An Assessment of Project Management Maturity in Construction Projects: The case of YOTEK Construction PLC

By

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A Research Paper Submitted to Addis Ababa University, School of Commerce in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Project Management

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Addis Ababa, Ethiopia

June, 2020

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The undersigned have examined the research paper entitled '**An Assessment of Project Management Maturity in Construction Projects: The case of YOTEK Construction PLC'** presented by **Nahom Woldegebriel**, a candidate for the degree of **Master of Arts in Project Management** and hereby certify that it is worthy of acceptance.

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DECLARATION

I, the undersigned, declare that this research paper titled "An Assessment of Project Management Maturity in Construction Projects: The case of YOTEK Construction PLC" is my own work and has not been previously presented in its entirety or in part at any university for a degree. Where material has been used from other sources, it has been properly acknowledged/referred.

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ABSTRACT

This research aimed to undertake an assessment of project management maturity in construction projects by taking the case of an Ethiopian grade-1 contractor—YOTEK Construction PLC. The assessment was done by investigating the maturity level of thirteen PMBOK's knowledge areas, which were taken from the Construction Extension of the PMBOK Guide. Among the various project management maturity models (PMMMs), the PM Solutions' PMMM was adopted as a model for conducting the project management maturity assessment. The research was a descriptive type of study having a cross-sectional time scope in data collection. It followed a mixed research approach, specifically the "Embedded Design Mixed Method," where a quantitative approach using a questionnaire survey was used as a primary method, while a qualitative approach using a document review had a secondary role in the study to support the quantitative results. The research found that there was a generally low application of project management practices in the company as 65.5% of knowledge area components were practiced below average and a company-wide maturity level of 2.64 (from 1-5 maturity level scale) was scored. Project time, financial, and scope management were the highest matured knowledge areas in the company, while project risk management was the least matured knowledge area with a maturity level of 1.8, followed by project equipment management with 2.01. Moreover, the results were compared with an industry benchmark values, and only the project time management knowledge area excelled its benchmark value counterpart. Finally, recommendations for identified project management practice gaps and priority areas are put forward so as to provide a road map towards improvement of maturity level for each knowledge area and the company as a whole.

Key Words: Construction Project Management, Project Management Knowledge Areas, Project Management Maturity, Project Management Maturity Model

ACKNOWLEDGMENTS

First off, I would like to thank my parents for the relentless support they've given me throughout my undertaking of this paper. I would also like to extend my gratitude to my advisor, Wubshet Bekalu (PhD), for his important comments and directions. Finally, I'm so grateful to the employees of YOTEK Construction PLC for their humble cooperation and participation, without which the research would have not been successful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS/ACRONYMS

CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integrated
ETB	Ethiopian Birr
EVM	Earned Value Management
GDP	Gross Domestic Product
HR	Human Resource
OPM3	Organizational Project Management Maturity Model
PM	Project Management
PM2	Project Management Process Maturity
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMMM	Project Management Maturity Model
PWC	Price Waterhouse Coopers
RBS	Risk Breakdown Structure
SPSS	Statistical Package for Social Science
WBS	Work Breakdown Structure

CHAPTER 1
INTRODUCTION

1.1 Background of the Study

Construction plays a decisive role in both economic and social development, especially in developing countries. According to Jekale (2004), major construction activities in developing countries account for about 10% of their GDP and more than 50% of the wealth invested in fixed assets. The 2018/19 Annual Report by National Bank of Ethiopia depicted that the Industry sector had 28.1% share in the GDP of the country; and Construction had a 72.5% share in the Industry sector. However, despite this significance, the performance of the construction industry in the developing countries is generally low as indicated in many researches. One, out of many, reason for this phenomenon is the poor project management practice in the construction organizations of these developing countries. The case in Ethiopia is no different. Researchers, such as Zelele (2016) and Yimam (2011), revealed that the level of construction project management practice in Ethiopia in terms of adapting general project management procedures, functions, tools and techniques is low.

The major task of project management in construction projects is to coordinate various professionals working in the project, so that they have a maximal contribution to the project (Chartered Institute of Building, 2002). According to Hendrickson (2008), the management of construction projects, in addition to understanding of project management, requires an understanding of the design and construction processes. In general terms, construction projects are complex and associated with many uncertainties. According to Gorecki (2015), the uncertainties usually come from the unique nature of a project and from the diversity of required resources and activities. Improving project management capability have a role in reducing these uncertainties. As project management becomes a dominant way for accomplishment of work, organizations become good at delivering projects successfully. For an organization to strive for a significant improvement requires a deep understanding of where the organization is and where it ought to be (Grant & Pennypacker, 2006). Here, project management maturity assessment comes of paramount importance.

As Ofori & Deffor (2013) described it, project management maturity is the progressive development of an organization-wide project management methodology, strategy and decision making process. According to the findings of (PM Solutions, 2014), organizations of different industries have seen significant value by increasing their PM maturity level, showing: decreased number of failed projects, improved customer satisfaction, higher number of projects delivered under budget, and improved productivity.

Project management maturity models (PMMMs) have arisen as a response to the need of organizations in evaluating and understanding their project management practices. Furthermore, the PMMMs can be used to compare the project management practices against an extensive set of project management best practices as well as with that of competing organizations (Moutawei et al., 2017). Researches by (Mateen, 2015; Yazici, 2009; Schiltz, 2003; PWC, 2004; PM Solutions, 2014) have shown that the greater an organization's project management maturity, the greater the positive impact it has on overall project success. Cooke-Davies & Arzymanow (2002) and Yazici (2009) stated that higher maturity levels can grant a competitive advantage in the marketplace to an organization; however, Jugdev & Thomas (2002) argued that the PMMMs can only grant temporary competitive advantage or competitive parity to the organization. Nevertheless, the importance of a PMMM cannot be disregarded.

This research aimed to conduct an assessment of project management maturity in YOTEK Construction PLC. The assessment was done by investigating the maturity level of each PMBOK's knowledge area. There were 13 knowledge areas investigated in the process. Among the various PMMMs, the PM Solutions' PMMM was adopted as a model for conducting the project management maturity assessment. This assessment provides the company a clear picture of its current state with respect to its project management maturity, identifies gaps in project management practices, and provides a road map for improvement action.

1.2 Background of the Company

YOTEK Construction PLC is an Ethiopian grade-I general contractor established in 1998 G.C. In the last 22 years, the company has established itself as one of the leading construction companies in Ethiopia providing various construction services

like construction buildings, roads, special factory foundations, bridges and various types of civil engineering structures contributing to the development of the construction industry. So far, YOTEK Construction PLC has accomplished various types of projects and is currently undertaking 19 projects worth ETB 4.5 billion across Ethiopia. Currently, the company has more than 5,500 employees which include 1100 permanent ones.

1.3 Statement of the Problem

Similar to almost all construction companies, YOTEK Construction PLC is a project driven organization. Its existence relies on the successes of the different construction projects it undertakes. According to PWC (2004), most project failures are a result of organizational project management failures, which accounts for 59% of the problems. Hence, the proper management of these projects is critical.

A state where the organization is in a perfect condition to achieve or reach its project activities is shown by its project management maturity (Andersen & Jessen, 2002). Project management maturity implies a potential for growth in capability; it further indicates the richness and effectiveness of an organization's process and how it's consistently applied throughout the organization's projects (Paulk et al. 1993; Crawford, 2002).

Understanding and assessing the project management maturity level of an organization enables it to understand its current state regarding project management, identify gaps in its practice of project management, and devise means on how to improve project performance. Unfortunately, YOTEK Construction PLC hasn't undertaken a documented assessment of its project management maturity, though the company has completed several projects. The research tried to bridge this gap. Furthermore, it was observed that there are limited researches and documentations regarding project management maturity of construction companies in Ethiopia. An empirical review revealed that most prior PM maturity assessments undertaken in Ethiopia focused on industries other than construction, such as software projects. The research also contributes to fill such a deficiency or gap of scarcity on project management maturity in Ethiopian construction companies.

1.4 Research Questions

This research tried to answer the following research questions:

1. How is project management practiced in YOTEK Construction PLC?
2. What are the maturity levels of the PMBOK's project management knowledge areas in YOTEK Construction PLC?

1.5 Research Objectives

1.5.1 General Research Objective

The general objective of this research is to assess the project management practices in YOTEK Construction PLC, as well as the maturity levels of the PMBOK's project management knowledge areas in the company.

1.5.2 Specific Research Objectives

This research has the following specific objectives:

1. To assess the project management practices in YOTEK Construction PLC
2. To assess the maturity levels of each of PMBOK's project management knowledge areas in YOTEK Construction PLC
3. To identify highest priority areas for improvement
4. To compare each knowledge area project management maturity of YOTEK Construction PLC with industry benchmark in African context

1.6 Significance of the Study

Mainly, this research has a significance for YOTEK Construction PLC as it helps the organization to understand its current status regarding project management practices, to identify shortcomings in its project management practices, and to provide a road map for improvement action by identifying priority areas and subjects. In addition, the study will grant an opportunity for the organization to compare itself with an industry standard, particularly in African context. The comparison can also be with other competing local companies in the construction industry, if similar assessments are to be done in the companies.

Furthermore, the study will be a baseline assessment to which future project management development or improvement efforts of the organization can be compared. It will also be a foundational study for further research on project management maturity of construction organizations in Ethiopia.

1.7 Scope of the Study

Theoretically, this research was delimited by 13 knowledge areas provided by the Construction Extension of PMBOK's Guide, namely: Project Scope Management Project Time Management, Project Cost Management, Project Quality Management, Project Procurement Management, Project Communications Management, Project Human Resource Management, Project Materials Management, Project Equipment Management, Project Stakeholder Management, Project Safety Management, Project Financial Management, and Project Risk Management.

The study mainly used quantitative method of data collection. But qualitative method of document review was also used to strengthen the quantitative data. Further on research approach is presented in Chapter 3.

As for the geographical scope, the study was delimited in Addis Ababa, Ethiopia as only those projects located in Addis Ababa were investigated. The projects consisted of road construction and building construction projects. Regarding the time scope, the research was a cross-sectional study as the data collection was bound to be done once.

1.8 Limitation of the Study

The study has encountered different limitations, most of which were accounted to the limited time frame given (3 months) to complete the work. The first one is that not all projects of YOTEK Construction were investigated, particularly those outside Addis Ababa, due to time and resource constraints. Second, the questions in the adapted questionnaire were limited in content, so that they wouldn't be lengthy and tedious for respondents to fill. Had it not been for this limitation, each knowledge area would have been investigated in a greater depth. Third, the accuracy of information the respondents provided was bound to be limited.

1.9 Organization of the Paper

This research paper contains five chapters. The first chapter is an introduction to the research. The second chapter is a literature review related to the research topic; it contains both theoretical and empirical review. The third chapter presents the research methodology which elaborates on the research approach & design, sampling, data collection method, data analysis method, validity & reliability, and ethical considerations of the research. Chapter four consists of the presentation, interpretation and discussion of results. Finally, the last chapter presents the summary of the findings, conclusions and recommendations of the research.

CHAPTER 2
LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Project and Project Management

The Project Management Institute definition of project is probably the widely used one in the Project Management literature. The PMBOK Guide by PMI (2013) defined project as a temporary endeavor undertaken to create a unique product, service, or result. Furthermore, Wysocki (2014) elaborated that a project is a sequence of unique, complex, and connected activities that have one goal or purpose and completed by a specific time, within budget and according to specification. Kerzner's (2009) project definition added the fact that projects consume human and nonhuman resources. Generally, a project is non-repetitive & goal oriented, holds a particular set of constraints, has a measurable output and changes something through being carried out (Fewings, 2005).

PMI (2013) defined Project Management as the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. It is the art of directing and coordinating human, financial and material resources throughout a project's duration by using modern management techniques to achieve predetermined goals (success criteria), which include, scope, cost, time, quality and stakeholder satisfaction (PMI, 2013). Project management is accomplished through the appropriate application and integration of the logically grouped project management processes (across the various PM knowledge areas), which are categorized into five process groups: Initiating, Planning, Executing, Monitoring & Controlling, and Closing (PMI, 2013).

Wysocki (2014) added to the above definition by introducing questions to which project management is designed to answer, these are: What business situation is being addressed by the project? What is to be done? How will it be done? How will you know you did it? How well did you do?

Generally, managing a project includes: identifying requirements; addressing the various needs, expectations and concerns of stakeholders; setting up, maintaining, and carrying out communications among stakeholders; managing stakeholders towards creating project deliverables and meeting project requirements; balancing the competing project constraints including scope, quality, schedule, budget, resources, and risks (PMI, 2013). According to the findings of Kwak & Ibbs (2000), the average cost of PM services is 6% of total project cost and 9.3%, for construction companies.

2.1.2 Construction Projects and Their Management

The nature and characteristics of construction projects have some differences from other kinds of projects. The Construction extension to the PMBOK Guide by PMI (2016), described the generally accepted principles for construction projects that are not common to all general project types. Inherently, construction projects more often occur in an ever-changing, complex environment, and often with a high degree of risk. PMI (2016) further added that construction projects simultaneously address the geography, physical environments, existing infrastructure, communities, site conditions, and a wide range of stakeholder requirements. Moreover, PMI (2016) noted that construction projects typically carry large penalties or damages for projects that are completed late.

Construction plays a major role in both economic and social development. However, according to Guangshe et al. (2008), one major problem in the construction industry is its large scale investment which is in a high contrast with its low benefit and inferior management. This problem magnifies in developing countries like Ethiopia. Therefore, project management is vital in order to implement and control the construction projects efficiently.

The major task of project management in construction projects is to coordinate various professionals working in the project, so that they have a maximal contribution to the project (Chartered Institute of Building, 2002). According to Hendrickson (2008), in addition to the knowledge of general and project management, the management of construction projects requires an understanding of the design and construction processes. Hendrickson (2008) summarized the functions of project management in construction as follows:

- Specifying project objectives and plans, which includes: defining the scope, preparing the budget and schedule, setting performance requirements, and selecting project participants.

- Maximum utilization of resources through labor, materials and equipment procurement in accordance with a plan and schedule.

- Implementing multitude of operations by properly coordinating and controlling the processes of planning, estimating, designing, contracting and construction

- Developing effective communications and mechanisms for conflict resolutions among various stakeholders.

2.1.3 Construction Project Management Knowledge Areas

Most of the knowledge areas in the PMBOK guide are applicable to construction projects with modifications to address the unique attributes, practices, and applications. The Construction Extension of the PMBOK Guide (PMI, 2016) provides these modifications and additional knowledge areas applicable to construction projects. The added knowledge areas are Project Health, Safety, Security, and Environmental (HSSE) Management; and Project Financial Management. Project Equipment Management and Materials Management are incorporated under Project Resource Management knowledge area beside Human Resource Management in the Guide. But in this research, the three Resource knowledge areas were treated individually for the sake of clarity. Furthermore, according to Sharma (2002), equipment and material costs account for up to 70% of the costs of a construction project. Therefore, the two knowledge areas were given due attention. The HSSE management knowledge areas were generalized to Project Safety Management. In total, there were 13 knowledge areas of construction project management evaluated in this research endeavor.

2.1.3.1 Project Scope Management

According to PMI (2013), Project Scope Management includes the processes required to ensure that the project covers all the work required, and only the work required, to complete the project successfully. According to Wysocki (2014), this knowledge area focuses in identifying and documenting of client requirements. In the construction industry, contract documents, and design drawings define the scope (PMI, 2016). The processes involved in this knowledge area are: Plan Scope Management; Collect

Requirements; Define Scope; Create WBS; Validate Scope; and Control Scope (PMI, 2013).

2.1.3.2 Project Time Management

The overall purpose of time management is to develop the project schedule, manage that schedule, and ensure the timely completion of the project (Crawford, 2002; PMI, 2013). Since construction is heavily dependent on time restrictions within contracts, there is an added emphasis to finish the project within the given schedule. As a result, this knowledge area in construction involves complex challenges mainly due to the magnitude of stakeholders involved (PMI, 2016). The processes involved in this knowledge area are: Plan Schedule Management; Define Activities; Estimate Activity Resources; Estimate Activity Durations; Develop Schedule; and Control Schedule (PMI, 2013).

2.1.3.3 Project Cost Management

Project Cost Management involves identifying required resources, estimating the cost of those resources, developing a project baseline to set a target and comparing progress against the target baseline (Crawford, 2002). Project Cost Management in construction includes cost estimating, cost budgeting, cost monitoring & control, and further entails managing the day-to-day project costs (PMI, 2016). The knowledge area is of vital importance to a construction project's success as it impacts the organization's profitability. According to PMI (2016), challenges to cost management in construction include the vast number of stakeholders involved, quality and availability of skilled labor in a particular area, weather impact on productivity, transportation in remote areas and fluctuations in material prices. Tracking and managing these costs involves detailed planning, monitoring and control. The processes involved in this knowledge area are: Plan Cost Management; Estimate Cots; Determine Budget; and Control Costs (PMI, 2013).

2.1.3.4 Project Quality Management

According to PMI (2013), Project Quality Management includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project requirements are met and validated. The knowledge area is integral to risk, safety and environmental management, and applies to all attributes of project management as it manages the quality of both process and

product of a construction project (PMI, 2016). The processes involved in this knowledge area are: Plan Quality Management; Perform Quality Assurance; and Control Quality (PMI, 2013).

2.1.3.5 Project Human Resource Management

The overall purpose of Project Human Resource Management is to identify and define the required set of skills for specific project activities, to identify individuals who are entitled with those skill sets, to assign roles and responsibilities for the project, to manage and ensure high productivity, and to forecast future resource needs (Crawford, 2002). Generally, it includes the processes that organize, manage, and lead the project team. The processes involved in this knowledge area include: Plan Human Resource Management; Acquire Project Team; Develop Project Team; and Manage Project Team (PMI, 2013).

2.1.3.6 Project Equipment Management

According to Sharma (2002), the cost of equipment in a construction project varies from 10 to 30 % of the total project cost, depending upon the extent of mechanization. Proper planning, selection, procurement, installation, operation, maintenance and equipment replacement policy plays an important role in equipment management (Sharma, 2002). Sharma (2002) added that the main task for equipment management is to reduce downtime, achieve optimum equipment utilization and increase production at minimum cost. The processes involved in this knowledge area include: Equipment Acquisition; Assignment Planning; Equipment Tracking and Monitoring; and Equipment Maintenance (Yimam, 2011).

2.1.3.7 Project Materials Management

As Sadiwala (2007) put it, "materials management is the process by which an organization is supplied with the goods and services that it needs to achieve its objectives of buying, storing and providing the appropriate material of right quality, right quantity at right place in right time so as to coordinate and schedule the production activity in an integrative way for an industrial undertaking." The processes involved in this knowledge area include: Material Planning; Managing Material Procurement Process; Monitoring and Controlling of Material use and Material Availability (Yimam, 2011).

2.1.3.8 Project Communications Management

Project Communications Management includes the processes required for ensuring projects to plan, create, collect, distribute, manage, store, retrieve, control, monitor, and dispose project information in a timely and appropriate manner (PMI, 2013). Communication within construction environments presents special challenges because of the various stakeholders and the interdisciplinary nature of project teams (PMI, 2016). Furthermore, the information is used for decision making (Crawford, 2002). The processes involved in this knowledge area include: Plan Communication Management; Manage Communications; and Control Communications (PMI, 2013).

2.1.3.9 Project Risk Management

Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project, with objectives of increasing the likelihood and impact of positive events, and decreasing the likelihood and impact of negative events in the project (PMI, 2013). Every construction project faces a variety of uncertain situations such as: complex technical processes, long duration and aggressive schedules, material shortages, changing environment, regulatory requirements, etc. (PMI, 2016). The processes involved in this knowledge area include: Plan Risk Management; Identify Risks; Perform Qualitative Risk Analysis; Perform Quantitative Risk Analysis; Plan Risk Responses; and Control Risks (PMI, 2013).

2.1.3.10 Project Procurement Management

Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project organization in support of the project (PMI, 2013; Crawford, 2002). It also includes the contract management and change control processes required to develop and administer contracts or purchase orders issued by authorized project team members. Construction projects are mostly based on the procurement of contractual arrangements between sellers and buyers, and include the procurement of project equipment and materials (PMI, 2016). PMI (2016) added that typical contractual relationships exist between the owner and the general contractor, and between the general contractor and its subcontractors and suppliers. The processes involved in this knowledge area include:

Plan Procurement Management; Conduct Procurements; Control Procurements; and Close Procurements (PMI, 2013).

2.1.3.11 Project Stakeholder Management

Project Stakeholder Management includes the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders in project decisions and execution, along with continuous communication with stakeholders to understand their needs and expectations, and manage conflicting interests (PMI, 2013). According to PMI (2016), in construction projects, the owner, consultants, and contractor are primary stakeholders who in turn bring other stakeholders to the group. The community, insurance providers, financial institutions, and regulatory agencies are also some of the most common stakeholders in construction projects (PMI, 2016). The processes involved in this knowledge area include: Identify Stakeholders; Plan Stakeholder Management; Manage Stakeholder Engagement; and Control Stakeholder Engagement (PMI, 2013).

2.1.3.12 Project Safety Management

Project Safety Management processes include all activities which determine safety policies, objectives, and responsibilities to ensure the project is planned and executed in a manner that prevents accidents so as to avoid personal injury, fatalities, or property damage (PMI, 2016). The safety of construction crews and project teams is a top challenge on construction projects and should be a priority in all levels of the organization (PMI, 2016). The processes involved in this knowledge area include: Plan Safety Management; Perform Safety Assurance; and Perform Safety Control (PMI, 2016).

2.1.3.13 Project Financial Management

Project Financial Management determines how the project will be financed, including the processes to acquire and manage the financial resources for the project; it is more concerned with revenue sources and monitoring net cash flows for the construction project than with managing day-to-day costs (PMI, 2016). The processes involved in this knowledge area include: Perform Financial Planning; Perform Financial Control; Administration and Records (PMI, 2016).

2.1.4 Maturity

The Webster dictionary (1988) defines ‘‘mature’’ as being ripe or having reached the state of full maximum development; hence maturity is the quality or state of being fully developed. According to the definition of Paulk et al. (1993), maturity is the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective. According to PMI (2003), maturity is the level of sophistication indicating an organization’s current project management processes and practices. Similarly, Kerzner (2009) defined maturity in project management as the implementations of a standard methodology and accompanying processes such that there exists a high likelihood of repeated successes.

Maturity implies a potential for growth in capability; it further indicates the richness and effectiveness of an organization’s process and how it’s consistently applied throughout the organization’s projects (Paulk et al. 1993; Crawford, 2002). Andersen & Jessen (2002) stated that maturity might refer to a state where the organization is in a perfect condition to achieve or reach its project objectives. Furthermore, a concept of maturity can also refer to the comparative level of advancement that an organization has, regarding any given activity or sets of activities (Gorecki, 2015). Andersen & Jessen (2002) measured maturity along three dimensions: capability to carry out different tasks (knowledge), willingness to carry them out (attitude), and actually doing them (actions).

Whereas, project management maturity is the progressive development of an organization-wide project management methodology, approach, strategy and decision making process (Ofori & Deffor, 2013). According to the findings of (PM Solutions, 2014), organizations of different industries have seen significant value by increasing their project management maturity level, showing: decreased number of failed projects, improved customer satisfaction, higher number of projects delivered under budget, and improved productivity.

Sarshar et al., (2000) compared mature and immature construction organizations by modifying the comparisons done by Paulk et al. (1993). "A mature organization possesses an organization-wide ability for management of design, construction and maintenance activities. The processes are accurately communicated to all employees and activities are carried out in accordance with the planned processes. The processes

mandated are fit for use and consistent with the way the work gets done. Roles and responsibilities within the defined processes are clear throughout the projects across the organization. On the other hand, in an immature construction organization, processes are generally improvised by practitioners as well as project managers. Even if a process has been specified, it is not rigorously adhered or implemented. The immature organization is reactionary as managers usually focus on fire fighting. The quality assurance and quality review are often cut short when projects fall behind schedule, hence product quality is difficult to predict" (Sarshar et al., 2000).

According to Ahern et al. (2008), an organization matures by steadily improving its process capability, which is the inherent ability of a process to produce planned results. As the capability of a process increases, it becomes measurable and predictable, and the most significant causes of poor quality and productivity are controlled or eliminated (Ahern et al., 2008).

Generally, having a fully matured organization is just a theoretical concept. According to Andersen & Jessen (2002), in the real world, finding the fully matured organization is impossible; the authors concluded, "no one has reached the stage of maximum development and no one will."

2.1.5 Project Management Maturity Models

2.1.5.1 Introduction

As most authors agree, the Crosby's model developed in 1979, was the basis for the development of maturity models. The model was based on 5 maturity levels, linked to quality standards in an organization. Based on this Crosby model, Capability Maturity Model (CMM) was developed to evaluate the management of software process (Moutawei et al., 2017). Detail of this model is presented in the "Review of different PMMMs" subsection.

Kerzner (2001) stated that the foundation for achieving excellence in project management can best be described as the Project Management Maturity Model (PMMM). A maturity model offers a framework with a number of defined levels of capability against which an organization's current position can be assessed objectively; it also defines the next level of capability to which the organization can aspire, creating an improvement target for development programs (Hillson, 2003).

A PMMM can be a roadmap showing an organization how it can systematically move to more mature levels of efficiently (Crawford, 2002). PMMMs identify organizational strengths and weaknesses, in addition to providing benchmarking information (Jugdev & Thomas, 2002). PMMMs provide a common set of process requirements that capture successful practices and practical knowledge in a format that can be used as a guide in setting priorities (Ahern et al., 2008). In general, Crawford (2002) put forward the following benefits of using PMMM in an organization:

- Determining the maturity of the organization's project management processes
- Mapping out a logical path to improve the organization's processes
- Setting priorities for short-term process improvement actions
- Tracking progress against the organization's project management plan
- Building a culture of project management excellence

PMMMs can also be used as a basis for comparing different organizations. Crawford (2002) remarked that any model selected to measure project management maturity must devise s way for progressive development or improvement. That is, pointing what specific actions should be implementing to move the organization forward.

The PMMM's assessment methods can be "continuous" and "staged" models. The continuous model establishes a baseline for an organization through an assessment: specific elements are then used as criteria to establish what to be improved and at what rate (Cleland & Ireland 2002). The staged model uses a 5-step model that establishes criteria for each step where each is considered essential to project maturity and given similar weight for improvements (Cleland & Ireland 2002). Pasian (2011) found out that most PMMMs use the staged method model. The various models will be briefly discussed in the "Review of different PMMMs" subsection.

2.1.5.2 Project Management Maturity Levels

Jugdev & Thomas (2002) cited the statement of Dinsmore (1998), "Companies demonstrate behaviors that reflect their maturity levels." As Paulk et al. (1993) described it, a maturity level is a well-defined evolutionary plateau towards achieving mature processes and each maturity level, comprising a set of process goals, provides a foundational layer for continuous process improvement. Hence, achieving each level

of the maturity framework results increment in the process capability of the organization (Paulk et al., 1993). The levels also help an organization prioritize its improvement efforts (Cooke-Davies & Arzymanow, 2003).

Most of the maturity models are based on the assumption that organizations progress through five stages of maturity adapted from the pioneer CMM model: initial level (where no established PM practices exist), repeatable level, defined level, managed level and optimizing level (where the company is fully mature) (Cooke-Davies & Arzymanow, 2003; Pretorius, et al., 2011). Grant & Pennypacker (2006) argue that there is no empirical support to assume that the effort and change required to progress from level 1 to level 2, is the same as that required to progress from level 2 to level 3, or any subsequent levels; which makes the difference between the levels of maturity non uniform. The authors, therefore, used the median computation for maturity level assessment in their study. Their study is summarized in the "Empirical Review" section.

Wysocki (2004) observed that level 3 is the transition between having a documented process and having all project teams using the process. Level 3 defines project management process practice (PP) level maturity; level 2 defines project management process definition (PD) level maturity; levels 1, 4, and 5 define both PD and PP level maturity (Wysocki, 2004).

In line with Grant & Pennypacker (2006), Cooke-Davies & Arzymanow (2003), defined the five levels as an ordinal scale for measuring the maturity of a process. According to Kerzner (2001), the five levels enable repeatability in terms of assessments and permit a measurement of progress over time; they also portray a firm's evolution from immature PM practices to solid practices. Hence, a progressive increase in maturity levels mostly needs major changes in any organization, which usually happens gradually (Crawford, 2002; Jugdev & Thomas, 2002). Generally, assessing Project Management Maturity level of an organization points out how good the organization is at managing its projects.

The maturity level for an organization is usually determined by a questionnaire and/or by conducting various in-depth interviews with relevant personnel; it can also be determined by collecting evidences/artifacts of using project management methods

and/or techniques, which are compared to outlined standards (Crawford, 2002; Jugdev & Thomas, 2002; Kerzner, 2001; PMI, 2003).

2.1.5.3 Limitations of PMMMs

Several criticisms and shortcomings of the PMMMs have been raised by different practitioners and researchers. However, many authors regard the criticisms by Jugdev & Thomas (2002) as the most thorough and critical ones, some of which are presented below:

- PMMMs emphasize explicit knowledge that can be codified and transferred readily, but they do not assess implicit knowledge or the organization's intangible assets (Jugdev & Thomas, 2002)
- PMMM assets are tangible, they are in the form of templates, documents, manuals, surveys or guidelines. They focus on the know-what within the firm, and moving to the next higher maturity level does not take the know-how into account (Jugdev & Thomas, 2002)
- PMMMs are not flexible when flexibility is needed for change management and in keeping with quality improvement principles (Jugdev & Thomas, 2002)
- PMMMs are usually oriented in identifying problems and increasing awareness but not solving problems (Jugdev & Thomas, 2002)
- The five maturity levels don't provide enough granularity in measuring progress over time (Jugdev & Thomas, 2002)
- With their emphasis on standard project management bodies of knowledge, they can be overly disciplinary, impractical and overwhelming as methodologies (Jugdev & Thomas, 2002)
- From a theoretical perspective, the field of PMMMs lacks empirical support for determining which competencies contribute most to project success (Jugdev & Thomas, 2002)
- PMMs are not difficult to imitate and do not lead to a sustained competitive advantage, rather they mostly lead to competitive parity or temporary competitive advantage (Jugdev & Thomas, 2002)

In line with Jugdev & Thomas (2002), (Pretorius et al., 2011; Labuschagne & Marnewick, 2009; and Isaacs, 2018) also argue that there is lack of empirical evidence that associates success with achieving a specific maturity level. Moreover, Andersen & Jessen (2003) added that there is missing standardization among different PMMMs and assessments are vulnerable to a frequent subjective bias. Whereas, Hillson (2003) observed that the complex structure of PMMMs can make assessments

difficult to perform, interpret and implement. In addition, Yimam (2011) found two major limitations in PMMMs, which are: the bunching of project management practice maturity with process maturity, and neglecting the "Practice Maturity" dimension in the assessments.

Despite the aforementioned shortcomings, many authors believe that PMMMs have made a significant contribution to the field. According to Jugdev & Thomas (2002), PMMMs have heightened awareness on competences and offer an initial paradigm with which to assess organizations and their project management maturity.

2.1.6 Review of Different Project Management Maturity Models

Beginning to be developed in the 1990s, PMMMs of more than 30 are currently available (Grant & Pennypacker, 2006). In his PhD dissertation, Paisan (2011) listed 54 different maturity models, of which 11 were PMMMs. The majority of PMMMs are based on the Capability Maturity Model (CMM) comprising of five distinct levels. Most of them use project management body of knowledge for the maturity assessment. The following PMMMs are reviewed in this subsection:

- Capability Maturity Model (CMM)
- Capability Maturity Model Integrated (CMMI)
- Kerzner's Project Management Maturity Model (K-PMMM)
- PM Solutions' Project Management Maturity Model
- Organizational Project Management Maturity Model (OPM3)
- Project Management Process Maturity Model (PM2)
- Hillson's Project Management Maturity Model (ProMMM)

2.1.6.1 Capability Maturity Model (CMM)

The Software Engineering Institute (SEI) at Carnegie Mellon University developed the first project management maturity model (PMMM) called the Capability Maturity Model. The development of CMM began in 1987 and the initial version was released in 1991. The model was initially developed to evaluate software contractor's capability in contract awarding and administration purposes, it was then used for

improvement of software development processes and extended for implementation in other areas as well. The model comprises of five maturity levels for evaluating 18 process areas, 52 objectives, and over 300 key practices (Paulk et al., 1993; Sarshar et al., 1999).

The characteristics of each maturity level of CMM are discussed as follows:

Level 1 (Initial): The processes are generally characterized as ad hoc, and sometimes chaotic. Only few processes are defined, and success is dependent on individual effort. The organization typically doesn't provide a conducive environment for developing and/or maintaining software. Planned procedures of projects are abandoned during crisis. Success depends entirely on having effective project team or an exceptional manager (Paulk et al., 1993).

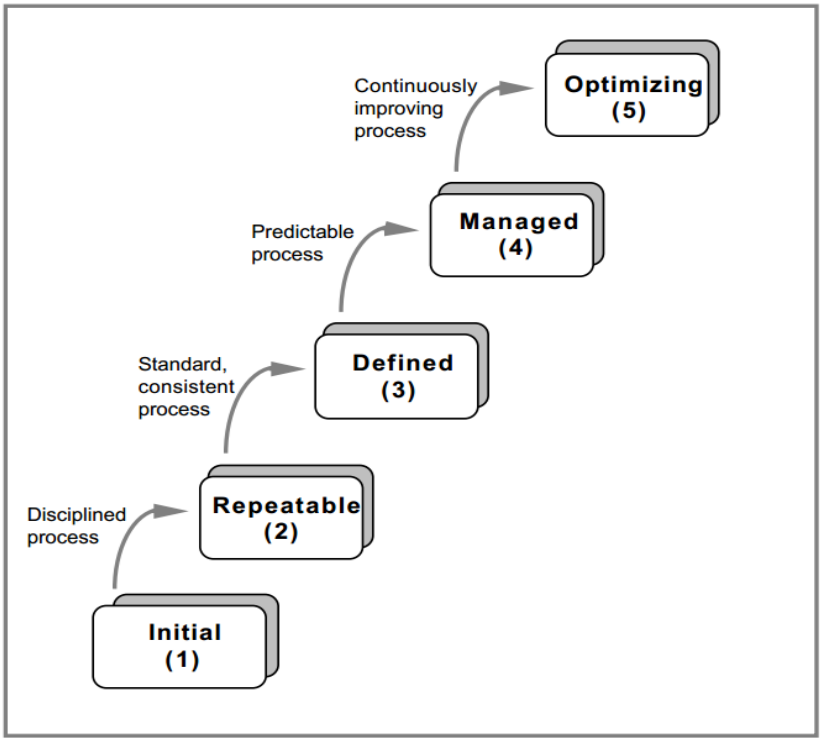
Level 2 (Repeatable): Basic PM processes are established to track functionality schedule, and cost. There is a necessary process discipline to repeat earlier successes on similar projects. Policies are established for managing projects with procedures to implement the policies. New projects are planned and managed based on experience with similar prior projects. Institutionalizing effective management process is an objective in achieving this level. An effective process can be characterized as trained, practiced, documented, enforced, measured, and able to improve. The level can be summarized as disciplined because projects' planning and tracking are stable and prior successes can be repeated (Paulk et al., 1993).

Level 3 (Defined): There is a standard software process for the organization in which management and engineering activities are documented, standardized, and integrated. All projects use an approved and tailored version of standard software process for development and maintenance in the organization. The level can be summarized as consistent and standard because of the stable and repeatable software engineering and management activities (Paulk et al., 1993).

Level 4 (Managed): There is a collection of product quality and detailed measures of organization's software process. Quantitative understanding and controlling exist for the software process and products. An organization-wide database of software process is used to collect and analyze data from defined software processes of projects. Well-defined and consistent measurements are applied to software processes. The level can

be summarized as predictable because there is a measured process operating within measurable limits (Paulk et al., 1993).

Level 5 (Optimizing): Continuous process improvement is enabled by a quantitative feedback from the process as well as from piloting innovations. There is a means to identify weaknesses and strengthen the process, with the purpose of reducing frequency of defects. The level can be characterized as continuously improving because the organization is continuously striving to improve the process capability range. Improvement typically occurs by incremental advancements (progressions) for existing process and by innovations using new methods and technologies (Paulk et al., 1993).



(Source: Paulk et al., 1993)

Figure 2-1 CMM's Five Maturity Levels

Each maturity level is decomposed into a number of key process areas indicating the areas of improvement the organization should focus on. Each key process area identifies a bunch of related activities that achieve a set of goals which are considered important for improving/enhancing process capability (Paulk et al., 1993).

2.1.6.2 Capability Maturity Model Integrated (CMMI)

Succeeding the Capability Maturity Model, CMMI was built from a combination of CMM's components of individual disciplines; it was published in 1993 and aimed for the improvement of software development processes (de Souza & Gomes, 2015; Yimam, 2011). Analyzing 135 research papers, de Souza & Gomes (2015) found that CMMI is the most frequently used project management maturity model by researchers, but applied mostly in the Information Technology industry.

The CMMI model posit two approaches: staged and continuous representation unlike the CMM that used only staged model. The staged approach provides the improvement path for organizations by defining the order for each process area implementation at maturity levels ranging from the initial level to optimizing level. Whereas, the continuous representation, unlike the staged one, provides a flexible approach to progressive improvement of processes by allowing an organization to choose specific process areas for improvement. Consequently, the organization can improve different processes at varying rates (Ahern et al., 2008; Yimam, 2011).

The continuous representation model has 6 capability levels defined by Generic Goals. The Generic Goals are in turn organized by Generic Practices. In similar manner, each process area is defined by Specific Goal and Specific Practices. A process area attains a certain capability level when it achieves all the specific goals within the process area and the generic goals of the corresponding capability level (Ahern et al., 2008).

Table 2-1 summarizes the description for each level

Table 2-1 Summary of CMMI's Capability Levels

Capability Level	Description
Level 0: Incomplete Process	A process that is partly performed or not performed at all. A specific goal/s of a process area is/are not met.
Level 1: Performed Process	A process that accomplishes/completes the works needed to obtain work product. Specific goals defined for each process area are satisfied.
Level 2: Managed Process	A performed process having the basic tools to support the process. It is planned and executed according to policy; involves relevant stakeholders; includes skilled people producing controlled outputs; and is evaluated whether it adheres to its process description.
Level 3: Defined Process	A managed process that is tailored in accordance with the set of standard processes of the organization; has maintained process description; and contributes process improvement information.
Level 4: Quantitatively Managed Process	A defined process which is quantitatively or statistically controlled. Attributes such as product & service quality, and process performance are controlled and measurable throughout projects. The sub processes are also statistically managed.
Level 5: Optimizing Process	A quantitatively managed process that is adapted to satisfy business objectives. It focuses on innovative and incremental improvements for process performance. Improvement of processes addressing problems such as common causes of process variation and defects, are identified, and evaluated. The improvements are chosen with a basis of quantitative understanding of their speculated contribution to meet improvement objectives and compared against their corresponding cost and impact.

(Source: Summarized from Yimam (2011))

2.1.6.3 Kerzner's Project Management Maturity Model (K-PMMM)

K-PMMM was developed by Harold Kerzner. The model is briefly discussed in his book published in 2001. Like most of the maturity models, K-PMMM is made up of five levels of maturity. Kerzner (2001) described the characteristics of the maturity levels along with roadblocks, risks and actions needed to accomplish each level. Moreover, at the end of each maturity level discussion, an assessment instrument is included. The assessment technique differs for each level. The maturity levels of K-PMMM are summarized below:

Level 1 (Common Language): The organization recognizes the need and importance of PM and understanding its basic knowledge as well as its language or terminology. Characteristics include: No executive-level support; Sporadic use of PM Virtually; No attempt to recognize the benefits of PM; No investment in PM training and education. Completion of this level is based upon gaining a knowledge of the fundamental principles of PM (Kerzner, 2001).

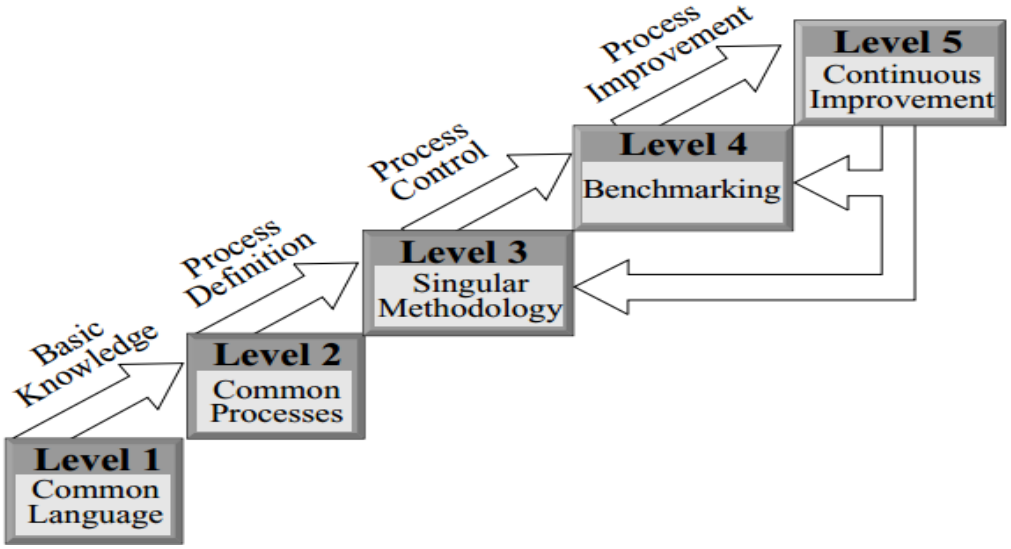
Level 2 (Common Processes): The organization recognizes the need for common processes definition and development such that one project's success can be repeated on others. Characteristics of this level include: Organizational support at all levels; Recognition of benefits of PM; Recognition of need for processes and/or methodologies; Acknowledgment of the need for controlling cost; Development of a PM training plan (Kerzner, 2001).

Level 3 (Singular Methodology): The organization gives recognition to the synergistic importance of consolidating methodologies in to a singular methodology within the organization, with project management being the center. Characteristics include: processes are integrated into one process incorporating all other processes; cooperative culture; management support at all levels; guidelines and checklists, rather than rigid policies and procedures, are a basis for the singular methodology; financial benefits from PM training; behavioral excellence (Kerzner, 2001).

Level 4 (Benchmarking): The organization recognizes that process improvement is necessary in the organization in order to maintain a competitive advantage. Benchmarking must be continuously performed by the company, after deciding whom and what to benchmark. Characteristics include: establishment of a project office; dedication to benchmarking with the performance of qualitative and quantitative benchmarking (Kerzner, 2001).

Level 5 (Continuous Improvement): The organization continuously evaluates the information gained by the benchmarking process and decides whether or not the information strengthens the singular methodology developed. Characteristics include: creation of lessons learned files at the end of projects; learned knowledge transfer to other projects and project teams through Project Office; a corporate-wide

understanding that strategic planning for PM is a continuous and ongoing process (Kerzner, 2001).



(Source: Kerzner, 2001)

Figure 2-2 K-PMMM's Five Levels of Maturity

2.1.6.4 PM Solutions' Project Management Maturity Model

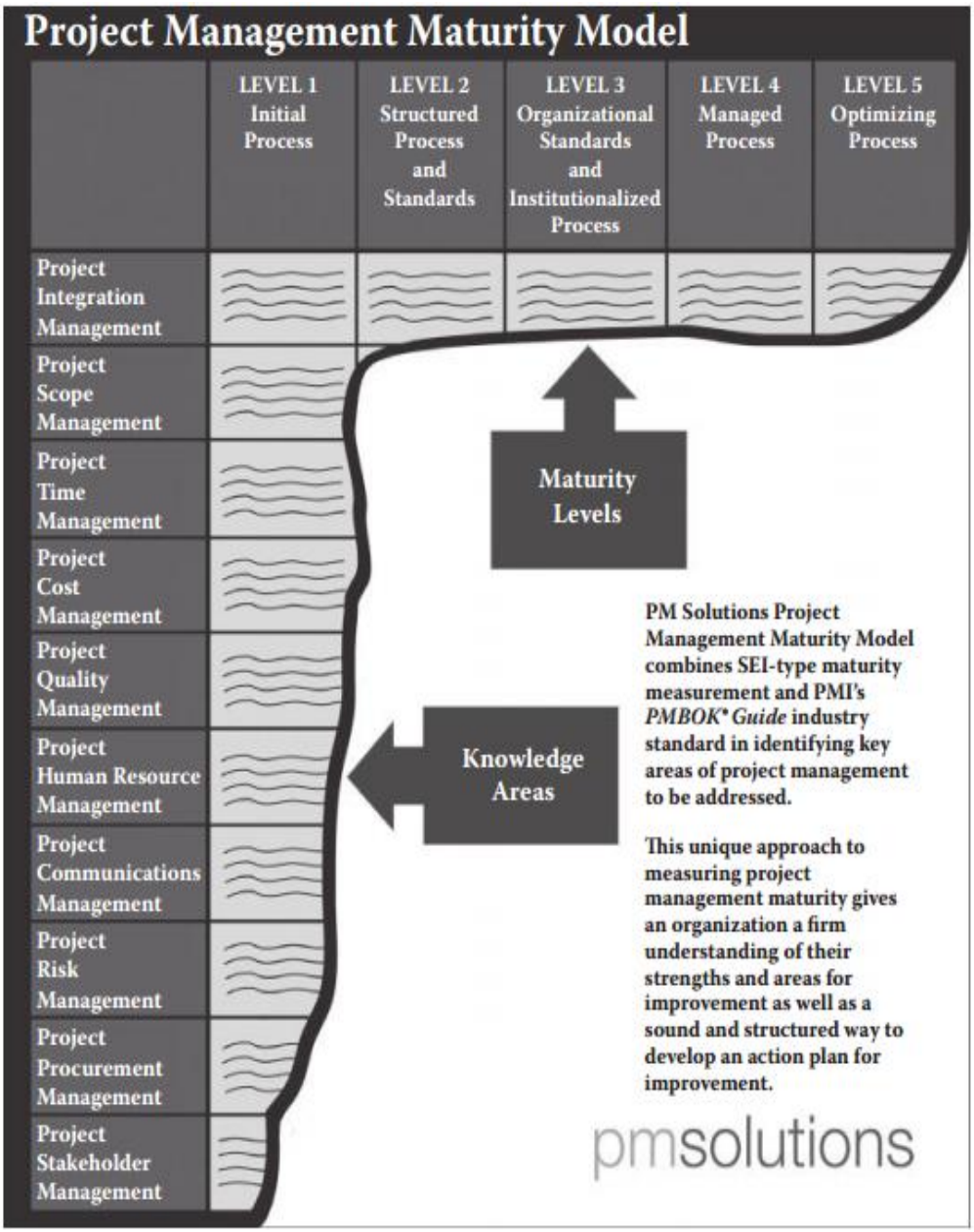
Crawford (2002) developed the PM Solutions' PMMM in 2002. The model is based on the combination of PMBOK's knowledge areas and CMM's five levels of maturity (see figure 2-3). Each knowledge area is first broken down into key components. Hence, the real measurement of maturity takes place on these components and will be summarized to the corresponding knowledge area. In addition, there were three areas where the model has found significant influence on adapting project management practices. These are management oversight, project office, and professional development. Regarding assessment, the model suggested that any thorough assessment would include the following: personal or group interview; artifact collection and evaluation; widespread survey input; benchmark comparison to established standards (Crawford, 2002).

The book by Crawford (2002) incorporates detailed descriptions of the components of knowledge areas for each maturity level. The general descriptions of the maturity levels are summarized in the table below.

Table 2-2 Summary of PM Solutions' Maturity Levels

Maturity Level	Key Attributes
Level 1: Initial Process	✓ Ad hoc processes ✓ Management awareness for the need of project management ✓ No established practices or standards & loose documentation
Level 2: Structure Process and Standards	✓ Basic processes; not standard on all projects; used on large projects ✓ Management supports and encourages project management use ✓ Mix of intermediate and summary-level information ✓ Estimates, schedules based on expert knowledge and generic tools ✓ Mostly a project-centric focus
Level 3: Organizational Standards and Institutionalized Process	✓ All processes, standard for all projects, repeatable ✓ Management has institutionalized standards and processes with formal documentation. ✓ Summary and detailed information ✓ Baseline and informal collection of actuals ✓ Estimates, schedules may be based on industry standards and organizational specifics; ✓ More of an organizational focus ✓ Informal analysis of project performance
Level 4: Managed Process	✓ Processes integrated with corporate processes ✓ Management mandates compliance ✓ Management takes an organizational entity view ✓ Solid analysis of project performance ✓ Estimates, schedules are normally based on organization specific ✓ Management uses data to make decisions
Level 5: Optimizing Process	✓ Processes to measure project effectiveness and efficiency ✓ Processes in place to improve project performance ✓ Lessons learned are regularly examined and used to improve project management processes, standards, and documentation ✓ Management focuses on continuous improvement

(Source: Crawford, 2002)



(Source: Crawford, 2015)

Figure 2-3 PM Solutions' PMMM

2.1.6.5 Organizational Project Management Maturity Model (OPM3)

OPM3 was developed in 2003 by the Project Management Institute (PMI). Similar to the PM Solutions' model, OPM3 is comprised of three elements: knowledge, assessment, and improvement. The knowledge element presents the contents of the standard; the assessment part provides a method for comparison with the standard; and the improvement element sets the stage for possible changes in the organization

(PMI, 2003). The standard lets organizations understand the organizational project management and helps in measuring their maturity against a comprehensive set of Best Practices of organizational project management (PMI, 2003).

Unlike other PMMMs, the progression of increasing maturity designed in this model comprises of several dimensions, meaning that organization's maturity is looked from different ways. One dimension is viewing the Best Practices in terms of their association with process improvement progressive stages (PMI, 2003), which are:

- Level 1: None – such practice doesn't exist
- Level 2: Standardize – standardized processes in the organization have been communicated and documented, but the practices are used only for few projects.
- Level 3: Measure - standardized processes in the organization are used by all the projects and effectiveness is evaluated by measuring processes.
- Level 4: Control – a correction of measured process for poor standardized practice application exists. Process is analyzed by establishing upper and lower limits.
- Level 5: Improve – there exists a continuous improvement of processes.

Other dimensions for the progression of increasing maturity of OPM3 include:

- The progression of the Best Practices associated with the three domains: Project Management, Program Management, and Portfolio Management (PMI, 2003).
- Incremental Capabilities progression leading to each of the Best Practices (PMI, 2003).
- Association of capabilities with the five project management process groups, which are, Initiating, Planning, Executing, Controlling, and Closing process groups (PMI, 2003).

Hence, the model was designed without a general system of maturity "levels" as the progression of maturity is multi-dimensional and cannot be established straight-forward. Maturity is assessed and reported as percentage of best practices through the entire dimensions. Multiple perspectives or dimensions for assessing maturity level allow flexibility in the model's application to unique needs of a given organization; it also provides a more rigorous body of information compared to that of a simpler and

linear system of levels, supporting decisions and plans for improvement by giving the organization a greater detail (PMI, 2003).

The steps for measuring maturity in PMI's OPM3 framework cycle can be summarized as follows:

- **Acquire Knowledge** – involves preparation for assessment of project management maturity and comprehending the contents of OPM3 and understanding the organization for its project management practices (PMI, 2003).

- **Perform Assessment** – all the data needed are gathered for measuring the maturity assessment. The data results are put in graphs depicting the maturity level of the organization for project management, program management and portfolio management. The self-assessment questionnaire contains 151 questions (PMI, 2003).

- **Manage Improvements** – the results from the previous stage are compared against the best practices standard of project management, program management and portfolio management. A set of best practices are defined for the purpose of comparing and improving. The result of comparison of existing practices against best practices allows the organization to devise improvement recommendations (PMI, 2003).

- **Repeat the Process**

2.1.6.6 Project Management Process Maturity Model (PM2)

The PM2 model was developed by Young Kwak and William Ibbs in 1997 first and later updated in 2002. The model was developed by integrating previous maturity models that measure PM levels across different industries. Like most of other PMMMs, this model constitutes five levels of maturity. Similar to PM solutions' maturity model, PM2 model breaks PM processes and practices into PMBOK's PM knowledge areas. Along with the knowledge areas, the model also further incorporates the five PM processes to assess and evaluate organization's PM maturity. The maturity model questionnaire consists of 148 multiple choice questions covering the knowledge areas and PM processes (Kwak & Ibbs, 2002).

Each maturity level's key PM processes, organization's characteristics, and focus areas are summarized from Kwak & Ibbs (2002) as follows:

Table 2-3 Summary of the PM2 Model

Maturity Level	Key PM Processes	Major Organizational Characteristics	Key focus areas
Level 1: Ad-hoc	PM processes or practices are not available in a consistent manner. PM data are not collected or analyzed in a consistent manner.	Functionally isolated and no senior management support Project success is dependent on individual efforts	Understanding and establishing of basic PM processes.
Level 2: Planned	PM process definition, PM problem identification and PM data collection are informal.	Weak teamwork Organizations possess strengths in performing similar work	Individual project planning.
Level 3: Managed at Project Level	Project planning and controlling systems as well as PM data are managed formally.	Medium team work Training of PM practices and skills are informal	Structured project planning and controlling for few projects.
Level 4: Managed at Corporate Level	Multiple program management. PM processes and data are integrated, quantitatively measured, analyzed, and stored.	Strong teamwork PM training for project team is formal	Professional planning and controlling in multiple projects.
Level 5: Continuous Learning	A continuous improvement and full understanding of PM processes. An optimized and sustained PM data	Project driven organization. Dynamic, and energetic organization. Continuous improvement of PM practices and processes.	Innovative ideas to improve PM practices and processes.

(Source: Kwak & Ibbs, 2002)

2.1.6.7 Hillson's Project Management Maturity Model (ProMMM)

ProMMM was developed by David Hillson in 2001. Like most of the PMMMs, this model adopts established concepts from CMM and other models. The majority of the models discussed in this review compare project management capability against standards, focusing on knowledge areas and process groups. ProMMM focuses on additional elements that contribute to project management capability, which includes vital areas of organizational culture, practical issues of implementation, and human aspects such as skills and experience levels. Regarding assessment, the model allows

highlighting of key strengths and weaknesses for further attention, and covers a several performance indicators within its hierarchical structure (Hillson, 2003).

The ProMMM, unlike most PMMMs, describes four levels of increasing PM capability, termed as Naïve, Novice, Normalized and Natural. Each ProMMM level is defined in terms of 4 attributes: culture, process, experience and application. The maturity levels defined by the model are summarized as follows:

Level 1 – Naïve: The attributes are at the lowest level; the need for PM is not recognized and the culture has resistance to change. There are no PM processes, as well as no experience of using and applying project management (Hillson, 2003).

Level 2 – Novice: The organization at this level is not fully convinced of PM benefits and may consider it as an overhead. PM processes are ad hoc, and their effectiveness is dependent on the experience of few employees presumably having little prior formal training. PM application is not consistent (Hillson, 2003).

Level 3 – Normalized: The organization has Normalized PM into its way of operating, along with a culture recognizing the importance of projects and expects to be benefited from the proper management of them. Generic as well as formal processes are in place. Necessary resources are available, and the project team is equipped with enough experience to practice an effective project management. There is routine and consistent project management application across all projects (Hillson, 2003).

Level 4 – Natural: The organization is driven by a project-centric culture into proactive project management which seeks to obtain the maximum advantages of the dynamic business conditions. There is an implementation of best practice processes, with active lesson learning and regular updating from prior projects. The project team, in its entirety, has experiences of implementing PM processes in assisting tasks, and PM application is widespread across all areas (Hillson, 2003).

2.1.6.8 Selection of a PMMM

The variety of PMMMs has made the choice between them somehow difficult. As depicted in the "Empirical Review" section, different researchers used different PMMMs. Khoshgoftar & Osman (2008) used 21 variables (based on definition of maturity, factor and characteristics of the models, role and function of the models, and definition of PM) to compare PMMMs. The researchers found OPM3 to be the most robust PMMM by their criteria. Whereas, the likes of (Labuschagne & Marnewick, 2009) used a maturity model that was a combination of different maturity models.

This research aimed to measure the project management maturity of a company through the assessment of knowledge areas provided by the Construction Extension of the PMBOK's Guide. OPM3, PM2 and PM Solutions' model provide this knowledge area dimension for the maturity assessment. However, OPM3 is a multidimensional model which uses 4 dimensions for maturity progression. This would raise scope issues for the research and hence, the model was not chosen despite its robustness. The PM2 model provides two dimensional approach (knowledge areas and project processes) having limited descriptions of the maturity levels for each knowledge area and its components. As a last option, we get the PM Solutions' PMMM. The model is a single-dimensional one but depicts detailed maturity level descriptions for each knowledge area as well as its components, and is relatively easy for executing the assessment. Thus, the PM Solutions' PMMM was selected for this research.

Table 2-4 Comparison of Maturity Levels of PMMMs

Lev	**Project Management Maturity Models**						
	CMM	**CMMI**	**PM Solutions'**	**K-PMMM**	**OPM3**	**PM2**	**ProMMM**
1	Initial	Performed Process	Initial Process	Common Language	None	Ad-hoc	Naive
2	Repeatable	Managed Process	Structure Process & Standards	Common Processes	Standardize	Planned	Novice
3	Defined	Defined Process	Organizational Standards & Institutionalized Process	Singular Methodology	Measure	Managed at Project Level	Normalized
4	Managed	Quantitatively Managed	Managed Process	Benchmarking	Control	Managed at Corporate Level	Natural
5	Optimizing	Optimizing Process	Optimizing Process	Continuous Improvement	Improve	Continuous Learning	-

(Source: Own Summary)

2.2 Empirical Review

In this section, different studies regarding assessment of project management maturity of organizations are reviewed.

Yimam (2011) conducted an extensive research on project management maturity in the construction industry taking the case of Ethiopian contractors. The researcher used 40 grade-I contractors as a research sample, among which 32 were local contractors (including YOTEK Construction PLC) and 8 were international. Unlike other researchers, the author proposed a new maturity assessment model that aimed to fit with the context of developing countries. The new model (modified from CMMI) consisted of two dimensions of maturity, namely: "Practice Maturity" and "Process Maturity." Using the proposed framework, the assessment showed that the PM process maturity and practice maturity of the Ethiopian grade-I contractors were at low level, 1.3 and 0.99 respectively. Yimam (2011) also found that the knowledge areas of time, procurement, cost, financial, material and HR management had shown comparatively higher maturity than other PM knowledge areas. Furthermore, the researcher found out that the PM maturity of road contractors is higher than that of building contractors, 1.75 and 1.15 respectively.

A study conducted by Kwak & Ibbs (2000), which required 2 years to complete, used the PM2 maturity model to assess the project management maturity of 38 companies across different industries. 15 of the companies were Engineering-Construction firms. The assessment framework consisted 148 questions covering 8 knowledge areas and 6 project phases of the PM life cycle (Project-driven Organization Environment was a phase added by the authors apart from the commonly known 5 phases). Integrating the maturity of the 6 project phases makes the research unique from other empirical researches reviewed in this section. (Ofori & Deffor (2013) used the 5 project phases of the PM life cycle as a basis to assess the maturity of organizations without using the PMBOK's knowledge areas). Kwak & Ibbs's (2000) PM maturity assessment for all companies averaged 3.26. The Engineering-Construction industry had the highest score (3.6), and the Information Systems application area has the lowest (3.06). Risk Management and the Project Execution Phase are areas of low maturity and Cost Management and the Project Planning Phase were areas of high maturity. The researchers also found out that an average of 6% of project costs is expended on PM

services. In contrary to Kwak & Ibbs, the Software Project Management studies by Sukhoo et al. (2005) and Labuschagne & Marnewick (2009) revealed that the Initiating phase had the least maturity level, while the Controlling phase was the highly matured one.

Grant & Pennypacker (2006) provided a benchmarking survey of project management maturity over various industries. A total of 126 organizations in 17 different industries were included in the survey and PM solutions maturity model was used as a framework for assessment. In contrast to other empirical studies reviewed in this section, Grant & Pennypacker (2006) treated the maturity levels as ordinal level, rather than interval level. Thus, the research relied on medians and proportions, rather than computing mean levels of maturity. According to the authors, the ordinal level treatment was used because there was no empirical support to assume that the effort and change required to progress from level 1 to level 2, is the same as that required to progress from level 2 to level 3, or any subsequent levels. The research used 42 components of PMBOK's 9 knowledge areas for comparison of maturities across the industries. The findings indicated that the median project management maturity across industries was level 2 (out of 5) in 36 of the 42 components. One component (change control component of project integration management) had median maturity of level 3. Project Risk Management was the least matured of all knowledge areas. The research also made comparisons across 4 industries, (Professional, Scientific & Technical services, Information, Finance & Insurance, and Manufacturing) and only three component areas were found to have a statistically significant difference. Hence, the researchers concluded that there is a high consistency of project management maturity among industries with limited number of exceptions.

PM Solutions (2014) also conducted a benchmarking survey across multitude of industries in the world. Project management maturity of 293 organizations were assessed. The research found that there is a significant correlation between the PM maturity of an organization and its overall performance. Moreover, the authors concluded organizations see significant value by increasing their PM maturity level. The research also found an average level of 2.5 for the organizations. The organizations are generally most mature in project integration management with a score of 2.7 and least mature in project risk management with 2.3.

Similarly, Mateen (2015) found that project management maturity in an organization has a direct and significant impact on its project performance after studying a company found in Pakistan. OPM3 maturity model was used as a framework for the assessment. Justifications for using OPM3 were described and a framework for comparison of the maturity models was established before selecting the model. The finding of the study showed that the company had a maturity level of 2.51. Project time management was the highest matured knowledge area; whereas Project risk management was the least matured one.

A study by Yazici (2009) also investigated the relationship between maturity levels on eight PMI knowledge areas and perceived organizational performance. The study consisted of 75 US companies mostly from service industries. Overall maturity was found to be 2.27. It was also shown that with higher project maturity, organizations can achieve substantial savings, show better competitiveness, and increase sale growth compared to competitors and best practices in their industry. Consistent with (Yazici, 2009; Mateen, 2015; PM Solutions, 2014), a survey of 200 respondents in 30 countries conducted by PricewaterhouseCoopers (PWC, 2004) concluded that as an organization's project management maturity increases, the positive impact on overall project performance increases.

Gorecki (2015) summarized the findings of construction project maturity assessments done by the "Deloitte's" researchers. The survey included 39 polish construction companies and an overall maturity level of 3.4 was found. Project safety management displayed the highest degree of maturity, followed by project quality, procurement, and financial management knowledge areas. Project communication management was the least matured knowledge area that the companies were capable to deal with.

Pretorius et al. (2011) studied the project management maturity of 255 South African engineering and construction industries. CMM was used as a framework and the average maturity level was found to be 2.88. The paper also investigated the relationship between PM maturity and project success in the industries. In contrary to the findings of (PM Solutions, 2014; Mateen, 2015; Yazici, 2009; Schiltz, 2003; PWC, 2004), the study failed to establish any statistical correlation between project management maturity and the perceived outcome of the projects. The authors came to a conclusion that higher project management maturity does not automatically lead to

project success and projects can be successful irrespective of the maturity level of the organization. This statement is in line with the findings and conclusion forwarded by Labuschagne & Marnewick (2009).

A study by Isaacs (2018) also surveyed 108 project managers in South Africa to investigate the impact of project maturity on project performance. The study revealed that there is a relationship between some of project management knowledge areas and project success. However, the author concluded, the relationship doesn't appear to be as strong as would be expected as most of the positive correlations found were low to moderate.

Moutawei et al. (2017) surveyed construction contractors in Egypt to assess their PM maturity. A total of 116 respondents from different construction contractors participated in the survey. The authors came into conclusion that Egyptian contractors are generally not aware of the importance and value of PMMMs for appraisal and improvement of project management practices. Furthermore, the study indicated that the organizations were not formally using any international project management methodologies or standards. Using the PM2 framework, the average maturity level of the organizations was found to be 1.44. Most of the knowledge areas have a score above level 1 except for project risk management.

Weldemariam (2013) used the PM solutions PMMM to assess the maturity of an Ethiopian organization, "Mesfin Industrial Engineering PLC." Findings from the assessment indicated that, the overall project management capability of the organization is at maturity level 2. The results indicated that some project management processes were defined but not consistently applied to all projects. Project scope, time, and cost management knowledge areas, with maturity level of 2.5, 2.3 & 2.3 respectively, showed higher maturity compared to other knowledge areas. Whereas, the remaining knowledge areas were below level 2.

The 15 studies reviewed are summarized in table 2-5.

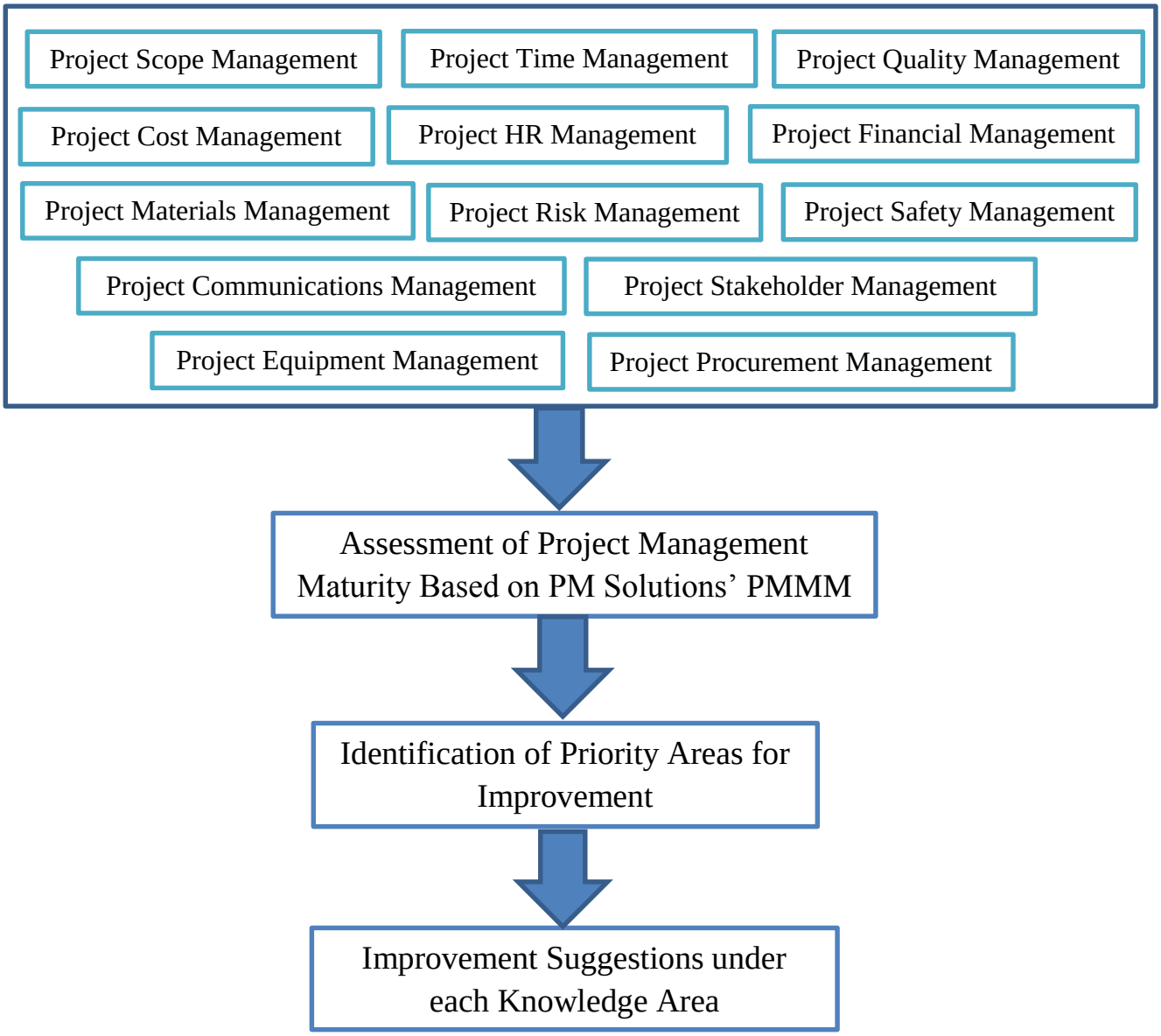
Table 2-5 Summary of Studies Reviewed

Researcher	Area of Research	PMMM Used	Average Maturity Level	Knowledge area with highest maturity	Knowledge area with lowest maturity
Gorecki (2015)	Construction	Modified from CMM	3.4	Project Safety Management	Project Communication Management
Grant & Pennypacker (2006)	Different Industries	PM Solutions	2	Project Integration Management	Project Risk Management
Isaacs (2018)	Different Industries	Modified from PM Solutions	3.7	Project Cost Management	Project Risk Management
Kwak & Ibbs (2000)	Different Industries	PM2	3.26	Project Cost Management	Project Risk Management
Labuschagne & Marnewick (2009)	Software	Combination of different models	3.61	Project Time Management	Project Risk Management
Labuschagne et al. (2013)	Construction	Combination of different models	3.06	Project Procurement Management	Project Risk Management
Mateen (2015)	Manufacturing	OPM3	2.51	Project Integration Management	Project Stakeholder Management
Moutawei et al. (2017)	Construction	PM2	1.44	Project Quality Management	Project Risk Management
PM Solutions (2014)	Different Industries	PM Solutions	2.5	Project Integration Management	Project Risk Management
Pretorius et al. (2011)	Engineering & Construction	CMM	2.8	Project Time Management	Project Risk Management
Sukhoo et al. (2005)	Software	CMM	2.29	Project Scope Management	Project Risk Management
Weldemariam (2013)	Electro Mechanical	PM Solutions	1.8	Project Scope Management	Project Risk Management
Yazici (2009)	Different Industries	PM Solutions	2.27	Project Quality Management	Project Risk Management
Yimam (2011)	Construction	CMMI	1.16	Project Time Management	Project Safety Management
Girma (2015)	Electric Power	PM Solutions	3	Project Cost Management	Project Stakeholder Management

(Source: Own Summary)

2.3 Conceptual Framework

Based on the reviewed literature, this research aimed to assess project management maturity of YOTEK Construction PLC as follows. First, maturities of components (processes & practices) of each PMBOK's knowledge area were investigated to find the maturity level of the corresponding knowledge area. The maturity levels of the knowledge areas were aggregated to find the organizational maturity. Then, priority areas or gaps on PM practices were identified. Finally, suggestions for improvement under each knowledge area were provided based on the assessment.



(Source: Own Development)

Figure 2-4 Conceptual Framework

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses issues related to the research methodology employed to assess the project management maturity level of YOTEK Construction PLC. It presents the research approach and research design used by the study along with the population and sampling issues, which define the target population and sample frame as well as discuss the sample size and technique used in sampling with plausible justifications. Moreover, data analysis method, data collection methodology and instrument of the research are explained. The scale validity and reliability of the instrument are also justified. Finally, ethical considerations of the research are presented.

3.2 Research Approach

This research has used the mixed research approach. Mixed method research is an approach involving both quantitative and qualitative data. Specifically, the "Embedded Design Mixed Method" was used in this study in which one data set provides a supportive and secondary role in a study primarily based on the other data type (Creswell & Plano Clark, 2011). Accordingly, the quantitative approach was mainly used to collect and analyze the relevant numbered data statistically, while qualitative approach was used to strengthen the quantitative approach. Hence, the qualitative component was embedded in the quantitative approach. The combination of qualitative and quantitative approaches provides a greater overall strength of a study than either approach alone (Creswell, 2014). A questionnaire survey was used to collect data quantitatively; whereas, a qualitative method of document review was used for supporting the survey.

3.3 Research Design

According to Kothari (2004), the research design is a conceptual structure within which research is conducted; it constitutes the blueprint for the collection,

measurement and analysis of data. There are various research designs, among which is descriptive research study. This type of research study is concerned with describing the characteristics of a particular individual, or a group (Kothari, 2004). According to Bhattacherjee (2012), descriptive research is directed at making detailed documentation of a phenomenon of interest.

In line with the above definitions, assessing project management maturity seeks to describe the current state of an organization with respect to project management practices. Hence, this research falls into a descriptive type research study.

Kothari (2004) remarked that the design must be rigid and not flexible; it must focus on: formulating the objective of the study, designing the methods of data collection, selecting the sample, collecting the data, processing and analyzing the data, and reporting the findings. These points are discussed in the forthcoming sections.

3.4 Population and Sampling

Bhattacherjee (2012) defines sampling as the statistical process of selecting a subset, called a sample, of a population of interest for purposes of making observations and statistical inferences about that population. The sampling process comprises stages of: defining the target population, choosing a sampling frame, and choosing a sample using a sampling technique (Bhattacherjee, 2012).

3.4.1 Target Population

Target population can be defined as the full set of cases from which a sample is taken (Saunders et al., 2009). The target population for this study were the employees of YOTEK Construction PLC, who were assumed to have a comprehensive knowledge about the corresponding project they have been assigned to. These consisted of: Project Managers, Project Office Engineers, Project Office Heads, and Project Follow-up Engineers. The total number of these key personnel were 117.

3.4.2 Sample Frame

A Sample Frame is an accessible section of the target population from where a sample can be drawn (Bhattacherjee, 2012). The Sample Frame for this study were the key personnel of YOTEK Construction PLC working in projects within the city of Addis

Ababa. Projects undertaken by the company outside Addis Ababa were not accessible due to time and resource constraints, and hence excluded. Therefore, the sample frame was composed of 63 key personnel consisting of:

- 10 Project Managers
- 40 Project Office Engineers
- 10 Project Office Heads, and
- 3 Project Follow-up Engineers

These key personnel were assigned to work across the 10 construction projects undertaken by YOTEK Construction in Addis Ababa (the projects are listed in Appendix - 2). Whereas, the Project Follow-up Engineers worked in the Head Office.

3.4.3 Sample Size

Taro Yamane's (1967) sample size determination formula was used to calculate the sample size from the sample frame. The equation is applicable for 95% confidence level and 5% margin of error. The equation is depicted below:

$$n = \frac{N}{1 + \mathrm{N}e^2}$$

Where,

n = sample size

N = Population (the sample frame in this case)

e = margin of error (0.05)

By using the above formula, and inserting the sample frame (63) into N, the sample size was found to be 55.

3.4.4 Sampling Design/Technique

A sample design is a definite plan for obtaining a sample from the sampling frame; it refers to the technique or the procedure the researcher would adopt in selecting some sampling units (Kothari, 2004). There are various sampling techniques presented by different authors, most of whom categorized the techniques into Probability and Non-

probability sampling techniques (Kothari, 2004; Bhattacherjee, 2012; Bryman, 2012; Saunders et. al., 2009).

This research used the random sampling design, specifically the proportionate stratified random sampling technique. In stratified sampling, the sampling frame is divided into homogeneous and non-overlapping subgroups which are known as strata, and a simple random sample is drawn within each subgroup (Bhattacherjee, 2012). The technique is advantageous as it ensures the resulting sample to be distributed in the same way as the population with respect to the stratifying criterion (Bryman, 2012).

The main reason to adopt this technique was to ensure all job positions of the key personnel were part of the research. Had it not been for the stratified sampling technique, key personnel such as Project Managers might not been represented well and Project Follow-up Engineers might not been selected at all randomly, as they were relatively small in numbers. This study used the job positions of the sample frame (the 64 key personnel) to construct strata. From each stratum, a sample was drawn in proportion to its corresponding stratum sample frame. Sample size for each stratum was calculated by the following formula:

$$n\ (stratum) = \frac{N(stratum)}{N\ (Total)} * n\ (Total)$$

Where, n = sample size & N = sample frame

Table 3-1 Summary of Stratum Sample Size

Stratum (Job Position)	Sample Frame	Sample Size
Project Office Engineers	40	36
Project Managers	10	8
Project Office Heads	10	8
Project Follow-up Engineers	3	3
Total	**63**	**55**

3.5 Data Collection Methodology and Instrument

Data collection can be of two types, primary and secondary. This study used primary data as a method of data collection. As Kothari (2004) described it, primary data are those which are collected for the first time, and are original in character.

A questionnaire survey was used as a main instrument to capture responses from respondents. The questionnaire was adapted from Yimam (2011) with some modifications applied from construction and project management literatures. It contained structured questions where respondents were asked to select an answer from given choices. It was comprised of three parts. The first part was a cover letter as an introduction. The second part consisted general information questions of respondents' job position, sex, work experience, and educational level. The third part contained the main project management maturity assessment tool consisting of 87 components under 13 construction project management knowledge areas. Respondents were asked to rate each component of the knowledge area from a 5 point rating scale. In order the respondents have a clear understanding of the questions, some terms and phrases were further explained. Prior researchers, such as Labuschagne & Marnewick (2009), Isaacs (2018), and Sukhoo et al. (2005) also used similar style of questionnaire for their studies.

A total of 55 questionnaires were distributed in the company's Head Office, as well as across the 10 projects undertaken by the company in Addis Ababa. The questionnaires were distributed and collected in person and through email. This process took 3 weeks to be completed. 52 questionnaires were returned, having a 94% response rate.

Furthermore, a qualitative method of document review was also used to strengthen the quantitative data. These documents were obtained from the largest construction projects undertaken by YOTEK Construction PLC, which are the AAMZLA and the AASTU construction projects. The documents reviewed in the projects include contract documents, design documents, various types of reports, risk registers, manuals and site diaries.

3.6 Data Analysis Method

Data analysis involves a number of closely related operations which are performed to summarize the collected data and organize these in such a manner that they are able to answer the research questions (Kothari, 2004). This study used descriptive data analysis methods to statistically describe, aggregate, and present the data. The data analysis was done using the SPSS Version 20 software.

Prior to the data analysis, data preparation was undertaken as per the processing operations described by Kothari (2004) & Bhattacherjee (2012), including data editing, data coding, data entry into a spreadsheet, and looking for missing values.

As the PM Solutions' model insists, the maturity level of each knowledge area was calculated by aggregating the maturity level of the components of each knowledge area. This was done by taking the mean rating of each component within a knowledge area as filled by the respondents. The questionnaire contained a five point rating scale for each component, ranging from "very low" to "very high" which represent maturity levels of level 1 up to level 5, respectively. Then, the maturity level of the organization was found by taking the mean of the maturity level of the 13 knowledge areas. In doing so, equal weight was given to each knowledge area as it was assumed that all the knowledge areas had equal contribution. Similarly, equal weight was given to the components of each knowledge area in finding the maturity level of the corresponding knowledge area. Yimam (2011) concluded that the knowledge areas had equal contribution to the overall maturity of an organization after analyzing the judgment of various practitioners and academicians.

3.7 Scale Validity and Reliability

Measuring validity and reliability are both needed to assure adequacy of the research instrument or measurement tool and in turn assure the credibility of the research (Bhattacherjee, 2012; Kothari, 2004; Saunders et al., 2009).

3.7.1 Validity

Validity is a critical criterion indicating the degree to which an instrument measures what it is supposed to measure (Kothari, 2004). Among the different types of validity,

this research assured its content validity. It is defined as the extent to which a measuring instrument provides adequate coverage of the topic under study (Kothari, 2004).

In this study's context, content validity is the extent to which the survey items (components) cover the maturity of project management in a representative and comprehensive manner. The research instrument was constructed relying on the Project Management Body of Knowledge (PMBOK) framework. Furthermore, the construction extension of the PMBOK Guide and other construction literatures were used to include additional knowledge areas in the instrument. In order to even further ensure the content validity, feedback from Project Managers and Project Office Heads was collected and incorporated in the instrument. Hence, the comprehensiveness and representativeness of the instrument to assess the project management maturity were assured.

3.7.2 Reliability

Reliability measures the degree to which a research instrument/tool yields consistent results (Bhattacherjee, 2012; Kothari, 2004). There are various statistical means of determining reliability as a range of scores can be correlated to identify their association with a desired construct (Isaacs, 2018). Internal consistency reliability is a measure of consistency between different items of the same construct (Bhattacherjee, 2012).

In this study, Cronbach's Alpha was used to determine the internal consistency reliability of the instrument with respect to each knowledge area. The test, designed by Lee Cronbach in 1951, calculates the average of all possible split-half reliability coefficients varying between 0 (meaning no internal reliability) and 1 (meaning perfect internal reliability); a measure of 0.7 can be referred as a satisfactory level (Bryman, 2012).

The calculation of the Cronbach's alpha was done by the SPSS software. Accordingly, all the knowledge areas had Cronbach's Alpha value of greater than 0.7, hence acceptable. Table 3-2 summarizes these results; while the Cronbach's Alpha when each item within a knowledge areas is deleted, is presented in Appendix – 4.

Table 3-2 Cronbach's Alpha per Knowledge Area

Knowledge Area	Cronbach's Alpha	Number of Items
Project Scope Management	0.787	4
Project Time Management	0.861	7
Project Cost Management	0.897	8
Project Quality Management	0.826	6
Project Human Resource Management	0.871	6
Project Equipment Management	0.849	6
Project Materials Management	0.853	7
Project Communications Management	0.801	5
Project Risk Management	0.892	9
Project Procurement Management	0.89	8
Project Stakeholder Management	0.91	4
Project Safety Management	0.87	8
Project Financial Management	0.888	9

(Source: Field Survey, 2020)

3.8 Ethical Considerations

In the context of research, ethics refers to the appropriateness of the researchers' behavior in relation to the rights of the participants (Saunders et al., 2009). This study has taken into account of the commonly known ethical considerations in the data collection process. First, the consent of the participants was assured before delivering the questionnaires. The purpose of the study was clearly explained in the preface of the questionnaire in order to make the respondents free of pressure while giving information. Anonymity of the respondents was guaranteed as the research instrument didn't have any section that allowed to disclose participant identity. Moreover, the information gained from the participants was kept confidential and used only for the purpose of academic research.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Introduction

This chapter includes the presentation of results as well as their interpretation and discussion. The discussion part is integrated under the result presentation of each knowledge area. The second section presents the general information of participants. The third and fourth sections present the maturity level of each knowledge area and the company; these sections answer the two research questions. The last section compares the maturity level results with industry benchmark values.

4.2 General Information of Respondents

As discussed in the "Data Collection" section of the previous chapter, out of the 55 questionnaires distributed, 52 were returned having a 94% response rate. The general information of these respondents are summarized in the table below.

Table 4-1 General Information of Respondents

General Information	Responses	Frequency	Percentage
Job Position	Project Manager	7	13.5
	Project Office Engineer	35	67.3
	Project Office Head	7	13.5
	Project Follow-up Engineer	3	5.8
Sex	Female	24	46.2
	Male	28	53.8
Work Experience	1-2 Years	11	21.2
	3-5 Years	20	38.5
	6-10 Years	16	30.8
	11-15 Years	3	5.8
	Above 15 Years	2	3.8
Educational Level	Bachelor Degree	44	84.6
	Master's Degree	8	15.4

(Source: Field Survey, 2020)

As discussed in the previous chapter, the participants of this research were the company's key personnel who were assumed to have a comprehensive knowledge about the corresponding project they have been assigned to.

A majority of the participants (67.3%) were composed of project office engineers. 13.5% of the participants account for project managers; and the same amount of percentage account for project office heads. The remaining 5.8% of the respondents were project follow-up engineers working at the head office of YOTEK Construction PLC.

Regarding gender composition, 46.2% of the respondents were females, while the 53.8% were males. The majority of the females (87.5%) were project office engineers; 25% of the males were project managers. This implies that, while the males are fairly distributed across the four job positions, the females were concentrated over one position (project office engineer).

Out of the 52 respondents, 21.2% had a work experience of 1-2 years, whereas, a relatively larger percentage of them (38.5%) worked for 3-5 years. 30.8% of the respondents had a work experience of 6-10 years. Only 5.8% of respondents had 11-15 years of work experience, while a minority of 3.8% were senior employees who worked for above 15 years. Regarding educational level, employees with a bachelor degree predominantly participated in this research as a majority of 84.6% of the participants had a bachelor degree, while the remaining 15.4% were at master's degree educational level.

4.3 Maturity Level by Knowledge Area

In this section, the maturity levels of the 13 knowledge areas are presented and discussed based on the quantitative data collected from questionnaire. Besides, the supportive (embedded) qualitative method of document review is used to strengthen the discussion. Some of the knowledge area component descriptions presented in this section are in a shortened form; whereas the questionnaire contained further elaboration for each item.

The questionnaire contained a five point rating scale for each component, ranging from "very low" to "very high" which represent maturity levels of level 1 up to level 5, respectively. The maturity level of each knowledge area was calculated by aggregating the maturity level of the components of each knowledge area. This was done by taking the mean rating of each component within a knowledge area as filled by the respondents. Each component of a knowledge area was given equal weight in calculating the maturity level.

4.3.1 Project Scope Management

The Project Scope Management knowledge area consisted of 4 components, which were rated by the 52 respondents. Table 4-2 summarizes the responses and the maturity level of each component.

Table 4-2 Project Scope Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Level of scope definition		3.8	34.6	38.5	23.1	3.81
2	Computer applications used in scope management process	59.6	30.8	9.6			1.5
3	Formal monitoring and controlling of project scope	3.8	19.2	46.2	30.8		3.04
4	Inspection for ensuring or verifying the completion of all scope of the work		11.5	30.8	38.5	19.2	3.65
Knowledge Area Maturity Level							**3.0**

(Source: Field Survey, 2020)

Scope definition, from construction perspective, refers to definition of contract documents and design drawings. 38.5% of the respondents agreed that there was a high level of definition in these documents that define the delimitation of construction projects. These documents of sample projects were reviewed as part of the document review method. The contract documents of the projects contained an extensive and detailed description of each activity to be done in the project site. The design drawings including architectural drawings, structural drawings, sanitary drawings, electrical drawings, were all specified with a satisfactory level of detail. Hence, in line

with the quantitative result (3.81), the qualitative document review pointed that the level of scope definition in the projects was in a higher level.

In contrast to the higher level of scope definition, a majority of 59.6% of the respondents labeled "the use of computer applications used for scope management process" as very low. The following rationale may explain why this lower value was found. According to Sarshar et al. (2000), during the construction phase, a rigorous scope management is not a necessity, as the scope has already been defined by this phase. Hence, at this phase, project scope management for the contractor company is mainly concerned with scope control. Strengthening the above statement, "formal monitoring and controlling of scope" scored a mean maturity level of 3.04. Scope inspection scored a relatively higher maturity level of 3.65 implying a higher verification for completion of all scope of work in projects. The relatively higher maturity levels of the two components were justified by reviewing site diaries and inspection formats of sample projects. The site diaries convey the performance record of the project site in a daily basis. They evaluate the project scope status and are used as a basis for corrective actions. As a result, formal monitoring and controlling of scope in the projects were practiced. A formal inspection format, upon which the projects' activities were supervised, was used in order to ensure and verify that all scope of the work was complete.

In total, the mean maturity level for the project scope management knowledge area was found to be 3.0, making it the 3rd most matured knowledge area of the company among the 13 knowledge areas (next to project time and financial management). According to Crawford (2002), at this level: scope management process involves stakeholder management; a fully integrated project team documents the project scope; the project teams follow the processes of scope change control system, analysis, and reporting.

4.3.2 Project Time Management

The Project Time Management knowledge area consisted of 7 components, which were rated by the 52 respondents. Table 4-3 summarizes the responses and the maturity level of each component.

Table 4-3 Project Time Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Preparation of updated schedule for project activities		7.7	48.1	34.6	9.6	3.46
2	Application of computer tools in scheduling			32.7	44.2	23.1	3.9
3	Application of WBS when defining schedule activities			30.8	42.3	26.9	3.96
4	Level of preparing resource estimates		11.5	21.2	51.9	15.4	3.71
5	Practice of using historical data in estimating activity duration	13.5	42.3	38.5	5.8		2.37
6	Continuous monitoring and controlling of progress of project activities		11.5	44.2	34.6	9.6	3.42
7	Practice of using EVM in controlling schedule	59.6	32.7	7.7			1.48
Knowledge Area Maturity Level							**3.19**

(Source: Field Survey, 2020)

"Preparation of updated schedule" scored a maturity level of 3.46 as most of the respondents agreed that there was a moderate to high level of preparing updated schedule having fixed start and finish dates for all project activities. Similarly, 44.2% of the respondents replied that there was a high level application of computer tools in scheduling. Prima Vera and MS-Excel were the predominant tools used for the purpose of scheduling. 42.3% of the respondents also agreed that application of WBS in defining schedule activities was high. The two components obtained a mean maturity level of 3.9 & 3.96 making them the 1st and 2nd ranked matured components among the total 87 components of knowledge areas. A majority of respondents (51.9%) rated the level of preparing resource estimates as high, implying the existence of a high precision of estimating of material, labor and equipment resources in projects. Whereas, the practice of using historical data (from prior projects undertaken by the company) in estimating activity duration was informal as 42.3% of the participants rated it low resulting a relatively lower maturity level (2.37).

Monitoring and controlling project activity progress obtained a relatively moderate maturity level of 3.42. In this regard, various types of reports were reviewed as one

part of the document review process. These reports were used for the purpose of monitoring and controlling the progress of each project activity. The reports included resource reports, activity reports, work progress reports etc. Key performance indicators (KPI's) were also used for monitoring and controlling purpose. For instance, "time elapsed" against "project progress" was compared. However, as the responses from the questionnaire indicate, Earned Value Management (EVM) computation was not practiced; a majority of 59.6% of the respondents assured that such a procedure didn't exist in controlling project activities. This component was among the least matured components with a rank of 86th from 87 components.

In general, the project time management knowledge area scored a maturity level of 3.19. It ranked 1st, being the most matured knowledge area of the company. According to the PM Solutions' model, the level 3 maturity of project time management include the following characteristics: processes are deemed an organizational standard and are applied by almost all of the projects; activity network templates and external dependencies are included in activity sequencing process; in calculating activity durations, project teams may rely upon simulation techniques, industry standards, expert knowledge and several standards and factors specific in the organization; schedule performance analysis includes the schedule control process Crawford, (2002).

4.3.3 Project Cost Management

The Project Cost Management knowledge area consisted of 8 components, which were rated by the 52 respondents. Table 4-4 summarizes the responses and the maturity level of each component.

Level of preparing cost estimates for resources scored a 3.62 maturity level. The resources include labor, material and equipment. 42.3% of respondents agreed that WBS application in preparing cost estimates was high. The WBS defined in the Prima Vera software, was used as a basis for cost estimating in most projects of the company. Consideration of historical actual cost data (from prior projects undertaken by the company) in preparing cost estimate scored 3.12 maturity level with an indication that some projects don't undertake such a practice. 50% of the respondents pointed out that the practice of applying cost-estimating software in managing cost or preparing the estimate was low.

Table 4-4 Project Cost Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Level of preparing cost estimates for resources		5.8	40.4	40.4	13.5	3.62
2	Application of WBS in preparing the cost estimate			40.4	42.3	17.3	3.77
3	Consideration of company's historical actual cost data in preparing cost estimate	7.7	13.5	42.3	32.7	3.8	3.12
4	Application of cost-estimating software in managing cost or preparing the estimate	50	30.8	19.2			1.69
5	Preparation of updated and time phased budget allocated to activities and resources	9.6	23.1	44.2	15.4	7.7	2.88
6	Continuous monitoring and controlling of the project cost		23.1	44.2	32.7		3.1
7	Practice of using EVM in controlling cost	75	19.2	5.8			1.31
8	Tracking of project cost against base line project budget		36.9	46.2	21.2	5.8	3.06
Knowledge Area Maturity Level							**2.82**

(Source: Field Survey, 2020)

Preparation of updated and time phased budget for activities and resources was perceived as moderate by 44.2% of respondents with a maturity level score of 2.88. The same percentage was true for continuous monitoring and controlling of project cost. A document review revealed that Planned Cost and Actual Cost were compared as part of a key performance indicator for the projects. However, as the responses from the questionnaire indicate, Earned Value Management (EVM) computation was not practiced. A staggering vast majority (75%) assured that such a practice didn't exist in the projects. The component scored a maturity level of 1.31 being the least matured one from the total 87 components. In contrast, tracking of project cost against baseline budget was perceived as moderate by 46.2% of the participants with a maturity level of 3.06.

In general, the project cost management knowledge area scored a maturity level of 2.82 (ranked 6th from the 13 knowledge areas). Despite being close, the knowledge

area was yet to reach level 3; as per the PM Solutions' model suggestion, the knowledge area was deemed to be characterized as level 2. Characteristics for level 2 of project cost management include the following: Equipment, materials, as well as all labor categories have a complete resource listing; the company has industry standard tools and techniques to approximate quantities; the company has a documented process for the generation and documentation of project cost estimates; there is a historical data base to develop cost standards and factors; there is a documented cost management plan and process, and is a standard practice on relatively large projects; the company is capable of tracking progress toward achieving project milestones; a documented process exists to prepare and distribute cost reports (Crawford, 2002).

4.3.4 Project Quality Management

The Project Quality Management knowledge area consisted of 6 components, which were rated by the 52 respondents. Table 4-5 summarizes the responses and the maturity level of each component.

Table 4-5 Project Quality Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Availability of standard quality management policies, procedures and guidelines		25	46.2	28.8		3.04
2	Level of quality planning	17.3	44.2	36.5	1.9		2.23
3	Quality assurance activities implemented	11.5	25	44.2	19.2		2.71
4	Quality control in the project	7.7	40.4	36.5	15.4		2.6
5	Quality audits in the project	44.2	46.2	7.7	1.9		1.67
6	Quality control and inspection of subcontractors' work	5.8	48.1	28.8	17.3		2.58
Knowledge Area Maturity Level							**2.47**

(Source: Field Survey, 2020)

Standard quality management policies, procedures and guidelines scored a maturity level of 3.04 with 46.2% of respondents rating it as moderate. Meanwhile, the 44.2% rated the level of quality planning as low indicating the existence of weak

determination of requirements and quality standards & strategies in projects. The same percentage of respondents perceived the implementation of quality assurance activities in projects as moderate, having a maturity level of 2.71. This implies that performing processes and procedures to assure meeting of quality objectives is mediocre.

On the other hand, quality control was low rated according to 40.4% of the respondents, indicating a poor practice of determining whether project activities comply with relevant quality standards/plans. Moreover, quality audit (a review to check if each project activity complied with quality requirement and policy) scored a very low maturity level of 1.67 (ranked 77th from 87 components) with 44.2% and 46.2% of participants giving it a "very low" and "low" label, respectively. Likewise, quality control and inspection of subcontractors' work was low labeled having a maturity level of 2.58.

In general, project quality management scored a maturity level of 2.47 (ranked 9th from the 13 knowledge areas). According to Crawford (2002), level 2 of project quality management includes the following characteristics: the quality planning process include processes of quality assurance; project teams devise checklists for the purpose of checking or promoting quality throughout the project life cycle; the quality process includes suggested approaches as well as guidelines for quality control; full acceptance specifications and/or criteria are developed including quality standards.

4.3.5 Project Human Resource Management

The Project Human Resource Management knowledge area consisted of 6 components, which were rated by the 52 respondents. Table 4-6 summarizes the responses and the maturity level of each component.

40.4% of the respondents rated the human resource planning in the company as mediocre with a maturity level of 2.69. Complying by standard process & procedure for employee recruitment and expulsion received an uncommon relatively fair distribution of rating. This may imply that the practice is not consistent across the different projects.

Table 4-6 Project Human Resource Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Planning for acquisition and management of human resource	17.3	19.2	40.4	23.1		2.69
2	Complying by standard process & procedure for recruitment and expulsion of project employees	21.2	28.8	38.5	11.5		2.4
3	Extent of definition of skill requirements, roles and responsibilities for all project job positions	21.2	42.3	34.6	1.9		2.17
4	Frequency of training (formal or informal) provided to project team members	30.8	34.6	25	9.6		2.13
5	Practice of formal tracking and controlling of human resource cost and work hour time	9.6	21.2	40.4	25	3.8	2.92
6	Practice of regular performance tracking of project team members and providing feedback for improvement	15.4	38.5	34.6	11.5		2.42
Knowledge Area Maturity Level							**2.46**

(Source: Field Survey, 2020)

42.3% of the respondents believed that the extent of definition of skill requirements, roles and responsibilities for job positions was low with maturity level of 2.17. Similarly, most of the respondents gave a "very low" and "low" rating (30.8% and 34.6%, respectively) to frequency of training provided to project team members. Having a 2.13 score, the component was the least matured one from the knowledge area. Practice of formal tracking and controlling of HR cost and work hour time was rated as moderate by 40.4% of the participants and scored 2.92. Performance tracking of project team members and providing feedback for improvement obtained a low and average rating by 38.5% & 34.6% of the respondents, respectively. It scored a maturity level of 2.42, implying that this practice was weakly applied in most projects.

In general, project human resource management scored a maturity level of 2.46 (with a rank of 10^{th} from 13 knowledge areas). According to Crawford (2002), level 2 of

project human resource management includes the following characteristics: a documented and repeatable process exists defining the acquisition, definition and management of the human resources; a basic overview of the types of skill-sets required as well as its approximate timeframe in which they are needed by the project are defined; basic responsibility definition also exists in the form of a responsibility assignment matrix; a project organization chart exists guiding individuals know who reports to whom; staff acquisition in the project consists of identifying the individuals who have the needed skill sets; the organization develops a track record documenting an individual's knowledge base, competence and experience (Crawford, 2002).

4.3.6 Project Equipment Management

The Project Equipment Management knowledge area consisted of 6 components, which were rated by the 52 respondents. Table 4-7 summarizes the responses and the maturity level of each component.

Table 4-7 Project Equipment Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Comprehensiveness of policy that guides equipment acquisition, use, maintenance and replacement decisions	25	48.1	25	1.9		2.04
2	Level of planning for acquiring and use of project equipment	28.8	48.1	21.2	1.9		1.96
3	Practice of economic and risk analyses done to decide between buy or rent options in acquiring equipment	57.7	32.7	5.8	3.8		1.56
4	Practice of tracking and monitoring performance of the project equipment	17.3	25	36.5	17.3	3.8	2.65
5	Practice of using software tools to plan, assign and track equipment	53.8	36.5	9.6			1.56
6	Availability of formal procedures for equipment sharing among the organization's projects	30.8	23.1	34.6	7.7	3.8	2.31
Knowledge Area Maturity Level							**2.01**

(Source: Field Survey, 2020)

48.1% of the participants responded that the policy that guides equipment acquisition, use, maintenance and replacement decisions had a lower comprehensiveness having a maturity level of 2.04. This implies that even though there exists a policy for equipment management, its depth of comprehensiveness is not satisfactory. In similar manner, 48.1% of the respondents rated the level of planning for acquiring and use of project equipment as "low"; the component scored a maturity level of 1.96 ranking 69th from the total of 87 components.

An intriguing majority of respondents (57.7%) assured that there was a very low practice of economic and risk analyses done to decide between buy or rent options in acquiring equipment in projects. This factor also has an impact on the profitability of the company as equipment costs are of paramount significance. The practice scored a lower maturity level of 1.56, being one of the least matured components (ranked 81st from 87 components).

In contrast, practice of tracking and monitoring performance of project equipment (including their time worked, productivity, and maintenance cost) was moderately rated by 36.5% of participants, earning a relatively greater maturity level of 2.65 (the highest within the knowledge area). On this regard, a document review was undertaken. Time sheets and quantity records were used to track and monitor performance of equipment in a daily basis. Data collectors record the duration of time worked and quantity of work done by each equipment, and report it to project office engineers. Based on the reports, the productivity of each equipment against its worked time was compared to track and monitor its performance. However, a comparison with a standard productivity rate was minimal.

Yet another majority of participants (53.8%) pointed that there was a very low practice of using computer software tools in equipment planning, assignment and tracking. This component scored a maturity level of 1.56, ranking 81st from 87 components. A relatively fair distribution of rating was observed for "availability of formal procedures for equipment sharing among projects" with respondents' rating ranging from "very low" to "low." This may imply that the application of formal procedures for equipment sharing is not uniform across the projects. The practice obtained a 2.31 maturity level being the 2nd best within the knowledge area.

In general, project equipment management scored a lower maturity level of 2.01. According to Sharma (2002), the cost of equipment in a construction project varies from 10 to 30 % of the total project cost, which depends on the extent of mechanization. Despite this significance, the maturity of the knowledge area in the company was ranked 12th from the 13 knowledge areas, only being above project risk management.

4.3.7 Project Materials Management

The Project Materials Management knowledge area consisted of 7 components, which were rated by the 52 respondents. Table 4-8 summarizes the responses and the maturity level of each component.

Table 4-8 Project Materials Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Level of planning done for acquiring and use of project materials	15.4	26.9	30.8	26.9		2.69
2	Considerations of purchase costs, order cost, holding cost, unavailability cost, unavailability risk, and cost increase in material planning	38.5	26.9	34.6			1.96
3	Considerations of special planning and monitoring for critical items and materials requiring long lead-time	26.9	5.8	44.2	15.4	7.7	2.71
4	Formal performance of tracking, monitoring and follow up of material purchase	15.4	15.4	40.4	21.2	7.7	2.9
5	Application of computer software tools in material planning, assignment and tracking	11.5	38.5	34.6	9.6	5.8	2.6
6	Efforts in monitoring and tracking material availability and use in the project		59.6	21.2	19.2		2.6
7	Practice of using a documented process to approve, check and test materials in the project site		26.9	38.5	30.8	3.8	3.12
Knowledge Area Maturity Level							**2.65**

(Source: Field Survey, 2020)

Planning for acquiring and use of project materials scored a 2.69 maturity level with 30.8% of the respondents rating it as average, and 26.9% as low. Whereas the consideration of different costs in material planning was rated as "very low" by 38.5% of the participants and scored a lower maturity level of 1.96 being the least matured one within the knowledge area (ranked 69th from 87 total components). This indicates the poor practice of considering purchase costs, order cost, holding cost, unavailability cost, unavailability risk, and cost increase in material planning of projects. In contrast, with 44.2% of respondents rating it as moderate, consideration of special planning and monitoring for critical items & materials obtained a 2.71 maturity level, despite the 26.9% rating it as "very low." This may be an indication that these considerations are not consistent across projects. Whereas, performance of tracking, monitoring and follow up of material purchase scored a 2.9 maturity level with 40.4% of respondents rating it as "average."

Application of computer software tools in material planning, assignment and tracking was generally rated as "low," though 34.6% of the respondents replied with an average rating. A majority of respondents (59.6%) agreed that there was a minimal (low) effort in monitoring and tracking material availability and use in projects. This implies that the monitoring and tracking of material availability and use is practiced in an informal or ad-hoc manner across the projects. In contrast, practice of using a documented process to approve, check and test materials in project site was relatively matured. It scored a maturity level of 3.12 being the most matured component within the knowledge area and the 22nd most matured component from the total 87 components. Document review was undertaken on the material testing procedures and reports. The results triangulated the quantitative output.

In total, project materials management scored a maturity level of 2.65. Accordingly, it didn't reach the level 3 maturity level. With this result, the knowledge area was ranked 7th from the 13 knowledge areas.

4.3.8 Project Communications Management

The Project Communications Management knowledge area consisted of 5 components, which were rated by the 52 respondents. Table 4-9 summarizes the responses and the maturity level of each component.

Table 4-9 Project Communications Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Practice of using a formal system or procedure for handling project documents		21.2	51.9	15.4	11.5	3.17
2	Practice of using a formal system or procedure for collecting and distributing information within and outside the project		51.9	28.8	17.3	1.9	2.69
3	Availability of plan or strategy prepared to address communication needs with different stakeholders	53.8	38.5	5.8	1.9		1.56
4	Practice of preparing project performance reports and providing to relevant stakeholders	11.5	11.5	38.5	25	13.5	3.17
5	Availability of standard format for preparation of reports		11.5	28.8	30.8	28.8	3.77
Knowledge Area Maturity Level							**2.87**

(Source: Field Survey, 2020)

A majority of respondents (51.9%) agreed that there was a moderate practice of using a formal system or procedure for handling project documents with a maturity level of 3.17. In this regard, the projects were striving to implement ISO standard document handling system and procedure. The same portion of respondents (51.9%) agreed that there was a low rated practice of using a formal system or procedure for collecting and distributing information within and outside projects. This implies collection and distribution of information are done informally. Again, a majority of participants (53.8%) responded that the availability of plan or strategy prepared to address communication needs with different stakeholders was very low/poor, implying the absence of any such process in the projects. With a maturity level of 1.56, the component was the least matured one within the knowledge area and ranked 81st from the 87 components.

Rating for the practice of preparing project performance reports and providing to relevant stakeholders mostly fell in the moderate-high range (35.5% & 25%, respectively). It scored a maturity level of 3.17 making it the 2nd most matured component of the knowledge area. The first rank was held by the component

representing the availability of standard format for preparation of reports. 30.8% of respondents gave it a high rate, while an intriguing 28.8% gave it a very high rate. It was the only component (from 87 components) to score a "very high" rate by this much number (28.8%) of respondents. The component generally scored a maturity level of 3.77 ranking 5th from the 87 components.

Furthermore, a review on the various reports prepared in sample projects ensured the consistency of the quantitative results. The reports can be generally classified into inside-project reports, reports to the head office, and reports to the consultants. Inside reports mainly consisted of activity and evaluation reports (mainly measuring work hours and productivity of manpower, utilization of materials and equipment) in the project sites. Reports to head office included weekly resource report, daily activity report, weekly work progress report and a much more comprehensive monthly report. Reports to the resident consultants included the weekly work progress report and monthly store report. Therefore, the availability of standard report formats as well as the practice of preparing performance reports and providing it to relevant stakeholders were assessed to be satisfactory, which is in line with the survey results.

In overall, project communications management scored a maturity level of 2.87 and ranked 5th from 13 knowledge areas. Despite being close, the knowledge area was yet to reach level 3; hence, as per the PM Solutions' model suggestion, the knowledge area would have similar characteristics with those at level 2. According to Crawford (2002), level 2 of project communications management includes the following characteristics: stakeholder communication needs in projects are identified; project status and progress reporting are prepared and distributed on a regular basis; the communications focus is on summary status and progress reporting of scope, schedule and cost; 3 types of summary reports for phase completion, progress and status are produced in the course of the project life.

4.3.9 Project Risk Management

The Project Risk Management knowledge area consisted of 9 components, which were rated by the 52 respondents. Table 4-10 summarizes the responses and the maturity level of each component.

Table 4-10 Project Risk Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Extent of a formal risk management plan	46.2	50	3.8			1.58
2	Level of identifying and documenting risks in a risk register	13.5	50	34.6	1.9		2.25
3	Use of risk break down structure (RBS) to identify or plan risks	30.8	50	19.2			1.88
4	Application of risk analysis to determine potential impact and likelihood of happening, and prioritization	23.1	50	25	1.9		2.06
5	Development of updated risk response strategy	32.7	48.1	17.3	1.9		1.88
6	Contingency time allowance in project's schedule for potential risk consequences	50	38.5	9.6	1.9		1.63
7	Contingency budget reserve for potential risk impact	42.3	46.2	9.6	1.9		1.71
8	Level of monitoring and controlling risks	48.1	48.1	3.8			1.56
9	Level of risk auditing	44.2	48.1	7.7			1.63
Knowledge Area Maturity Level							**1.8**

(Source: Field Survey, 2020)

Almost all respondents, except only a portion of 3.8%, responded that the extent of a formal risk management plan was "low" or "very low." Consequently, the component scored a very low maturity level of 1.58 and ranked 80th from 87 components. This indicates that the process of defining how to conduct risk management activities in the project is very poor. The level of identifying and documenting risks in a risk register was also rated low by 50% of respondents. But, it had a relatively higher maturity level (2.25) which made it the greatest score within the knowledge area. A document review was undertaken in this regard. Sample risk registers of projects were reviewed. It was observed that different types of risks were incorporated in the risk registers. However, they were not updated on a regular basis.

Moreover, half of the respondents pointed out that there was a low practice of using a risk break down structure to identify or plan risks. The same portion of respondents gave a low rate to application of risk analysis to determine potential impact and

likelihood of happening and prioritization, having a relatively moderate maturity level of 2.06. The reviewed risk registers contained risk category, risk description, causes, probability of occurrence, classification based on impact, and risk control measure. However, any formal quantitative or qualitative risk analysis procedure was not undertaken.

48.1% of the participants rated the development of updated risk response strategy as "low" with a maturity level of 1.88 and ranking of 72nd from 87 components. This implies that even though there are some control measures included in the risk registers, the multitude of risk response strategies (risk avoiding, risk mitigating, risk transferring and risk accepting) are not used exhaustively and were not timely updated. 50% of respondents replied that there was a very low contingency time allowance in project schedule for potential risk impact. The component scored a maturity level of 1.63 ranking 78th from 87 components. The same was true for contingency budget reserve for potential risk impact as 46.2% of participants gave it a low rate and had a 1.71 maturity score.

Level of monitoring and controlling risks was one of the least matured components with a 1.56 score (ranked 81st) as the vast majority of respondents rated the practice as "very low" and "low." This implies that identifying new changing risks, closing outdated risks, and tracking already identified risks are poorly practiced in the projects. Level of risk auditing was also among the least matured ones, with a score of 1.63 (ranked 78th) and 48.1% of respondents rating it low. This indicates that (also assured from document review) the effectiveness of the risk response strategies as well as the risk management processes are not formally examined and documented

In overall, project risk management scored a low maturity level of 1.8, ranking it last from all the knowledge areas. As per the PM Solutions' model (authored by Crawford, 2002), since the knowledge area had not attained level 2, it was assumed to have the project risk management characteristics at level 1, which include the following: risks evident in projects are not identified as a normal practice; if risks are identified, speculation on the impact to the project is mostly done in an informal manner without any analysis, or standard approach and process; risks are considered as they arise in projects and mitigation strategies for contingencies for future risk events are rarely determined; historical database on typical risks encountered do not

exist and individual team members rely on their past experiences and discussions with other project team members (Crawford, 2002).

4.3.10 Project Procurement Management

The Project Procurement Management knowledge area consisted of 8 components, which were rated by the 52 respondents. Table 4-11 summarizes the responses and the maturity level of each component.

Table 4-11 Project Procurement Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Degree of planning for procurement of goods and services	9.6	9.6	55.8	21.2	3.8	3
2	Practice of identifying special supply items	9.6	7.7	51.9	17.3	13.5	3.17
3	Availability of standard procurement documents		7.7	25	42.3	25	3.85
4	Level of supplier and subcontractor qualification screening	9.6	46.2	36.5	7.7		2.42
5	Level of documented contract management or administration processes		30.8	32.7	28.8	7.7	3.13
6	Level of defined process for managing contract change	7.7	38.5	36.5	17.3		2.63
7	Level of defined process for payment review and authorization	17.3	32.7	32.7	17.3		2.5
8	Level of defined process for contract closing	5.8	63.5	21.2	9.6		2.35
Knowledge Area Maturity Level							**2.88**

(Source: Field Survey, 2020)

A majority of respondents (55.8%) consented that the degree of planning for procurement of goods and services was moderate and an exact average maturity score of 3 was obtained. Similarly, a majority of 51.9% of the respondents rated the practice of identifying special supply items as average resulting a 3.17 maturity level score. The special items were those required in large quantity (such as cement and aggregate), and those requiring special manufacturing or long process to acquire (such as spare parts that are only manufactured abroad and are not readily available locally).

42.3% and 25% of the participants gave a "high" and "very high" rate, respectively, to the availability of standard procurement documents. The component scored a relatively higher maturity level of 3.85, being the greatest score within the knowledge area and ranked 3rd from the 87 components. A document review supported this result, as standard procurement documents, like standard purchase order document, sub-contract document, and supplier agreement existed in the projects. On the other hand, a relatively lower maturity level of 2.42 was scored as 46.2% of respondents rated the level of supplier and sub-contractor qualification screening as low. This is an indication that there is a poor practice of adhering to consistent procedures in screening sub-contractors, to whom wide range of works were assigned.

Level of documented contract management or administration processes scored a maturity level of 3.13 with a relatively fair distribution of respondents' rating (30.8%, 32.7%, and 28.8% of respondents rated "low," "average," and "high" respectively). Whereas, 38.5% of respondents agreed there was a low level of defined process for managing contract change, scoring a maturity level of 2.63. In similar manner, 32.7% of respondents rated the level of defined process for payment review and authorization as low, scoring a maturity level of 2.5. Moreover, a vast majority of 63.5% of participants gave a low rating to the level of defined process for contract closing yielding the least maturity level score for the knowledge area (2.35) and ranked 59th from 87 components.

In general, the project procurement management knowledge area scored a maturity level of 2.88 which ranked it 4th from the 13 knowledge areas. Since the knowledge area had not attained level 3, it was assumed to have the project procurement management characteristics at level 2 as described by Crawford (2002). The characteristics include the following: a documented basic process exists for procurement of goods and services, but is not a standard practice; large projects' procurement process is considered as standard practice, while other projects are encouraged to use it; the project is involved in the process and focuses on its technical knowledge; there is an appropriate level of detail for managing contracts, with regular reporting (Crawford, 2002).

4.3.11 Project Stakeholder Management

The Project Stakeholder Management knowledge area consisted of 4 components, which were rated by the 52 respondents. Table 4-12 summarizes the responses and the maturity level of each component.

Table 4-12 Project Stakeholder Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Practice of undertaking a formal stakeholder analysis in the project.	36.5	34.6	23.1	5.8		1.98
2	Availability of a formal stakeholder management plan	40.4	32.7	26.9			1.87
3	Continuous effort of working and communicating with stakeholders to influence their expectation, resolve issues and address their concern	7.7	19.2	36.5	26.9	9.6	3.12
4	Monitoring of overall project stakeholder relationships	7.7	38.5	30.8	23.1		2.69
Knowledge Area Maturity Level							**2.41**

(Source: Field Survey, 2020)

A majority of respondents rated a lower level to the practice of undertaking a formal stakeholder analysis in the project (36.5% of them rated it as “very low” and 34.6%--“low”). The component scored a maturity level of 1.98 ranking 68th from 87 components. This implies that there is no or informal analysis of stakeholders which include client, consultants, sub-contractors, material suppliers, service providers, community, regulatory agencies, etc.

Similarly, 40.4% of the participants replied that the availability of a formal stakeholder management plan was very low. The component was the least matured one in the knowledge area with a maturity level of 1.87 and ranked 74th from the 87 components. This indicates the absence of a devised strategy on how to deal with the need and expectation of relevant stakeholders of the projects. In contrast a better rating was given to “continuous effort of working and communicating with stakeholders to influence their expectation, resolve issues and address their concern” as 36.5% of the respondents rated it as average. Consequently, a relatively higher

maturity level of 3.12 was scored (ranked 22nd from 87 components). In contrast, 38.5% of the respondents replied that the monitoring of overall project stakeholder relationships was generally low, while the 30.8% rated it as average leading to component maturity level of 2.69.

In general, the project stakeholder management knowledge area scored a maturity level of 2.41. With this score, the knowledge area was ranked 11th from 13 knowledge areas, only exceling project equipment management and project risk management knowledge areas. According to the updated edition of PM Solutions' Model (Crawford, 2015), level 2 of project stakeholder management includes the following characteristics: a stakeholder analysis might be conducted but with varying process from project to project; summary information about phase completion, progress, and status are provided to stakeholders; the processes of working and communicating with stakeholders vary from project to project (Crawford, 2015).

4.3.12 Project Safety Management

The Project Safety Management knowledge area consisted of 8 components, which were rated by the 52 respondents. Table 4-13 summarizes the responses and the maturity level of each component.

44.2% of the participants responded that there was a mediocre level of application of organizational policies, procedures and guidelines for safety management, while 28.8% & 11.5% responded by giving it a high and very high rating, respectively. This component scored a maturity level of 3.37 being the highest within the knowledge area and ranked 15th from 87 components. Consistent with this result, it was observed that the project sites (especially around working areas) included safety precaution posts, safety signs along with their interpretations, procedures to follow, and commands regarding wearing protective equipment.

Scoring a maturity level of 2.4, the safety planning was mostly rated low to average by 36.5% and 46.2% of the respondents, respectively. This implies that there is a moderate level of determining safety standards & requirements, devising action plans or strategies, staffing (mainly of safety engineers), and allocating budget to safety management.

Table 4-13 Project Safety Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Application of organizational policies, procedures and guidelines for safety management		15.4	44.2	28.8	11.5	3.37
2	Level of safety planning performed	13.5	36.5	46.2	3.8		2.4
3	Level of site neighborhood safety characteristics study done	23.1	34.6	40.4	1.9		2.21
4	Level of hazard analysis performed for project activities	5.8	34.6	40.4	19.2		2.73
5	Level of safety control process implemented		32.7	51.9	15.4		2.83
6	Application of safety audit	38.5	42.3	9.6	9.6		1.9
7	Provision of personal protective equipment for workers		23.1	36.5	34.6	5.8	3.23
8	Level of safety training provided for workers	15.4	32.7	32.7	19.2		2.56
Knowledge Area Maturity Level							**2.65**

(Source: Field Survey, 2020)

A fair distribution of rating, ranging from "very low" to "average" is observed for the level of site neighborhood safety characteristics study done, implying that such a study is not done formally in most of the projects. Whereas, level of hazard analysis performed for project activities scored a maturity level of 2.73 with 40.4% of the respondents rating it as average. In this regard, a document review revealed that there was a documentation on level of accidents occurred (serious, fatal, near miss, and first aid level) and were recorded and reported accordingly. The site engineers record the accidents in a report or site diary format.

A majority of 51.9% of the respondents agreed that the implementation of safety control process was in a moderate level, implying the existence of inspection of project activities on whether they complied with safety standards while undertaking the activities, at least in some projects. Whereas, a predominantly low rating was given to the application of safety audits in projects as 38.5% and 42.3% of the participants responded a "very low" and "low" rating, respectively. Consequently, the

component scored a lower maturity level of 1.9, making it the least one in the knowledge area and ranking it 71st from 87 components. This implies that there is a poor practice of reviewing whether project activities had complied with safety requirements. Provision of personal protective equipment for workers scored a relatively higher maturity level of 3.23 (ranked 2nd within the knowledge area) as 36.5% and 34.5% of the participants rated the practice as moderate and high, respectively. This is an indication that personal protective equipment such as helmets, safety shoes, safety vests, are provided to most site workers, if not all.

In overall, the project safety management knowledge area scored a maturity level of 2.65. Accordingly, it didn't attain the level 3 maturity level. With this result, the knowledge area shared the 7th rank with project materials management.

4.3.13 Project Financial Management

The Project Financial Management knowledge area consisted of 9 components, which were rated by the 52 respondents. Table 4-14 summarizes the responses and the maturity level of each component.

A maturity level of 3.04 was scored for the level of financial plan prepared for the projects including how much and when funding is needed; 40.4% and 25% of the participants rated the component as average and high, respectively. Whereas, 26.9% and 42.3% of the respondents replied with a low and average rating, respectively to the consideration of effects in changing exchange rate, escalating labor and material cost in the plan. The component scored a maturity level of 2.87. However, a document review revealed that these change effects (especially exchange rate change) were not incorporated in the financial plans in a timely and updated manner.

Frequency of cash flow analysis performed for projects scored the least component maturity level (2.6) as 32.7% and 46.2% of the respondents rated it as low and moderate, respectively. This indicates that, even though cash flows are prepared, the projects do not focus on updating them in a timely manner. A fairly distribution of rating was observed regarding the effort in controlling the project finance as 28.8%, 38.5% and 21.2% of the respondents rated it as low, average and high, respectively. The component scored a moderate maturity level of 2.92, implying the existence of an

average effort to make sure that money is properly spent as planned and properly authorized.

Table 4-14 Project Financial Management Maturity Level

No.	Knowledge Area Component Description	Rating Responses in Percentage of 52 Respondents					Mean Maturity Level
		Very Low	Low	Avg.	High	Very High	
		1	2	3	4	5	
1	Level of financial plan prepared for the project	3.8	25	40.4	25	5.8	3.04
2	Consideration of effects in changing exchange rate, escalating labor and material cost in the plan	5.8	26.9	42.3	25		2.87
3	Frequency of cash flow analysis done for the project	9.6	32.7	46.2	11.5		2.6
4	Effort in controlling the project finance	5.8	28.8	38.5	21.2	5.8	2.92
5	Frequency of preparing timely financial reports of the project		9.6	34.6	48.1	7.7	3.54
6	Level of established system or procedure for creating and handling financial documents		13.5	38.5	44.2	3.8	3.38
7	Reliability of financial audits done in the project	3.8	13.5	48.1	34.6		3.13
8	Practice of using a standard process and format to record, store and report financial information		15.4	30.8	50	3.8	3.42
9	Practice of using computer systems in filling and retrieval of financial information in the project	5.8	26.9	38.5	25	3.8	2.94
Knowledge Area Maturity Level							**3.09**

(Source: Field Survey, 2020)

48.1% of the participants gave a high rating to the frequency of preparing timely financial reports of projects. Scoring a maturity level of 3.54, the component was the most matured one for the knowledge area and ranked 10th from the 87 components. A document review supported the above result. A monthly financial report was sent to the head office from each project incorporating revenues (contract revenue and other incomes); direct costs (including labor cost, machinery cost, sub-contractor cost, and miscellaneous costs); indirect costs (including overhead cost, salaries, wages, benefits, and indirect material cost); and price escalations. Similarly, a relatively

higher maturity level of 3.38 was scored by the component "level of established system for creating and handling financial documents" as 44.2% of the participants gave it a high rating.

The reliability of financial audits done in projects was given an average rating by 48.1% of the respondents and high rating by the 34.6%, producing a score of 3.13. In similar manner, a majority of 50% of respondents agreed that there was a high practice of using a standard process and format to record, store and report financial information. Its 3.42 maturity score ranked it 2nd within the knowledge area and 12th from 87 components. With 38.5% of respondents rating it average, practice of using computer systems in filling and retrieval of financial information scored a maturity level of 2.94 implying a moderate use of computer systems in the area.

In general, the project financial management knowledge area scored a higher maturity level of 3.09. The knowledge area was ranked 2nd next to project time management. It was also one of the three knowledge areas to attain level 3 maturity level.

4.4 Project Management Maturity Level of the Company

As described in the previous section, the maturity levels of components under each knowledge area were first computed. From the total of 87, 57 components (65.5%) scored a maturity level below 3, of which 20 (23%) scored below maturity level 2. (The rank of each component is attached in Appendix -3.) The components were then used to measure the knowledge area maturity level.

Project time, financial, and scope management were the highest matured knowledge areas with maturity levels of 3.19, 3.09, and 3.0, respectively. Similarly, prior researchers (including on industries other than construction), such as Labuschagne & Marnewick (2009), Pretorius et al. (2011) and Yimam (2011), found out that the project time management knowledge area scored the highest maturity level in their studies; whereas, Sukhoo et al. (2005) and Weldemariam (2013) found the project scope management knowledge area ranking first.

Project risk management was the least matured knowledge area in the company with a maturity level of 1.8, followed by project equipment management with 2.01.

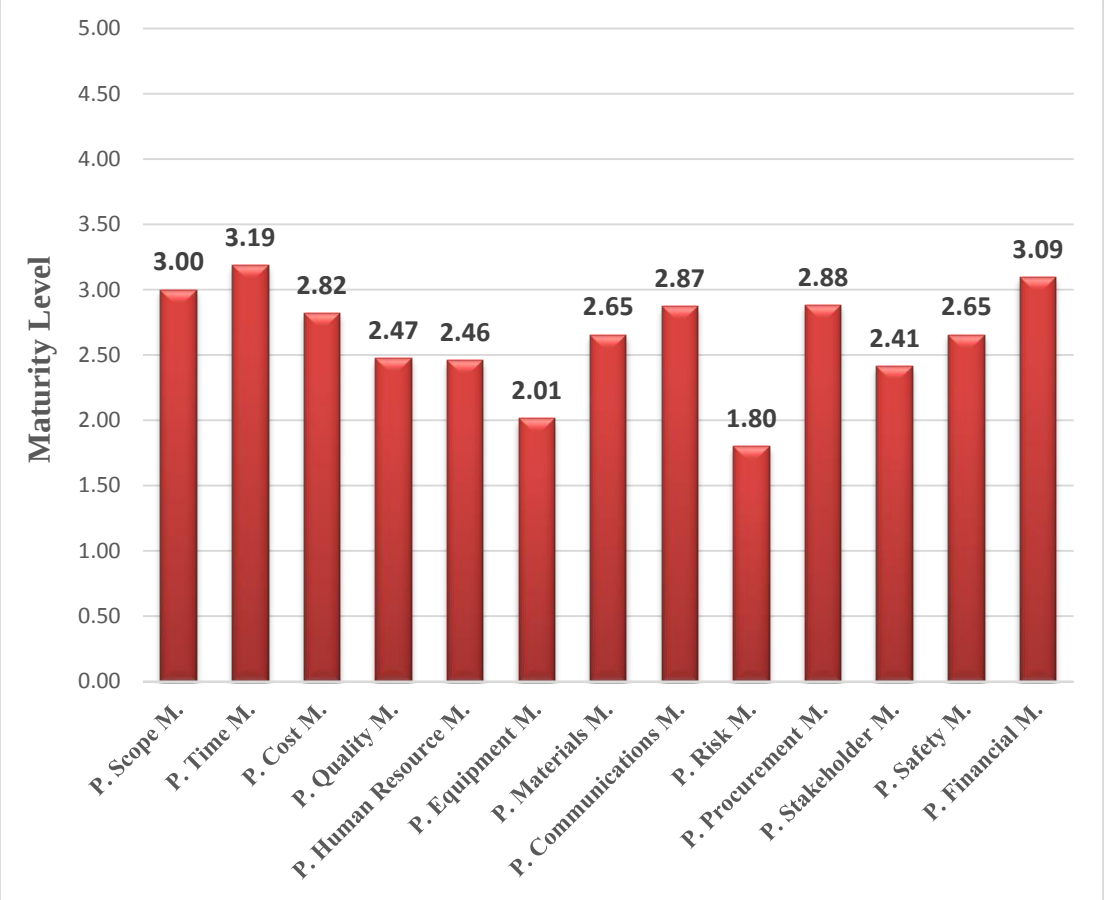
Researchers, such as Grant & Pennypacker (2006), Isaacs (2018), Kwak & Ibbs (2000), Labuschagne & Marnewick (2009), Labuschagne et al. (2013), Moutawei et al. (2017), PM Solutions (2014), Pretorius et al. (2011), Sukhoo et al. (2005), Weldemariam (2013), Zelele (2016) and Yazici (2009), also found out that project risk management was the least matured knowledge area in the corresponding organizations they assessed.

The 13 knowledge area maturity level were aggregated to obtain the PM maturity level of the company, which was 2.64. Table 4-15 summarizes the knowledge area and company maturity levels.

Table 4-15 Company Project Management Maturity Level

Knowledge Area	**Maturity Level**	**Rank**
Project Scope Management	3.00	3
Project Time Management	3.19	1
Project Cost Management	2.82	6
Project Quality Management	2.47	9
Project Human Resource Management	2.46	10
Project Equipment Management	2.01	12
Project Materials Management	2.65	7
Project Communications Management	2.87	5
Project Risk Management	1.80	13
Project Procurement Management	2.88	4
Project Stakeholder Management	2.41	11
Project Safety Management	2.65	7
Project Financial Management	3.09	2
Company Project Management Maturity Level	**2.64**	

(Source: Field Survey, 2020)



(Source: Field Survey, 2020)

Figure 4-1 Summary of Knowledge Area Maturity Level

A company-wide maturity level of 2.64 implies that the company is yet to fully attain a level 3 maturity. Hence, the company is assumed to incorporate the maturity characteristics of level 2 or "structure process and standards." According to Crawford (2002), in such organizations: there are basic processes but not standard on all projects; documentation exists on the basic processes; application of PM is supported by management, but involvement and understanding are not consistently applied to all projects; there are basic metrics for tracking project cost, technical performance, and schedule, even though data might be collected manually; information available for the management of projects is usually a mix between detail-level data and summary-level data (Crawford, 2002).

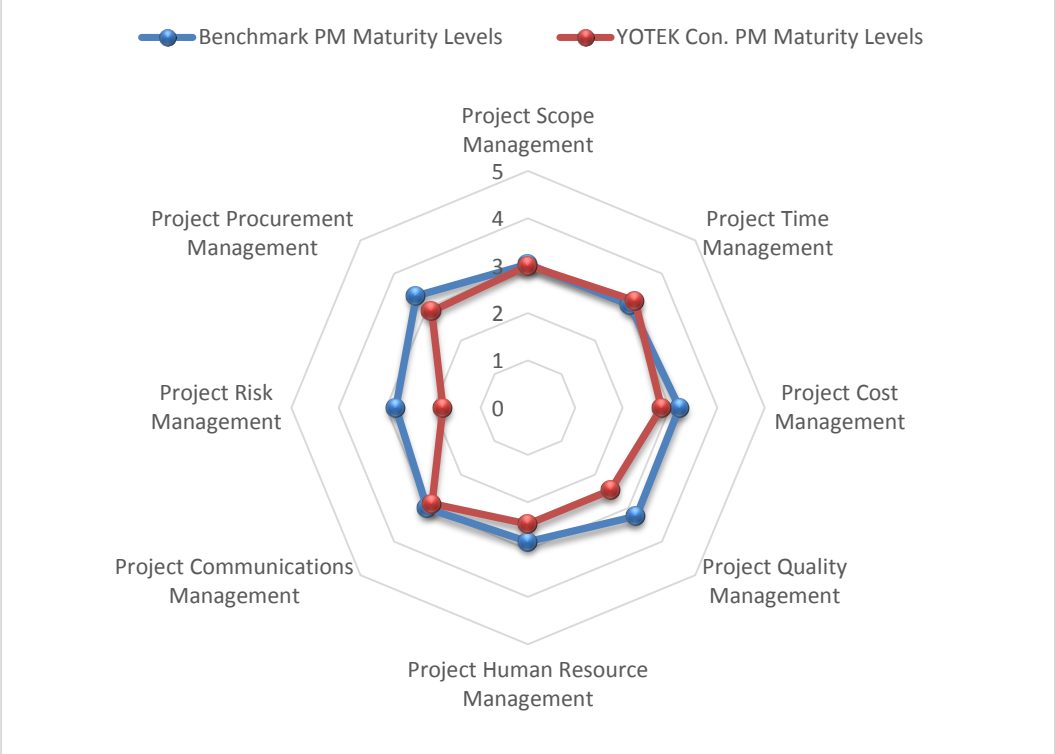
4.5 Comparison of Results with Industry Benchmark

One of the specific objectives of the research was to compare the project management maturity of YOTEK Construction PLC with industry benchmark in African context. For this purpose, the benchmark defined by "Prosperous Report: The African Edition" (authored by Labuschagne et al., 2013) was selected. The study covered 13 developing African countries to investigate the project management maturity of 218 construction projects found in those countries. Only 8 knowledge areas were analyzed in the report; therefore, only those knowledge areas were used for comparison. The following table and figure depict the comparison of the benchmark report's knowledge area maturity levels with that of YOTEK Construction PLC. Except for project time management, all knowledge areas had maturity levels less than the corresponding industry benchmark values.

Table 4-16 Comparison of Results with Industry Benchmark Values

Knowledge Areas	Benchmark PM Maturity Levels	YOTEK Con. PM Maturity Levels
Project Scope Management	3.03	3
Project Time Management	3.06	3.19
Project Cost Management	3.2	2.82
Project Quality Management	3.24	2.47
Project Human Resource Management	2.83	2.46
Project Communications Management	3.01	2.87
Project Risk Management	2.79	1.8
Project Procurement Management	3.34	2.88

(Source: Field Survey, 2020)



(Source: Field Survey, 2020)

Figure 4-2 Comparison of Results with Industry Benchmark Values

CHAPTER 5
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The general objective of this research was to assess the project management practices in YOTEK Construction PLC, as well as the maturity levels of the PMBOK's project management knowledge areas in the company. Furthermore, the research aimed to identify highest priorities areas for improvement and to compare results with industry benchmark in African context.

From component perspective, 57 out of the total 87 components (65.5%) were found to be practiced below average which indicates a generally low application of project management practices in the company. A company-wide maturity level of 2.64 was also found by aggregating the maturity results of the knowledge areas. This implies that the company have completed maturity level 2 (structure process and standards) and should strive to fully attain maturity level 3 (organizational standards and institutionalized process).

Project risk management was the least matured knowledge area in the company with a maturity level of 1.8, followed by project equipment management with 2.01. Only three knowledge areas (project time, scope, and financial management) attained maturity level 3. Project time management was the most matured knowledge area in the company. Since construction is highly dependent on time bounds within contracts, there is an extra emphasis and focus on finishing the project within the allotted timeframe. Having a relatively greater maturity level in project time management implies that the company has been giving the due attention to this area relative to other areas.

The research also compared the result of each knowledge area maturity level with an industry benchmark in African context. Accordingly, only the project time management knowledge area maturity level excelled its counterpart of the benchmark value.

5.2 Conclusion and Recommendations

Most researchers agree on the positive impact of improving maturity levels on project success. Hence, it's imperative for YOTEK Construction PLC to further increase its maturity level in order to accomplish projects more efficiently. It should strive more to fully attain an overall maturity level 3. It is observed that the company has given greater attention to project time, financial, and scope management, as these were the relatively highly matured knowledge areas. The company should broaden this focus of attention to other knowledge areas as well. In doing so, the project management practice gaps (under 13 knowledge areas) identified in this research are of paramount importance in providing a road map to improvement. Moreover, the priority knowledge areas identified (project risk management and project equipment management) should be given special attention as they have been found to be the main improvement subjects.

The recommendations for each knowledge area posited in the next sub-section can be used as a stepping stone towards improvement.

5.2.1 Recommendations for Improving Maturity Level

The following points suggest possible improvement measures to be taken by the company to attain a higher maturity level on each knowledge area. These recommendations focus on components that scored lower maturity level under each knowledge area and hence, evaluated as practice gaps whose improvement efforts should be prioritized.

- Regarding project scope management, computer applications should be thoroughly used for managing scope in the projects undertaken by the company.
- Improvement priority area observed in project time and cost management relates to Earned Value Management (EVM). EVM is not practiced at all in YOTEK Construction PLC. The practice of EVM is very important for the control of schedule and cost. It is a mechanism that can help organizations determine how much work has been accomplished for the money spent enabling to make meaningful and rigorous comparisons between actual and planned schedules and costs. EVM evaluates a project by integrating the three criteria: time, cost, and

value. Therefore, the company would be highly beneficial if this controlling tool is used in period-by-period basis in every project.

- Regarding project quality management, the company should give special attention in practicing quality audits in projects, which is a process of undertaking a review to check if each project activity complied with quality requirement and policy. The level of quality planning should also be improved by further determining requirements, quality standards and strategies. It is also recommended that the company establishes a formal quality management unit, consisting of employees who specialized in quality management, across all the projects.
- Formal and informal training should be provided to improve competencies of project team members, more frequently than it is now. Special trainings must be devised to increase the level of skills and awareness of project team members regarding all the knowledge areas. Regular performance tracking of project team members and providing feedback for improvement are also other priority areas for the company to focus on, under project HR management.
- The project equipment management knowledge area was one of the least matured ones. The planning for acquiring and use of project equipment must include the details of what, how much and when equipment are needed. Sharma (2002) pointed out the main issues to be applied regarding equipment planning, which includes: working shifts; number and size of equipment; matching units; procurement scheduling; workshop and stores planning; and site conditions. A scientific planning technique (consisting of 5 stages devised by Sharma, 2002) using a mathematical model should also be applicable. Furthermore, the practice of economic and risk analyses done to decide between buy or rent options in acquiring equipment must be developed as the cost of equipment can account up to 30% of total project cost.
- Regarding project materials management, the company should develop/improve the level of planning for acquiring and use of project materials by considering purchase costs, order cost, holding cost, unavailability cost, unavailability risk and cost increase.
- The major drawback in project communications management of the company was regarding the availability of plan or strategy to address communication needs with

different stakeholders. Thus, preparation of such plan/strategy and applying it to all projects is vital.

- Project risk management was the least matured knowledge area in the company. Thus, it's imperative to apply fundamental improvement measures to risk management practices and processes. Formal risk management plan should be devised for all projects; risk registers should be updated regularly; formal risk analysis should be undertaken regularly; contingency time and budget allowance should be reserved for risk impacts; risk monitoring, controlling, and auditing activities should be applied in timely manner to all projects.
- The component with the lowest maturity level for project procurement management was the supplier and sub-contractor qualification screening process. A formal and consistent screening procedures should be followed by the company in the qualification of suppliers and especially sub-contractors, to whom wide range of works are assigned in the project sites.
- Regarding project stakeholder management, the company should undertake a formal stakeholder analysis in all projects. Furthermore, a formal stakeholder management plan should be prepared to handle stakeholders' needs and expectations.
- Application of safety audits was the least matured component in project safety management. Therefore, the company should give focus on reviewing project activities to check whether they complied with safety requirements. Moreover, a rigorous site neighborhood safety characteristics should be studied in all project sites.
- Regarding project financial management, the company should improve in performing cash flow analysis frequently across all projects.

5.2.2 Recommendations for Further Research

Generally, PM maturity assessments are multi-dimensional and dynamic in essence. Further research can be undertaken by broadening the scope that this research was limited to. Thus, the following points are recommended for further research regarding project management maturity in Ethiopian construction projects.

First, the relationship between construction project management maturity and project success should be addressed in a rigorous methodology. Various researches have been

undertaken on this relationship for IT projects but not for construction projects. The impact of the maturity assessments should be clear as the value of PM maturity assessment depends on this crucial link. The impact of each knowledge area on the successful delivery of projects should also be studied.

Second, the depth of investigation for each knowledge area can be increased by incorporating an in-depth interview with project managers and senior management staff to come up with a more robust finding.

Third, additional knowledge areas should be included in the assessment of construction PM maturity. For instance, the likes of "Project Environmental Management" and "Project Claim Management" knowledge areas can be investigated in depth as the construction industry is progressively expanding to comprehend multitude of field of studies.

Fourth, the maturity assessments can be undertaken in multiple dimensions. Beside the progressive improvement of knowledge areas, the five project management process groups (Initiating, Planning, Executing, Controlling and Closing) dimension can also be incorporated in the assessment.

PM maturity assessments can also be done across different companies of the construction industry to better comprehend the status of construction PM maturity in the industry. An extensive longitudinal research can also be undertaken to measure the difference in maturity level of organizations as well as knowledge areas across time.

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APPENDICES

Appendix -1: Questionnaire for Respondents

ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

SCHOOL OF COMMERCE

DEPARTMENT OF PROJECT MANAGEMENT

Dear Respondent:

I'm a graduate student in School of Commerce, Addis Ababa University. Currently, I am undertaking a research, titled "An Assessment of Project Management Maturity in Construction Projects: The case of YOTEK Construction PLC" in partial fulfillment of the requirements for the degree of Master of Arts in Project Management.

You are one of the respondents who have been selected to participate in this research. I would like to kindly request you to take few minutes of your time and fill the following attached questionnaire. All of the questions included are multiple choices with a five point scale. Your innocent cooperation in providing sincere information is very important for the successful accomplishment of the research project. I would like to guarantee you that your responses will be held private, confidential and used only for academic research purpose.

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

Email: nahomwg@gmail.com

Tel.: +251912397960

Sincerely,

Nahom Woldegebriel

Addis Ababa, Ethiopia

Part I – General Information

1. Position/role at the project or your organization? (mark "X" on the space provided)

   [ ] Project Manager **[ ] Office Engineer**

   [ ] Office Head **[ ] Project Follow-up Engineer**

   [ ] Other

2. Sex?

   [ ] Female **[ ] Male**

3. Years of working experience?

   [ ] 1-2 **[ ] 3-5**

   [ ] 6-10 **[ ] 11-15**

   [ ] above 15

4. Educational level?

   [ ] Diploma **[ ] Bachelor Degree**

   [ ] Master's Degree **[ ] Doctorate Degree**

   [ ] Other

Part II – Project Management Maturity Questions

General Direction: There are 13 project management knowledge areas to be assessed. Try to respond to all the practice/process descriptions by marking 'X' on the space provided. If a practice/process doesn't exist in your organization/project, choose the "very low" option. If you have any additional comment, please write it on the space provided under each table.

1. Project Scope Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Level of scope definition (of Contract Documents, Specifications, and Design Drawings) in the project					
2.	Computer applications or tools used in scope management process					
3.	Formal monitoring and controlling of scope in the project					
4.	Inspection to ensure or verify that all scope of the work is complete					

Additional comments: _____

2. Project Time Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Preparation of updated schedule for project activities having fixed start and finish dates					
2.	Application of computer tools such as Microsoft project, Primavera, Microsoft excel etc. in scheduling					
3.	Application of WBS (Work Breakdown Structure) when defining the schedule activities					
4.	Level of preparing resource estimates (Material, Labor, and Equipment resources)					
5.	Practice of using historical data (from prior projects) in estimating activity duration					
6.	Continuous monitoring and controlling of progress of project activities					
7.	Practice of using Earned Value Management (EVM) in controlling schedule					

Additional comments: _____

3. Project Cost Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Level of preparing cost estimates for resources (labor, material, Equipment)					
2.	Application of WBS (Work Breakdown Structure) in preparing the cost estimate					
3.	Consideration of company's historical actual cost data in preparing the cost estimate					
4.	Application of cost-estimating software in managing cost or preparing the estimate					
5.	Preparation of updated and time phased budget allocated to activities and resources					
6.	Continuous monitoring and controlling of the project cost					
7.	Practice of using Earned Value Management (EVM) in controlling cost					
8.	Tracking of project cost against base line project budget					

Additional comments: _____

4. Project Quality Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Availability of standard quality management policies, procedures and guidelines in your organization					
2.	Level of quality planning (including determination of requirements and quality standards & strategies) in the project					
3.	Quality assurance activities implemented in the project (performing processes and procedures to assure quality objectives are met)					
4.	Quality control in the project (determining whether project activities comply with relevant quality standards or plans)					
5.	Quality audits in the project (a review to check if each project activity complied with quality requirement and policy)					
6.	Quality control and inspection of subcontractors' work to ensure compliance with quality requirements					

Additional comments: _____

5. Project Human Resource Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Planning for acquisition and management of human resource					
2.	Complying by standard process & procedure for recruitment and expulsion of project employees					
3.	Extent of definition of skill requirements, roles and responsibilities for all project job positions					
4.	Frequency of training (formal or informal) provided to project team members to improve competencies					
5.	Practice of formal tracking and controlling of human resource cost and work hour time					
6.	Practice of regular performance tracking of project team members and providing feedback for improvement					

Additional comments: _____

6. Project Equipment Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Comprehensiveness of policy that guides equipment acquisition, use, maintenance and replacement decisions					
2.	Level of planning for acquiring and use of project equipment (the plan includes the details of what, how much and when equipment are needed)					
3.	Practice of economic and risk analyses done to decide between buy or rent options in acquiring equipment					
4.	Practice to track and monitor performance of project's equipment, including their time worked, productivity, and maintenance cost					
5.	Practice of using software tools to plan, assign and track equipment					
6.	Availability of formal procedures for equipment sharing among the organization's projects					

Additional comments: _____

7. Project Materials Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Level of planning done for acquiring and use of project materials					
2.	Considerations of purchase costs, order cost, holding cost (cost of storing materials), unavailability cost, unavailability risk, and cost increase in material planning					
3.	Considerations of special planning and monitoring for critical items and materials requiring long lead-time (long process to acquire)					
4.	Formal process to track, monitor and follow up material purchases, in order to assure the timely supply of materials					
5.	Application of computer software tools in material planning, assignment and tracking					
6.	Efforts in monitoring and tracking material availability and use in the project					
7.	Practice of using a documented process to approve, check and test materials in the project site					

Additional comments: _____

8. Project Communications Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Practice of using a formal system or procedure for handling project documents					
2.	Practice of using a formal system or procedure for collecting and distributing information within and outside the project					
3.	Availability of plan or strategy prepared to address communication needs with different stakeholders					
4.	Practice of preparing project performance reports and providing to relevant stakeholders					
5.	Availability of standard format for preparation of reports					

Additional comments: _____

9. Project Risk Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Extent of a formal risk management plan (the process of defining how to conduct risk management activities) in the project					
2.	Level of identifying and documenting risks in a risk register					
3.	Use of risk break down structure (RBS) to identify or plan risks					
4.	Application of risk analysis to determine their potential impact along with their likelihood of happening and prioritization					
5.	Development of updated risk response strategy (strategies include: risk avoiding, mitigating, transferring and accepting)					
6.	Contingency time allowance in the project's schedule for potential risk consequences					
7.	Contingency budget reserve for potential risk consequences					
8.	Level of monitoring and controlling risks (identifying new changing risks, closing outdated risks, and tracking already identified risks)					
9.	Level of risk auditing (examination and documentation of effectiveness of risk response strategies and risk management processes)					

Additional comments: _____

10. Project Procurement Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Degree of planning for procurement of goods and services needed for the project					
2.	Practice of identifying special construction items (like items required in large quantities, needing special manufacturing or longer lead-time)					
3.	Availability of standard procurement documents (like standard purchase order document, sub-contract document, and supplier/vendor agreement)					
4.	Level of supplier and subcontractor qualification screening in the project					
5.	Level of documented contract management or administration processes in your organization					
6.	Level of defined process for managing contract change					

7.	Level of defined process for payment review and authorization					
8.	Level of defined process for contract closing					

Additional comments: _____

11. Project Stakeholder Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Practice of undertaking a formal stakeholder analysis in the project. (Stakeholders include client, consultants, subcontractors, material suppliers, service providers, community, regulatory agencies etc.)					
2.	Availability of a formal stakeholder management plan (a devised strategy on how to deal with the need and expectation of relevant stakeholders)					
3.	Continuous effort to work and communicate with stakeholders for influencing their expectation, resolve issues and address their concern					
4.	Monitoring of overall project stakeholder relationships					

Additional comments: _____

12. Project Safety Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Application of organizational policies, procedures and guidelines for safety management					
2.	Level of safety planning performed (includes determining safety standards & requirements, devising action plans or strategies, staffing, allocating budget)					
3.	Level of site neighborhood safety characteristics study done					
4.	Level of hazard analysis performed for project activities					
5.	Level of safety control process implemented (inspecting whether project activities comply with safety standards)					
6.	Application of safety audit (a review whether project activities complied with safety requirements)					
7.	Provision of personal protective equipment (such as helmets, safety shoes, safety vests) for all workers in the project site					
8.	Level of safety training provided for workers					

Additional comments: _____

13. Project Financial Management

No.	Description	Very Low	Low	Avg.	High	Very High
1.	Level of preparing financial plan for projects including when and how much project funding is needed					
2.	Consideration of effects in changing exchange rate, escalating labor and material cost in the plan					
3.	Frequency of cash flow analysis done for the project					
4.	Effort in controlling the project finance to make sure that money is properly spent as planned and properly authorized					
5.	Frequency of preparing timely financial reports of the project					
6.	Level of established system or procedure for creating and handling financial documents					
7.	Reliability of financial audits done in the project					
8.	Practice of using a standard process and format to record, store and report financial information					
9.	Practice of using computer systems in filling and retrieval of financial information in the project					

Additional comments: _____

Thank You for Your Cooperation

Appendix – 2: List of Projects Undertaken by YOTEK Construction PLC in AA

NO.	List of Projects Currently Undertaken by YOTEK Construction PLC in Addis Ababa	Type of Project
1	Addis Ababa Science and Technology University (AASTU) Research and Technology Center Construction (Lot-1)	Building Construction
2	Addis Ababa University (AAU) College of Health Science 2B+G+12 Student Dormitories Construction	Building Construction
3	Addis Ababa University (AAU) 6 kilo Forum Building (3B+G+14) Construction	Building Construction
4	Addis Ababa Meles Zenawi Leadership Academy (AAMZLA) Construction, consisting: Syndicate and Lecture room (2B+G+6); Office Tower (2B+G+13); Conference Hall (2B+G+5); Indoor Game Hall (2B+G+4); Dormitories (1B+G+10).	Building Construction
5	Package 20 Road Project: Shiromeda – Kuskuam Asphalt Road Project	Road Construction
6	Package 36 Road Projects: FAFA Food Factory – Dama Hotel – Bihere Tsige – Sene 9 School – Debrezeyt Road Asphalt Road Project	Road Construction
7	AMOLEITA Educational Institution Construction	Building Construction
8	40/60 Saving Condominium House (2B+G+12) Construction at Bole Beshale Site	Building Construction
9	Addis Ketema Justice Office & Law Court Building (B+G+M+6) Construction (Lot-1)	Building Construction
10	Mekodonya Homes for Elderly and Mentally Disordered People	Building Construction

Appendix – 3: Item/Component Descriptives

Descriptive Statistics and Rank

	N	Minimum	Maximum	Mean	Rank	Std. Deviation
Scope_#1	52	2	5	3.81	4	.841
Scope_#2	52	1	3	1.50	85	.672
Scope_#3	52	1	4	3.04	27	.816
Scope_#4	52	2	5	3.65	8	.926
Time_#1	52	2	5	3.46	11	.779
Time_#2	52	3	5	3.90	2	.748
Time_#3	52	3	5	3.96	1	.766
Time_#4	52	2	5	3.71	7	.871
Time_#5	52	1	4	2.37	58	.793
Time_#6	52	2	5	3.42	12	.825
Time_#7	52	1	3	1.48	86	.641
Cost_#1	52	2	5	3.62	9	.796
Cost_#2	52	3	5	3.77	5	.731
Cost_#3	52	1	5	3.12	22	.963
Cost_#4	52	1	3	1.69	76	.781
Cost_#5	52	1	5	2.88	35	1.041
Cost_#6	52	2	4	3.10	25	.748
Cost_#7	52	1	3	1.31	87	.579
Cost_#8	52	2	5	3.06	26	.850
Quality_#1	52	2	4	3.04	27	.740
Quality_#2	52	1	4	2.23	62	.757
Quality_#3	52	1	4	2.71	39	.915
Quality_#4	52	1	4	2.60	47	.846
Quality_#5	52	1	4	1.67	77	.706
Quality_#6	52	1	4	2.58	51	.848
HR_#1	52	1	4	2.69	41	1.020
HR_#2	52	1	4	2.40	56	.955
HR_#3	52	1	4	2.17	64	.785
HR_#4	52	1	4	2.13	65	.971
HR_#5	52	1	5	2.92	32	1.007
HR_#6	52	1	4	2.42	54	.893
Equipment_#1	52	1	4	2.04	67	.766
Equipment_#2	52	1	4	1.96	69	.766
Equipment_#3	52	1	4	1.56	81	.777
Equipment_#4	52	1	5	2.65	45	1.083
Equipment_#5	52	1	3	1.56	81	.669
Equipment_#6	52	1	5	2.31	60	1.112
Materials_#1	52	1	4	2.69	41	1.039
Materials_#2	52	1	3	1.96	69	.862
Materials_#3	52	1	5	2.71	39	1.242
Materials_#4	52	1	5	2.90	34	1.142
Materials_#5	52	1	5	2.60	47	1.015
Materials_#6	52	2	4	2.60	47	.799
Materials_#7	52	2	5	3.12	22	.855
Comm_#1	52	2	5	3.17	17	.901
Comm_#2	52	2	5	2.69	41	.829
Comm_#3	52	1	4	1.56	81	.698
Comm_#4	52	1	5	3.17	17	1.167
Comm_#5	52	2	5	3.77	5	1.002
Risk_#1	52	1	3	1.58	80	.572
Risk_#2	52	1	4	2.25	61	.711

Risk_#3	52	1	3	1.88	72	.704
Risk_#4	52	1	4	2.06	66	.752
Risk_#5	52	1	4	1.88	72	.758
Risk_#6	52	1	4	1.63	78	.742
Risk_#7	52	1	4	1.71	75	.723
Risk_#8	52	1	3	1.56	81	.574
Risk_#9	52	1	3	1.63	78	.627
Procure_#1	52	1	5	3.00	30	.929
Procure_#2	52	1	5	3.17	17	1.080
Procure_#3	52	2	5	3.85	3	.894
Procure_#4	52	1	4	2.42	54	.776
Procure_#5	52	2	5	3.13	20	.950
Procure_#6	52	1	4	2.63	46	.864
Procure_#7	52	1	4	2.50	53	.980
Procure_#8	52	1	4	2.35	59	.738
Stakeho_#1	52	1	4	1.98	68	.918
Stakeho_#2	52	1	3	1.87	74	.817
Stakehol_#3	52	1	5	3.12	22	1.078
Stakeho_#4	52	1	4	2.69	41	.919
Safety_#1	52	2	5	3.37	15	.886
Safety_#2	52	1	4	2.40	56	.774
Safety_#3	52	1	4	2.21	63	.825
Safety_#4	52	1	4	2.73	38	.843
Safety_#5	52	2	4	2.83	37	.678
Safety_#6	52	1	4	1.90	71	.934
Safety_#7	52	2	5	3.23	16	.877
Safety_#8	52	1	4	2.56	52	.978
Financial_#1	52	1	5	3.04	27	.949
Financial_#2	52	1	4	2.87	36	.864
Financial_#3	52	1	4	2.60	47	.823
Financial_#4	52	1	5	2.92	32	.987
Financial_#5	52	2	5	3.54	10	.779
Financial_#6	52	2	5	3.38	14	.771
Financial_#7	52	1	4	3.13	20	.793
Financial_#8	52	2	5	3.42	12	.801
Financial_#9	52	1	5	2.94	31	.958
Valid N (listwise)	52					

Appendix – 4: Knowledge Area Cronbach's Alpha if Item Deleted

Item-Total Statistics (per knowledge area)

Item/ Component	Knowledge Area Mean if Item Deleted	Knowledge Area Variance if Item Deleted	Corrected Item-Total Correlation per Knowledge Area	Squared Multiple Correlation per Knowledge Area	Knowledge Area Cronbach's Alpha if Item Deleted
Scope_#1	8.19	3.452	.764	.815	.642
Scope_#2	10.50	4.490	.565	.599	.755
Scope_#3	8.96	3.332	.857	.791	.592
Scope_#4	8.35	4.505	.301	.350	.893
Time_#1	18.85	12.054	.643	.680	.839
Time_#2	18.40	11.696	.759	.803	.823
Time_#3	18.35	11.525	.774	.714	.821
Time_#4	18.60	11.618	.634	.684	.841
Time_#5	19.94	11.663	.710	.741	.829
Time_#6	18.88	12.418	.523	.422	.857
Time_#7	20.83	13.950	.371	.327	.871
Cost_#1	18.92	19.955	.631	.642	.888
Cost_#2	18.77	19.357	.806	.766	.873
Cost_#3	19.42	19.935	.490	.656	.905
Cost_#4	20.85	19.427	.733	.689	.879
Cost_#5	19.65	18.231	.648	.751	.890
Cost_#6	19.44	19.310	.792	.808	.874
Cost_#7	21.23	21.201	.665	.641	.888
Cost_#8	19.48	18.451	.809	.832	.871
Quality_#1	11.79	9.503	.537	.787	.810
Quality_#2	12.60	9.108	.617	.805	.795
Quality_#3	12.12	8.418	.611	.568	.796
Quality_#4	12.23	8.181	.744	.691	.765
Quality_#5	13.15	10.015	.444	.550	.827
Quality_#6	12.25	8.662	.624	.621	.792
HR_#1	12.06	13.153	.704	.572	.843
HR_#2	12.35	13.760	.668	.708	.849
HR_#3	12.58	14.053	.805	.813	.831
HR_#4	12.62	13.300	.729	.648	.838
HR_#5	11.83	13.989	.585	.456	.865
HR_#6	12.33	14.695	.572	.440	.865
Equipment_#1	10.04	11.802	.655	.774	.821
Equipment_#2	10.12	11.241	.781	.817	.800
Equipment_#3	10.52	12.019	.596	.443	.831
Equipment_#4	9.42	10.719	.557	.405	.846
Equipment_#5	10.52	12.215	.679	.499	.822
Equipment_#6	9.77	9.985	.657	.465	.825
Materials_#1	15.88	19.947	.571	.573	.840
Materials_#2	16.62	19.653	.776	.709	.814

Materials_#3	15.87	18.668	.570	.958	.845
Materials_#4	15.67	18.107	.712	.957	.818
Materials_#5	15.98	20.882	.476	.714	.853
Materials_#6	15.98	20.921	.653	.652	.831
Materials_#7	15.46	20.528	.654	.711	.830
Comm_#1	11.19	8.551	.523	.334	.781
Comm_#2	11.67	8.107	.704	.662	.730
Comm_#3	12.81	9.609	.468	.522	.797
Comm_#4	11.19	6.315	.757	.600	.702
Comm_#5	10.60	8.128	.523	.394	.784
Risk_#1	14.62	16.830	.731	.648	.875
Risk_#2	13.94	16.408	.639	.745	.881
Risk_#3	14.31	15.825	.762	.866	.871
Risk_#4	14.13	16.158	.640	.924	.881
Risk_#5	14.31	16.805	.516	.804	.892
Risk_#6	14.56	16.408	.604	.947	.884
Risk_#7	14.48	16.058	.692	.957	.877
Risk_#8	14.63	16.942	.702	.841	.877
Risk_#9	14.56	16.957	.627	.702	.882
Procure_#1	20.06	22.801	.690	.926	.874
Procure_#2	19.88	21.869	.668	.924	.878
Procure_#3	19.21	22.484	.766	.788	.867
Procure_#4	20.63	24.393	.625	.560	.881
Procure_#5	19.92	22.661	.687	.831	.874
Procure_#6	20.42	22.210	.838	.918	.860
Procure_#7	20.56	22.330	.701	.918	.873
Procure_#8	20.71	26.523	.357	.245	.901
Stakeho_#1	7.67	6.656	.759	.677	.897
Stakeho_#2	7.79	6.994	.794	.719	.889
Stakehol_#3	6.54	5.900	.769	.793	.901
Stakeho_#4	6.96	6.155	.898	.859	.849
Safety_#1	17.87	19.413	.540	.653	.863
Safety_#2	18.83	19.911	.566	.596	.860
Safety_#3	19.02	19.274	.616	.752	.855
Safety_#4	18.50	18.451	.726	.809	.843
Safety_#5	18.40	19.814	.686	.718	.850
Safety_#6	19.33	19.832	.446	.457	.875
Safety_#7	18.00	18.235	.722	.852	.843
Safety_#8	18.67	17.401	.742	.743	.840
Financial_#1	24.81	25.649	.540	.680	.885
Financial_#2	24.98	25.823	.589	.719	.880
Financial_#3	25.25	26.701	.513	.658	.886
Financial_#4	24.92	24.425	.650	.694	.876
Financial_#5	24.31	26.531	.574	.446	.881
Financial_#6	24.46	25.312	.752	.860	.868
Financial_#7	24.71	25.111	.755	.691	.867
Financial_#8	24.42	25.229	.730	.842	.869
Financial_#9	24.90	24.089	.716	.745	.869