions

The following questions will be addressed by the research study:

- What is the current level of adoption of agile project management in the Ethiopia's post-tension construction industry?
- How effective is agile project management in improving project outcomes such as cost, schedule, and quality in Ethiopia's post-tension construction industry?
- What are the best practices for using agile project management in the post-tension construction industry?

1.4 Objectives of the study

The general objective of the study is to investigate the adoption and effectiveness of agile project management in real-world construction projects in Ethiopian's post-tension industry.

The specific objectives of the study include:

- To determine the current level of adoption of agile project management in the Ethiopian post-tension construction industry.

- To assess the suitability and effectiveness of agile project management in improving project outcomes such as cost, schedule, and quality in the Ethiopian post tension construction industry.
- To develop recommendations and best practices for the successful adoption and implementation of Agile project management in the Ethiopian post-tension construction industry.

1.5 Significance of the study

This study has the potential to significantly improve the understanding of project management in Ethiopia's post-tension industry, and specifically in the use of agile project management. By examining the effectiveness of agile project management and identifying best practices for project managers, this study can provide valuable insights into how to improve project outcomes in the post-tension construction industry.

The findings of this study can also have practical implications for project managers in the post-tension industry, providing them with guidance on how to adopt and implement agile project management practices effectively. This, in turn, can lead to improved project outcomes, including reduced project duration, cost savings, improved quality, and increased stakeholder satisfaction.

Furthermore, this study can contribute to the broader literature on project management and agile project management by examining their use in a specific context, the post-tension industry in Ethiopia. This can add to the body of knowledge on project management in the PT construction industry, and specifically on the use of agile project management in emerging economies.

A summary of the expected outcomes of this study are as follows:

- An assessment of the awareness and current level of adoption of agile project management in the Ethiopia’s post-tension construction industry
- Identification of the benefits of using agile project management in the post-tension industry in Ethiopia
- Recommendations for the adoption and implementation of agile project management in the post-tension industry in Ethiopia

Overall, this study can provide valuable insights into the use of agile project management in Ethiopia's post-tension industry, contributing to improved project outcomes and providing practical guidance for project managers.

1.6 Scope of the study

The scope of this study focused on the use of agile project management in Ethiopia's post-tension industry. The study aimed to explore the current level of adoption of agile project management in the Ethiopia's post-tension construction industry, evaluate the effectiveness of agile project management in improving project outcomes such as cost, schedule, and quality, and identify best practices for using agile project management in the post-tension construction of Ethiopia.

The study was limited to the post-tension industry in Ethiopia and didn't include other sectors of the construction industry. The study also focused on the use of agile project management and didn't cover other project management approaches in detail.

The focus of this research was exclusively on the post-tension construction sector. Given the emergence of a couple of engineering firms that apply post-tensioning technology and provide post-tensioning solutions and services in Ethiopia, this study particularly focused on an engineering firm, EASE Engineering. This company was noteworthy because it is the first company licensed to deliver tailored engineering solutions and has a team of experts leading the way in introducing post-tensioned structures to the region. Furthermore, this firm holds a significant position in the industry as it has been operating for a considerable duration and is the sole entity undertaking various types of projects such as bridge, private, and public projects. Geographically speaking, the company's head quarter is located in Addis Ababa, Ethiopia. This research investigated the adoption and effectiveness of agile project management in real-world post-tension construction projects undertaken by EASE Engineering in various locations across Ethiopia, including Addis Ababa.

As the research's scope was limited to EASE Engineering, data was gathered from all 44 (forty-four) Engineering professionals who were associated with both past and ongoing projects as well as an examination of various project types, such as public projects, private projects, and bridge projects undertaken by EASE to determine the research's findings. Therefore, the study's

viewpoint was from an internal employee perspective and doesn’t include external stakeholders' opinions.

1.7 Potential limitations of the study

This study, while seeking to contribute valuable insights into the adoption and effectiveness of agile project management in Ethiopia's post-tension construction industry, acknowledges certain limitations that may impact the research findings. Recognizing these potential constraints is essential for maintaining transparency and ensuring a nuanced understanding of the study's outcomes. These limitations encompass:

- Self-reporting bias- the study will rely on self-reported data from project managers, professionals, experts, and team members, which may be subject to biases and inaccuracies. Participants may be inclined to report positively on their experiences with agile project management, potentially skewing the results.
- Cultural and language barriers- cultural and language barriers may pose a challenge to the study, especially in collecting data through interviews and surveys. Some participants may have difficulty understanding or expressing their thoughts in English, the language of the study.
- Unforeseen challenges- there may be unforeseen challenges or obstacles that arise during the course of the study that can impact the quality and validity of the data collected and the conclusions drawn from the study.

1.8 Organization of the study

This research is composed of five distinct chapters, each of which fulfills a specific objective Chapter one provides an overview of the background of the study, research problem, research questions, objectives, significance of the study, scope, and limitations. Chapter two reviews relevant literature on agile project management & post-tension technology and includes empirical studies and a conceptual framework of the research. Chapter three describes the research design, sampling techniques, data collection methods, and data analysis techniques employed in the study. The fourth chapter presents the data analysis and findings, utilizing various methods such as figures, tables, and descriptive statistics to provide a comprehensive summary of the research

findings. Lastly, the fifth and final chapter summarizes the research's key findings, presents conclusions, and proposes appropriate recommendations based on the research outcomes.

All the sources cited in the study will be included in the reference section. The appendices section of the study encompasses supplementary materials that are pertinent to the research. This includes copies of the interview and questionnaires used to collect data from participants, as well as graphs that depict the research results. Including these supplementary materials in the appendices enhances the research study by promoting transparency, supporting replicability, and providing visual representations of the research results.

1.9 Definition of key terms

- Agile methodology is a project management framework that provides the flexibility to make changes in response to changing business needs (Miller, 2019).
- Agile Project Management is a project management approach that emphasizes flexibility and adaptability, with a focus on delivering value to the customer through iterative and incremental development. Agile project management emphasizes collaboration, communication, and responding to change over following a strict plan (Agile Manifesto, 2001).
- Construction- refers to the process of building or assembling something, such as a home, office building, or infrastructure project (Investopedia).
- Post Tensioning involves the use of high-strength steel strands or cables to reinforce concrete structures. This technique can increase the strength and durability of concrete structures, making them more resistant to cracking, settling, and other types of damage (ACI Committee 423, 2014).
- Project Management is the practice of planning, organizing, and managing resources (such as people, time, and money) to achieve specific goals or objectives (Project Management Institute, 2013).

Chapter 2: Literature Review

This chapter delves into the relevant literature surrounding agile project management. A conceptual review will be carried out to explain the emergence of APM and further discusses APM values and principles as pertains to the construction industry. The review aims to provide a comprehensive understanding of agile project management and post-tensioning and aims to establish a robust basis for exploring the relationship between agile project management and post-tension technology drawing from both theoretical and empirical studies. The emergence, benefits, and challenges of both adopting agile project management and the post tension technology will be briefly discussed. The chapter concludes by reviewing empirical studies.

2.1 The Emergence of Contemporary Project Management

Construction projects are complex, unique, temporary, involve multiple stakeholders and involve somewhat difficult working conditions. All of these can pose a significant challenge to effective project management. Turner (2014) suggests that construction projects require adaptable leadership and management in order to effectively address the various changes that may arise throughout their implementation.

The waterfall methodology, which is also referred to as the traditional project management approach, is widely used in construction project management. This technique entails establishing distinct checkpoints between each task, with predetermined deadlines, outputs, and client requirements arranged in a well-defined schedule (The Constructor, 2021). The conventional project management methods are commonly plan-driven, document-driven, or task-driven methodologies (Serour, 2005). It appears that traditional project management methods, which have a long history of development, are no longer adequate to address the challenges that companies face today, irrespective of their country of origin (Spalek, 2014). Hence, the conventional project management methods were found to have shortcomings, prompting the development of agile project management techniques suitable for application in the construction sector (Turner R. , 2014).

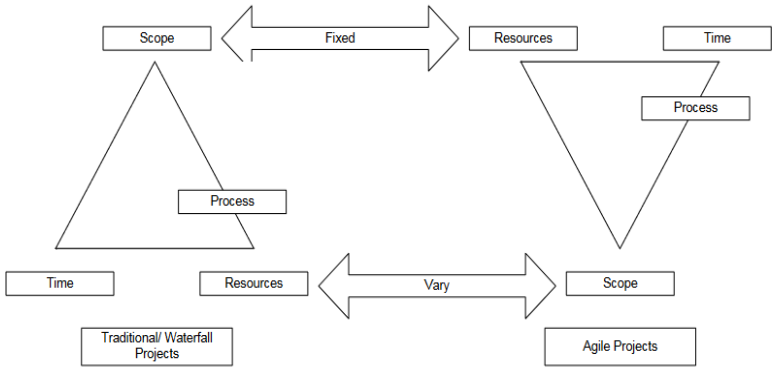


Figure 1: Shift from Traditional to Agile Project Management (R.L. Owen, 2006)

While this diagram can be universally applied to various design or product development processes, caution should be exercised when using it in production scenarios. This is because in industries such as construction, the availability of resources is subject to change if the project scope is altered (R.L. Owen, 2006)

2.2 Agile Project Management

The shift from traditional to agile methodology began with the transformation of software development. According to (Sacolick, 2022), the origins of agile can be traced back to the 1990s, when a group of software developers, frustrated with the limitations of the waterfall methodology, came together to discuss new ways of working. These developers were working on internet applications and found that the traditional approach of planning everything upfront and then executing on the plan was too inflexible and too slow to keep up with the rapidly changing requirements of internet applications. These software developers began experimenting with iterative and incremental development methods. In 2001, the Agile Manifesto was created by 17 technologists to officially introduce agile.

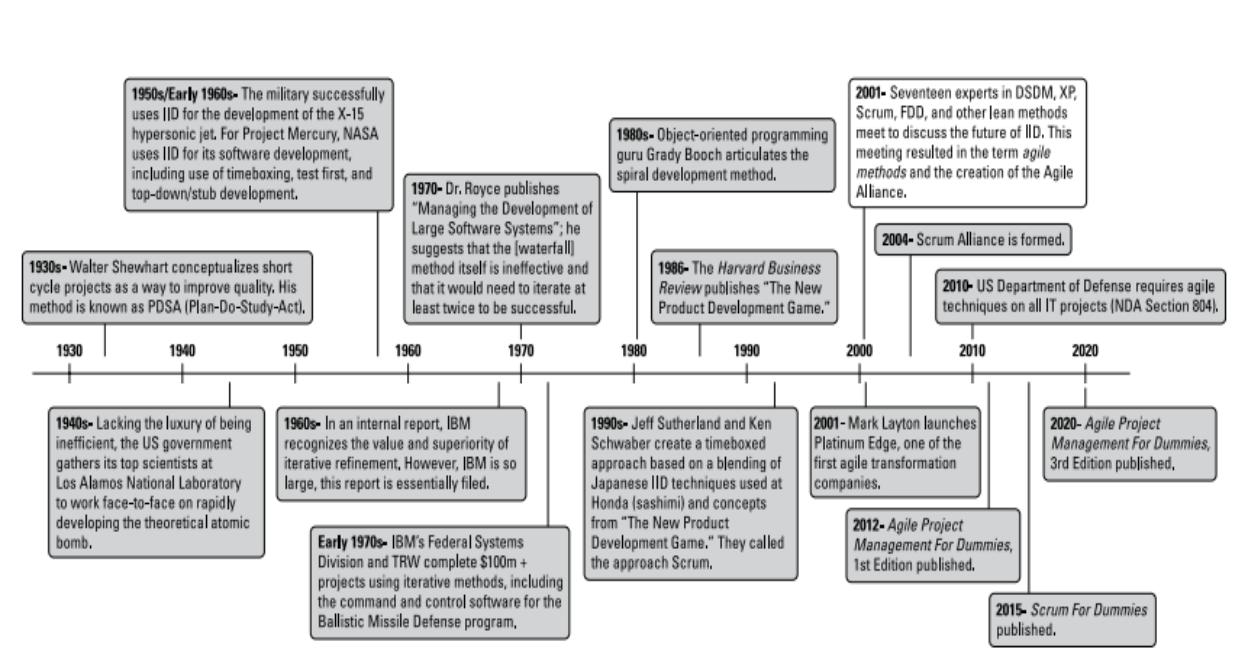


Figure 2 Agile project management timeline (Mark C. Layton, 2020)

So, what exactly is agile project management and how can it be linked to the construction industry?

Agile is a project management approach characterized by a mindset that prioritizes the timely delivery of business value, ongoing refinement of both the product and its creation processes, adaptable project scope, team collaboration and contribution, and the production of thoroughly tested products that align with customer requirements (Mark C. Layton, 2020).

The Agile Manifesto (2001) outlines four core values that guide agile project management. These values can be translated to the construction industry as:

- *Individuals and interactions over processes and tools*- accentuate communication and collaboration among all stakeholders involved in the project.
- *Working software over comprehensive documentation*- employing software to replace labor-intensive manual procedures and enhance performance and quality management.
- *Customer collaboration over contract negotiation*- putting more emphasis on ongoing input and communication with important project stakeholders than on the restrictions imposed by contracts.

- *Responding to change over following a plan*- adjusting to the opportunities and obstacles of the current environment to achieve optimal outcomes in the present, while cultivating a mindset of ongoing growth to improve performance in the future.

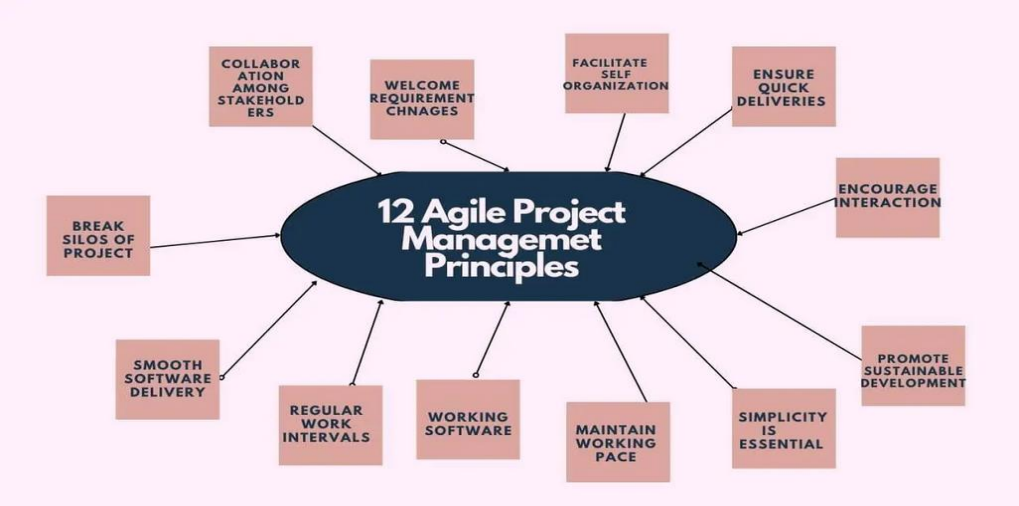


Figure 3- Agile project management principles (Devsamurai, 2023)

Chen Jin et al., (2017) explains agile as a way of managing projects that involves breaking down large projects into smaller, more manageable tasks that can be completed in stages and relates this concept with the construction industry. The process is repeated until the entire product is complete. There are several advantages to using the agile approach in the construction industry, including reducing project costs, improving project efficiency, increasing customer satisfaction, and delivering high-quality results.

(John, 2018) revealed that agile methodologies are not only applicable to the IT industry but also to construction industry. Agile processes have been adopted in the construction industry to tackle change management and improve project outcomes by increasing client involvement and using sprint AFD methods. To manage document processing delays and transitions, sprint preparation principles have been put in place. This involves greater involvement of clients in each sprint, from preparation to design, improved communication with contractors, shared risk responsibilities, and quality control using agile methodologies. In summary, the implementation of sprint preparation principles with increased client participation and agile methods is aimed at addressing delays and transitions in document processing in the construction industry.

(Piotr Nowotarski, 2015) revealed that the implementation of agile methodology was found to be an effective solution to problems and issues such as inadequate coordination, documentation errors, and project overruns. In particular, agile methodology's emphasis on problem-solving techniques and collaboration is well-suited to the challenges of the construction industry. To sum up, the researcher recommends that the construction industry adopts an agile approach to project management to achieve better outcomes in complex and unpredictable projects.

Loizou (2021) in his blog post 'Agile project management in the construction industry' explains that agile implementation may not be as simple or straightforward as some people may believe because the construction sector is more complex. He further describes how agile can still be adapted to a number of building process phases, including the initiation, planning and execution phase.

In the initiation and planning phase, participation of the client/product owner will result in clear and well-defined requirements and specifications, and ultimately, a clear end product. The participation of the client provides ongoing feedback encouraging teamwork, enhancing communication, and relieves the team of unneeded stress and work. The culmination of the aforementioned ideas will result in a quicker production schedule, fewer errors or modifications, and greater client satisfaction.

In conclusion, he states that agile can bring benefits to construction projects, but there are challenges to its implementation. Changes in execution phase can increase project cost, meetings cannot be minimized, and agile deliverables for construction projects cannot be handed over piece by piece. Implementing agile in construction management requires efficient organizing and administration. If implemented correctly, agile can improve project efficiency, collaboration, progress monitoring, and continuous improvement.

Although there are benefits to agile, literature identifies obstacles of using agile. According to Chen (2004), in projects that have a fixed deadline and strict scope, incorporating the flexibility that is a fundamental aspect of agile methodology may not be feasible. Additionally, contractual, and regulatory constraints can limit the degree of flexibility that can be incorporated into certain aspects of project management, which is crucial for ensuring the effectiveness of agile project management (Turner R. , 2014). Gustavsson (2013) stated that the presence of conflicting business

interests can pose significant obstacles to the effective implementation of agile project management in certain projects. In many cases, these conflicting interests may take precedence over project interests, undermining the effectiveness of agile management practices.

2.3 Post-Tensioning

Post-tensioning technology emerged as engineers sought to enhance the performance of reinforced concrete structures. Reinforced concrete involves the incorporation of steel bars or mesh within the concrete to provide additional strength and flexibility. While reinforced concrete offered significant benefits, such as increased load-bearing capacity and resistance to cracking, there were limitations in terms of its span lengths and design flexibility. Post-tensioning technology was developed to overcome these limitations and further improve the structural capabilities of concrete. It involved the use of high-strength steel cables or tendons that were placed within the concrete elements and then tensioned. This process applied a pre-determined level of force to the tendons, compressing the concrete and enabling it to withstand greater loads and longer spans. (Post-Tensioning Institute, 2023).

In simpler terms, post-tensioning is like tightening a belt around the waist to make it stronger and more secure. The tendons act like the belt, holding the concrete in place and making it stronger, so that the structure can withstand more stress and strain over time.

Post-Tensioning allows for longer spans, reduced material costs, and increased structural strength, making it an attractive option for construction projects. The use of post-tensioning can result in significant cost savings and improved durability of the structure (Post-Tensioning Institute, 2023).

Table 1- Applications of post-tension for construction professionals

Developer	Architect	Contractor	Engineer
Increased safety of installation Improved structural performance Economical Reduced material Increased speed of program Lighter structures Long design life	Flexibility in design Safety of method/system Flexibility for remedial works Allows for thinner slabs Reduction in materials Economical	Fully coordinated design fulfilling standard and code requirements Increased safety of installation Economical Fast and efficient construction schedule Less on-site storage required Reduced materials	Allows flexibility for remedial works Thinner slabs, longer spans, extra floors for the same story height Improved structural performance Lighter structure Reduction in materials Deflection control

Source: (Clare, 2020) What is Post-tensioning?

2.3.1 Overview of the Post Tension Industry in Ethiopia

The first application of post-tension technology in Ethiopia was in 2013, where this technology was applied to recover and enhance the Omo river bridge, a 128m long steel bridge. Due to a defective link between the launching nose and the structure during the launch, this bridge collapsed into the river. External post-tensioning was used to enhance the bridge's capacity.

This post-tension technology was later licensed by the Ethiopian Construction Industry Development Agency (ECIDA) to be practiced in 2015. Since then, numerous building and bridge construction projects have utilized this technology, resulting in its increasing acceptance and rapid growth (EASE Group, 2022).

2.4 Agile Project Management in the Post Tension Construction Industry

Based on the previous sections of the literature, agile project management can serve as an alternative to inflexible project management approaches, i.e., traditional project management. APM also plays a significant role in revolutionizing the management practices of the construction industry.

The four core values as presented by the Agile Manifesto can be translated from the software industry to the post-tension construction industry to establish a link between APM and PT (Agile Manifesto, 2001):

- *Individuals and interactions over processes and tools*

The post-tension construction industry involves multiple stakeholders, including architects, engineers, contractors, and clients (Chinyio, 2008). According to Gustavsson's (2013) observation, implementing agile management in construction projects holds significant importance in ensuring client satisfaction and business success. By prioritizing human interaction and communication over rigid processes and tools, agile project management can help foster a more positive and productive working environment, where team members feel valued and engaged. This teamwork and collaboration can help to break down silos and encourage knowledge-sharing among different stakeholders in the post-tension industry.

- *Working software over comprehensive documentation*

Sturdier, more durable, and more cost-effective structures are provided by post-tensioning technology (Post-Tensioning Institute, 2023). Agile project management prioritizes delivering working software or products quickly and continuously, while minimizing unnecessary documentation that can slow down the process. By adhering to the steps of the agile methodology, projects are conducted according to specific standards that are crucial in producing a high-quality end product (Turner R. , 2014).

- *Customer collaboration over contract negotiation*

The post-tension industry requires close collaboration between the client and the project team to ensure that the structure meets the client's needs and specifications. By utilizing agile management, project managers can establish strategies that promote the fulfillment of the client's needs throughout the project management process (Chin, 2004).

- *Responding to change over following a plan*

The post-tension industry often involves changing requirements and unforeseen challenges, such as weather conditions or site-specific issues. Agile Project Management allows for a flexible and adaptable approach that can easily accommodate changes and adjustments to the project, ensuring that the final structure meets the client's needs and standards (Turner R. , 2014).

Ineffective agile project management approaches result in unpredictable outcomes, recurrent mistakes, and inefficient use of resources (Chin, 2004). According to Hoda, Noble, and Marshall (2008), one of the important steps to implement agile project management in the post-tension industry is to develop a clear understanding of the agile methodology in order to avoid errors.

Additionally, simply having the Agile Manifesto and its principles is not enough to start agile product development, even if one is eager to do so. The reason is that principles and practices are dissimilar (Mark C. Layton, 2020).

2.5 Benefits of Agile Project Management in the Post Tension Industry

Based on the review of various literature, the benefits of agile project management can be summarized as below:

A report by Owen et al., (2006) “Is agile project management applicable in construction” states that overall, it is determined that APM offers tremendous application potential in predesign and design but that there are significant barriers to its implementation in the stage of construction itself. If challenges are addressed, APM offers advantages that go far beyond the scope of any one project.

In another report ‘Agile construction project management” by the same authors states that the adoption of agile project management could be advantageous for the construction industry, which

has a less than stellar track record with project management. The underlying justifications for agile have been investigated in order to arrive at an agile theory, which has identified more promising research.

Divakar et al., (2016) state that agile project management (APM) is a participative and incremental management approach that can be used in a setting with a lot of flexibility. Agile methodology has been shown to increase project delivery reliability by breaking the project down into smaller, more manageable sections and finishing these parts with higher delivery value.

Pareliya (2019) states that during the construction phase, implementing scheduling and time management strategies, boosting employee motivation, and involving the client can all contribute to reducing uncertainty and risk while also decreasing delays. These actions can lead to improved project outcomes overall.

Bacheri et al., (2014) states in order to boost client satisfaction, the research looks at how agile techniques can make the program and system stages of building projects more efficient. It is simpler to maintain the project's goal focus when each stage is divided into shorter cycles. Making unwelcome adjustments becomes less expensive leading to positive client satisfaction and client involvement.

Yellen (2012) states that agile project management, according to research, is best suited for large, complicated projects where it is challenging to specify the product in advance. This thesis investigated the potential benefits of applying the agile project management methodology during the design stage of construction projects. An increase in the client's involvement is one of the agile approach's main benefits. Additionally, it helps reduce ambiguity and enhance risk management.

Research by Ekstom (2016) employed a qualitative approach that utilized a literature review, interviews, and a survey to answer the research questions. The findings suggest that the use of agile project management, specifically within the design team and led by the designer, can lead to significant benefits, such as reduced risk for large and expensive rework. Overall, the thesis suggests that project management approaches used in construction projects may not be as inflexible as previously described in the literature.

Overall, agile project management can help organizations in the post-tension industry to become more responsive, efficient, and customer-focused, leading to better outcomes and increased competitiveness in the marketplace.

2.6 Factors Affecting the Adoption of Agile Project Management in the Post Tension Industry in Ethiopia

(Anoop Prakash, 2022) identified seven significant determinants of agile project management adoption in the construction industry. These factors are:

- *People factors*

Numerous studies have emphasized the critical role of people related factors in the adoption and implementation of agile approaches. Agile methodologies place a strong emphasis on people and social aspects, which means that the abilities, experiences, and interactions of practitioners are critical to the success of agile projects. For example, effective communication, collaboration, and teamwork are essential for agile project management.

- *Project characteristics*

Factors such as complexity and uncertainty of projects can impact the adoption of agile project management. Agile is better suited to projects that are complex and uncertain and require frequent feedback and adaptation.

- *Organizational culture*

The prevailing culture within organizations can have a significant impact on the adoption of agile project management. If an organization values flexibility, collaboration, and rapid delivery of results, agile may be more readily adopted. On the other hand, if an organization has a rigid and hierarchical culture that values stability and predictability, agile may face resistance.

- *Agile practices*

Agile practices, such as iterative development, continuous integration, and collaborative approach, can have a significant impact on the adoption of agile project management. They promote an agile

mindset, increase understanding of the value of agile, and provide early feedback, flexibility, and a culture of trust and open communication. By fostering a culture of continuous learning and improvement, agile practices can drive adoption of agile project management as a way of working, particularly in response to rapidly changing market conditions and customer needs.

- *Close communication*

Effective communication is essential for agile project management, and the availability of appropriate communication channels can affect its adoption. If the communication channels are limited, adopting agile may be challenging.

- *Business needs*

Business needs can significantly influence the adoption of agile project management. For instance, agile project management can help businesses meet the ever-changing needs of the market, especially when time-to-market is crucial. Adopting agile methodologies can enable businesses to deliver products and services quickly, remain flexible, and adapt to changes rapidly. Additionally, agile project management fosters innovation and creativity, which can help businesses differentiate themselves from competitors.

- *Construction 4.0*

Emphasizes the integration of technology, collaboration, continuous improvement, risk management, and project delivery, which can benefit from the adoption of agile project management. Agile project management's focus on flexibility, cross-functional teams, iterative development, and risk management can enable construction teams to implement new technologies, collaborate effectively, identify areas for improvement, mitigate risks, and deliver projects more efficiently. By working together, Construction 4.0 and agile project management can drive innovation and efficiency in the construction industry.

In terms of elaboration, it is worth noting that agile project management is a relatively new approach in the post-tension industry in Ethiopia. As such, there may be resistance to change, particularly from stakeholders who are used to more traditional project management approaches.

Adopting agile may require a significant cultural shift within organizations, and this can take time and effort.

Furthermore, agile project management is not a one-size-fits-all solution. It is important to assess the specific needs of the post-tension industry in Ethiopia and determine whether agile is the most appropriate approach. This may involve a trial-and-error process, where agile is assessed on a small scale before being implemented on a larger scale.

2.7 Empirical Review

This empirical review will investigate the application of agile project management, the potential benefits of implementing agile project management in the construction industry, examine any potential challenges or limitations to implementing agile project management. It will provide insights into how agile project management can help improve project outcomes, reduce risks, and increase efficiencies in the post-tension industry. It will focus on existing studies and research.

Owen et al., (2006) studied the suitability of agile project management in the construction industry by evaluating it subjectively and categorizing it into three phases: pre-design, design, and construction. In the pre-design phase, agile principles and methods offer the potential for an improved approach that balances appropriate structure with flexibility to allow for creative solutions and opportunities to be explored. When it comes to the design phase, the suitability of adopting agile project management principles depends on the complexity and uncertainty of the project. Agile methods may be particularly appropriate in situations where solutions to requirements are likely to change throughout the project, there are a considerable number of clients involved, conflicting requirements generate trade-offs, and early delivery of value is a priority. Effectively managing construction execution would require a significant amount of effort, including a shift in the sector's culture. This need arises from the sector's fragmented nature, inadequate employment practices, and lack of emphasis on training. It is important to note that this situation is not applicable everywhere, as Denmark is an exceptional case.

Research by Oyegoke et al. (2008) centered around effectively managing risks and uncertainties in construction projects, particularly in response to owner dissatisfaction and the dynamic nature of agile construction environments. The study identifies certain areas within the supply chain

process that pose greater risks and uncertainties. The overall conclusion of the paper is that involving agile specialists can help mitigate these risks and uncertainties, improve project quality, and facilitate a modular approach to design that incorporates expert knowledge in construction and design. This approach is particularly relevant for building projects that involve prefabricated elements and standardized materials, as well as large and complex building and infrastructure projects.

Turner (2014) states that incorporating agile methodologies in project management can have a significant impact on reducing the costs associated with the implementation process. He also states that agile methodology follows a set of steps that ensure project implementation adheres to certain standards. These standards are essential in producing a high-quality end product.

Hoda et al., (2008) states that agile provides a well-defined process that managers can follow, and this process helps to prevent mistakes that could potentially increase project costs. By incorporating various phases of agile management, such as design, potential unplanned issues can be avoided, ultimately leading to a reduction in project costs.

Chen (2004) states that the use of agile methodology has been shown to significantly enhance the quality of the final product.

All the above-mentioned research and other similar ones play an important role order to gain a more comprehensive understanding to study the adoption and effectiveness of agile project management in real-world construction projects in the Ethiopian post-tension industry.

Chapter 3: Research Methodology

This section discusses the methodology that was used to investigate the adoption and effectiveness of agile project management in real-world construction projects in the Ethiopian post-tension industry, i.e., the research design, data sources and data collection techniques, study population and sampling methods, data collection procedures and instruments, research approach, methods of data analysis and interpretation.

3.1 Research Design

This research project adopted a descriptive research design with the application of causal tools as it allows to collect and analyze data to gain a better understanding of the adoption and effectiveness of agile project management and explore the relationships and potential causal effects between different factors or variables in real-world construction projects in the Ethiopian post-tension industry, without manipulating the variables under study. It would also enable the provision of a detailed and comprehensive description of the research problem and generate insights that can inform future research and practice in the industry. A cross-sectional study will be implemented as data will be collected at one specific instance.

Both quantitative and qualitative research methods were conducted to provide a comprehensive understanding of the research problem by triangulating data from different sources and methods. This also helped to validate and complement the findings obtained from each method. The quantitative aspect of the study involved collecting data through questionnaires to investigate the adoption of agile project management in the post-tension industry in Ethiopia. The questionnaire also investigated the effectiveness of agile project management in terms of project outcomes such as cost, schedule, and quality. The qualitative aspect of the study involved collecting data through semi-structured interviews. Qualitative data would also provide insights into the experience of project managers, team members, and stakeholders in using agile project management in real-world construction projects.

3.2 Description of Study Variables

Based on the above literature review and the specific objectives of the research, the study variables are:

Dependent Variables

- Project outcomes- this variable includes measures of project performance, such as cost, quality, and schedule adherence. It assesses the effectiveness of APM in improving these outcomes (Turner R. , 2014) (Chin, 2004) (Rashina Hoda, 2008)

Independent Variables

- Adoption of agile project management- these variable measures the extent to which agile project management practices and principles are adopted in the post-tension construction projects in Ethiopia.

3.3 Description of Study Area and Target Population

The research design focused on analyzing the knowledge acquired through the implementation of previous and ongoing post-tension construction projects carried out by EASE Engineering, a specialized engineering firm known for delivering tailored engineering solutions. The study involved exploring different categories of projects, including public ventures, private, and bridge projects.

The methodology employed in this study involved the use of a census approach, whereby data was collected from the entire population of engineering professionals working at EASE. This approach allowed for the inclusion of all individuals in the population, without applying any sampling or selection criteria. These 44 (forty-four) engineering professionals are from diverse roles and positions within EASE Engineering who have contributed their expertise and skills to the successful completion of previous endeavors, as well as those currently engaged in ongoing projects. Questionnaires were administered to gather data from these engineering professionals. Additionally, interviews were conducted with key personnel including the technical head, operations head, and construction head.

3.4 Data Collection

The data for this study was collected through mixed research design using both qualitative and quantitative data using semi-structure interviews and questionnaires respectively. In this research, primary data was mainly used to answer the research question. This was justified by the need to collect first-hand information from the relevant stakeholders in the Ethiopian post-tension industry regarding the adoption and effectiveness of agile project management practices in real-world PT construction projects. Questionnaire was chosen to gather standardized information from a larger sample size of Engineering professionals, allowing for quantitative data collection on the adoption and effectiveness of agile project management practices. Open-ended questions in the questionnaire provided qualitative insights and opinions. Semi-structured interviews were selected to explore the perspectives of technical, operation, and construction department heads, enabling in-depth discussions and capturing rich qualitative data on factors influencing agile project management adoption and effectiveness. By using both questionnaires and interviews, this study aimed to gather comprehensive data, including quantitative measurements and qualitative insights, providing a thorough understanding of agile project management in post-tension construction projects by EASE Engineering in Ethiopia

Primary data for this study was collected through two methods: questionnaires and semi-structured interviews. The questionnaires included both closed-ended and open-ended questions and were distributed in-person and via email to engineering professionals working at EASE and included individuals working in the tender and coordination team, designers, project managers, and team members from the operation and construction team involved in both past and on-going public, private and bridge post-tension project undertaken by EASE Engineering. In addition to the questionnaire, semi-structured interviews were conducted with technical, operation and construction department heads. The interviews were conducted face-to-face and via google meet and were recorded and transcribed for analysis.

3.5 Data Analysis

Data collected from primary sources was analyzed using content analysis. The data collected from qualitative method was analyzed using thematic analysis and involved identifying, analyzing, and interpreting patterns, themes, and meanings in textual data and contrasting the results with those

from the literature review in section two. It involved a systematic approach to coding and categorizing data, which helped to identify key themes and patterns that emerge from the data. Data obtained from quantitative method used descriptive statistics to summarize and describe the main features of the dataset, such as the mean, standard deviation, range, and sum. IBM SPSS statistics 27 software was used as it helps to organize, summarize, and present data in a meaningful way, enabling to identify patterns and trends in the data. In addition to descriptive statistics, simple linear regression will be used to model the relationship between independent variable and dependent variable. Using results from the regression analysis, the correlation coefficient will be calculated.

3.6 Data Validity and Reliability

The research has given careful attention to the validity and reliability of the study. The questions both for questionnaire and interview questions were developed based on the research objectives and the constructs being measured. To enhance the validity of the questionnaire, consultations were undertaken with my advisor to identify and rectify any inherent measurement errors in its design. A pilot study was conducted, where the reliability of the questionnaire was assessed using the Cronbach's alpha test in IBM SPSS 27. A subset of responses, comprising 20% of the sample size, was used for this analysis. Individual reliability tests were conducted for each construct as well as overall reliability tests and the results are presented below in table 2.

Table 2- Cronbach's Alpha reliability test results

Items Assessed for Reliability	**Cronbach's Alpha**	**No. of items**	**Scale**
Adoption of APM in Ethiopia's PT construction industry	0.70	4	1-5
Prospects from implementing APM in Ethiopia's PT industry	0.74	4	1-5
Optimizing APM in Ethiopia's PT construction industry	0.70	4	1-5
Overall reliability	**0.85**	**12**	**1-5**

Source- own survey, 2023

An overall Cronbach's alpha value of 0.85 indicates an acceptable internal consistency. The reliability of each knowledge area was also satisfactory, with Cronbach's alpha values ranging from 0.74 to 0.88. These results align with the guidelines provided by (Mallery D. G., 2003) and indicate the questionnaire's reliability for this research.

3.6 Ethical Considerations

This research ensured ethical considerations by obtaining informed consent from all participants, maintaining confidentiality, and ensuring that the research did not cause harm to any participants. The research adhered to ethical guidelines set by the university's research ethics committee.

These ethical issues were considered:

1. Privacy and confidentiality: during the research process, privacy and confidentiality of the participants were maintained. An informed consent was obtained from the participants and participants were ensure that their data was anonymized and kept secure.
2. Informed consent: this research ensured that participants understood the research purpose and the use of their data. Participants were informed of any potential risks and benefits and were given the option to withdraw their participation at any point.
3. Respect for participants: the research ensured that the participants were not harmed physically, psychologically, or socially. The participants' opinions, cultures, and beliefs were respected.
4. Fairness and objectivity: the research was conducted with fairness and objectivity, and favoritism of any particular group or individual didn’t take place.
5. Data integrity and accuracy: data was collected accurately and with integrity. The research study ensured that data wasn’t falsified, fabricated, or manipulated.
6. Conflicts of interest: the research study will declare any conflicts of interest that may arise during the research process. Conflicts of interest can include personal, financial, or professional interests that may affect the research's integrity or validity.
7. Plagiarism: plagiarism is a significant ethical issue, and this research ensured that all sources were cited correctly and that the work is original.

8. Social responsibility: this research hopes that this work benefits society and does not harm it. It was conducted in a manner that is ethical, transparent, and respectful of human dignity.

By considering these ethical issues, the research ensured that the work was conducted with integrity and benefits society. I, Yeabtsega Tassew, adhered to these ethical standards when conducting this research, especially when dealing with human subjects.

Chapter 4: Data Presentation and Analysis

In accordance with the objectives outlined in the first chapter, this research paper investigated the adoption and effectiveness of agile project management in real-world construction projects in the Ethiopian post-tension industry. The research was conducted at an Engineering firm that introduced PT technology to Ethiopia. The primary focus of the study was to assess the current level of adoption of APM practices in the Ethiopian post-tension industry, evaluate its effectiveness, and develop recommendations and best practices for its successful implementation. This chapter presents a summary of the data collected from primary sources pertaining to the aforementioned objectives.

A questionnaire consisting of general demographic questions, twelve 5-point Likert scale questions as well as five open-ended questions was distributed to 44 (forty-four) engineering professionals at Ease Engineering. Out of these, 40 (forty) completed responses were obtained indicating an approximately 91% viable responses. Additionally, semi-structured interviews were conducted with technical, operations, and construction heads. The collected data for the research variables, as indicated in the questionnaire, was analyzed using descriptive and inferential statistics to identify response patterns among the respondents. In order to ensure the accuracy and reliability of the data analysis, IBM Statistical Package for Social Sciences (SPSS) version 27 was employed to measure the relationships between variables.

The study is organized into the following sections. The first section presents the demographic characteristics of the respondents. The second section focuses on descriptive statistics analysis, providing a summary and description of the collected data. The subsequent sections involve correlation and regression tests, which explore relationships between variables in the data. Throughout these sections, findings from interviews are incorporated to provide additional insights. Each section includes research summaries that condense the key findings and conclusions of the study, aiding in understanding and interpretation.

4.1 Demographic Profiles of Respondents

The variables included in the demographic section are gender, age, educational level, work experience and role at EASE. The table below presents a consolidated overview of the responses for each of these variables.

Table 3- Overview of the demographic data

Demographic Variables		Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	37	92.5	92.5	92.5
	Female	3	7.5	7.5	100.0
Age	Under 25	3	7.5	7.5	7.5
	25-30	25	62.5	62.5	70.0
	31-45	11	27.5	27.5	97.5
	46-50	1	2.5	2.5	100.0
Education level	PhD	1	2.5	2.5	2.5
	MA/MSc	3	7.5	7.5	10.0
	BA/BSc	36	90.0	90.0	100.0
Work Experience	0-5 years	21	52.5	52.5	52.5
	6-10 years	13	32.5	32.5	85.0
	11-15 years	3	7.5	7.5	92.5
	More than 15 years	3	7.5	7.5	100.0
Role At EASE	Tender and coordination	4	10.0	10.0	10.0
	Design Team	8	20.0	20.0	30.0
	Operation Team	20	50.0	50.0	80.0
	Project Manager	6	15.0	15.0	95.0
	Other	2	5.0	5.0	100.0

Source: Own survey, 2023

4.1.1 Gender of Respondents

The figure below illustrates the gender distribution of the respondents, indicating that the larger proportion of the respondents are male, accounting for 92.5%, while the female respondents make up 7.5%. The higher representation of males in the respondents suggests that agile project management adoption in the PT construction industry is predominantly driven by male professionals. This might indicate a potential gender gap in awareness, knowledge, or opportunities related to agile project management practices.

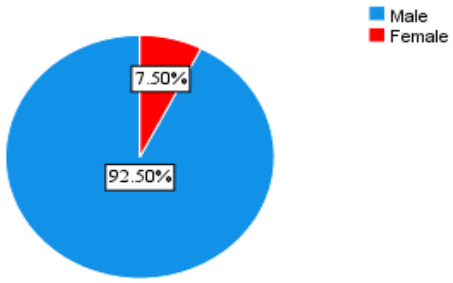


Figure 4- Gender of respondents

Source: Own survey, 2023

4.1.2 Age Category of Respondents

According to the figure below, the majority of the respondents, accounting for 62.5%, are aged 25 and 30 followed by 27.5% of respondents between 31 and 45 age group and 7.5% of respondents under 25. A smaller proportion, 2.5%, falls between the ages of 46 and 50. This suggests that since the younger generations often have a stronger familiarity and comfort with technology and agile methodologies rely on digital tools and platforms for communication, collaboration, and project tracking, the younger team members may adapt more easily and effectively utilize these tools.

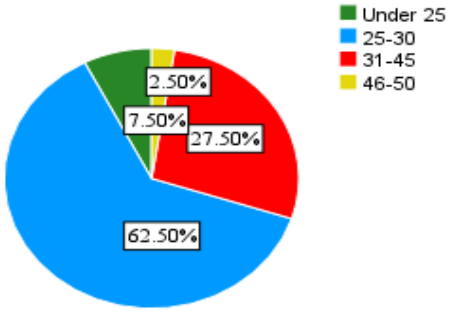


Figure 5- Age category of respondents

Source: Own survey, 2023

4.1.3 Education Level

According to Figure 6, the majority of the respondents, comprising 90% of the total, hold a first degree as their highest educational attainment. This is followed by postgraduates, accounting for 7.5%. The smallest percentages are for PhD holders at 2.5%. This data indicates that a significant portion of the team possesses higher educational qualifications, presenting an opportunity to implement advanced contemporary project management methods such as agile.

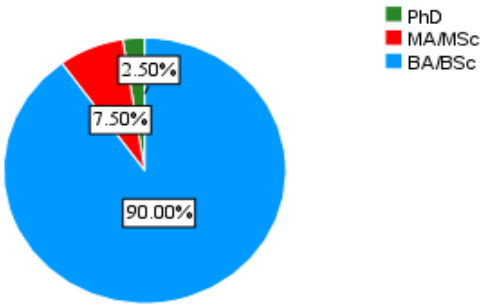


Figure 6- Educational level of respondents

Source: Own survey, 2023

4.1.4 Work Experience

The analysis of the respondents' work experience in Figure 7 reveals valuable insights into their familiarity with agile project management practices. It shows that a significant portion of the respondents, accounting for 52.5%, have work experience ranging from 0 to 5 years. This suggests that a considerable number of participants are relatively new to the industry or have limited professional experience. Additionally, 32.5% of the respondents have between 6 to 10 years of experience, indicating a moderate level of expertise in the field. Another 7.5% of the respondents have between 11 to 15 years of experience, representing a smaller but notable group of individuals with more extensive experience. Importantly, 7.5% of the respondents possess more than 15 years of experience, indicating a subset of professionals with substantial knowledge and expertise in the PT construction industry.

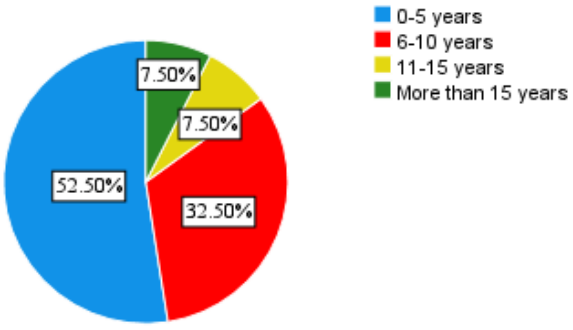


Figure 7- Work experience of respondents

Source: Own survey, 2023

The diversity of work experience levels among the respondents is beneficial for studying agile project management adoption and effectiveness. By including a mix of experience levels, the analysis encompasses a broader range of perspectives. This allows for a more comprehensive understanding of trends, challenges, and success factors related to agile project management practices in the industry. The familiarity of the respondents with agile project management practices suggests that they have encountered these methodologies during their professional

experience. The extent of their familiarity, understanding, and implementation of agile practices was assessment through the questionnaire distributed.

Overall, incorporating respondents with varying levels of work experience enriches the study, providing a more robust foundation for examining the adoption and effectiveness of agile project management in the post-tension construction industry.

4.1.5 Role of Respondents at EASE Engineering

The study primarily targeted engineering professionals working in various departments at EASE, aiming to gain insights into their experiences and perspectives within their respective engineering roles. Figure 8 provides a breakdown of the departmental distribution of the respondents, shedding light on the representation of different teams or departments within the organization.

The data from Figure 8 reveals that the operations team had the highest representation, accounting for 50% of the respondents. This indicates that a significant portion of the participants belong to the operations department, which likely plays a crucial role in the execution and management of projects. The design team constituted 20% of the respondents, suggesting their involvement in the creative and technical aspects of project development. The inclusion of professionals from the design team offers insights into how agile project management practices are perceived and applied within the design phase of construction projects. Project managers made up 15% of the respondents, indicating their involvement in overseeing and coordinating project activities. Their perspectives are crucial for understanding the implementation and effectiveness of agile project management methodologies at the project management level. The tender and coordination department represented 10% of the respondents, contributing insights into the procurement and coordination aspects of projects. Their involvement can shed light on the integration of agile project management practices into these specific domains. Lastly, the Architecture and QA/QC department accounted for 5% of the respondents, providing insights into the architectural design process and the quality control aspects of construction projects.

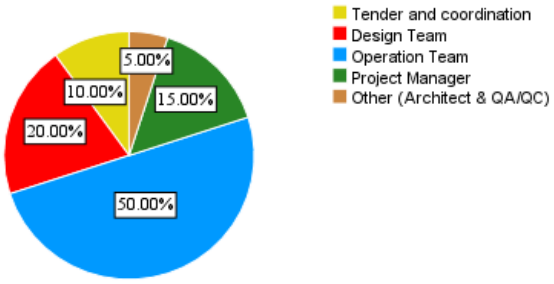


Figure 8- Role of respondents

Source: Own survey, 2023

The distribution of respondents across different departments offers valuable information for the study. It allows for a deeper exploration of how agile project management practices are perceived, adopted, and implemented within specific functional areas of the organization. By considering the perspectives of professionals from various departments, the study can capture a comprehensive view of the adoption and effectiveness of agile project management in the post-tension construction industry.

4.2 Descriptive Statistics

The collected data from the questionnaire was analyzed using descriptive statistics, such as mean and standard deviation. Each variable or question item in the questionnaire was interpreted based on these statistics. The quantitative results were complemented by qualitative data gathered from open-ended questionnaires and semi-structured interviews. This section of the study is organized according to grouped variables, including the current level of adoption of agile, its prospects and optimization and best practices of APM in Ethiopia's post-tension construction.

To interpret the items rated on a 5-point Likert scale, the mean scores were utilized. The mean scores were categorized as follows: a mean score of 1-1.8 indicated a response of "strongly disagree," 1.81-2.6 represented "disagree," 2.61-3.40 denoted "neutral," 3.41-4.20 reflected "agree," and 4.21-5.0 indicated "strongly agree." This interpretation framework facilitated a comprehensive analysis of the collected data and provided valuable insights into the perspectives of the participants.

4.2.1 Level of APM adoption in Ethiopia's post-tension construction industry

Adoption of APM refers to the process organizations and project teams embrace and implement APM principles and practices within their project management approaches. It signifies the decision to incorporate agile methodologies and the extent to which they are integrated into project workflows.

In a recent study by Chathuranga et al. (2023), 10 potential practices were identified to facilitate the adoption of agile methodologies. These practices were presented to an architectural consultancy firm in Colombo, Sri Lanka, to evaluate their usage in successfully adopting agile methods. The researchers suggested five practices for construction firms to effectively adopt agile project management with BIM software during the design phase. The findings indicate that the firm achieved success by implementing practices like maintaining a backlog, conducting sprints, involving cross-functional teams, ensuring continuous integration, and embracing iterative/incremental design development.

This research analyzed the adoption of agile project management in the Ethiopian post-tension construction industry using responses from engineering professionals at EASE. The study aimed to investigate the extent to which agile methodologies have been embraced and integrated into project management approaches within the industry, drawing insights from the experiences of professionals as well as considering the successful adoption practices identified in the aforementioned study by Chathuranga et al. (2023). The participants were asked to rate their responses using a 5-point Likert scale, and a total of four questions were designed to gather their understanding of the adoption of APM. The following table presents a summary of the responses obtained.

Table 4- Results from the assessment of APM adoption in Ethiopia's PT construction industry

S/N	Questions the level of adoption in Ethiopia's post-tension construction industry	N	Mean	Std. Deviation
1	Indicate your level of familiarity with agile project management principles and practices in general	40	3.75	0.71

2	Our organization has a good understanding of agile project management principles and practices	40	3.73	0.78
3	Agile project management is used throughout the lifecycle of post-tension projects	40	3.55	1.13
4	There are challenges when using agile project management in post-tension projects that needs to be addressed	40	3.88	0.79
	Valid N (listwise)	40		

Source: Own survey, 2023

The analysis of responses indicates that engineering professionals at EASE Engineering agree that they are familiar with agile project management principles and practices, with a mean value of 3.75. They also agree that their organization has a good understanding of agile project management, with a mean value of 3.73. Furthermore, respondents agree that agile project management is used throughout the lifecycle of PT projects, as indicated by a mean value of 3.55. However, they also acknowledge the existence of significant challenges associated with using agile project management in PT projects, with a mean value of 3.88.

The interview results with the technical department head suggests that the adoption of agile methodology in the PT construction industry was driven by the nature of the work, which is fast-paced and requires agility. The specific characteristics of PT construction necessitate the adoption of agile practices. The nature of post-tension construction projects inherently involves iterative and collaborative work processes. There is a need for continuous adjustments and adaptations based on the specific project requirements, design changes, and client inputs. These characteristics align with the core principles of agility, such as flexibility, adaptability, and customer collaboration. Currently, the Scrum methodology is being applied in the post-tension construction industry. The organization is in the process of establishing a structured approach for its implementation. On the other hand, synthesis of interview response with the operations head indicates that the adoption of agile methodology was not voluntary but forced due to the volatile desires and changing requirements of clients. The implementation process involves customer

collaboration and clear communication within teams in order to satisfy client's desires and handle changes within the respective teams. It was observed from the interview with the construction department head the construction team predominantly adheres to traditional project management methods, and the adoption of agile methodology is still in its early stages. The technical and operation department heads emphasize that the adoption of APM is more pronounced in larger projects compared to small-sized PT projects. This is attributed to the increased complexity and higher occurrence of changes in large projects. They explain that small PT projects generally involve fewer changes as the client, designer, and team are well-prepared and have addressed most matters.

The technical department head who oversees the tender and coordination as well as the design team and the operations head who leads the operation team collaborate to ensure APM is implemented throughout the entire project lifecycle suggesting that there is no alternative approach in the PT construction industry. Each project stage is treated as a mini project, with progress tracking facilitated through engineering sheets and software tools. Clear communication, milestone tracking, and documentation support project progress monitoring. Lessons from past incidents and mistakes are documented for future reference. Project outcomes are measured, and necessary changes are incorporated into the execution process by the design team. Constant communication, documentation, and use of letters for significant changes are emphasized. As-built drawings are provided to the client upon project completion.

Both department heads acknowledge the challenges associated with using agile project management in PT projects. The limited knowledge and understanding of agile methodology among stakeholders, including clients and contractors, presents a significant challenge as it leads to misalignment. As the structured implementation of agile is currently ongoing, there are plans to engage in discussions with clients and subcontractors to foster a shared understanding and collaborative approach towards agile implementation.

Fast-paced projects face challenges in managing frequent design changes, causing delays and tension between clients and the construction team. These changes pressure team members to adapt and make adjustments. Moreover, these changes impact fabricated materials, which may become

unsuitable for revised requirements. Sourcing necessary materials promptly can be challenging, resulting in potential delays or difficulties in obtaining required materials from available stock.

Based on the experiences shared by various respondents regarding their experience with APM, it was observed that some individuals have limited experience due to being recent graduates or having recently joined the workforce. Despite their limited practical application of agile methodologies, these respondents still acknowledge and recognize the potential benefits that APM can offer. The respondents identified several challenges faced while using agile project management. One common challenge mentioned was the overwhelming nature of changes and continuous design alterations. To address this, the respondents emphasized prioritizing clear communication, managing scope effectively, embracing agile planning and iteration, utilizing project tracking tools, and fostering a culture of continuous improvement.

Another challenge mentioned was the lack of good management, poor communication, and collaboration, as well as inconsistent processes and practices across teams when using APM. To overcome these challenges, the respondents aimed to improve communication by actively creating channels for sharing needs and encouraging participation. They also sought to establish a network of functional teams to ensure productive feedback and facilitate progress.

The lack of extensive experience with agile project management was highlighted as a significant hurdle. Professionals unfamiliar with the agile process may resist change, leading to difficulties in implementation. Training was identified as a solution to address the lack of familiarity and ensure the availability of trained personnel for specific tasks.

Other challenges mentioned include the whole team not fully understanding the workflow, the difficulty of estimating project requirements due to frequent changes, the use of new technologies and rare materials that add unpredictability in resource identification, and the lack of likable client involvement leading to increased costs and transparency issues. The respondents also noted structural problems within the company and the need for improved human resource management and schedule coordination.

Overall, the challenges identified revolve around managing changes effectively, improving communication and collaboration, addressing resistance to change, providing training and support,

adapting to new technologies and materials, and overcoming structural and organizational obstacles.

In conclusion, the level of adoption of agile project management in Ethiopia can be characterized as moderate, based on the interview and respondents' feedback. While not yet widespread across all parties, active implementation of agile methodologies is observed primarily among PT subcontractors. Ongoing efforts are being made to foster a shared understanding and collaborative approach towards agile implementation through planned discussions with clients and subcontractors. These findings are consistent with prior research by Yellen (2012), which suggests that agile project management adoption tends to be more prominent in larger projects.

Table 5- Overall descriptive statistics for the level of APM adoption in Ethiopia's PT construction industry

	N	Mean	Std. Deviation	Skewness		Kurtosis	
				Statistic	Std. Error	Statistic	Std. Error
ODS1	40	3.73	0.43	0.42	0.37	0.09	0.73
Valid N (listwise)	40						

Source: Own survey, 2023

The overall mean for this independent variable is 3.73, indicating that the majority of responses agree with the selected questions related to the current level of adoption of APM in Ethiopian PT construction industry. Additionally, we can assess the normality of the distribution by examining the skewness and kurtosis. In SPSS, the acceptable range for skewness is within -1.0 to +1.0. Skewness values greater than +1.0 indicate a right-skewed distribution, while values less than -1.0 indicate a left-skewed distribution, both of which deviate significantly from a normal distribution. As for kurtosis, values greater than 1 suggest a peaked distribution (leptokurtic), while values less than -1 suggest a flat distribution (platykurtic), both of which also deviate significantly from a normal distribution. It’s observed from the table above that the skewness value is 0.42 (right

skewed) and the kurtosis value is 0.09 (platykurtic) both of which fall between the acceptable range. Therefore, we can conclude that the data is normally distributed.

4.2.2. Prospects arising from the implementation of agile approach in Ethiopia's post-tension industry

Prospect of implementing agile signifies the potential positive outcomes, opportunities, and advantages that can be expected as a result of adopting agile project management practices within the post-tension industry in Ethiopia.

Agile project management has been recognized as a contemporary project management approach that has demonstrated its efficacy in ensuring project success. APM and its methodologies have been shown to bring about significant benefits in construction projects such as customer satisfaction (Gustavsson, 2013), cost reduction (Turner, 2014), error prevention (Hoda et al., 2008), and enhanced quality (Chen, 2004) according to existing literature.

This section presents the results of the study's second research question, which aimed to explore how effective agile project management is in improving project outcomes such as cost, schedule, and quality in Ethiopia’s post-tension construction industry. The participants were asked to rate their responses using a 5-point Likert scale, and a total of four questions were designed to gather this information. The following table presents a summary of the responses obtained.

Table 6- The effectiveness of agile project management is in improving project outcomes in Ethiopia’s post-tension construction industry

S/N	Questions for assessing effectiveness of agile project management is in improving project outcomes in Ethiopia's post-tension construction industry	N	Mean	Std. Deviation
1	Agile project management is more effective in managing post-tension construction project than traditional project management approaches	40	4.48	0.60
2	Agile project management is effective in improving post-tension construction project outcomes such as cost, schedule, and quality	40	4.55	0.55

3	Customer satisfaction, teamwork, and project performance have improved since using agile project management	40	4.20	0.69
4	Agile project management has the potential to transform the post-tension construction industry in Ethiopia	40	4.27	0.72
	Valid N (listwise)	40		

Source: Own survey, 2023

The analysis of responses indicates that respondents strongly agree that agile project management is more effective in managing post-tension construction project than traditional project management approaches with a mean value of 4.48. The majority of respondents, with a mean value of 4.55 strongly agree that agile project management is effective in improving post-tension construction project outcomes such as cost, schedule, and quality with a mean value of 4.55. Additionally, a mean value of 4.2 indicates that respondents strongly agree that customer satisfaction, teamwork, and project performance have improved since using agile project management. A mean value of 4.27 indicates that respondents strongly agree that agile project management has the potential to transform the post-tension construction industry in Ethiopia.

Response gathered from the interview highlighted that agile project management is more effective in managing post-tension construction projects compared to traditional approaches due to its flexibility, collaboration, continuous improvement, and adaptability to uncertainties. By embracing the core principles of agility, teams can deliver projects that meet client expectations, adapt to changing requirements, and achieve better overall project outcomes.

Several benefits associated with the adoption of agile project management in the construction industry were also discussed. The most significant benefit mentioned was improved client satisfaction and retention, as the flexibility offered by agile methodologies allows for better alignment with client needs. This, in turn, leads to increased trust and potential referrals. The other benefit includes the suitability of agile project management for fast-paced and volatile nature of projects and the industry.

The extracts from the open-ended questions from the questionnaire respondents provided their feedback and insights regarding the use of project management in post-tension construction projects. They highlighted that the use of agile project management in post-tension construction projects has provided various benefits and improvements. The flexibility and adaptability offered by agile have allowed for efficient solutions to challenges faced during projects. This flexibility in design has reduced project costs and enabled alterations to meet customer needs, which would have been difficult with traditional construction practices.

Agile project management, combined with the post-tension system, has addressed the inefficiencies, waste, delays, and high costs often associated with traditional construction methods. By focusing on cost savings, high-quality work, and meeting client expectations, agile has proven to be a sustainable approach. It helps reduce rework and redesign, accommodating changes and modifications throughout the project, ultimately minimizing costs.

Agile project management enables openness to change in customer demand, market trends, and material availability. This ensures that projects are not delayed due to material shortages, as alternative options can be utilized. While alternative options may come with increased costs, the overall benefit is evident in the successful delivery of projects.

The involvement of all project stakeholders, including clients, throughout the project process has shown positive outcomes. Incorporating their feedback has resulted in excellent project outcomes, controlled budgets, and efficient project completion. Agile project management also aids in providing optimal project schedules and reducing costs through effective resource allocation.

The benefits observed in post-tension construction projects include improved quality, time-saving progress, team collaboration, and the adoption of modern project strategies. Involving the client in the construction progress ensures client satisfaction, while early planning and internal cooperation contribute to project success. Aligning post-tensioning technology with agile project management allows for continuous improvement and better coordination with subcontractors and other stakeholders.

Overall, agile project management in post-tension construction projects provides better control, flexibility, adaptability, and minimizes project completion periods. It helps achieve high-quality

work, meet client and user needs efficiently, streamline processes, and address user complaints promptly. While there may be a need for greater awareness and alignment with agile project management in certain contexts, the advantages of implementing agile are evident and agree with existing literature. (Turner R. , 2014) (Chin, 2004) (Rashina Hoda, 2008)

Table 7- Overall descriptive statistics for the assessment of the effectiveness of agile project management is in improving project outcomes in Ethiopia's post-tension construction industry

	N	Mean	Std. Deviation	Skewness		Kurtosis	
				Statistic	Std. Error	Statistic	Std. Error
ODS2	40	4.38	0.49	-0.41	0.37	-0.74	0.73
Valid N (listwise)	40						

Source: Own survey, 2023

The overall mean for this independent variable is 4.38, indicating that the majority of responses strongly agree with the selected questions related to the assessment of the effectiveness of agile project management is in improving project outcomes in Ethiopia's post-tension construction industry. Additionally, we can assess the normality of the distribution by examining the skewness and kurtosis. Considering the previously mentioned acceptable ranges and the observations from the above table, the skewness value is -0.41 (left skewed) and the kurtosis value is -0.74 (platykurtic) both of which fall between the acceptable range. Therefore, we can conclude that the data is normally distributed.

4.2.3. Optimizing agile project management in Ethiopia's post-tension construction: Insights and strategies

Optimizing agile project management in Ethiopia's post-tension construction: Insights and strategies refers to the process of improving the implementation of agile project management practices in the specific context of Ethiopia's post-tension construction industry. The goal is to gain

valuable insights and develop effective strategies to enhance the efficiency and effectiveness of agile methodologies within this industry.

This section presents the results of the study's final research question, which aimed identify the best practices for using agile project management in the post-tension construction industry. The participants were asked to rate their responses using a 5-point Likert scale, and a total of four questions were designed to gather this information. The following table presents a summary of the responses obtained.

Table 8- The best practices for using agile project management in the post-tension construction industry

S/N	Questions for optimizing agile project management in Ethiopia's post-tension construction: Insights and strategies	N	Mean	Std. Deviation
1	The current level of adoption of agile project management in Ethiopia's post-tension construction industry are in line with international standards and best practices in the field	40	2.45	1.06
2	Project teams in the post-tension construction industry need to incorporate end-user feedback throughout the product/service development process	40	4.60	0.50
3	Project teams in the post-tension construction industry require training in the most up-to-date tools and technologies to support agile project management	40	4.85	0.36
4	The appropriate agile methodologies should be implemented in a way that is tailored to the specific post-tension project's requirements	40	4.22	0.89
	Valid N (listwise)	40		

Source: Own survey, 2023

The analysis of responses indicates that respondents disagree that the current level of adoption of agile project management in Ethiopia's post-tension construction industry are in line with international standards and best practices in the field with a mean value of 2.45. A mean value of 4.6 indicates that respondents strongly agree that project teams in the post-tension construction industry need to incorporate end-user feedback throughout the product/service development process. The majority of respondents, with a mean value of 4.85 strongly agree that project teams in the post-tension construction industry require training in the most up-to-date tools and technologies to support agile project management. Additionally, a mean value of 4.22 indicates that the respondents strongly agree that appropriate agile methodologies should be implemented in a way that is tailored to the specific post-tension project's requirements.

Response obtained from the open-ended questionnaire argue that current level of adoption of agile project management in Ethiopia's post-tension construction industry aren't in line with international standards and best practices in the field. Agile project management in post tension construction faces several challenges. The limited industry development makes it difficult to meet market demands for materials and designs. Additionally, high stakeholder expectations can create unrealistic demands that add pressure on project teams. The industry's traditional project management practices pose obstacles to training teams in agile methodologies and assembling skilled personnel. Weak capacity, including limited access to technology and skilled manpower, along with a lack of collaboration among stakeholders, hinders successful implementation. Risk management becomes challenging as agile practices address risks as they emerge, potentially deviating from the initial plan. Administrative and documentation challenges arise due to limited awareness and commitment to agile methodologies. Maintaining transparency with clients regarding operational progress is also a challenge. Cost estimation and control become difficult with changes made throughout agile projects. Suitability for long-term projects that require predictability and extensive documentation may be limited. Lastly, complexity and scalability are concerns, particularly in larger and more complex projects. Being aware of these challenges can help project teams navigate and address obstacles when utilizing agile methodologies in post tension construction.

The interview response from both the technical and operation head also indicates that current level of adoption of agile project management in Ethiopia's post-tension construction industry aren't in

line with international standards and best practices in the field. They indicated that there is a lack of education and awareness about agile project management in the industry. Professionals and stakeholders may not be fully familiar with agile methodologies, leading to a lower level of adoption and implementation. The current infrastructure and support systems in Ethiopia's post-tension construction industry may not be fully conducive to agile project management. This can include aspects such as limited access to technology, inadequate training resources, and insufficient collaboration platforms. Additionally, the lack of definite measurements due to ongoing implementation makes it challenging to assess the full impact. Despite the challenges and gaps identified, the interview responses also highlight the potential for improvement. There is a recognition of the benefits and effectiveness of agile project management, indicating a willingness to explore and enhance its adoption in the industry. The nature of the work inherently aligns with agile principles, with the team operating in an agile manner from the beginning. The focus now is on structuring and refining the agile processes further.

In conclusion, the findings of this study highlight the current gaps and challenges in the adoption of agile project management in Ethiopia's post-tension construction industry, deviating from international standards. Limited education, infrastructure, and collaboration hinder its implementation. However, there is optimism for improvement, as the industry's inherent alignment with agile principles and the recognition of its benefits provide a foundation for further exploration and refinement. To optimize agile project management in Ethiopia's post-tension construction, strategies should focus on addressing the identified challenges, including enhancing education and awareness, improving infrastructure, fostering collaboration, and measuring impact. By implementing these insights and strategies, the industry can pave the way for more effective and successful adoption of agile methodologies, ultimately improving project outcomes and meeting the evolving needs of the construction sector.

Table 9- Overall descriptive statistics for the optimizing agile project management in Ethiopia's post-tension construction: Insights and strategies

	N	Mean	Std. Deviation	Skewness		Kurtosis	
				Statistic	Std. Error	Statistic	Std. Error

ODS3	40	4.03	0.42	-0.56	0.37	-0.35	0.73
Valid N (listwise)	40						

Source: Own survey, 2023

The overall mean for this independent variable is 4.03, indicating that the majority of responses agree with the selected questions related to the optimizing agile project management in Ethiopia's post-tension construction: Insights and strategies. Additionally, we can assess the normality of the distribution by examining the skewness and kurtosis. Considering the previously mentioned acceptable ranges and the observations from the above table, the skewness value is -0.56 (left skewed) and the kurtosis value is -0.35 (platykurtic) both of which fall between the acceptable range. Therefore, we can conclude that the data is normally distributed.

4.3 Correlation Analysis

After calculating the mean scores of the variables, a Pearson correlation test was conducted. The significance of the correlations was determined based on established criteria. The following Pearson correlation value ranges were considered:

- Strength: strong (0.7-1), moderate (0.3-0.7) & weak (less than 0.3)
- Nature: positive and negative

Interpreting these values obtained from strength and nature, the associations between the variables were assessed.

Table 10- Correlation analysis

		Adoption of APM	Project Outcomes
Adoption of APM	Pearson Correlation	1	.579**
	Sig. (2-tailed)		<.001
	N	40	40
Project Outcomes	Pearson Correlation	.579**	1

	Sig. (2-tailed)	<.001	
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Own survey, 2023

From the above table, we can conclude that the adoption of APM and project outcome is moderate to a moderately strong relationship since the value of 0.58 lies between 0.7 and 0.1. The nature between the adoption of APM and project outcome is positive (0.58). A correlation coefficient of 0.58 indicates a moderate to moderately strong positive correlation, suggesting that as the adoption of agile project management increases, project outcomes tend to improve.

4.4 Regression Analysis

Regression analysis is a statistical technique used to examine the relationship between two or more variables. It allows to quantify how changes in the independent variables relate to changes in the dependent variable. A linear regression model was employed to measure the strength of the relationship between the independent variable and the dependent variable. Through this model, the extent to which the independent variables contribute to predicting the dependent variable can be determined. Overall, regression analysis provides valuable insights into the associations between variables and helps quantify their impact on the dependent variable.

4.4.1 Linear Regression Analysis

To assess the strength of the relationship between the independent variables and the dependent variable, as well as to evaluate the acceptability of this relationship, both the Model Summary and the ANOVA table analyses were conducted. These analyses provide valuable insights into the overall performance of the regression model and help determine the statistical significance of the relationships between variables.

4.4.1.1 Model Summary Analysis

A Model Summary analysis is a summary of key statistical measures and information about the performance and fit of a regression model. It provides an overview of how well the model explains the variation in the dependent variable and evaluates the overall goodness-of-fit of the model.

R-squared measure indicates the proportion of variance in the dependent variable that is explained by the independent variables in the model. R-squared ranges from 0 to 1, where 0 implies that the independent variables do not explain any of the variation in the dependent variable, and 1 suggests that the independent variables explain all the variation. Higher R-squared values indicate a better fit of the model.

Table 11- Model summary of independent versus dependent variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.579[a]	.336	.318	.93018

a. Predictors: (Constant), adoption of agile project management

Source: Own survey, 2023

The R-squared value in the above model summary suggests that approximately 34% of the variation in the dependent variable can be explained by the independent variables. Consequently, an R-squared value of 0.336 suggests that approximately 34% of the variance in project outcomes can be explained by the adoption of agile project management (APM).

4.4.1.2. ANOVA Analysis

The ANOVA test helps to know the significance of the model, i.e., are the predictor variable a good predictor of the outcome variable. A one-way ANOVA was used to examine the effects of the independent variable on a dependent variable.

The ANOVA analysis produces an F-statistic and associated p-value. The F-statistic compares the between-group variability to the within-group variability, and the p-value indicates the statistical significance of any observed differences. If the p-value is below a predetermined significance level (usually 0.05), it suggests that there are significant differences between the groups.

Table 12- ANOVA of independent vs. dependent variable

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.621	1	16.621	19.210	<.001[b]
	Residual	32.879	38	.865		
	Total	49.5	39			

a. Dependent Variable: Project outcome

b. Predictors: (Constant), adoption of agile project management

Source: Own survey, 2023

As shown in the above model, the significance value is <.001. This value is less than alpha (0.05), we can conclude that the model is significant.

F (1,38) =19.21 p=<.001

Given the statistically significant results, as evidenced by a Sig. value of <.001, it can be concluded that the adoption of agile project management, as the independent variable mentioned earlier, has a notable impact on project outcome.

4.4.1.3 Coefficients

The table provided displays both standardized and unstandardized coefficients, which can be used to quantify the predicted or estimated change in the dependent variable (Y) for each unit change in the respective independent variable. These coefficients are adjusted to account for the effects of

other independent variables, allowing us to examine the specific impact of each independent variable while holding the others constant.

Table 13- Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.462	1.216		2.848	.007
	Adoption of APM	.604	.138	.579	4.383	<.001

a. Dependent Variable: Project outcomes

Source: Own survey, 2023

Y= 3.462+0.604 X

In this model, Y represents the dependent variable, and "Adoption of APM" represents the independent variable. The equation implies that the value of Y is predicted or estimated based on the value of "Adoption of APM." The coefficient 0.604 indicates the relationship between the dependent variable (Y) and the independent variable (Adoption of APM). Specifically, for every unit increase in the Adoption of APM, the value of Y is expected to increase by 0.604 units, assuming all other variables remain constant. Similarly, for every unit decrease in the Adoption of APM, the value of Y is expected to decrease by 0.604 units. The intercept term, 3.462, represents the value of Y when the Adoption of APM is zero. In this case, it suggests that even if the Adoption of APM is zero, the estimated value of Y would still be 3.462.

Based on the obtained results, it can be concluded that Adoption of APM has a significant impact on improved project outcomes, as indicated by the statistically significant sig value of <.001, which is less than the predetermined significance level of 0.05. Therefore, the finding supports the notion that adoption of APM is linked to improved project outcomes.

Chapter 5: Summary of Findings, Conclusions and Recommendations

The study's findings, conclusions, and recommendations are outlined in this section. It provides a review of the research problem and presents the findings in relation to the stated objectives. Additionally, this chapter includes recommendations aimed at addressing the challenges identified in the study. The limitations of the research are acknowledged, and suggestions for future research directions are provided.

5.1 Summary of Findings

The research findings were considered satisfactory as they drew upon a substantial participation of engineering professionals from EASE Engineering, ensuring a comprehensive understanding of the subject matter. The results indicated that the engineering professionals are predominantly comprised of males and millennials, with a significant portion between the age of 25-45. The majority of the respondents, 90%, hold a BSc degree. The summary reveals that a significant proportion of the respondents possess 0-5 years of professional experience. 50% of the respondents are affiliated with the operations team.

It can be inferred that the specific characteristics of PT construction necessitate the adoption of agile practices. Hence, there was no transition from traditional project management to agile project management i.e., APM was adopted from the start for both the technical and operations teams. However, for the construction team, the implementation of agile methodology is still in its early phase. The current level of adoption of APM in Ethiopia is moderate, with PT subcontractors being the primary adopters. Currently, the Scrum methodology is being applied in the post-tension construction industry. The organization is in the process of establishing a structured approach for its implementation.

The majority of the respondents are well versed with the principles and practices of APM. While some respondents have limited experience or have not yet applied agile, they recognize its potential benefits, such as creating organized teams, producing high-quality outputs, and delivering value incrementally.

The respondents' experiences with agile project management (APM) indicate that it has had a positive impact on their projects and operations. APM's flexibility has allowed for adaptable execution and design, leading to improved work processes and schedules. The implementation of APM has resulted in value-adding engineering works, high-quality deliverables, and customer satisfaction. The breakdown of work and iterative approach have facilitated efficient design processes and tendering stages. APM has also enabled the teams to adapt to changing requirements and win market demand. In the construction industry, APM has helped minimize project complexity and create more organized teams, although limited client involvement can be a challenge. Some respondents have limited experience with APM, but it has shown promise in planning and initial project stages. Overall, APM is seen as a valuable approach that promotes collaboration, adds value, and delivers projects successfully while being adaptable to changes. Challenges in adopting APM identified revolve around managing changes effectively, improving communication and collaboration, addressing resistance to change, providing training and support, adapting to new technologies and materials, and overcoming structural and organizational obstacles.

The respondents in the study highlighted several key best practices for implementing agile methodology in post tension construction. These practices include prioritizing customer satisfaction, welcoming changing requirements, emphasizing collaboration and communication, breaking down projects into smaller tasks, providing training and education, incorporating technology, ensuring quality assurance and efficiency, and fostering a culture of continuous improvement. These practices aim to enhance project outcomes, promote flexibility, improve organizational structure, and deliver high-quality work.

5.2 Conclusion

The primary objective of this study was to investigate the adoption and effectiveness of agile project management in real-world construction projects in the Ethiopian post-tension industry. In summary, this study aims to enhance the understanding of project management in Ethiopia's post-tension industry, with a specific focus on agile project management. The study aimed to determine the current level of adoption of agile project management in the Ethiopian post-tension construction industry, assess its suitability and effectiveness in improving project outcomes such

as cost, schedule, and quality and to develop recommendations and best practices for the successful adoption and implementation of agile project management in the Ethiopian post-tension construction industry. The findings of this study have significant implications for both future research in this area and practical applications within similar organizational contexts.

- The findings suggest that agile project management is gaining traction in the PT construction industry in Ethiopia. The adoption of agile practices seems to be driven by the specific characteristics of PT construction, which require flexible and adaptive approaches to effectively manage projects. While the current level of APM adoption is moderate, it is promising to see PT subcontractors taking the lead in embracing these agile methodologies. The utilization of the Scrum methodology in the PT construction industry indicates a step towards more structured project management practices. However, it is important to acknowledge that the organization under study is still in the process of establishing a structured approach for APM implementation. This suggests a recognition of the need for a systematic framework to guide and optimize the adoption of agile practices in their projects.
- With proper implementation strategies and adequate support, the PT construction industry in Ethiopia has the potential to reap significant rewards from the adoption of agile practices. The findings strongly indicate the potential benefits of adopting agile project management practices. Agile methodologies offer valuable solutions to the unique challenges faced by the industry. The flexibility provided by agile practices enables project teams to adapt to changing project requirements and respond effectively to unforeseen circumstances, which are common in construction projects. This adaptability can lead to improved project outcomes, such as better cost control, timely project delivery, and enhanced quality. Moreover, the emphasis on continuous improvement and customer feedback aligns with the notion of incorporating stakeholder involvement and feedback throughout the project lifecycle is crucial for successful project execution. The iterative nature of agile project management allows for early identification of issues, enabling prompt corrective actions and minimizing the potential for costly delays and rework. In conclusion, the findings strongly support the viewpoint that agile project management can bring about positive transformations in the PT industry of Ethiopia. It’s evident that embracing agile

methodologies can address industry-specific challenges and lead to more efficient and successful project outcomes. However, it is crucial to approach the implementation process with a comprehensive understanding of the industry's dynamics and the need for organizational readiness and change management strategies.

- The insights and recommendations shared by the respondents in the Ethiopian PT construction industry provide valuable guidance for the successful adoption and implementation of agile project management. Their emphasis on conducting thorough feasibility analysis and allowing adequate planning time aligns with good project management practices. Addressing the dynamic nature of projects in this industry requires careful consideration of design alterations caused by client involvement, and taking the time to plan and accommodate changes can significantly contribute to project success. Emphasis on improved communication, collaboration, and consistent processes highlights the importance of effective teamwork and streamlined project workflows. Establishing channels for sharing needs and facilitating feedback can enhance coordination and ensure that project requirements are met efficiently. Additionally, the suggestion of continuous training and education reflects that fostering a culture of learning and professional development is vital for successful agile project management implementation as it enhances the understanding and proficiency of agile practices, enabling project teams to adapt and respond effectively to project dynamics.

5.3 Recommendations

Given the observation that agile project management is being adopted in the Ethiopian post-tension construction industry without a structured implementation approach, it is crucial to formulate a clear and comprehensive plan for its successful implementation. Secondly, comprehensive training programs should be provided to enhance the understanding and skills of team members. Establishing an Agile Project Management Office can offer guidance and support, while fostering collaboration and knowledge sharing among teams is crucial. Additionally, implementing a monitoring and evaluation system will help track progress and identify areas for improvement. By following these recommendations, organizations can effectively implement agile project management and improve project outcomes in the post-tension construction industry.

It has been observed that clients and other stakeholders in the Ethiopian post-tension construction industry may not have a clear understanding of agile project management practices. This lack of awareness can hinder the successful implementation of agile methodologies, as effective collaboration and alignment with all parties involved are essential for its success. To address this issue, it is recommended to educate clients and stakeholders about agile project management principles and its benefits. Providing training sessions or workshops can help raise awareness and enhance their understanding of the agile approach. Additionally, establishing open lines of communication and regular engagement with clients throughout the project can help manage expectations and foster a collaborative environment.

Another challenge mentioned is the potential for clients to take advantage of the flexibility offered by agile project management, leading to a lack of accountability and laziness. To mitigate this, it is crucial to set clear expectations and boundaries from the beginning of the project. This includes clearly defining project scope, deliverables, and timelines, as well as establishing a transparent feedback and review process. Regular monitoring and communication can help ensure that clients remain actively engaged and accountable for their responsibilities within the agile framework.

Overall, promoting awareness, education, and effective communication with clients and stakeholders is essential for the successful adoption and implementation of agile project management. By fostering a shared understanding and commitment to the agile principles, it becomes possible to overcome the challenges associated with client awareness and maintain a productive and collaborative project environment.

To enhance the adoption and effectiveness of agile project management in the Ethiopian post-tension construction industry, it is recommended to consider transforming the approach of PT design. Currently, the focus is primarily on slab design, but expanding it to include other vertical elements can yield significant benefits. However, it is important to address the challenge posed by permit authorities, as they typically require full design submittal before allowing the design process to commence. To overcome this hurdle, there is a need for flexibility in delivering the full design in phases, allowing for iterative submissions that align with the permit requirements. This approach will ensure compliance with regulations while still maintaining the agility and adaptability of the project management process.

5.4. Research Limitations and Areas of Further Research

The research findings reveal certain limitations and suggest potential areas for future study.

5.4.1 Limitations of the Study

Based on the nature of the post-tension industry in the research context, it is acknowledged that the study was limited to assessing only one engineering firm with only engineering professionals. This limitation arises from the fact that this particular firm is the pioneer and the sole active subcontractor in the post-tension sector. While this focus provides valuable insights from a leading company in the field, it is important to recognize that the findings may not be fully representative of the entire post-tension industry. Future research should strive to include additional engineering firms, if available, to ensure a more comprehensive understanding of the adoption and effectiveness of agile project management in the post-tension construction industry.

5.4.2 Recommendations for Further Study

In order to further advance the understanding of agile project management in the post-tension construction industry, several recommendations for future research have been identified. These include conducting comparative analyses involving multiple engineering firms to assess the adoption and effectiveness of agile practices across different companies and project types. Additionally, exploring the perspectives of various stakeholders such as clients, subcontractors, project managers, and regulatory authorities can provide a comprehensive understanding of the challenges and opportunities associated with agile project management. Furthermore, investigating the impact of agile methodologies in terms of project outcomes, cost, schedule, and quality can contribute to the development of best practices for successful implementation. Finally, given the unique nature of the post-tension industry, further studies can examine the scalability and adaptability of agile project management in different project contexts and explore the potential benefits of integrating agile principles into the overall project management framework.

References

ACI Committee 423. (2014). *Tendon installation and stressing practices for post-tensioned slabs.* American Concrete Institute.

Adekunle Sabitu Oyegoke, M. M. (2008). Managing risk and uncertainty in an agile construction environment: application of agile building specialist model. *International Journal of Agile Systems and Management*, 248-262.

Agile Manifesto. (2001). *Manifesto for Agile Software Development*. Retrieved April 2, 2023, from https://agilemanifesto.org/

Ahmed, S. F. (2021). EVALUATION OF POST TENSIONED SLAB AND ITS CONTRAST WITH TRADITIONAL RCC SLAB: REVIEW. *International Journal of Engineering Applied Sciences and Technology, 6*(1).

American Concrete Institute. (2019). *ACI 318-19 Building Code Requirements for Structural Concrete and Commentary.* American Concrete Institute.

Anoop Prakash, D. K. (2022). Factors Influencing Adoption of Agile Project Management in Construction Industry. *Mathematical Computing and Engineering Artificial Intelligence*.

Chin, G. (2004). *Agile Project Management: How to Succeed in the Face of Changing Project.* Amacom.

Chinyio, E. &. (2008). Practical Approaches for Engaging Stakeholders: Findings from the UK. *Construction Management and Economics, 26*(6), 591-599.

Clare. (2020). *What is Post-tensioning?* Retrieved from Freyssinet: https://freyssinet.co.uk/what-is-post-tensioning

Debebe, A. (2019). *Adoption Level and Challenges of Implementing Agile Project Management Methodology at the Private Banking Industry in Ethiopia.* Addis Ababa University.

Derya Bahceci, L. H. (2014). Agile Perspectives In Construction Projects-How To Improve Efficiency In The Design Phase. *Real Estate And Construction Management*, 1-40.

Devsamurai. (2023). *12 Agile Project Management Principles*. Retrieved from User Story Map: https://www.userstorymap.io/agile-project-management-principles/?utm_source=rss&utm_medium=rss&utm_campaign=agile-project-management-principles

Divakar.K, A. a. (2016). Application of Agile Project Management to Reduce the Time Overrun. *International Research Journal of Engineering and Technology*, 3380-3384.

EASE Group. (2022). *Omo River Bridge Recovery and Enhancement*. Retrieved from EASE Group Ltd: https://www.ease-int.com/general-construction/featured-projects-2/omo-river-bridge-recovery-and-enhancement/

Fekadu, A. (2021). *Assessing the Practice of Agile Project Management Methodology in Ethiopian Social Enterprises: The Case of Whiz Kids Workshop.* Addis Ababa University.

Gustavsson, T. (2013). *Agile - the art of completing projects.* Liber AB.

Hailemarkos, H. T. (2020). *Ethiopian Construction Project Management Maturity Model Determination and* . Walden University.

Heda, M. G. (2010). *Fundamentals of Agile Project Management: An Overview.* American Society of Mechanical Engineers.

Jin, C. (2017). Agile in Construction Projects. *Harrisburg University of Science and Technology*.

Johansson, M. Y. (2012). *Agile project management in the construction.* Royal Institute of Technology.

John, B. (2018). Framework of agile management's sprint planning in construction projects – AFD method. *International Journal of Advance Research and Development, 3*(5).

Loizou, A. (2021). *AGILE PROJECT MANAGEMENT IN THE CONSTRUCTION INDUSTRY*. Retrieved from LinkedIn: https://www.linkedin.com/pulse/agile-project-management-construction-industry-anninos-loizou/

Mallery, D. G. (2002). *SPSS for Windows Step by Step: A Simple Guide and Reference/11.0 Update.* Routledge Member of the Taylor and Francis Group.

Mallery, D. G. (2003). *SPSS for Windows Step by Step: A Simple Guide and Reference.* (4. ed., Ed.) Boston: Allyn & Bacon.

Mark C. Layton, S. J. (2020). *Agile Project Management for dummies.* John Wiley & Sons, Inc.

Miller, G. J. (2019). *Project Management Tasks in Agile Projects: A Quantitative Study.* Federated Conference on Computer Science and Information Systems.

Pallant, J. (2010). *SPSS Survival Manual- A step by step guide to data analysis using IBM SPSS.* New York: McGraw Hill.

Pandit, M. P. (2018). *Implementing Agile Project Management (SCRUM) approach in the development of Building Projects.* CEPT University.

Patterson, A. E. (2016). *Agile Project Management in the Design Stage.* Royal Institute of Technology.

Piotr Nowotarski, &. J. (2015). Barriers in Running Construction SME – Case Study on Introduction of Agile Methodology to Electrical Subcontractor. *Procedia Engineering, 122*, 47-56.

Post-Tensioning Institute. (2023). *PT Applications*. Retrieved from Post-Tensioning Institute: https://www.post-tensioning.org/education/ptapplications/pt101.aspx

Project Management Institute. (2013). *A guide to the project management body of knowledge* (5th ed.). Newton Square.

R. Owen, L. K. (2006). Is Agile Project Management Applicable To Construction. *University of Salford*, 51-66.

R.L. Owen, &. L. (2006). AGILE CONSTRUCTION PROJECT MANAGEMENT. *The University of Salford*.

Rashina Hoda, J. N. (2008). Agile Project Management. *In New Zealand Computer Science Research Student Conference, 6*, 218-221.

Sacolick, I. (2022). *A brief history of the agile methodology*. Retrieved from InfoWorld: https://www.infoworld.com/article/3655646/a-brief-history-of-the-agile-methodology.html

Sanjaya Chathuranga, S. J. (2023). Practices Driving the Adoption of Agile Project Management Methodologies in the Design Stage of Building Construction Projects. *Buildings 2023*, 1-19.

Serour, B. H.-S. (2005). Creating a Dual-Agility Method: The Value of Method Engineering. *Journal of Database Management, 16*(4), 1-24.

Spalek, S. (2014). Assessing Project Management Maturity in the Area of Knowledge Management in Select Companies. *International Journal of Economics, Finance and Management Sciences, 2*(2), 164-170.

The Constructor. (2021). Retrieved from 4 Important Construction Project Mangement Appraches: https://theconstructor.org/construction/construction-project-management-approaches/361258/

Turner, J. R. (2008). *The Handbook of Project-based Management: Leading Strategic Change in Organizations.* McGraw-Hill Professional.

Turner, R. (2014). *The Handbook of Project-based Management* (4th ed.). McGraw Hill.

Williams, S. K. (1995). *Post-tensioned Concrete Floors.* Butterworth-Heinemann Ltd.

World Bank. (2021). *Ethiopia*. Retrieved from https://data.worldbank.org/country/ethiopia

Zelalem Regassa, J. M. (2017). *Agile Methods in Ethiopia: An Empirical Study.* Addis Ababa University.

Zelele, T. A. (2016). Assessment on Performance and Challenges of Ethiopian Construction Industry. *Journal of Architecture and Civil Engineering*, 1-11.

APPENDICES

APPENDIX 1

Addis Ababa University

College of Business and Economics

School of Commerce

Master of Arts in Project Management

Questionnaire for Post-tensioning Professionals at EASE Engineering

Dear Participant,

I would like to invite you to participate in a research study on 'Agile project management in modern Ethiopia's construction industry- The case of application of post-tension technology' which is part of my final project work submitted to the School of Graduate Studies of Addis Ababa University, College of Business and Economics, School of Commerce in partial fulfillment of the requirements for the Degree of Master of Arts in Project Management. The purpose of this study is to investigate the adoption and effectiveness of agile project management in real-world construction projects in the Ethiopian post-tension industry. I kindly request your cooperation in completing the questionnaire to the best of your ability. Your honest and thoughtful responses will be greatly appreciated.

The questionnaire you will be completing seeks to investigate the current level of adoption of agile project management, its effectiveness in improving project outcomes such as cost, schedule, and quality and the best practices for using agile project management in Ethiopia's post-tension construction industry. It will take approximately 25-30 minutes to complete. The responses you provide will be kept strictly confidential, and your identity will remain anonymous.

I appreciate your time and effort in completing this questionnaire, as your input is vital to the success of this study. If you have any questions about this study or the questionnaire, please do not hesitate to contact me at ✉ **yeabtsegatassew@gmail.com**.

Thank you for your participation.

Sincerely,

Yeabtsega Tassew

Instructions: Please take the time to read each question carefully before answering. Please answer all questions to the best of your ability. For part I and part II, kindly mark your selection with an "X". For part three, present your answers in the space provided. If you find any question difficult or unclear, please feel free to reach out to me. Your input is essential to this research, and I want to ensure that you can provide accurate and thoughtful responses without any hindrance.

Part I- Demographic characteristics and general profile of the respondent

1. Gender

Male ☐ Female ☐

2. Age

Under 25 ☐ 25-30 ☐ 31-45 ☐ 46-50 ☐

3. Educational level

PhD ☐ MA/MSc ☐ BA/BSc If other, please specify_____

4. Work experience

0-5 years ☐ 6-10 years ☐ 11-15 years ☐ More than 15 years ☐

5. Which one of the following best describes your role at EASE Engineering?

Tender & coordination ☐ Design team ☐ Operation team ☐ Project Manager ☐

If other, please specify_____

Part II- Please indicate your level of agreement or disagreement with the statements below regarding agile project management in Ethiopian post-tension construction industry on a 5-point Likert scale ranging from Strongly Disagree to Strongly Agree. Please check the box next to the statement that best represents your response.

SD- Strongly disagree D- Disagree N-Neutral A- Agree SA- Strongly agree.

S/N	Statements	SD	D	N	A	SA
Assessing agile project management adoption in Ethiopia's post-tension construction industry						
1	Indicate your level of familiarity with agile project management principles and practices in general					
2	Our organization has a good understanding of agile project management principles and practices					
3	Agile project management is used throughout the lifecycle of post-tension projects					
4	There are challenges when using agile project management in post-tension projects that needs to be addressed					
Prospects arising from the implementation of agile approach in Ethiopia's post-tension industry						
5	Agile project management is more effective in managing post-tension construction project than traditional project management approaches					
6	Agile project management is effective in improving post-tension construction project outcomes such as cost, schedule, and quality					

7	Customer satisfaction, teamwork, and project performance have improved since using agile project management					
8	Agile project management has the potential to transform the post-tension construction industry in Ethiopia					
Optimizing agile project management in Ethiopia's post-tension construction: Insights and strategies						
9	The current level of adoption of agile project management in Ethiopia's post-tension construction industry is in line with international standards and best practices in the field					
10	Project teams in the post-tension construction industry need to incorporate end-user feedback throughout the product/service development process					
11	Project teams in the post-tension construction industry require training in the most up-to-date tools and technologies to support agile project management					
12	The appropriate agile methodologies should be implemented in a way that is tailored to the specific post-tension project's requirements					

Part III- Please provide your detailed and thoughtful responses to each question in the space provided.

1. Briefly explain your experience with agile project management.

_____

_____

_____

_____

_____

_____

2. What benefits have you observed in using agile project management in your post-tension construction projects, such as cost savings, schedule improvements, or better-quality outcomes?

3. What challenges have you faced when using agile project management in your post-tension construction projects, and how did you address them?

4. In your opinion, what are the best practices for using agile project management in the post-tension construction industry in Ethiopia?

5. What do you think are the potential drawbacks or limitations of using agile project management in the post-tension construction industry in Ethiopia?

APPENDIX 2

Addis Ababa University

College of Business and Economics

School of Commerce

Master of Arts in Project Management

Interview questions with department heads at EASE Engineering

The aim of this interview is to explore the real-world adoption and effectiveness of agile project management in the Ethiopian post-tension industry. The interviewees are department heads who oversee and direct post-tension construction projects from conception to completion.

The technical head, the operations head and the construction head will be taking part in this interview. These department heads were selected as my interviewees because they have a deep understanding of the post-tension construction industry, its challenges, and its needs. As leaders in their organizations, they have insight into the decision-making processes that lead/led to the adoption of agile project management, as well as the benefits and challenges that have arisen during its implementation. Furthermore, as they are responsible for overseeing project outcomes, they make a valuable source of information to investigate the adoption and effectiveness of agile project management in real-world construction projects in the Ethiopian post-tension industry.

A semi-structured interview approach is chosen to gather detailed information and insights from the interviewees, as the topic is complex. This approach gives the flexibility of asking follow-up questions and explore interesting or unexpected answers apart from the set of questions already

prepared. This can lead to more detailed and meaningful responses than a fully structured interview where questions are strictly predetermined. The interview questions are based on the research questions and objectives highlighted in the proposal.

Questions:

Assessing agile project management adoption in Ethiopia's post-tension construction industry

1. When and how did your organization adopt agile methodology? Could you walk me through the key factors that led to adoption of agile methodologies within your organization, and the implementation process.
2. Have you noticed any differences in the adoption and effectiveness of agile project management between large and small post-tension construction projects?
3. How do you ensure that the agile project management methodology is followed consistently throughout the life cycle of the project and what strategies do you use to track progress and ensure that project outcomes are being met?
4. How do you ensure that all stakeholders, including clients, contractors, and project team members, are aligned, and committed to the agile project management approach, and what strategies have you found to be most effective in achieving this alignment?

Prospects arising from the implementation of agile approach in Ethiopia's post-tension industry

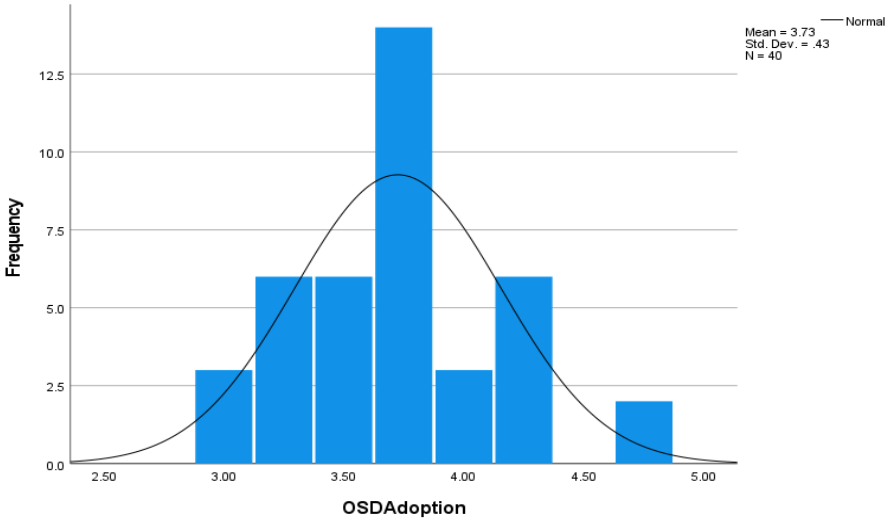
5. What are some of the benefits and challenges you have experienced with adopting agile project management in the post-tension construction industry?
6. How does agile project management impact project outcomes such as cost, schedule, quality, and stakeholder satisfaction, and what are the key success factors for achieving these outcomes?
7. How do you measure the success of agile project management in your post-tension construction projects?
8. Have you noticed any changes in team dynamics or communication since implementing agile project management? If so, can you describe them?

Optimizing agile project management in Ethiopia's post-tension construction: Insights and strategies

9. What specific agile project management approach has been most effective for your department, and why?
10. How do you ensure that the agile project management methodology is tailored to the specific needs and requirements of the post-tension construction industry, and what strategies do you use to ensure that best practices are being followed?
11. Based on your knowledge and expertise, what are the recommended approaches for implementing agile project management in the post-tension construction sector?
12. How do you see the use of agile project management evolving in the post-tension construction industry in the future? (Closing question)

Additional follow-up questions that may arise during the interview session will be analyzed as part of the interview data and included in the appendix of the final paper.

APPENDIX 3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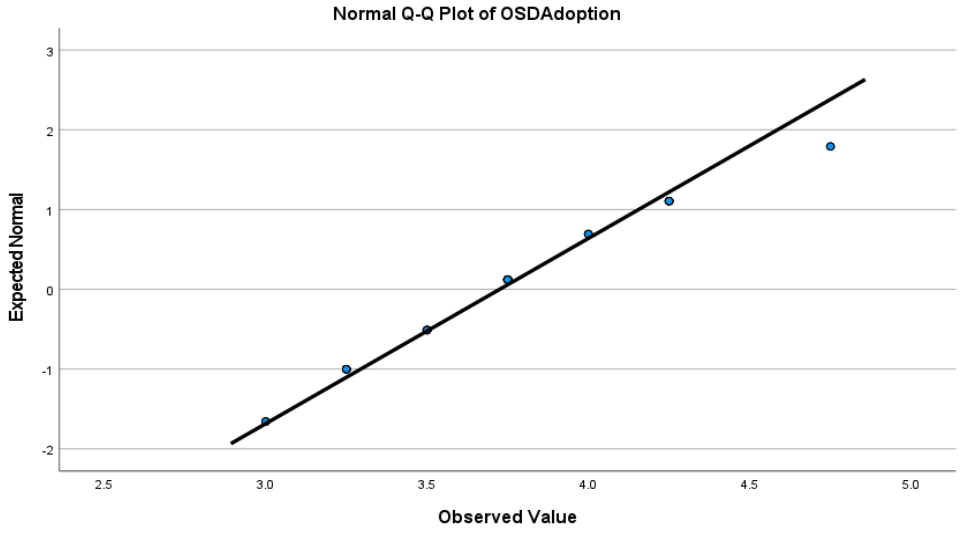
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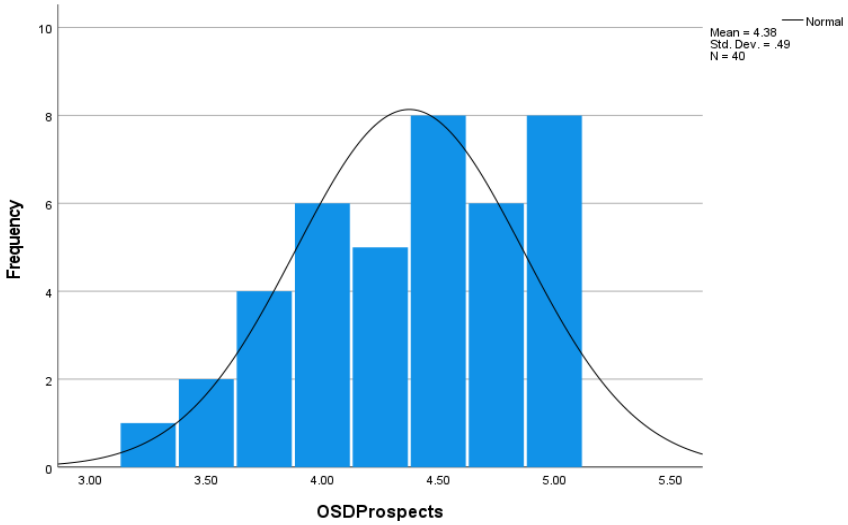
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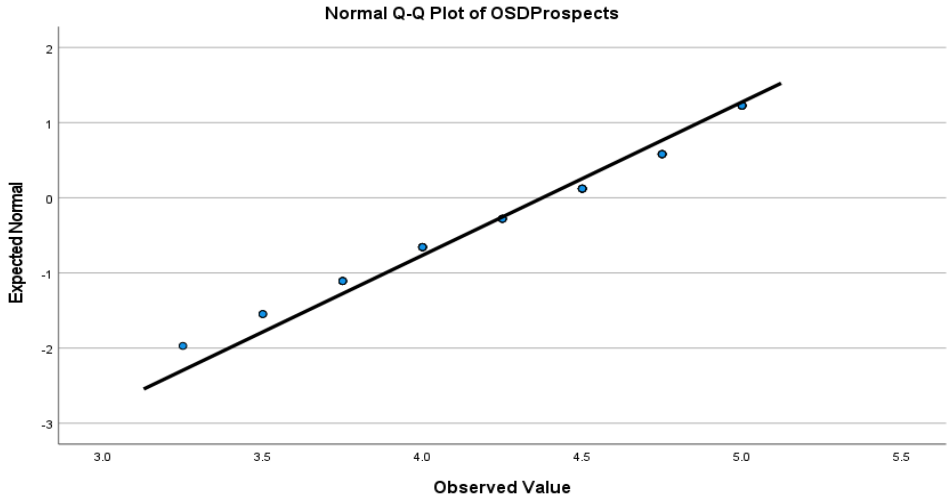
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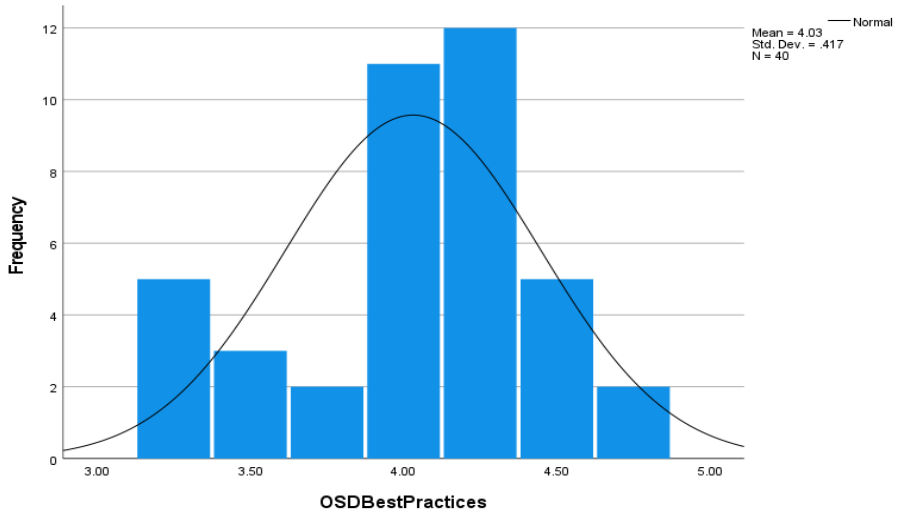
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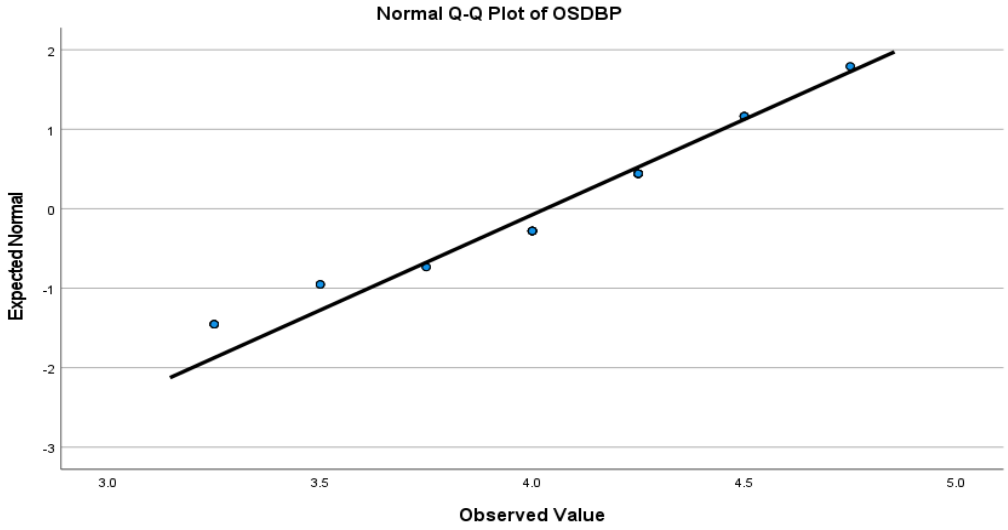
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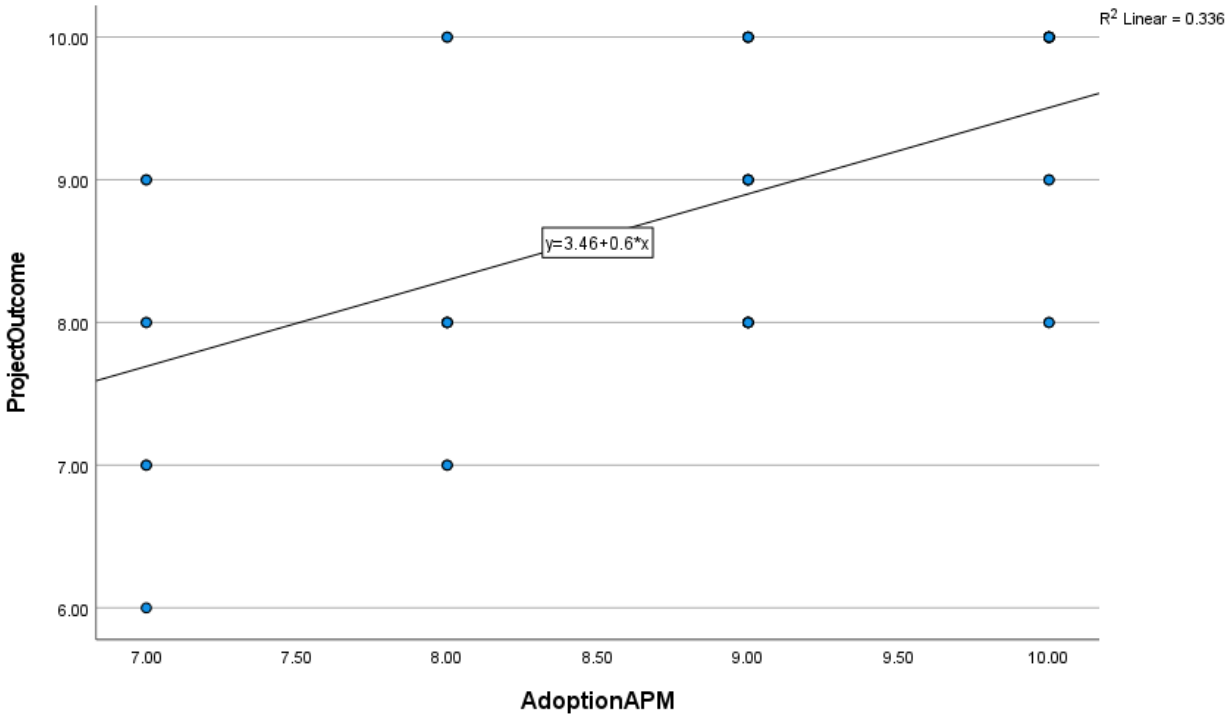
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