Assessment of Project Management Maturity on Selected Research Projects: The case of Armauer Hansen Research Institute (AHRI)

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ADDIS ABABA UNIVERSITY
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DEPARTMENT OF BUSINESS ADMINISTRATION AND INFORMATION SYSTEM

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DECLARATION

I declare that the research topic entitled "Assessment of Project Management Maturity on Selected Research Projects: The case of Armauer Hansen Research Institute (AHRI)" is my work. Sources and Materials used in the thesis have been duly acknowledged. The work had not been submitted to any educational institutions to meet the requirements of any award.

Asfaw Debella **Date**

September, 2024

CERTIFICATE

This is to certify that the thesis prepared by Asfaw Debella, entitled: "Assessment of Project Management Maturity on Selected Research Projects: The case of Armauer Hansen Research Institute (AHRI)" submitted in Partial Fulfillment of the requirements for the degree of a Master of Arts degree in Project Management complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Wubeshet Bekalu (PhD)

Research Work Advisor

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ABBREVIATIONS AND ACRONYMS

AHRI	Armauer Hansen Research Institute
ALERT:	All-Africa Leprosy, Tuberculosis, and Rehabilitation Training Centre
EPHI:	Ethiopian Public Health Institute
FMOH:	Federal Ministry of Health
GMU:	Grant Management Unit
GTP:	Growth and Transformation Plan
HSTP:	Health Sector Transformation Plan
IRB:	Institutional Scientific and Ethical Review Board
MDG:	Millennium Developmental Goal
NORAD:	Norwegian Agency for Development Cooperation
PMMM:	Project Management Maturity Model
PMBOK:	Project Management Body of Knowledge
SAEO:	Strategic Affairs Executive Office (former Planning, Partnership and Grant Management Directorate)
SOP:	Standard Operational Procedure
SMART:	Stands for Specific, Measurable, Achievable, Realistic and Timely
SDG:	Sustainable Developmental Goal
SIDA:	Swedish International Development Cooperation Agency
SP:	Strategic Planning
WHO:	World Health Organization

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ABSTRACT

The main purpose of this study was to assess the research project management maturity level, determine the project management body of knowledge, and identify the limitations in the project management practice of the Armauer Hansen Research Institute (AHRI). AHRI is the core technical wing of the Ministry of Health that generates evidence on a scientific basis from health research projects for informed decision-making by the Ministry. Although there are extended efforts for the successful accomplishment of research project management at AHRI, there are challenges and limitations in the project management that are displayed by the delays of projects, cost overruns, inferior deliverables quality, in some cases research project termination. This emphasizes the crucial need for the implementation of an efficient project management system and practices as a core competence to achieve the strategic goals of the institute. The study employs a cross-sectional mixed study design using primary and secondary data to collect pertinent information and identify various factors on project management maturity and knowledge areas. The maturity assessment was based on a five-level project management maturity model devised by PM Solutions to assess selected research projects ethically reviewed and approved by the Institutional Review Board of AHRI. Descriptive statistics of frequency mean standard deviation, and percentage tables were used to present the results of the study. The result of the study was obtained through empirical analysis and review of project management processes. Findings from the assessment indicated that the overall project management capability of AHRI is at maturity level 2. The result revealed that some project management processes were defined but not consistently applied to all projects. The outcome supports the need for improving the project management knowledge and practices of the institute for positive change to the success of research projects. Based on the result, it was concluded that most of the knowledge areas were being practiced informally, hence possessing lower maturity levels. Some of the knowledge areas relatively have higher maturity as compared to the others. This difference was attributed to a lack of proper integration of project management knowledge and practices. Therefore, improving project management knowledge areas and practices, devising appropriate mechanisms for tracking performance and financial utilization, creating project management standards, and awareness creation of the leadership towards efficient project management, supporting the project management unit within the Strategic Affairs Executive Office, and providing training to researchers on project management have been recommended as a means of improving project management practice and attaining higher maturity in AHRI.

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***Keywords**: Project management, maturity model, capability assessment*

CHAPTER ONE

I. INTRODUCTION

1.1 Background of the Study

Projects remain the mechanism of choice for international development partners, governments, and policymakers to alleviate developmental challenges and enhance economic growth. Project management plays a vital role in any organization's transformation from being less organized, less standardized, and less documented to one that achieves higher standards with greater consistency (Snyder, 2014). Project maturity is one of a project's key success factors which relies on good project portfolio management within the organization to improve the likelihood of meeting quality expectations, the allocated cost and time, and the set project goals. Project Management Maturity models (PMMM) provide a framework for an organization's improvement efforts and provide a guide to develop capability. It is the foundation for achieving excellence in project management (Jugdev and Thomas, 2002).

Assessment of project management maturity allows the organization to enhance its project management capability (Albrecht and Spang, 2014). It is also useful to identify the project management culture in organizations; particularly targeted to determine the limitations and strengths of the project management processes. This could support the measures for continuously improved systems, better project management performance, and a high probability of project success (Pennypacker et al., 2002; Ferreira and Pereira, 2015). Maturity in project management is a never-ending task, with a never-ending cycle of bench-marking and continuous improvement. A high value of project management maturity ensures best performance for delivering projects whereas project performance will be poor for less mature project management processes. Hence, organizations, that evaluate their project management capabilities continually improve their project performance effectively and efficiently to successfully meet the expected goal and thus have a competitive advantage in the marketplace (Qureshi et al., 2009).

The globalized world is highly competitive due to the rapidly changing environment henceforth requiring an efficient and effective execution of projects as a crucial component for competitive advantage and successful outcome of projects (Alvarenga et al., 2019; Jugdev and Müller, 2005). Currently, almost half of the world's economic activity is delivered through projects and programs in the form of gross capital formation and this number even tends to be higher in emerging and transition economies than in developed ones (World Bank, 2014; Youker, 1999). Project failures are estimated to cost billions of euros and dollars annually, regardless of developed and developing countries (Joslin and Müller, 2016). Approximately 30% of all projects incur cost overruns, miss deadlines of completion, or do not meet the quality standards requirements (Busse et al., 2020).

The effect of project management maturity on the success of projects may vary across nations. Hence, it is vital to study the impact of project management maturity on project management success (Bond-Barnard et al., 2015). Numerous studies on project management maturity have been undertaken in developed countries. Some of the study's findings report include the USA (Grant and Pennypack, 2006; Ibbs and Kwak, 2000), Canada and North America (Mullaly, 2006), the United Kingdom (Brookers, 2014; Busse, 2020; Albrcht and Spang, 2016), Sweden (Backlund et al., 2014), Italy and Brazil (Archibald and Prado, 2014b). The various studies found that organizations with higher levels of project management maturity are successful in terms of project effectiveness and efficiency and thus have a competitive advantage in the marketplace. The studies also indicated the relationship between the project's success and the levels of project management maturity.

Africa is progressively becoming the global growth driver due to long-term investment. Projects have been employed extensively as a mechanism for economic development. However, the performance of projects in Africa is very poor, henceforth, project stakeholders and beneficiaries have been dissatisfied with the results and impacts of projects (Ika et al., 2012). The few studies that have been conducted in Africa are exemplified by the case in Ghana where organizations operating in the non-profit, non-governmental organization category exhibited higher maturity levels compared to private companies and state-owned organizations (Ofori and Deffor, 2013).

The study conducted on project management organization executives, project managers, and staff in Southern Africa displayed the highest impact on the performance outcome in nine knowledge areas of project management (Khalema, 2015). Pretorius et al., (2012 and 2021) found that the average perceived project management maturity level in the engineering and construction industries in Southern Africa was 2.88 (57.6%), which is lower compared to similar other studies. The results of the project management maturity study in Botswana revealed serious insufficiency in project risk management maturity (Tembo and Rwelamina, 2021). Analysis of project management maturity in Cameroon public projects revealed a maturity level of 68% which affected the delivery of efficient services (Kala Kamdjoug and Motcheka, 2015). In Egypt, Abu El-Maaty et al., (2017) reported the poor competency of contractor's technical staff to accomplish the projects, which led to low project maturity. Similarly, the study conducted in Nigeria showed design defects, inadequate contract management, and poor financing leading to time and cost overruns resulting in low project maturity which are important focal areas for improvement (Koko et al., 2013; Abdulrahman et al., 2019).

Empirical studies conducted in Ethiopia mainly emphasized the construction and financial sectors for the determination of the level of project management maturity. The study conducted by Yimam (2011) on project management maturity in the construction industry found that 22% of the contractor's cost management process is incomplete, resulting in projected cost overruns in the construction industry. Likewise, Tebeje (2015) also pointed out that the main factor causing cost overruns in construction projects was poor planning. The assessment of the project management office of the information technology division of Ethiopian Air Lines revealed an overall maturity value of 49%, which is an intermediate level (Kidane, 2022). Strong positive correlations (Pearson's ranging from 0.502 to 0.677) were observed for all measures of project success and project management maturity scores of Levels-1 and Level-2 in the construction industry (Hailemarkos, 2020). Assessment of the project management maturity level in the housing projects of Addis Ababa showed an overall project management maturity of level 2 in ten PMBOK's area which is in a basic project process (Demes, 2023). Similarly, Haile, (2018) showed that the overall level of project management maturity of METEC was Level 3. on the maturity ladder. Ambaw (2017) indicated that project cost management was considered the most important aspect compared to the management of other knowledge areas in the financial performance of banks in Ethiopia.

Which indicated the proximity of project management maturity and cost. Likewise, Ejigu, 2017 indicated lack of proper integration of the knowledge areas practices with project management practices contributed to the lowered maturity level of the Commercial Bank of Ethiopia.

Despite the importance of the determination of the project management capability using the project management maturity model (PMMM) for providing a guide for improvement and best practices in the project management of an organization, there are no so far reports of empirical studies conducted on the health sector project maturity. This necessitates undertaking studies on the status of project management maturity in institutions such as the Armauer Hansen Research Institute (AHRI) which entertains mega research projects. The Armauer Hansen Research Institute (AHRI) is the core technical arm or wing of the Ministry for generating evidence on a scientific basis from health research of various disciplines. The Ministry of Health and the health sector generally use scientific evidence generated from health research projects for informed decision-making, formulating policies, developing strategic plans to protect the public from health threats as well as improving the accessibility and quality of health care delivery (Ministry of Health, 2015 and 2021). Considering the significant roles played by AHRI in health research projects that support designing initiatives and programs to improve the health care system, an overview is given about AHRI below under organizational background.

1.2 Background of the organization

The Armauer Hansen Research Institute (AHRI) located next to the All-Africa Leprosy Rehabilitation and Training Hospital (ALERT) was established in 1970 as a biochemical research institute through the ingenuity of the Swedish and Norwegian Save the Children organizations supported by the Ministry of Health. It is named after Gerhard Henrik Armauer Hansen, the Norwegian physician who first described the bacteria that caused leprosy, *Mycobacterium leprae*. The institute became part of the All African Leprosy, Rehabilitation and Training Center (ALERT) hospital as a research department and researched leprosy, TB, leishmaniasis, and various hospital-related studies. It has made significant contributions to the understanding of leprosy and its control (AHRI, 2024A).

AHRI fully joined as a technical arm of the Ministry of Health in 2016 by proclamation No.376/2016 following the decision of the Council of Ministers. According to the proclamation, its stipulated missions are to improve medical care, health, and well-being of the public, develop new and improved tools and methods through medical and clinical research, and capacity building in medical research and research training besides serving as a core point for technology transfer (Proclamation no. 376/2016).

AHRI is dedicated to generating and delivering scientific evidence for decision-making in infectious disease prevention and control, and its mission is to improve medical care by advancing the health and well-being of the public through health research and training as well as disseminating scientific and technological knowledge.AHRI has received marked recognition internationally and is considered to be a prominent research institution in the are**as of** basic and applied biomedical research, epidemiological, and translational research (AHRI, 2024A and 2024B).

The recently issued mandate of AHRI by the Council of Ministers following the restructuring of all the agencies under the Ministry of Health indicated under regulation no. 530/2023 gave a mandate as an autonomous federal government office having its legal personality to lead and conduct basic, applied, medical, preclinical, clinical and bioequivalence, translational, operational, epidemiological research on communicable and non-communicable diseases, and other areas based on the ministries national research priority areas (Regulation no. 530/2023). The second Strategic Planning (SP-II) of the AHRI from 2020/21 to 2091/30 is currently in the implementation process. Alignment of the SP-II was done with the second Health Sector Transformation Plan (HSTP-II) of the Ministry of Health and other relevant national (GTP-II) and global health security documents such as Sustainable Developmental Goal (SDG) and other strategies, and frameworks. The implementation and overseeing of the various health research projects of the AHRI are undertaken by the principal investigator, project manager, and project teams, the AHRI/ALERT Ethical Review Committee (AAERC); the Strategic Affairs Executive Office, (SAEO); Grant Management Unit (GMU) and the research directorates where the respective research projects are undertaken following up the progress as well as the executive offices such as Competence and Human Resource, Property and Finance also plays a role for the success of projects (AHRI, 2020).

Despite the remarkable accomplishment of the former AHRI strategic planning and the contributions of the research projects for the informed decision-making on medical intervention and influence the health program improvement, there could be difficulties and challenges to completing research projects within the timeline and allocated budgets, and there may be also inconsistency in project performance quality. These and other difficulties and challenges are attributed to the project management system of the institute. These conditions raise the need for an efficient and effective research project management system to be in place within AHRI to contribute, support, and strengthen the various interventional, and disease prevention and control health programs in the health sector through evidence generation and technology outputs to entertain the challenge of the continued pressure of quadruple burden of diseases and public health challenges as well as addressing the growing unmet health care need in the health sector of Ethiopia.

The results of the research endeavor of AHRI are very crucial for the Ministry of Health, and the health sector for informed decision-making and in designing initiatives and programs aimed at protecting public health. This entails the importance of an efficient research project management system and practices in AHRI to meet the desired project outcomes. The significance of an efficient and effective project management system and practices is to meet the highest standard level of project management maturity as a core competence to achieve the strategic goals of the institute thereby the HSTP-II of the Ministry of Health (Ministry of Health, 2021). Thus, this study intends to evaluate the research project management maturity level and the project management practice in AHRI, thereby proposing means of intervention to improve the research project management maturity level.

1.3 Statement of the Problem

Managing projects has been crucial for the success of any organization's survival and sustainability. Thus, evaluating organizational capabilities towards project management, analyzing the gaps, and creating enabling and corrective measures for improvement of project management maturity level have paramount importance (Levine, 2005; Torres, 2014).

Most projects' cost overruns, late completion times, and failure to meet their objectives when implemented may be attributed to the poor management knowledge areas of projects and the low level of project management maturity that determines the performance, time management, identification, and earlier intervention of the various factors that affect the project outcome (Shenrar and Devir, 2007). Surveys conducted on the performance and success rate of different projects revealed that 64% of donor-funded projects failed to deliver within the timeline and allocated budget, and the required quality features and functions, and 24% total failure due to cancelation before completion (Hekala, 2012). This necessitates the continuous evaluation of the project management level of maturation to find areas of improvement and ensure an acceptable level of project management maturity for better performance achievements of projects. AHRI in line with its vision of becoming the "Center of Excellence in medical research and research training" guided by the values of continuous learning and improvement, creativity and innovation, evidence-based public health, human-centered, proactive and responsive, problem-solving approach, and timely action.

Although there are extended efforts undertaken by the research project coordinators at AHRI, there are still limitations in delays of projects and cost overruns that become the cause for project completion with cost overrun, extended completion time, inferior deliverables quality, poor risk and uncertainty management, in some cases research project termination that may lead to lost confidence by the financial sponsor or partner organization (Degaga, 2022). These problems necessitate an effective and efficient management of the various research projects, whose achievements are very crucial for the success of the strategy.

Henceforth, a need for continuous assessment of the research project management strengths and weaknesses to find areas of improvement and ensure the high value of project management maturity for the best accomplishments of research projects. Reviewing the literature on project management maturity showed very few research works that are focused on the construction and financial sectors' project management maturity levels assessment in the context of Ethiopia (Yimam, 2011; Towlde, 2013; Tebeje, 2015; Ejigu, 2017; Ambaw, 2017; Haile, 2018; Hailemarkos, 2020; Kidane, 2022). However, there are no so far, any of such studies conducted in the health sector projects including research institutes such as AHRI.

Thus, the purpose of this study is to investigate the research project management maturity level and identify the limitations, and gaps in the project management practice in AHRI, thereby proposing means of mitigation to improve the research project management maturity level

1.4 Research Questions

Main research question

What is the level of maturity of research project management, the way project management knowledge practices, limitations and gaps in the practice, and approach to intervening for improvement of project management maturity?

This study will attempt to address the following sub-research questions.

1. What is the current level of capability and maturity of research project management in the AHRI?
2. What are the perception and understanding of Project Management knowledge (PMBOKs) relative importance in AHRI?
3. Which areas of Project Management knowledge (PMBOKs) are being practiced in the context of AHRI?
4. How proficient are the areas of Project Management knowledge (PMBOKs) that are being practiced in AHRI?

1.5 Research Objectives

1.5.1 General Objectives

The major objective of this study is to undertake the research project management maturity level assessment and determine the project management body of knowledge.

.1.5.2 Specific Objectives

The specific objective of this study includes

1. To undertake research project management maturity level determination.
2. To evaluate the area of the project management body of knowledge and proficiency of the practices.

3. To assess the perception and understanding of the relative importance of project management body of knowledge
4. To propose means of intervention to improve the research project management maturity level.

1.6 Significance of the Study

The study will play a role in generating valuable evidence on the situation of project management in AHRI by determining the institute's project management knowledge and maturity level. This could facilitate interventions for improvement. It will identify the different factors contributing to project delays, cost overruns, and attributes for preventive actions. The result will also add value by proposing recommendations and inputs for improved project management practice for research project coordinators, research directorate directors, the Strategic Affairs Executive Office, (SAEO), Grant Management Unit (GMU), and AHRI/ALERT Ethical Review Committee (AAERC) as well as the executive offices such as Competence and Human Resource, Property, and Finance to intervene for best practices of research project management. The findings will serve as a baseline and the lesson learned could stimulate further study for benchmarking best project management practices that favor the desired outcomes of the second Strategic Planning (SP-II) of the institute. The result may also give insight to other research institutes on the importance of such initiatives to improve project management practices.

1.7 Scope of the Study

The scope of the study mainly focused on the area of project management maturity in selected research projects of AHRI due to time and resource constraints. Although efforts will be made by the investigator, the study may not provide complete pieces of comprehensive information on the project management knowledge, practices, and performance data from principal investigators/project coordinators, project managers, and concerned executive offices dealing directly or indirectly with project management.

1.8 Terms and Concepts Operational Definitions

The operational definition used in this proposal

- **A project** is a sequence of unique, complex, and connected activities having one goal or purpose that must be completed by a specific time, within budget, and according to specification (Alexander, 2015)
- **Project Management** is defined as the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements (PMBOK, 2013).
- **Project Maturity in an organizational context** is a state that creates perfect conditions to handle projects for the organization to achieve its desired objectives. (Andersen and Jessen, 2003).
- **Project management maturity models (PMMM)** provide best practices and framework to improve the performance of projects repeatedly and systematically (Brookes et al., 2014)
- **Communication** is the exchanging of information from one point of the project to the other point in an efficient manner (Dortok, 2006).
- **Monitoring and Evaluation System -** to learn, identify limitations, and take timely rectifying measures to keep the project on track (Dortok, 2006).
- **Project Success** has been defined by the criteria of time, budget, and deliverables (Alexander, 2015).
- **Successful project** completed on schedule, within the budget, and in conformance with predetermined performance specifications
- **Unsuccessful project** results in loss of resources, time, and reputation.

1.9 Organization of the Research Report

This research work is organized into five sections. The first chapter provides an overview of the background of the study. In the second chapter, literature related to the study is presented to create an in-depth understanding of the subject matter of the study. This chapter discusses the theoretical frameworks on which the study is founded and empirical reviews on project maturity. The third chapter deals with the methodological approach of the study.

The analysis of the data, results, and discussions of the study's major findings are described in chapter four. The final chapter, chapter five composed of the result summaries, conclusions and recommendations, and implications of the study. Citations of the used references and lists of appendices are indicated towards the end part of the study report.

CHAPTER TWO

II. RELATED LITERATURE REVIEW

This chapter is composed of elaborations on literature related to the concepts of projects and project management, project and non-project organizations, and project management maturity. Previous empirical studies regarding project management maturity are also reviewed, analyzed, and compared.

2.1 Theoretical Review on the Concept of Project and Project Management

A project is defined by various scholars as having similar interpretations. According to Kerzner (2009), a project is a temporary, unique set of coordinated series of activities and tasks that have a specific objective to be completed within defined performance specifications, having a defined beginning and completion time, financial limits, consume human and nonhuman resources (*i.e.*, money, people, equipment), are multifunctional (*i.e.*, cut across several functional lines). The common theme of the definition revolves around some important features of projects. The features include a defined timeline, an objective from the inception, resources and their limitations, specifications, and others. According to PMI (2013), a project has a definite starting and completion timeframe. But this does not necessarily mean the duration is short, it does not also apply to the product, service, or result created by the project. The project comes to an end at the end of the duration when the project's objectives have been accomplished or before the scheduled duration when the project is terminated because its objectives will not or cannot be achieved, or when the project is no longer required by the organization. In projects, each of the three primary targets of cost, time, and performance is likely to be subject to risk and uncertainty (Figure 2.1).

Figure 2.1: Project management triangle (Triple constraints) (Minkiewicz, 2015).

The three elements are interconnected which is an important attribute of managing time, cost, and quality for project work activities. Any change to one of these elements affects one or both of the others and introduces constraints leading to cost overruns, delays, unsatisfactory performance in terms of quality leading to customer and/or end-user dissatisfaction, loss of productivity and revenue, project termination, and lawsuits (Atkinson, 1999).

Projects are distinguished from the organizational operations or processes. An operation or process is defined as ongoing and day-to-day tasks in which organizations are engaged in their activities to produce goods and services (Pinto, 2010). The operation or process management deals with general management. The fundamental difference between Project Management and General Management stems from the difference in the type of work they manage. Project Management deals with the management of projects that are temporary and unique whereas, General Management deals with the management of operations that are ongoing and repetitive. Furthermore, Project activities change continually as the project progresses through its various phases and terminate when the mission is accomplished; whereas operation activities sustain for a long period and continue assuming a broader outlook (PMI, 2004). Despite the existence of fundamental differences between project management and general management, both share many things in common. They mutually share the same basic philosophies, make and implement decisions, allocate resources, manage organizational interfaces, and provide leadership for the people who are involved in performing the work (Cleland and Ireland, 2002). A project is said to be successful if it achieves the triple objective outcome within time, scope, and performance criteria as well as meeting the pre-determined objective and goal of the project and the quality of the project process (PMBOK, 2008; Erling et al, 2006; Lim and Mohamed 1999; Kandelousi and Abdollahi, 2011).

Project success needs to be investigated from the perspective of the project team and stakeholders, from the advantages of the recipients, customers, or end-users, and from the theoretical and practical point of view of critical success criteria and characteristics of the project (Steinfort, 2011). Project management is the utilization of knowledge, skills, tools, and techniques to project activities to achieve the project requirements. Project management is accomplished by applying and integrating the project management processes of initiating, planning, executing, monitoring and controlling, and closing.

Project management is the facilitation of the planning, scheduling, and controlling of all activities that must be done to meet the predetermined project objectives/goals safely, within the agreed scope, cost, time, performance criteria, and customer/end-user satisfaction (PMBOK Guide, 2013; Lewis, 2005). Project management combines and improves the resources such as skills, talents, and collaborative efforts of the project team, facilities, equipment, information, systems, tools, and techniques as well as finance to complete projects successfully. Failing to deliver according to these can result in project failure (Kerzner, 2013). Project management generally helps to clarify goals and identify problem areas and risks, isolates activities and easily monitors outcomes. It improves accountability since activities are isolated from assigned responsibilities. It facilitates focusing on a few specific and important tasks (PMI, 2004). The current growing trend within project management is strategic project management. The strategic project management of an organization involves a holistic way of considering the strategic objectives as a means to meet the organizational goals. Aligning projects with the strategic objectives of the organization creates a clear understanding of the bigger picture.

This leads to a sense of purpose and direction, and team empowerment to work towards common goals. Strategic thinking approaches of projects facilitate not only meeting the triple constraints *i.e.*, time, budget, and project performance (or scope) but also guarantee the sustainable achievement of the organizational strategic objectives and goals (Jugdev, 2003; Shenhar,2004). The project management knowledge area comprises the complete set of concepts, techniques, and processes that require the technical expertise of the profession or area of specialization, a project management field that employs always on projects (PMI, 2013). A brief description of the twelve project management knowledge areas is elaborated as follows.

Project integration management: It comprises of activities that identify, define, combine, unify, and coordinate the various processes of project management within the project management process groups (PMI, 2013). This knowledge area addresses and links all of the deliverables from the process groups into the unified as whole (Wysocki, 2014).

Project scope management: It considers all the work and the process requirements that the project is expected to include to complete the project successfully. In general, the management of the project scope is primarily concerned with defining and controlling what is equally important and explicitly excluded in the project (PMI, 2013).

Project time management: It consists of the process requirements to manage the completion of the project within a set time (PMI, 2013). It includes the estimation of time for the duration of the project task as well as the effort or labor time required to complete project tasks. It is also involved in the comparison of the estimated time plan with the actual implementation time as well as managing the schedule and cost variances (Wysocki, 2014).

Project cost management: This comprises the process requirements in planning, estimating, budgeting, financing, funding, managing, and controlling the costs to complete the project within the approved budget and set timeframe (PMI, 2013).

Project quality management: It describes the performing of processes and activities of the projects as per the determined organizational quality policies, objectives, and responsibilities so that the project will meet the requirements for which it was undertaken (PMI, 2013).

Project human resource management: It focuses on various actions related to the features of the human in the execution of the project. According to PMI (2013), it includes the various processes of organizing, managing, coordinating, and leading the project team.

Project communication management: This includes the processes required to ensure the timely planning for the collection, creation, distribution, storage, retrieval, management, control, and monitoring for the ultimate disposition of the information of the project (PMI, 2013).

Project risk management: It considers the whole processes in risk management. It includes the planning, identification, analysis, response planning, and controlling risk on a project. Its objectives are to increase the likelihood and impact of positive events while decreasing the likelihood and impact of negative consequences of the project (PMI, 2013).

Project procurement management: The processes necessary to purchase or acquire products, services, or result needs of the project that is carried out outside the project team (PMI, 2013).

Project stakeholder management: It comprises 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 (PMI, 2013).

Project Health, Safety, Security, and Environmental Management: It is the process of assessing and controlling environmental factors that can potentially affect the health of workers during the project and the operation deliverables. Its goal is to prevent disease, accidents, injuries, or environmental damage and create a health-supportive environment (PMI, 2013).

Project Finance Management: It is also called project budget management. It consists of the process of handling all financial aspects of a project in an organization. It also includes key steps such as estimation, budgeting, risk management, and financial reporting. (PMI, 2013).

2.2 Project Management Maturity

Organizations or institutions are adopting project management practices as an essential capability to achieve the organization's strategic goal. Project management emphasizes on the connection between the organization's competence in managing programs, portfolios, and projects and its effectiveness in implementing strategy. It also endows organizations with skills, knowledge, tools, and techniques to plan, execute, control, and monitor the success of projects (Shenhar et al., 2001). Organizations are striving to deliver projects effectively and successfully because project management has become the dominant way to accomplish organizational strategies.

The degree to which an organization is capable of practicing project, program, and portfolio management in alignment with the achievement of strategy is referred to as its organizational project management maturity (Grant and Pennypacker, 2006). Maturity in the context of an organization is a state that creates the precise conditions for the organization to accomplish its anticipated objectives (Mateen, 2015). The trend in the use of maturity models for increasing an organization's performance has been growing since it could be employed in the diagnosis of the project management culture in organizations.

Project management maturity aims to identify limitations and strengths in its management of project processes so that it can then define a set of actions and measures to better its execution as an organization (Ferreira and Pereira, 2015). Maturity is, "the full development or a complete condition that signifies the understanding or visibility as to why success occurs and ways to prevent common difficulties". Dinsmore (1999) describes project management maturity as: "… a measure of an organization's effectiveness in the behaviors concerned in delivering projects". Dinsmore (1999) additionally disputes that a maturity assessment is a way of establishing the extent to which the organization has combined project management into its mode of working. The more superior the organization or institute is in delivering projects, the higher in enhancing its maturity. Organizational maturity indicates that competency must be grown over time. This is related to capabilities that can produce repeatable success in project management.

Project Management Maturity Models (PMMM) provide a systematic way to perform benchmarking and hence are adding significant value to existing organizations. The Maturity Models grant an evaluation framework that facilitates an organization to compare its project delivery with best practices or against competitors, eventually defining a structured route to improvement (Project Management Institute, 2003). According to Levin and Skulmoski (2002), project management improvement does not happen instantly, and it cannot be applied when desired. The results of a project management maturity assessment provide the opportunity to continually improve and develop an organization's competitive advantage and promote its business through projects. The maturity models provide a roadmap to facilitate organizations to increase their competence to deliver projects as per the schedule, within budget, and according to the desired technical quality performance.

Maturity models provide a progressive standard to facilitate the organization's continuous improvement in their project management processes. Evaluation of the project management maturity accumulates evidence by assessing the organization's performance against the requirements as outlined in the maturity model. It then makes a judgment of whether a certain level of maturity has been achieved or not (Levin and Skulmoski, 2000).

2.2.1 Project Management Maturity Models

There are numerous maturity models in use today to measure the project management maturity of a project in an organization. The models illustrate the differences among organizations in terms of their utilization of projects as a means to achieve objectives (PMI, 2004). Maturity in an organizational context is a state that creates the perfect condition for an organization to accomplish its desired objectives (Mateen, 2015). Andersen and Jessen (2003) described that maturity, when applied to project organization, provides perfect conditions to handle projects. Maturity models are employed in the diagnosis of project management culture in organizations. It is also aimed to identify weaknesses and strengths in their project management processes. There are different maturity models although they may have limitations in scope. Some of these models are organizationally focused maturity models and the others are project-based models. Some of the maturity models that are widely used in modern project management practices are described briefly as follows.

1) **Capability Maturity Model Integrated by Software Engineering Institute (SEI-CMMI):** The model was developed by the Software Engineering Institute (SEI) at Carnegie Mellon University in 1991. The model was primarily developed to evaluate software contractor`s capability for contract award and administration purposes. Later the model has been used by software developers as a guide for the improvement of their processes (Mateen, 2015). This model was subsequently substituted by its successor, the Capability Maturity Model Integration (CMMI) in 2002. The latest version of CMMI consists of a structure that permits the generation of multiple models.

   CMMI guides in managing, measuring, and monitoring software development processes and helps organizations enhance the software development processes for both products and services by describing the features of best practices. CMMI deals with the five maturity levels that can only be reached one after the other to exert an improvement in the process of the maturity level stages (SEI, 2006).

Level 1- Initial: The processes are variable, poorly controlled, and responsive to situations at this level. The software process is characterized and set up solely in response to a specific situation or problem without considering wider issues.

Level 2- Managed/ Repeatable: It is a basic project management process established to track cost, schedule, and functionality. The processes are planned, documented, executed, monitored, and controlled at the project level to duplicate the earlier project's successes with similar applications. This stage is often reactive.

Level 3- Defined: The software process for both management and engineering activities is documented, well characterized, understood, and integrated into a standard software process for developing and maintaining software at this maturity level. Processes, standard values, techniques, tools, etc. are defined at the level of the organization. The stage is a proactive level.

Level 4- Quantitatively Managed: Detailed measures of the software processes and product quality are controlled using statistical and other quantitative techniques. Both the software process and products are quantitatively understood and controlled.

Level 5- Optimizing: When the organization reaches at this level, the process performance is persistently improved by quantitative feedback from the process and through incremental and innovative ideas, and technological improvements.

Paulk et al. (1993) structured the internal architecture of the CMMI model along the lines illustrated in the following Figure 2.2. Each maturity level is composed of key process areas consisting of a cluster of activities; when these activities are collectively executed they achieve the goals necessary for enhancing process capability.

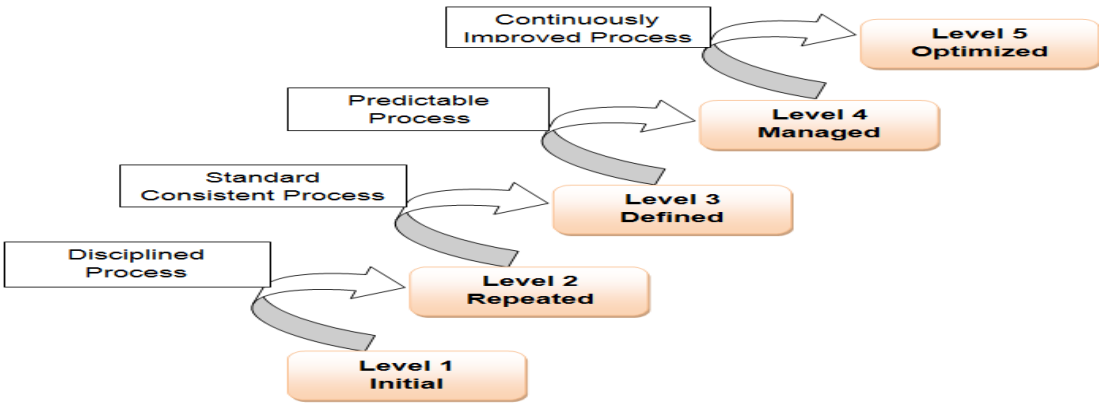

Figure 2.2: CMM for Software Development Source Paulk et al., (1993).

2) /Organizational Project Management Maturity Model (OPM3) by Project Management Institute: Organizational Project Management Maturity is defined as "The extent to which an organization practices organizational project management". OPM3 is a structure that grants an organization-wide sight of portfolio management, program management, and project management to support in accomplishing best practices. OPM3 is intended to support organization that wishes to initiate improvements and determine the capabilities. It is required to achieve the desired best practices to manage portfolios and meet their strategic objectives through successful delivery while conserving limited organizational resources (PMI, 2003 and 2008A).

Figure 2.3: Organizational Project Management Maturity Model (OPM3) Source: PMI, 2003

OPM3 framework cycle comprised of three general elements *i.e.*, acquire knowledge, perform assessment, manage improvements, and repeat the process for measuring maturity. Each of the progressions is a continuum along which most organizations aspire to advance. These two dimensions are the progressions of incremental capabilities leading to each best practice which can be graphically illustrated as shown in Figure 2.3. The details of the OPM3 framework cycle of the general elements for measuring maturity are explained below (PMI, 2008A).

Acquire Knowledge: This element of the OPM3 cycle comprises the groundwork for the evaluation of project management maturity using the list of questions for self-assessment. It accompanies the knowledge foundation and contains the complete list of best practices. A good understanding of OPM3 contents and organization for project management practices are developed before carrying out an assessment.

Perform Assessment: This comprises the collection of all the data required for the measurement of maturity evaluation. The PMI has formulated a set of self-evaluation method (SAM) questionnaires to enable an organization a comprehensive assessment of its project management practice. The outcome of the data is devised in the form of a graph that depicts the organization's maturity level for project, program, and portfolio management.

Manage Improvements: The outcome from the performance assessment stage is matched up against best practices and standard value of project, program, and portfolio management. This best practice standard defined by PMI provides the basis for enhancement. The result of a comparison between the current practices and best standard practices permits recommendations for improvement. This stage involves implementing the plans to improve the best practices and competencies to get a higher maturity level. In addition, OPM3 also categorizes the capabilities in terms of their association with the five Project Management Process Groups, that is., initiating, planning, executing, controlling, and closing (IPECC), permitting evaluation of a fourth dimension of maturity. The structure of the organizational project management maturity model (OPM3) has five steps illustrated as follows (PMI, 2013).

- The first step involves the OPM3 Knowledge foundation which is a prerequisite for the other two elements. It comprises forms to initiate assessments, a database of best practices, an electronic version of the OPM3 knowledge foundation book, and improvement plans based on the completed assessments. It also consisted of a description of how OPM3 should be conducted and the prominent practices related to OPM3.
- The second step is undertaking the assessment using the OPM3 product suite or performing an online self-assessment. The scope of the assessment is defined at the start and covers a detailed assessment of the best practices and competencies of an organization.
- The third step is using the plans to enhance best practices and competencies that were weak according to the earlier accomplished assessment to grow to a higher maturity level. The improvement track is extracted from the product suite through a report.

- The fourth step is to implement the improvement plans to enhance the organizational maturity level of the project management.
- The final fifth step is to repeat the evaluation and go through the same process to find out if the improvements affected the maturity of the organization or not.

3) Project, Program, Portfolio Management Maturity Model (P3M3) by Office of Government Commerce (OGC): The Portfolio, Program, and Project Management Maturity Model (P3M3) is the improved version of the Office of Government Commerce's (OGC's) Project Management Maturity Model, based on the process maturity structure that evolved into the Capability Maturity Model (CMM) (OGC, 2006). It could also be used as the foundation for systematically building a set of tools, including maturity questionnaires. Like CMM and PMMM, this model has a five-level maturity, each depicting different maturity levels. The Portfolio, Program, and Project Management Maturity Model (P3M3) can be used as the basis for enhancing the portfolio, program, and processes of project management (OGC, 2006). P3M3 is an all-encompassing model containing three distinct models, namely, the portfolio management maturity model (PfM3), program management maturity model (PgM3), and project management maturity model (PjM3). Even though connected, there is no relationship between these models, which allows for independent evaluation in any of the specific disciplines. The P3M3 was aware of not only the program and project management activities being carried out at the particular program and project level (OGC, 2008).

Nevertheless, P3M3 also considers those activities within an organization that provides focus and facilitate maintaining the effort to build a program and project infrastructure of successful program and project method and management practices. P3M3 uses five-level maturity frameworks that are characterized in the following table, (Table 2.1) (OGC, 2008; Introduction and Guide to P3M3, 2010).

Table 2.1: The structural components constituted of the five levels of the P3M3

Maturity	Project	Program	Portfolio
Level 1 - Initial or Awareness process	Does the organization appreciate projects and run them differently from its ongoing business? (Projects may be run informally with no standard process or tracking system.)	Does the organization realize programs and run them differently from projects? (Programmes may be run informally with no standard process or tracking system.)	Does the organization recognize programs and projects and run an informal list of its investments in programs and projects? (There may be no formal tracking and reporting process.)
Level 2 - Repeatable process	Does the organization ensure that each project is run with its processes and procedures to a minimum specified standard? (There may be limited consistency or coordination between projects)	Does the organization make certain that each program is run with its processes and procedures to a minimum specified standard? (There may be limited consistency or coordination between programs)	Does the organization make sure that each program and/or project in its portfolio is run with its processes and procedures to a minimum specified standard? (There may be limited consistency or co-ordination)
Level 3 - The defined process	Does the organization have its own centrally managed project processes, and can individual projects move within these processes to suit the actual project?	Does the organization have its own midway-managed program processes and can individual programs move within these processes to suit the actual program?	Does the organization have its own medially managed program and project processes and can individual programs and projects move within these processes to suit actual programs and/or projects? And does the organization have its portfolio management process?
Level 4 - Managed process	Does the organization obtain and preserve specific measurements on its project management performance and illustrate a quality management organization to better predict future performance?	Does the organization acquire and retain specific measurements on its program management performance and illustrate a quality management organization to better predict future program outcomes?	Does the organization achieve and maintain specific management metrics on its whole portfolio of programs and projects as a means of predicting future performance? Does the organization assess its capacity to manage programs and projects and prioritize them accordingly?
Level 5 - Optimised process	Does the organization carry out sustained process improvement with proactive problem and technology management for projects to improve its capability to illustrate performance over time and optimize processes?	Does the organization take on continuous process improvement with proactive problem and technology management for programs to improve its capability to illustrate performance over time and optimize processes?	Does the organization commence continuous process improvement with proactive problem and technology management for the portfolio to improve its capability to illustrate performance over time and optimize processes?

4) Project Management Maturity Model (PM3): All nine project management knowledge areas are included in PM3 at each level in the model (Figure 2.4). It is a fairly close adaptation of the CMM. It also has five levels and their definitions reflect the same types of goals as the CMM (Table 2.2) (PMI, 2000).

Table 2.2: Definition of the Levels of PMMM. Source: Crowford (2010).

Level	Name	Characteristics
Level 1	Initial process	There are no established practices or standards and individual project managers are not held accountable by any specific standards. Documentation is loose and set up solely in response to specific situations or problems without considering wider issues.
Level 2	Structured Process and Standards	Many project management processes exist in the organization but they are not considered an organizational standard. Documentation exists on these basic processes.
Level 3	Organizational Standards and Institutionalized Process	All project management standards are in place and are organizational standards. Almost all projects use these standards with few exceptions. Management is regularly involved in the input and approval of key decisions and issues.
Level 4	Managed process	Metrics become the norm for managerial decision-making. These help to make decisions based on past performance efficiency and prediction of future performance.
Level 5	Optimizing process	All processes are in place and are actively used to improve project management processes.

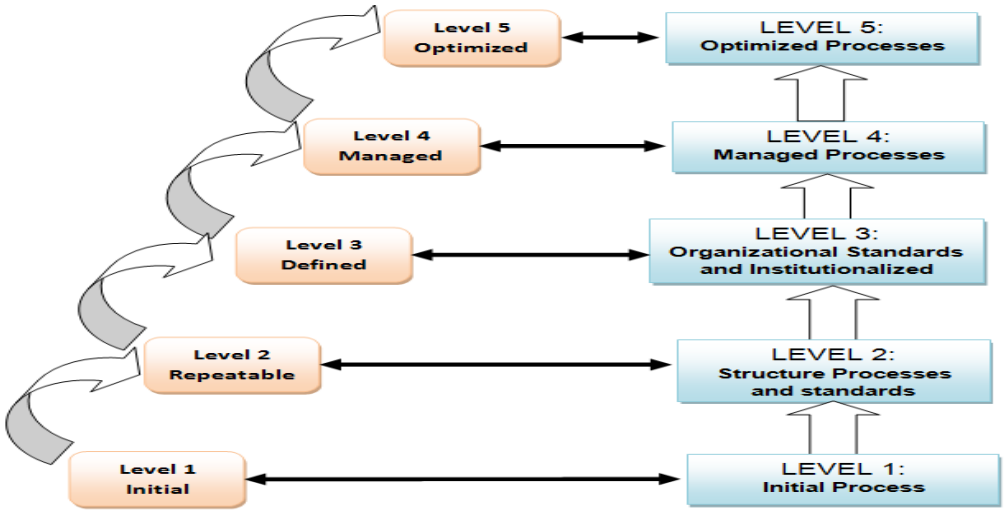

Figure 2.4: Mapping of CMM to PMMM. Source: Crowford (2010)

5) Project Management Maturity Model by H. Kerzner: The model bears several similarities to CMM. It is a five-level model with continuous improvement at the uppermost level. Like PM2 and CMM, Kerzner's Maturity Model defines five levels by which an organization is ranked from insufficient project management processes to adequate project management processes leading to continuous improvement (Kerzner, 2004). According to Kerzner (2009), the CMM models consisted of five levels. Each level represents a different intensity of maturity in project management that can be utilized to assist organizations in performing strategic planning for project management and achieving maturity and excellence in a reasonable period. The foundation for accomplishing excellence in project management can best be explained by the way of the project management maturity model (PMMM). Kerzner's maturity model can be used as a foundation for attaining excellence in project management. When an organization reaches a continuous improvement level of maturity, it means that it has institutionalized project management to the extent that its continuous process improvement cycle is self-sustaining. The model is comprised of five levels, each level representing a different degree of maturity in project management.

Level 1- Common Language: In this level, the organization recognizes the importance of project management. It is the need for a good understanding of the basic knowledge of project management, along with the accompanying language terminology.

Level 2- Common Processes: In this level, the organization recognizes that common processes need to be defined and developed such that successes on one project can be repeated on other projects. Also included in this level is the recognition that project management principles can be applied to and support other methodologies employed by the company.

Level 3- Singular Methodology: In this level, the organization recognizes the synergistic effect of combining all corporate methodologies into a singular methodology, the center of which is project management. The synergistic effects also make process control easier with a single methodology than with multiple methodologies.

Level 4- Benchmarking: This level contains the recognition that process improvement necessary to maintain a competitive advantage. Benchmarking must be performed continuously. The organization company must decide whom to benchmark and what to benchmark.

Level 5- Continuous Improvement: In this level, the organization evaluates the information obtained through benchmarking. The organization must then decide whether or not this information will enhance the singular methodology (Kerzner, 2009 and 2014).

The five levels do not need to be performed sequentially, rather, some of the levels can and do overlap. Although overlapping does occur, the order in which the phases are completed cannot change. That is, even though Level 1 and Level 2 can overlap, Level 1 must still be completed before Level 2 can be completed (Kerzner, 2009 and 2014).

6) Project Management Maturity Model by PM Solutions: The model like the PM2, CMM, and PMMM by Kerzner, also pursues a process maturity of five levels and the PM knowledge areas from the project management institute's PMBOK Guide (PM Solutions, 2014A). The model is useful for examining the project management maturity of an organization and for directing organizations toward important PM competencies that they should obtain to attain project management growth and excellence (Crawford, 2002 and 2010). According to Grant and Pennypacker (2006), the PM Solutions project management maturity model adopts two-dimensional (2-D) framework. Both of the dimensions are based on accepted standards. The first dimension reflects the level of maturity. The second dimension describes the key knowledge areas of project management. Each knowledge area was further decomposed into key components that provide more rigorous and specific capabilities.

The five levels of PM solutions are depicted below (PM Solutions,2014B)

Level 1: Initial Process - Not established practices or standards. Metrics and project documentation are informally collected.

Level 2: Structured Process and Standards - Basic metrics and project documentation are present but no organizational standard is set.

Level 3: Organizational Standards and Institutionalized Process - All projects use organizationally institutionalized formal standards.

Level 4: Managed Process - Metrics are used to manage projects, and integrated into other corporate systems to maximize overall organizational performance.

Level 5: Optimizing Process - Lessons Learned are routinely studied to improve PM processes.

7) Project Management Process Maturity (PM)2 Model: The (PM)2 Model is organized by integrating previous maturity models that measure the PM levels of different companies and industries. The model serves as the basis for evaluating and positioning an organization's current PM maturity level. It comprises a series of steps to help an organization incrementally improve its overall PM effectiveness (Kwak and Ibbs, 2000).

Table 2.3: Key PM processes, organization's characteristics, and focus areas of (PM)2 model (Kwak and Ibbs, 2002).

Maturity level	Key PM processes	Major organizational characteristics	Key focus areas
Level 5 Continuous Learning	PM processes are continuously improved	Project-driven organization	Innovative ideas to improve PM processes and practices
	PM processes are fully understood PM data are optimized and sustained	Dynamic, energetic, and fluid organization Continuous improvement of PM processes and practices	
Level 4 Managed at the Corporate Level	Multiple PM (program management)	Strong teamwork	Planning and controlling multiple projects in a professional matter
	PM data and processes are integrated	Formal PM training for the project team	
	PM processes data are quantitatively analyzed, measured, and stored		
Level 3 Managed at Project Level	Formal project planning and control systems are managed	Informal training of PM skills and practices	Systematic and structured project planning and control for individual project
	Formal PM data are managed	Team-oriented (medium)	
Level 2 Planned	Informal PM processes are defined	Team oriented (weak)	Individual project planning
	Informal PM problems are identified	Organizations possess strengths in doing similar work	
	Informal PM data are collected		
Level 1 Ad-hoc	No PM processes or practices are consistently available	Functionally isolated	Understand and establish basic PM processes
	No PM data are consistently collected or analyzed	Lack of senior management support	
		Project success depends on individual efforts	

The (PM)2 Model breaks PM processes and practices into nine PM knowledge areas and five PM processes by adopting PMI's PMBOK (Table 2.3). This permits an organization to ascertain the strengths and limitations of the current PM practices and focus on the weaknesses of PM practices to achieve higher PM Maturity. Each PM maturity level possesses key PM processes, organizational characteristics, and emphasized areas as illustrated in the following tables (Kwak and Ibbs, 2000).

8) Project Management Office Maturity Model (The PMO Maturity Cube)

The PMO Maturity Cube, as its name suggests has three dimensions and their categories. The dimensions are the Scope of the PMO (Enterprise, Departmental, or Program/Project PMO); Approach (Operational, Tactical, or Strategic PMO), and Maturity (Basic, Intermediate, or Advanced) (Pinto et al., 2010).

The scope of a PMO comes from how widespread its performance is within the organization. There are three mutually exclusive assurances: the project-program PMO, the scope of which covers just one of the organization's projects or programs; the departmental PMO, which covers an area, department, directorship, or business unit, i.e., just a part of the organization; and finally the corporate or enterprise PMO, which covers the organization as a whole (Pinto et al., 2010). The PMO operates strategically, tactically, or operationally, or it may operate with all three simultaneously. The third dimension is the maturity of the PMO defined as the degree of sophistication that it provides to each service for which it is responsible (Pinto et al., 2010). The PMO Maturity Cube results from unifying the three concepts, i.e., strategically, tactically, or operationally which have all been associated into one specific model for assessing the maturity of PMOs for any type of organization.

9) Project Management Office (PMO) Continuum: A project management methodology offers a standard, replicable process to guide project accomplishment from concept to completion. This "project management methodology" function enables the Project Management Office (PMO) to:

- Establish the standard method of project management that is to be used by all project managers within the relevant organization.
- Familiarize project management practices increasingly, beginning with those that have the greatest effect on project and business success.

- Attain consensus for executing a common project management life cycle across the pertinent organization's technical and business parts.
- Provide for collection of relevant project data used in distinct and collective analyses of project performance.
- Recognize and integrate technical and business processes into the project management methodology (Hill, 2008).

According to Hill (2008), PMO and the project management methodology evolve through five stages which are called the "PMO competency continuum". Along these stages (Table 2.4), the project management methodology of the PMO is characterized by:

- Development and execution of increasingly more complete and inclusive project management processes and practices
- Increased integration of technical and business process activities
- Wider cross-functional influence at advanced stages of the spectrum, in association with the broader oversight authority and responsibility for project management prescribed by the methodology

The five stages listed below with their respective project management methodology are the descriptions for the PMO competency continuum.

Table 2.4: Range of Project Management Methodology Activities across the PMO Continuum (Hill, 2008**)**

Project Office	Basic PMO	Standard PMO	Advanced PMO	Center of Excellence
- Applies effective practices for project performance and oversight; and employs standard lifecycle processes when available	- Introduces critical processes and practices of project management - Identifies and develops critical processes - Manages cross-project critical process use - Identifies best and preferred practices	- Establishes and monitors the use of a complete project management methodology - Provides full project life-cycle coverage - Integrates technical processes - Conducts methodology user training	- Enhances content and monitors the use of a comprehensive methodology - Integrates business processes - Optimizes automated tool alignment - Facilitates methodology use across relevant business units	- Conducts project management methodology analyses - Examines process variation in business units - Assesses methodology use and ongoing process improvement

2.2.2 Uses and Benefits of Project Management Maturity Models

Project management maturity reflects to organization's ability to spearhead successful projects. Organizations that improve their level of maturity will meet the goals and objectives. The project management body of knowledge areas and organizational level perspectives are the basis for project management maturity measurement**.** Project management maturity presents a path and structure that enables organizations to handle projects in perfect conditions and achieve excellence in project management performance. Project management maturity has a direct impact on project performance. Project management maturity evaluation enables the organization to further improve its project management structure (Albrecht and Spang, 2014).

Project Management Maturity Models (PMMMs) are assessment models comprised of structured components for alteration and execution in the organization. for project management best practices and process improvement plans. It provides a structured framework and a path for measuring, benchmarking, and strategy to enhance project management practices which enable firms to achieve excellence in project management (Yazici, 2009)**.**

Project Management Maturity Models and assessments are important and used to set direction, precedence actions, and begin cultural change rather than primarily recognizing the current level at which an organization is performing. It is also useful to compare project capability between organizations' norms as a means to benchmark their maturity compared to others. PM maturity assessment can be utilized as a "checkup" tool to measure progress and to identify the subsequent logical forward steps and hence support organizations as a strategic enabler (Backlund, et al., 2014). According to PMBOK, 2008 guide project management maturity model is based on the two-dimensional framework. The first dimension reflects key areas of the project management body of knowledge areas, which include., Project Integration Management; Project Scope Management; Project Schedule Management; Project Cost Management; Project Quality Management; Project Resource Management; Project Communication Management; Project Risk Management; Project Procurement Management; Project Stakeholder Management; Project health, safety, security, and Environmental Management; Project financial management. The second dimension depicts five levels of maturity from the Capability maturity model (Figure 2.5) (PMI, 2013; Pretorius et al., 2012).

Maturity models are useful for the analysis and identification of project management culture in organizations. It is especially targeted to identify the limitations and strengths in the management of project processes so that they can support the definition of a set of actions and measures for better project management performance of the organization (Ferreira and Pereira, 2015). Maturity in project management is a never-terminating voyage, with a never-ending cycle of bench-marking and continuous improvement. As an organization gains project management process maturity, it institutionalizes its project management process via policies, standards, and organizational structures (Kerzner, 2001).

Project management maturity possessing a high value ensures high accomplishment for delivering projects whereas the performance of projects will be low for less mature project management processes projects. Andersen and Jessen (2003) and Hillson (2003) advocated that to deliver projects with effectiveness and increased performance, it is important that organizations continuously assess the results of their projects to find areas of improvement to increase project management maturity. The improvement endeavor for delivering projects must have a focused approach. This is done by measuring where the organization stands for its project management and where it desires to go. The best practice is an optimal way to include the ability to deliver projects with predictability, and consistency and magnificently execute organizational strategies to accomplish the stated goal or objective. The maturity of project management is an ongoing process of periodically assessing project management strengths and weaknesses, identifying, measuring, implementing, and reassessing continuous improvement opportunities in the project delivery system and supporting infrastructure such that the organization can enhance its capability to accomplish its strategic goals and objectives to maximize values (Kerzner 2019; Brookes et al., 2014).

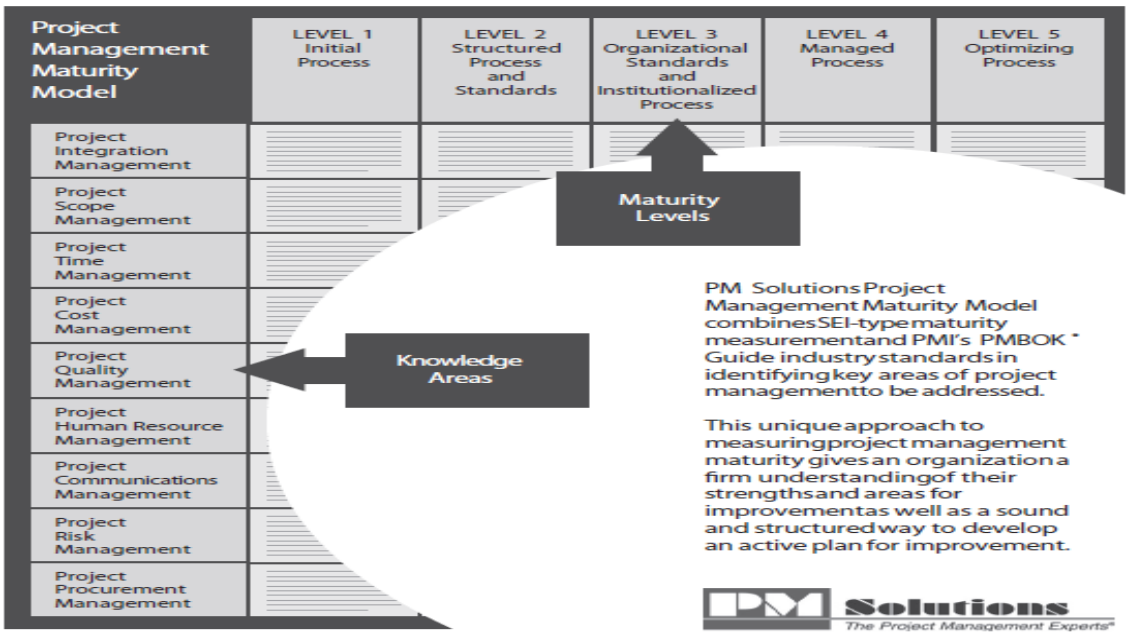

Figure 2.5: Project Management Maturity Model (Crawford, 2006)

2.3 Empirical Review on Project Management Maturity

Grant and Pennypacker (2006) undertook a benchmarking study across 17 different industries in 126 organizations using a website survey to collect quantitative data. They employed nine PMI knowledge areas by devising five levels of maturity to study 42 components of maturity. The outcome of the survey revealed that the organizations had a maturity level of two, which indicated a median level of project management maturity with no significant difference across the investigated industries. Similarly, Cooke-Davies and Arzymanow (2003) conducted a study to explore the variations in project management practice in 21 organizations across six industries. The investigators employed an in-depth interview with knowledgeable project management practitioners. A score value was given to each organization for each previewed area so that the general maturity level could be calculated from these score values. The analyzed data was presented as maturity profiles plotted on a spider web instead of determining the levels of maturity of the organization with a single number which made it easy to identify differences across the nine domains. The investigators concluded that users of more established practices of project management such as the engineering-based industries demonstrate a higher level of maturity.

The individual domain results that were displayed from the plots on a spider web were found to be useful and important since these results could direct where effort was required to improve the PM practice. The report of Mullaly (2014) indicated the longitudinal analysis results of the maturity of project management that was conducted in 550 international organizations over six years. The investigator employed a maturity model with five maturity levels and 12 competency areas that were from unpublished works. The Data was collected using multiple-choice questionnaires with some limited verification, interviewing of informants, and reviews of the practices. The result showed that the number of organizations at level I ranges from 30% to 72%, and organizations at level II and level III decrease from 64% to 28%, and from 6% to 0%, respectively. No organizations were found to be at either level IV or V. The major reason for the decline in maturity was suggested to be due to the year-to-year variations in the organizations participating in the study. The analysis of the investigators showed that higher maturity levels were exhibited by organizations in the engineering industry. This result was found to be consistent with the conclusion reached by Cooke-Davies and Arzymanow (2003)

Young and Zapata (2011) employed the P3M3 model to assess the level of maturity in the three perspectives namely, in project, program, and portfolio management of the Australian government agencies. The findings of the study revealed that project management processes were mainly at level II maturity (repeatable stage) although some of the functions were at lower maturity e.g. benefits management displayed at level I (awareness stage) while risk management was at level III (defined stage). Program management process maturity levels were between level I and level II. Portfolio management processes were between level II and level III which was the highest of the three perspectives. The investigators also additionally analyzed the data to evaluate if there was any substantial difference between small and large agencies. The results showed that portfolio management had improved accomplishment in small agencies while the performance of large agencies was better than the others in project management. However, the performance of program management was poor regardless of the size of the agency. The discrepancy in maturity levels of small and large agencies was suggested to be due to the variation in the scale of the projects being undertaken by the different-sized agencies. That is, smaller agencies may undertake fewer minor projects that can be managed at an agency level as one overall portfolio. Larger agencies certainly have much and bigger projects necessitating more effort to manage at a portfolio level.

This indicates that agencies may have considered exerting more focus on managing at the project level. This indicated that the practices of the three perspectives of project, program, and portfolio management maturity levels are completely independent of each other (Young and Zapata, 2011). Likewise, Simangunsong and Da Silva (2013) conducted an empirical study to assess project management maturity levels in construction, services, manufacturing, oil and gas, and others. The survey included 127 respondents from different industries. The outcome of the study indicated that construction is the only industry that has maturity level III (normalized stage). The investigators described that the management of projects and the project management formalization process were widely implemented in the construction industry. The findings and the conclusion reached by this empirical study were found to be matching with the results of Cooke-Davies and Arzymanow (2003) and Mullaly (2010). The absence or insufficient proper project management training and certification were the major constraints identified in this study as determinants of the general project management maturity level of the organizations.

The performance of projects that have been carried out in Africa was poor, thereby leading project stakeholders and beneficiaries dissatisfied with the outcomes and impacts *(*Ika et al., 2012). The limited investigations that have been conducted in Africa are illustrated by the case of Ghana where organizations operating in the non-profit NGO category exhibited higher maturity levels compared to private companies and the public sector (Ofori and Deffor, 2013). The study conducted on project management organization (PMO) executives, staff, and project managers in Southern Africa to determine the relationship between PMO maturity and the nine knowledge areas showed that a PMO's strategic' maturity has the highest impact on the performance outcome of the nine areas of organizational project management (Khalema, 2015). Pretorius et al., (2012) found that the average perceived project management maturity level in the engineering and construction industries in Southern Africa was 2.88 (57.6%), which is lower than the results found in similar other studies. The results of the project management maturity study in Botswana revealed serious inadequacies in project risk management maturity (Tembo, and Rwelamina, 2021). Analysis of project management maturity in Cameroon public projects revealed a maturity level of 68%. This positively affects the delivery of services (Kala Kamdjoug and Motcheka, 2015).

The study conducted in Nigeria showed design flaws, poor contract management, and poor financing leading to time and cost overrun, and displayed low project maturity which are important nodes for improvement Koko et al., 2013., Abdulrahman et al., 2019. Likewise, In Egypt, Abu El-Maaty et al., (2017) reported that the contractor's technical staff was insufficient and ineligible to accomplish the project, which led to low project maturity.

In the Ethiopian context, Yimam (2011) conducted an assessment of project management maturity in the construction industry of developing countries considering the case of Ethiopian contractors by the inclusion of a total of 40 contractors of which 32 were local and eight were international. The result showed that the construction PM process and practices maturity of the contractors were found to be at a very low level which was with an average maturity level of 1.30. The investigators indicated in their conclusion that the knowledge areas of the PMBOK guide are executed informally. Contractors who possessed certifications or were on the way to acquiring certification showed higher PM process maturity and practices. When comparing the PM maturity of contractors engaged in road construction and building construction, the road construction contractors group showed higher PM maturity. Likewise, Tebeje (2015) also pointed out that the main factor causing cost overruns in construction projects was poor planning.

A case study was conducted by Tewelde (2013) to assess the project management capability for key project management processes and best practices of Mesfin Industrial Engineering PLC in Mekelle. The project management maturity model employed for the study was developed using two-dimensional frameworks that depict key knowledge areas and five-level maturity. The result of the study obtained through empirical analysis and review of project management processes showed that the overall project management capability of the organization is at maturity level 2 and below. The investigator concluded that the observed maturity level was attributed to the processes of some project management that were defined but not consistently applied to all projects.

The assessment of the project management office (PMO) of the Ethiopian Air Lines IT division revealed an overall maturity score of 49%, which is an intermediate level (Kidane, 2022). Evaluation of the level of project management maturity in the housing projects of Addis Ababa showed an overall project management maturity of level 2 which is in a basic project process (Demes, 2023).

Likewise, Haile, 2018 assessed the maturity status of Project Management practice in METEC in executing the sugar plant projects of 'Omo kuraz one' and 'Beles' using a project management maturity model. The results of the study showed that the overall level of project management maturity of METEC was the third Level on the maturity ladder. However, the knowledge areas such as time, cost, and risk management were lagging which are still at Level 2. The investigator recommended the need for due emphasis in the lagging knowledge areas to improve the maturity level of METEC to the next level of maturities, level 4 and then 5. Similarly, Hailemarkos, 2020 conducted a study on the project management maturity of Ethiopian Construction for the determination and correlation prediction of the success of the project. The study participants were 193 project managers working as contractors, consultants, and clients.

The investigator employed a project management body of knowledge and stakeholder theory, two existing valid and reliable survey instruments, the Construction Project Success Factors, and the Kerzner Project Management Maturity Measurement questionnaire to collect the data. The result showed the presence of a strong positive correlation (Pearson's ranging from 0.502 to 0.677) for all measures of project success, and project management maturity scores of Level-1 and Level-2 were observed in the Construction Project Management (Hailemarkos, 2020). The study provided strong evidence that construction project management maturity level was correlated and predicted the project success rate. The findings of the study may support improving the project management knowledge, organization, and delivery system for positive social change outcomes.

Ejigu, 2017 undertook a project management maturity levels assessment in the context of the Ethiopia financial sector within the Commercial Bank of Ethiopia. The investigator found lower maturity levels in the total knowledge areas. Moreover, some of the knowledge areas possess relatively higher maturity as compared to the others. This difference in the knowledge areas may be attributed to the established processes and practices that the bank used in its operations. Furthermore, the lack of proper integration of the knowledge areas practices with project management practice may also contribute to the lowered maturity level of the project management practice at the bank. The investigator concluded that most of the knowledge areas were being practiced casually and unofficially.

Overall, the empirical review of the project management process maturity and practices revealed variations in the levels of maturity that depend on the implementation of the knowledge areas of the PMBOK guide, training on project management and acquiring certification, the types or sizes of agencies in the perspectives of project, program, and portfolio management implementations. It can be inferred that those organizations or agencies with well-organized project management display higher maturity than the others. In the current dynamic, uncertain, and competitive environment, the efficient and effective management of projects by organizations is very crucial for the achievement of their strategies or mere existence since projects have become a common occurrence for many organizations (Grant and Pennypacker, 2006). Thus, due emphasis should be given by organizations and institutions to continuously evaluate projects to find areas of improvement to deliver projects effectively and efficiently, through ensuring the high value of project management maturity for the best performance of projects and achievement of organizational strategy.

Conceptual Framework

The conceptual framework is a diagrammatical representation of the hypothesized relationship between the independent and dependent variables, and the effects of the study**.** Figure 2.6 displays the conceptual work for the determination of project management maturity in the health research of AHRI. From the literature review, the different project management knowledge and the level of project management maturity are independent variables that enhance the project management effectiveness and efficiency while the dependent variable is the creation of a framework for an organizational project management capability system and sustainable improvement in pursuit of delivering the desired outputs and outcomes from the projects (Cooke-Davies, 2005; Mullay, 2006).

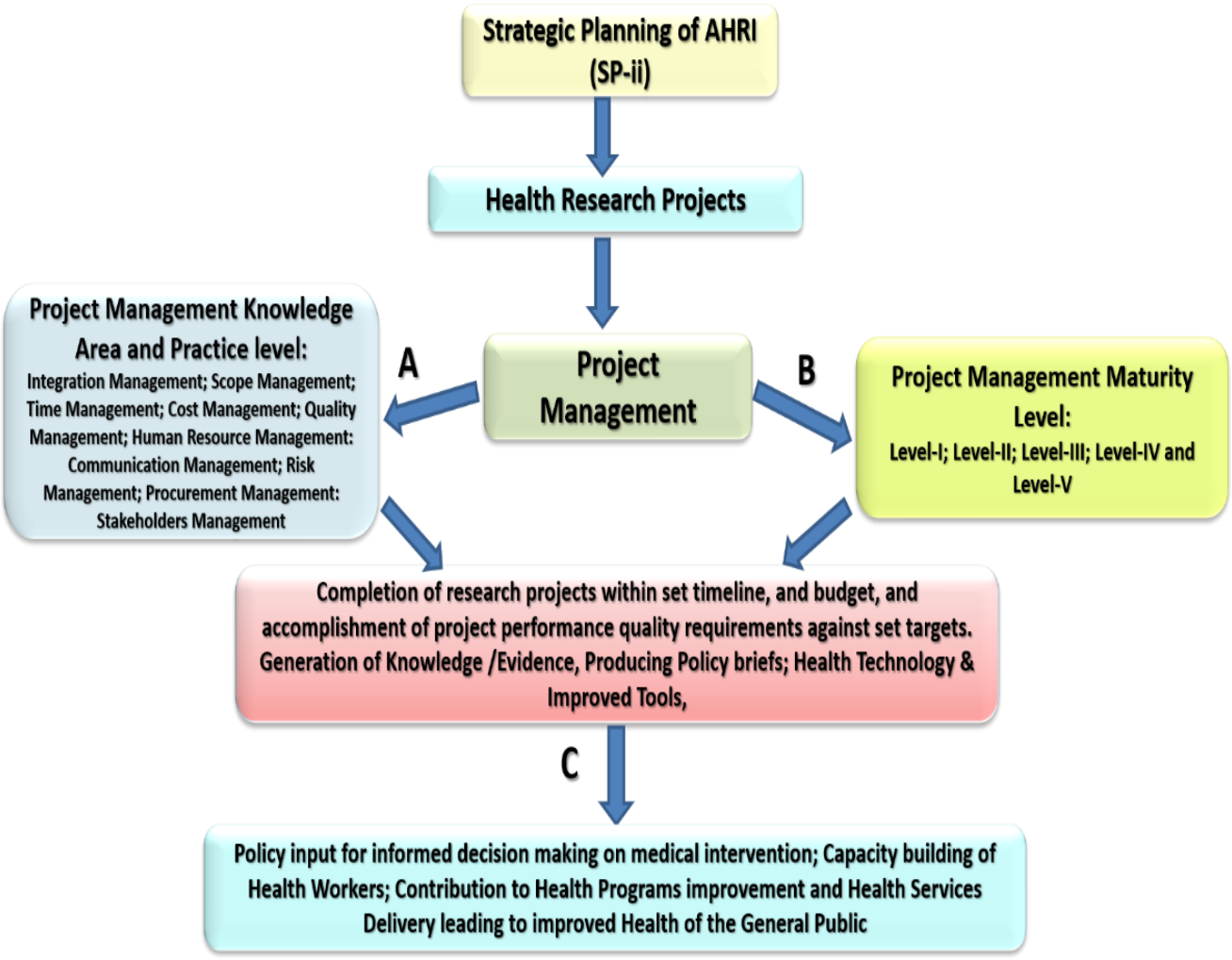

Figure 2.6: Conceptual framework for the assessment of health research project management maturity in AHRI

CHAPTER THREE

This chapter of the research report provides an outline of the research methodology that is employed in the measurement of the project management maturity level and project management practices for the success of the research projects in AHRI. A description of the research design, data source, sampling, techniques for sampling, instruments employed for the collection of the data, and methods and procedures for the analysis of data are provided in this part of the thesis. Ethical concern are also explained in this chapter.

III. RESEARCH METHODOLOGY

3.1 Study Approach

The determination of the project management capability was performed using the project management maturity Model (PMMM) of five levels and ten knowledge areas and practices, with the project management body of knowledge (PMBOK) as a guide. The purpose of using the maturity model is to identify ways of improvement by assessing the existing practices of project management thereby strengthening the link between strategic planning and execution, and identifying best practices (Levin and Skulmoski, 2000). The assessment provides a useful "road map" direction or "guidebook" about what improvements should be tackled first. Khoshgoftar and Osman, 2009 describe that the various maturity model differs from each other in terms of their characteristics, factors, scope, and structure to achieve the desired purpose. Various existing maturity models require selection based on criteria appropriate to choose suitable for a study. In the present study, the project management solutions (PM solution) project management maturity model (PM solution, 2014) was selected to assess the project management practice of the research project in the AHRI.

The model is well structured with a two-dimensional framework that is based on accepted standards. The first dimension reflects the level of maturity. It is based on the structure of the SEI Capability Maturity Model. The second dimension depicts the key knowledge areas of project management that adapt the structure of the PMI's knowledge areas. It is relatively easy to use and the outcomes of the model are applicable to enhance the maturity of organizations towards project management (Man, 2007).

The selection of PM solutions to evaluate the practice of the research projects project management is based on its use by many researchers and is relatively easy to employ. It is well-designed based on accepted standards with a two-dimensional framework. It has a well-defined knowledge area and maturity level, and up-to-date knowledge area and processes. The results of the PM solution model are applicable to improve the maturity level of an organization toward efficient and effective project management (Man, 2007).

3.2 Study Design

A cross-sectional mixed design (quantitative and qualitative) descriptive approach (Cruswell, 2009., Leedy and Ormond, 2005) was employed in this study to collect pertinent information and identify various factors on project management maturity and knowledge areas. The data collection was based on a realistic combination of tools that are fitted to the assessment of maturity level. The primary source of data was collected using self-filled questionnaires or interviews by employing an open-ended flexible discussion point of the study participants to collect pertinent information. The secondary sources of data such as proposals, reports, SOPs, policy briefs, proceedings, technical reports, publications, etc. were also reviewed to collect key information using a data abstraction sheet. The secondary data supports data triangulation and strengthens the analysis.

The questionnaire that was used for this study was adapted and developed from the reviewed literature (PM solution, 2014; Ferreira and Pereira., 2015; Kerzner, 2019; Mateen, 2015; PMI, 2013), pre-tested, tailored, and validated for the current assessment/investigation. The questionnaires were then transferred to the KoboToolbox, an online powerful and intuitive data collection tool (ee.KoboToolbox.org link) for ease of sharing the questionnaires, online filling, and submission by the study participants. The questionnaires were composed of five parts. The purpose of the first part was to capture overall background data about the study participants. The second part questions were grouped into the ten knowledge areas set by PMI in the project management body of knowledge (PMBOK) guide (PMBOK, 2008).

Under these knowledge areas were various questions devised to measure the degree of maturity of the project management practice. Various reports also indicated the adaption and reshaping of the questionnaires as appropriate for the intended study by different researchers (Tahri and Drissi-Kaitouni, 2006; Abadir, 2011., Mateen, 2015). The collected data was evaluated with criteria used to determine the maturity of project execution based on the project maturity model.

3.3 Study Period and Area Coverage

The study was conducted in July 2024 and August 2024. The study area was the Armauer Hansen Research Institute (AHRI) where basic, applied, medical, preclinical, clinical, translational, operational, and epidemiological research was undertaken, based on the priority national health research agenda to generate evidence on a scientific basis for informed decision making and in designing initiatives and programs aimed at protecting the public health.

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3.4 Population

Source Population: The source population for this study was the research coordinators for ethically approved research projects during the last four years that are completed, terminated, or currently ongoing in AHRI in which the various phases of project management are undertaken. These include research projects' idea initiation and planning, ethical reviewing and approval, coordination and implementation, monitoring, and evaluation, dissemination, and closing-up.

Target Population: The target study population was the research project principal coordinator or investigator, and project manager, in the absence of the principal investigator the co-principal coordinator or research team member of the research project, who led and participated in the health research projects. The executive offices and research directorates who have direct or indirect roles in the research project management *i.e.*, research directorates, Scientific and Ethical Review Board (ALERT/AHRI-IRB office), Strategic Affairs Executive Office (SAEO), Grant Management Unit (GMU), Property and Finance Executive Office, Competency and Human resource development. Executive officers who were serving as key informants were also the target population.

3.5 Inclusion and Exclusion

Inclusion Criteria

- Interdisciplinary research projects including PhD student research proposals.
- Study participants who could provide written or oral informed consent to participate in this study.

  The study participant may belong to one of the following groups: Principal coordinators or Co-principal coordinators, executive office heads, directors of research directorates, ALERT/AHRI-IRB office, SAEO, GMU, Property and Finance, Competency and Human resource development.

Exclusion Criteria

- Those who were not willing to provide written or oral informed consent to participate in the study
- Projects with incomplete information about project management and strategic delivery outputs/outcomes e.g. triple constraints, technical reports and manuscripts, etc.

3.6 Sample Frame, Sampling Techniques, and Sample Size

The research projects in AHRI that were reviewed and approved by ALERT/AHRI-IRB during the last four years that are completed, terminated, or currently ongoing were considered as the study population. This signifies the population of project coordinators or investigators. The study participants also include concerned executive office heads *i.e.*, IRB, SAEO, GMU, property and finance, competency and human resource development, and technical directorate directors who directly and indirectly significantly play in the research project management of the respective researchers.

The required sample size for the current investigation was determined, considering the total of 224 reviewed and approved research projects by ALERT/AHRI-IRB, multi partners, interdisciplinary research projects, and graduate students' research project proposals in the last four years (Table 3.1), the very stringent time limitations to complete the study, and the financial constraints that the investigator has to exhaust all possible data.

The following assumptions are considered for calculating the sample size; population, 224, setting precision (epsilon value) e= 7% Using Yamane's (1967) formula, the sample size or number of research projects considered in the study was computed as follows,

$n = N / 1 + N (e)^2$ (where n is the sample size N signifies the population under study e signifies the margin error)

$n= 224 / 1 + 224 (0.07)^2$

$n = 224/ 1 = 224 (0.0049) = 224 / 2.10 = 106.6 = 107$

Taking into account 10% contingency, the sample size considered for this study becomes 118 research project proposals.

A stratification approach was employed to allocate the sample size considered for the study proportionally based on annually reviewed and approved research projects (Table 3.1).

Table 3.1: Sample frame consideration for sampling

S. No	Year for proposal review and approval	Proposal No /Population (**N**)	Sample No from Sampling (n)
1	2021	44	23
2	2022	71	37
3	2023	83	44
4	2024	27	14
Total		**224**	**118**

The IRB-approved research project proposals considered for the study were then selected systematically and randomly after listing the projects on an annually reviewed and approved basis and considering the inclusion criteria to collect the primary and secondary information as described under source and target population.

Independent variables

- Socio-demographic characteristics (age, sex, educational background, work experience, training or opportunity in project management, position in the project, etc.).
- Goal for the research projects and links with the strategy (SPM).

- Project management of ten PMBOK knowledge and practice areas (scope, time, cost, finance mobilization; project planning and scheduling; project risk; project M&E, closure; communication Logistics and supplies conditions; stakeholders; and human resources).
- Project management maturity.

Dependent variables

- Type of level for project management maturity and capability.
- Project management knowledge area and practice level.
- Project success (completion of project within set timeline budget, and expected performance quality).
- Project deliverables outcomes (contributions for policy inputs, health service program improvement; technology package for production).

3.7 Data Collection Instrument and Procedure

Source of Data: Primary and secondary data were the source of data in this study**.** The primary source of the data was collected using self-filled pre-tested questionnaires and interviews using open-ended flexible discussion points. The secondary source of data was collected through document review using a data abstraction checklist.

Data collection instruments: The pre-tested questionnaires were self-filled (quantitative approach) and were transferred to the KoboToolbox, an online and intuitive data collection tool (ee.KoboToolbox.org link) and shared for online filling, and submission by the study participants. The interviews of the key informants (KI) were conducted using open-ended flexible discussion points to collect pertinent information. The secondary data sources of the AHRI (policy briefs, strategic documents, reports, proposals, technical reports and manuscripts, workshop dissemination, plans, activity reports, operational procedures, etc.) were collected through document review using a data abstraction checklist beside the exhaustive internet literature search.

3.8 Data quality control, validity, and reliability

Data quality control: Pilot testing (pre-testing) was undertaken for the questionnaires by submitting initially to 10% of the sample to check its effectiveness and efficiency in capturing the required information.

The necessary modifications to the questionnaires were then made based on the pre-test results before the actual data collection to ensure the instrument's reliability. Pilot testing is an indication of whether the instrument was measuring the right concept, hence its validity and reliability (Fellows and Liu, 2008)

Reliability: The reliability of the data signifies the consistency or dependability of a measure over time, over questionnaire items, or observer rates. The reliability test depicts the consistency degree of the collected data which is measured by the Cronbach alpha coefficient. The data collected in this study (Table 3.2) from the questionnaire respondents was analyzed with SPSS to calculate the value of Cronbach's alpha and a value greater than 0.7 was considered acceptable in ensuring data consistency (Carmines and Zeller, 1979; Allen and Bennett, 2010)

Table 3.2: Cronbach alpha coefficient values for reliability test of the data collection instruments

Variables	Cronbach's Alpha	No of items
Project integration management	0.902	8
Project scope management	0.924	7
Project time management	0.954	9
Project cost management	0.939	9
Project quality management	0.943	9
Project human resource management	0.898	8
Project communication management	0.960	8
Project risk management	0.977	7
Project procurement management	0.917	7
Project stakeholder management	0.956	5

Source: Own survey computed in SPSS, 2024

Validity: Validity concerns the extent to which a measurement measures those features that the investigator wishes to measure and provides information that is relevant to the question being asked. Validity is ensured by making sure that the sampling techniques are free from bias by giving each subject an equal opportunity. It is also improved by making questionnaires to be comprehensive and covering all the variables being measured (Golafshani, 2003). Recording interviews and reviewing the recorded information is also another way to ensure internal validity. The data collection instrument validity could be also checked against the adapted literature to crosscheck information (Creswell, 2008).

Thus, in the current study, the information collected through interviews was compared with literature reports when possible. Furthermore, all interviews were recorded, and reviewing the recorded information was done to ensure the correct presentation of the findings to enhance validity.

3.9 Data processing and Analysis methods

Each respondent-filled questionnaire and information captured during the interview was organized in an Excel spreadsheet and checked for completeness and accuracy before transferring the data into SPSS. The data was cleaned for errors and missing data, coded, categorized, and sorted to facilitate the analysis, and entered into the SPSS Version 23 computer software to analyze the data. The analysis of the data followed the descriptive methods of data analysis. Summary statistics, including the computation of means, standard deviations, frequency counts, and percentages of demographic characteristics, constraints factors, and effects/consequences of constraints as well as project maturity level and perceived importance of project management body of knowledge data were evaluated. A p-value < 0.05 was considered to declare a result as statistically significant in this study. The results were summarized using tables, charts, and graphs to analyze the actual practice observed from the responses collected using questionnaires and secondary sources. The results of the survey were also compared with the criteria of the project maturity model. Recommendations are forwarded for the identified limitations and gaps to facilitate the improvement of project management.

3.10 Ethical Considerations

A support letter for facilitating the study was secured from the School of Commerce, College of Business and Economics, Addis Ababa University, and submitted to the Deputy Director General (DDG) of AHRI to facilitate ethical clearance and permission. The proposal for the study was then directed by the DDG of AHRI to ALERT/AHRI-IRB for ethical review and approval. The study was initiated once the proposal secured ethical clearance and approval by the IRB (Approval letter No AAERC Form AF-04-008, dated June 24, 2024). Informed consent was obtained using the written or verbal consent form from the study participants after explaining the details about the study, the objective, and the right to decide whether or not to participate during the assessment study. Secondary data was extracted from the research project anonymously. Ethical wavering was requested for the secondary data access permission from ALERT/AHRI-IRB. All data were kept confidential and used only for study purposes.

CHAPTER FOUR

IV. RESULT AND DISCUSSION

This chapter presents the results and discussion of the data obtained from the study participants regarding the project management maturity of the research projects undertaken in AHRI. The first part outlines the demographic profiles of the respondents. The second section evaluates the project management knowledge areas characteristic processes practices maturity level of the research projects by analyzing the detailed responses of the respondents in comparison with the maturity model benchmarking values. Then, each knowledge area's average project management maturity level was presented. Finally, the relationship between the perceived understanding of the importance of management knowledge areas and project management knowledge areas processes practices was analyzed and described.

4.1 Data analysis and presentation

An empirical approach was employed to collect pertinent data on the project management maturity of AHRI using questionnaires, interviews, and secondary data sources from various documents. The self-administered questionnaires that were prepared in KoboToolbox were shared with principal investigators, coordinators, co-investigators, and project managers of research projects for online filling and submission.

A five-point Likert scale structured close-ended questionnaire was used to measure respondents' perception observation and practices. This will help to assess the various characteristic variables, project management maturity in each project management knowledge area, and best practices to evaluate the capability of the institute in handling research projects. In addition to the questionnaires relevant information was also gathered by interviewing key informants using open-ended flexible discussion points or by filling out the online shared open and closed-ended interview questions prepared in Google Sheets for the key informants who did not have time for face-to-face interviews.

The collection of secondary sources of data from various documents *i.e.*, proposals, technical reports, manuscripts, policy briefs, reports, strategic documents, etc was also carried out from archives of AHRI using a data abstraction checklist. The data obtained through the distributed questionnaires was transferred to the SPSS version 23 analyzed and interpreted using descriptive statistics, such as frequency count, percentages, mean, and standard deviation. Information was gathered also through interviewing of key informants. The replies to the questions of the interview and the abstracted information from various documents were organized thematically to summarize respondents' reflections. The major findings of the primary and secondary data analysis were presented as follows.

Reliability: Piloting data was obtained before the commencement of the study to determine the reliability of the instruments employed to collect the data. The collection process of the data from the pilot study involved 23 researchers and research project leaders who were working other than AHRI. The filled questionnaire was then analyzed with SPSS. The result indicated internal consistency of the measure over questionnaire items that was determined by calculating the Cronbach's alpha coefficient. The values of Cronbach's alpha for each variable ranged between 0.874 and 0.977 (Table 3.2). This implies that the instruments used for the data collection were highly acceptable and reliable. Cronbach's alpha coefficient value greater than 0.7 is considered acceptable in ensuring data consistency and an unbiased estimate of data generalizability (Carmines and Zeller, 1979).

4.2 Demographic profile of the study participants

A total of 118 participants were invited to participate in this study and shared the online self-filled questionnaires that were prepared in KoboToolbox online through emails. Of whom101 participants responded to the questionnaire and returned the filled questionnaires. 85.6% responded which showed a good response rate for the study participants. The demographic features of the respondents including education level, work experience, position and role in the research project management, etc were analyzed to provide the summarized information about the respondents in Table 4.1.

Table 4.1: Demographic Characteristics of Study Participants

Variable characteristics	Category of variable	Frequency (n)	Percent	Valid Percent	Cumulative percent
Gender	Male	60	59.4	59.4	59.4
	Female	41	40.6	40.6	100
	Total	**101**	**100**		
Age	20-30 yrs	8	7.9	7.9	7.9
	31-40 yrs	47	46.5	46.5	54.5
	41-50 yrs	31	30.7	30.7	85.1
	Above 51 yrs	15	14.9	14.9	100.0
	Total	**101**	**100**		
Highest level of Education	BA/BSc	8	7.9	7.9	7.9
	MD; DVM	10	9.9%	9.9%	59.4%
	MPH/MSc/MA and candidates	42	41.6%	41.6%	49.5%
	MD/MPH, MD//MSC; DVM/MSc, DVM/MPH	10	9.9%	9.9%	69.3%
	MD + clinical specialization	14	13.9%	13.9%	83.2%
	PhD and PhD candidates	**17**	16.8%	16.8%	100%
	Total	**101**	**100%**		
Work Experience	Less than 5 years	2	2%	2%	2%
	6 to 10 years	25	24.8%	24.8%	26.7%
	11 to 15 years	41	40.6%	40.6%	67.3%
	16 to 20 years	23	22.8%	22.8%	90.1%
	More than 21 years	10	9.9%	9.9%	100%
	Total	**101**	**100%**		
Current Job Position	Junior Researcher	12	11.9%	11.9%	11.9%
	Associate researcher	56	55.4%	55.4%	67.3%
	Senior Researcher	30	29.7%	29.7%	97%
	Lead Researcher	3	3%	3%	100%
	Total	**101**	**100%**		

Source: Own survey data, 2024

Males were the major participants compared to females, accounting for 60% vs. 40%. This indicated that the participation of females in the research project management as principal or co-principal investigators, and project managers was comparably low. The age group 31 to 40 years and 41 to 50 years accounted for higher rates of 47% and 31%, respectively. This displays that the age group 31 to 50 years is most of the study participants. From this, it is possible to assume that a significant number of the respondents could be experienced or well-oriented about the research project management practices. Regarding the work experience of respondents, 25 (24.8%) of the respondents indicated a service year of 6 to 10 years, 41(40.6%) of them responded as serving for 11 to 15 years while 23 (22.8%) of the respondents replied a work experience of 16 to 20 years.

This indicated that the majority of study participants have more than 10 years of overall work experience. Some of the respondents in the work experience years group of 6 to 10 years may be affiliated with other institutes in the consortium of research projects or maybe the academic staff of various universities who joined AHRI as graduate students to undertake their postgraduate research work at MSc and PhD levels sponsored by AHRI. Postgraduate research work at the MSc and PhD levels is supervised by the senior members of the institute. Concerning educational levels, 17 (16.8%) of the respondents were at the PhD degree level, 14 (13.9%) had an MD with a medical specialty, 42 (41.6%), and 10 (9.9%) had a master's degree level, respectively, although some of the study participants were sponsored by AHRI to pursue their research work to fulfill either Masters or PhD degree requirements of their affiliated universities. Most of the respondents that have PhD and MDs with medical specialty and at master's degree levels in some cases could be the senior members of AHRI or research collaborating institutes.

The senior members of the institute or collaborating institutes may have a principal investigator or co-investigator role in the research project management of an interdisciplinary consortium of research projects that are hosted by AHRI. Moreover, 3 (3%) and 30 (29.7%) of the respondents were lead and senior researchers levels, respectively who could serve as the principal coordinators of research projects. The majority of respondents 56 (55.4%) responded as associate researchers while a few of the respondents (12 (11.9%)) indicated as junior researchers (Table 4.1). These may be a graduate student or institute research staff members in their earlier careers that could render them a better opportunity to work with seniors to become familiar with the research project management practices in the institute.

Respondents with longer periods of service and at PhD, MDs with medical specialty, MD/DVM, and MPH/MSC educational levels are more experienced and in a better position to explain processes and activities involved in project implementation. Education and experience are determinantal to deal with problems and challenges maturely due to accumulated skills that were acquired and developed through the practices of the acquainted knowledge or theoretical concepts. Less experience and skills in project management may hinder and have negative implications on the efficiency of research project performance (schedule and cost overrun, poor quality) (Table 4.1).

The involvement of highly qualified and experienced professionals and senior researchers has a high positive influence on the efficiency of project executions that tend to enhance the good performance accomplishment of research projects (Murithi, *et al.*,2017).

Table 4.2: Research grant and Timeline of research projects

Variable characteristics	Category of variable	Frequency(n)	Percent	Valid Percent	Cumulative percent
Average research project monetary fund/grant secured for the research project	Less than 5 million Birr	21	20.8%	20.8%	29.6%
	5 - 20 million Birr	27	26.7%	26.7%	67.6%
	20 – 35 million Birr	1	1%	1%	69.0%
	36 million Birr and more	5	5%	5%	76.1%
	Not applicable or other means	17	16.8%	16.8%	100%
	Total External finance secured projects	71	70.3%	70.3%	
	External finance non-secured projects	30	29.7%	29.7%	
	Total	**101**	**100%**		
Timeline of the research projects	Less than 3 years	21	20.8%	20.8%	20.8%
	3 - 5 Years	63	62.4%	62.4%	83.2%
	6- 10 years	1	1%	1%	84.2%
	More than 10 years	6	5.9%	5.9%	90.1%
	Timeline not fixed	10	9.9%	9.9%	100%
	Total	**101**	**100%**		

Source: Own survey data, 2024

Assessment of the study participants' responses regarding the research project's grant sources revealed that 71 (70.3%) of the research projects secured their financial source from international competitive research grants such as EDCTP, Gates Foundation, etc, or global partner collaborations research grants E.g. NORAD and SIDA on public health research and intervention thematic areas. (Table 4.2).

Of which, the secured grant amount 25 (26.7%) was 5 - 20 million Birr, 21 (20.8%) was less than 5 million Birr, and 5 (5%) was 36 million Birr and more, respectively. The remaining 30 (29.7%) were not secured grants from external financial sources for the execution of research projects. Their financial source may be the governmental allocated budget through AHRI based on the priority importance of the research project. The timeline for the implementation and completion of research projects ranges showed that 21 (20.8%) were less than 3 years, 63 (62.4%) were 3 to 5 years, 1 (1%) was 6-10 years, and 6 (5.9%) were more than 10 years, respectively. The timeline for 10 (9.9%) research projects was not fixed, these may be related to research and interventional activities with periodic evaluations of the outcome (Table 4.2).

4.3 Research project management maturity

The research project management maturity level of AHRI was evaluated by the judgment-based scoring system using the Likert rating scale. Numeric values of 0 to 5 were assigned to each response to the questionnaires for the project management (PM) knowledge areas and maturity levels. The average results from each PM knowledge area were used to find out the overall research project management level of maturity. The level of maturity of all knowledge areas and processes were analyzed from the detailed responses of the respondents in comparison with the Maturity Model based on the value ranges as benchmarking (Table 4.13) (Shukla and Sushil, 2022). The results obtained from the questionnaires intended to capture each project management knowledge area and processes using the five levels of maturity are displayed below.

4.3.1 Integration Management:

Integration management is concerned with the understanding of knowledge and practices in project planning, execution, change control, and the overall coordination aspects of the research project process (PMI, 2004). The assessment findings of integration management are indicated in Table 4.3.

Table 4.3: Respondents response to aspects of Integration Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis (0)	Very low (1)	Low (2)	Aver (3)	High (4)	Very High (5)	Total n (%)	
1	Project constraints are clearly defined for each research project.	3 (3%)	10 (10.9%)	31 (30.7%)	46 (45.5%)	7 (6.9%)	3 (3%)	101 (100%)	2.51 (0.986)
2	Formal organizational standard guidelines exist for research project management processes that include all required resource management, methodology, and control tools.	2 (2%)	10 (9.9%)	26 (25.7%)	52 (51.5%)	7 (6.9%)	4 (4%)	101 (100%)	2.63 (0.967)
3	Research project planning methodology is documented and strictly adhered.	3 (3%)	11 (10.9%)	17 (16.8%)	54 (53.5%)	12 (11.9%)	4 (4%)	101 (100%)	2.72 (1.04)
4	A research Project Management Information System (PMIS) is in place.	12 (11.9%)	16 (15.8%)	37 (36.6%)	28 (27.7%)	5 (5%)	3 (3%)	101 (100%)	2.07 (1.18)
5	There is an overall research project change control process.	5 (5%)	23 (22.8%)	35 (34.7%)	28 (27.7%)	6 (5.9%)	4 (4%)	101 (100%)	2.19 (1.13)
6	A Performance measurement criterion has been developed to establish how project progress will be determined and reported.	4 (4%)	9 (8.9%)	17 (16.6%)	56 (55.4%)	13 (12.9%)	2 (2%)	101 (100%)	2.70 (1.01)
7	Research project progress process follow-up is part of the project management continuous improvement process.	--	10 (9.9%)	22 (21.8%)	50 (49.5%)	14 (13.9%)	53 (5%)	101 (100%)	2.82 (0.963)
8	There is periodic project management training for the research team and concerned office members for efficient and effective research project management.	8 (7..9%)	19 (18.8%)	39 (38.6%)	28.8 (27.7%)	5 (5%)	2 (2%)	101 (100%)	2.09 (1.08)
Integration Management Maturity Level Average Mean (SD)								**2.47 (0.902)**	

Source: Own survey data, 2024

The overall mean of the integration management area of knowledge and characteristic process practice collected using eight characteristic process variables was found to be 2.47 (0.992). The value showed that the maturity of the integration management sub-component of the project's body of knowledge area could be considered at level 2 This indicated that the requirements for project management standards were in place as per the consistent basic approach of project execution of the institutional standard. The mean values for characteristic processes variables practices range from 2.07(1.18) to 2.82 (0.963) (Table 4.3). This indicated that almost all research projects were in the basic approach processes of research project implementation **(**Shukla and Sushil, 2022**)**.

The characteristic variables “A research project management Information System (PMIS) is in place” and “ There is periodic project management training for the research team and concerned office members on research project management” showed mean values of 2.07 (1.18) and 2.09 (1.08), respectively, which are comparatively the lower means values compared to the others (Table 4.3). The reasons for the comparatively low level of performance in this sub-component of integration management may be accounted for by the inconsistent execution of project activities without proper understanding and development of a project plan to integrate various project activities and requirements.

PMIS consisted of the tools and techniques that could be utilized to collect, integrate, and disseminate the output of the research project management processes, as well as the overall change control processes to manage scope change and maintain performance measurement integrity. Capacitating the research team members through periodic training in project management enhances the performance of research projects. Institutions or organizations with strategic plans and the implementation approaches of projects with well-defined standard operational procedures (SOPs) for the processes and practices will have an opportunity for a higher maturity level (DyReyes, 2008). According to Antvik and Sjöholm (2007), lack of integration management often leads to delays, high costs, and problems in the general execution of projects.

4.3.2. Scope Management

Scope management ensures that the project comprises all the required work to be undertaken, and only the work necessitated to complete the project successfully. It involves processes such as the identification of requirements, defining the range of activities, creating a work breakdown structure, and verifying and controlling the overall aspects of the scope (PMI, 2004).

Table 4.4: Respondents' response to aspects of Scope Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis (0)	Very low (1)	Low (2)	Aver (3)	High (4)	Very High (5)	Total n (%)	
1	A Project scope statement is created for every research project.	3 (3%)	11 (10.9%)	35 (34.7%)	40 (39.6%)	9 (8.9%)	3 (3%)	101 (100%)	2.50 (1.006)
2	Project Scope Statements are prepared with end-user or customer input throughout the project development process.	6 (5.9%)	14 (13.9%)	45 (44.6%)	26 (25.7%)	8 (7.9%)	2 (2%)	101 (100%)	2.22 (1.05)
3	A Documented Scope change Control Process is in place for managing Change to the research project Scope.	4 (4%)	18 (17.8%)	48 (47.5%)	19 (18.8%)	10 (9.9%)	2 (2%)	101 (100%)	2.19 (1.05)
4	All research Project participants endorse the Scope Statement.	4 (4%)	21 (20.8%)	44 (43.6%)	17 (16.8%)	13 (12.9%)	2 (2.0%)	101 (100%)	2.20 (1.10)
5	Approved changes to the research project scope statement are communicated to the project team and the end user/customer	4 (4.0%)	17 (16.8%)	41 (40.6%)	26 (25.7%)	11 (10.9%)	2 (2.0%)	101 (100%)	2.29 (1.06)
6	The management, project team, and the end user monitor and review all research project progress regularly.	3 (3%)	7 (6.9%)	31 (30.7%)	44 (43.6%)	15 (14.9%)	1 (1%)	101 (100%)	2.63 (0.956)
7	A work breakdown structure document (WBS) containing a detailed description of the research project's activities, responsibilities, and resources required is created for each research project.	1 (1%)	7 (6.9%)	31 (30.7%)	40 (39.6%)	17 (16.8%)	5 (5.0%)	101 (100%)	2.79 (1.00)
Scope Management Maturity Level Average Mean (SD)								**2.40 (1.03)**	

Source: Own survey data, 2024

The perception, knowledge, and practices about the scope management of the respondents were collected using seven characteristic process variables. The mean for the customer input consideration during scope statement preparation and change control processes practices is 2.22 (1.05) which is equivalent to 44.4% of the respondents. The perception of 45.8% of the respondents' mean (2.29 (1.06)) was that the approved research project scope changes were well communicated to the project team and customers. Moreover, 52.6% of the respondents (mean 2.63 (0.956)) reflected that the management, the project team, and the customer all research project progress regularly. The mean values of the scope process variables practices range between 2.19 (1.05) and 2.79 (1.00) with an overall mean value (standard deviation) of 2.40 (1.03) (Table 4.4).

The value indicated that the maturity of the scope management sub-component of the research project's knowledge area could be considered at level 2. This may display that the scope management of the research project's knowledge area was in the basic approach of research project implementation of the institute **(**Shukla and Sushil, 2022**)**. The scope variable process practice "A work breakdown structure document (WBS) containing a detailed description of the research project's activities, responsibilities, and resources required are created for each research project" showed a higher mean value compared to the others, mean, 2.79 (1.00). This may be due to the enhanced efforts of the research team on the description of activities (Table 4.4).

Lower means values were obtained compared to the others for the characteristic scope process variable 'A documented scope change control process is in place for managing change to the research project scope" mean, 2.19 (1.05) and the scope process variable "All research Project participants endorse the scope Statement", mean, 2.20 (1.10) (Table 4.4). These comparatively low values may be attributed to the rare application or the exertion of minimal effort of some of the scope management practices**.**

4.3.3. Time Management

Time management deals with the process required to ensure the timely completion of a project. This involves defining and sequencing activities, identifying relationships among project activities, estimating activity resources and duration as well as developing and controlling schedules (PMI, 2004). Nine process variables were employed to measure the extent of the research project's time management knowledge process practice. The analysis of respondents' opinions about time management practices is shown in the following Table 4.5.

Table 4.5: Respondents response to aspects of Time Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis(0)	Very low (1)	Low (2)	Aver (3)	High (4)	Very High (5)	Total n (%)	
1	Awareness is present of the relevance of time, and the efforts undertaken in managing research project time are formal.	3 (3%)	5 (5%)	20 (19.8%)	47 (46.5%)	20 (19.8%)	6 (5.9%)	101 (100%)	2.93 (1.05)
2	The project requirements (deliverables) are reflected in the project's work Breakdown Structure (WBS) which contains a detailed description of the research project activities.	2 (2%)	6 (5.9%)	20 (19.8%)	47 (46.5%)	18 (17.8%)	8 (7.9%)	101 (100%)	2.96 (1.06)
3	The research project WBS and resource estimate are used to develop the project's baseline schedule, that is the beginning and completion dates are approved and fixed.	2 (2%)	7 (6.8%)	33 (32.7%)	39 (38.6%)	16 (15.8%)	4 (4%)	101 (100%)	2.71 (1.01)
4	Activity duration estimates are prepared and research project schedules are updated regularly against the baseline plan.	--	9 (8.9%)	29 (28.7%)	48 (47.5%)	12 (11.9%)	3 (3%)	101 (100%)	2.71 (0.898)
5	All the research project assumptions are documented when developing the project schedule	1 (1%)	3 (3%)	39 (38.6%)	43 (42.6%)	12 (11.9%)	3 (3%)	101 (100%)	2.70 (0.867)
6	The progress of research project activities is controlled and monitored continuously.	2 (2%)	3 (3%)	16 (15.8%)	57 (56.4%)	19 (18.8%)	4 (4%)	101 (100%)	2.99 (0.900)
7	The research project schedule identifies schedule constraints driven by the end-user or consumer, technology, suppliers or management.	3 (3%)	5 (5%)	37 (36.6%)	43 (42.6 %)	12 (11.9%)	1 (1%)	101 (100%)	2.58 (0.908)
8	A critical path (the activities that are time and resource-intensive) analysis is performed on the research project schedule during each progress update cycle.	5 (5%)	37 (36.8%)	27 (26.7%)	20 (19.8%)	11 (10.9%)	1 (1%)	101 (100%)	1.98 (1.,14)/
9	Resource-constrained and resource – leveled schedule is created and maintained	3 (3%)	28 (27.7%)	38 (37.6%)	25 (24.8%)	6 (5.9%)	1 (1%)	101 (100%)	2.06 (0.988)
Time Management Maturity Level AverageMean (SD)								**2.62 (0.980)**	

Source: Own survey data, 2024

The lowest ratings were given to the process characteristics stating "A critical path (the activities that are time and resource-intensive) analysis is performed on the research project schedule during each progress update cycle" mean 1.98 (1.,14) followed by " Resource-constrained and resource –

leveled schedule is created and maintained" mean 2.06 (0.988). The majority of respondents reflected that "The progress of research project activities is controlled and monitored continuously" mean of 2.99 (0.900), and "The project requirements (deliverables) are reflected in the project's work breakdown structure (WBS) which contains a detailed description of the research project activities" mean of 2.96 (1.06). These values indicated an effort toward the practices of these characteristics process of project time management. The means values for the characteristics process practices of time management range from 1.98 (1.14) to 2.99 (0.900). The overall mean values of all the process variables of time management knowledge and practice were found to be 2.62 (0.980). The mean value is equivalent to 52.4% of the total score of five points which is assigned as the maximum achievable point of maturity level. The scored value for time management implies that all activities were related to Level 2 (Table 4.5).

This value may indicate that the time management sub-component of the research project's body of knowledge area was in the basic approach of research project implementation of the institute **(**Shukla and Sushil, 2022**)**. The value may imply weak institutional consideration of the standard requirements although some of the characteristic processes may be practiced in time management. Institutions or organizations with implementation approaches of projects with well-defined standard guidelines for the time management requirements processes and practices will have an opportunity for a higher maturity level (DyReyes, 2008).

4.3.4. Cost Management

Cost management contains the processes involved in estimating, budgeting, and controlling the project costs to facilitate the completion of the approved budget. It also consists of resource planning, cost estimating, budgeting, and cost control (PMI, 2004). Table 4.6 shows the cost management practice of the research projects that were evaluated using nine characteristic process variables. The respondents confirmed there is an effort in the practice of most of the cost management knowledge characteristics variables since the mean value ranges between 2.72 (1.01) to 3.11 (0.847). This implies that the cost activities process practices ranged from level 2 to 3.

Table 4.6: Respondents response to aspects of Cost Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis(0)	Very low (1)	Low (2)	Average (3)	High (4)	Very High (5)	Total n (%)	
1	Research Project Financial Standards processes and procedures are documented and consistently followed.	1 (1%)	5 (5%)	22 (21.8%)	52 (51.5%)	13 (12.9%)	81 (7.9%)	101 (100%)	2.94 (0.978)
2	The research project management environment has formal processes that support the gathering of financial data for periodic reports.	2 (2%)	4 (4%)	26 25.7%)	52 (51.5%)	12 (11.9%)	5 (5%)	101 (100%)	2.82 (0.942)
3	Research project budgets are based on resource estimates and the resource plan.	---	2 (2%)	18 (17.8%)	55 (54.5%)	19 (18.9%)	8 (6.9%)	101 (100%)	3.11 (0.847)
4	The research project team and the project management office members receive training and awareness in financial standards and procedures to improve the efficiency of project cost management	6 (5.9%)	20 (19.8%)	41 (40.6%)	23 (22.8%)	9 (8.9%)	2 (21%)	101 (100%)	2.15 (1.09)
5	The actual cost is tracked and reconciled with the original estimated plan	2 (2%)	4 (41%)	14 (13.9%)	65 (64.4%)	10 (9.9%)	6 (5.91%)	101 (100%)	2.94 (0.904)
6	There is a consistent process documenting all estimates and cost assumptions.	4 (4%)	7 (6.9%)	21 (20.8%)	53 (52.5%)	13 (12.9%)	3 (3%)	101 (100%)	2.72 (1.01)
7	A common list of cost categories exists for all research project budgets with regular updates.	3 (3%)	5 (5%)	20 (19.8%)	58 (57.4%)	10 (9.9%)	5 (5%)	101 (100%)	2.81 (0.967)
8	A common documented process is in place for completing all financial procedures required to close a research project.	3 (3%)	3 (3%)	26 (25.7%)	55 (54.5%)	10 (9.9%)	4 (4%)	101 (100%)	2.77 (0.926)
9	The research project cost is monitored and controlled regularly to track actual project expenditures against the budget on the project schedule	3 (3%)	6 (5.91%)	18 (17.8%)	52 (51.5%)	17 (16.8%)	5 (5%)	101 (100%)	2.88 (1.023)
Cost Management Maturity Level Average Mean (SD)								**2.79 (0.965)**	

Source: Own survey data, 2024

The characteristic variable process "The research project team and the project management office members receive training and awareness in financial standards and procedures to improve the efficiency of project cost management" has a mean value of 2.15 (1.09). It is the only lowest-scored value compared to the other characteristics variables (Table 4.6).

The overall mean values of all characteristics process of cost management knowledge and practice were found to be 2.79 (0.965). This mean value is equivalent to 55.9% of the total score of 5 points which is assigned as the maximum achievable point of maturity level. The scored average value for cost management indicated that all activities related to Level 2 (Table 4.6). This level may indicate that the cost management sub-component of the research project's body of knowledge area was in the basic approach of research project implementation of the AHRI **(**Shukla and Sushil, 2022**)**. This may be attributed to low institutional consideration of the standard cost requirements although most of the characteristic processes of cost management may be practiced informally.

.4.3.5. Quality Management

Quality indicates the steps or procedures that include quality planning, performance quality assurance, and performance quality control. It also incorporates organization or institution activities to find out quality policies, objectives, and responsibilities of any project to satisfy the necessity for the undertaking of the project. (PMI, 2004).

Table 4.7 indicates the quality management practice of the research projects that were evaluated using characteristic process variables. Out of the nine characteristics processes of quality management, two characteristic processes namely ”The research project team and project management office members receive training and awareness in quality standards procedures, and requirements to improve the efficiency of research project quality management” and ”The quality change control process for the research project is established and followed.” have a mean value of 2.20 (1.16) and 2.25 (1.14), respectively. These mean values are lower compared to others.

The respondents reflected that the practice of most of the quality management knowledge practice characteristics processes variables mean value ranges between 2.62 (1.04) to 2.82 (1.00). The mean value of all characteristics of the quality management knowledge areas and practice was 2.52 (1.11) hence the institute's maturity level towards quality management belongs to level 2 (Table 4.7). This value may indicate that the quality management sub-component research project's body of knowledge area was in the basic approach of research project implementation of the institute **(**Shukla and Sushil, 2022**).**

Table 4.7: Respondents response to aspects of Quality Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis (0)	Very low (1)	Low (2)	Aver (3)	High (4)	Very High (5)	Total n (%)	
1	A formal documented procedure exists for creating, planning, managing, and maintaining the research project quality.	2 (2%)	5 (5%)	29 (28.7%)	43 (42.6%)	17 (16.8%)	5 (5%)	101 (100%)	2.82 (1.00)
2	Every research project has a Quality Assurance plan.	5 (5%)	27 (26.7%)	29 (28.7%)	17 (16.8%)	19 (18.8%)	4 (4%)	101 (100%)	2.30 (1.29)
3	The quality change control process for the research project is established and followed.	5 (5%)	19 (18.8%)	41 (40.6%)	22 (21.8%)	10 (9.9%)	42 (4%)	101 (100%)	2.25 (1.14)
4	The research project team and project management office members receive training and awareness in quality standards procedures, and requirements to improve the efficiency of research project quality management	7 (6.9%)	18 (17.8%)	40 (39.6%)	24 (23.8%)	8 (7.9%)	4 (4%)	101 (100%)	2.20 (1.16)
5	The research project team reviews all of the processes and procedures that apply before the start of every project.	2 (2%)	10 (9.9%)	38 (37.6%)	31 (30.7%)	11 (10.9%)	9 (8.8%)	101 (100%)	2.65 (1.14)
6	Common documented processes and procedures for technical performance and quality, performance is applied to every research project.	3 (3%)	8 (7.9%)	33 (32.7%)	42 (41.6%)	10 (9.9%)	5 (5%)	101 (100%)	2.62 (1.04)
7	An initial review of the research project plan involving all participants is to devise the quality strategy and set standards before creating the baseline of the research project plan to ensure completeness and consistency.	2 (2%)	10 (9.9%)	29 (28.7%)	44 (43.6%)	9 (8.9%)	7 (6.9%)	101 (100%)	2.68 (1.07)
8	Quality variances are reviewed between the current progress status and research project quality against the baseline plan regularly.	2 (2%)	13 (12.9%)	44 (43.6%)	30 (29.7%)	9 (8.9%)	3 (3%)	101 (100%)	2.40 (0.991)
9	The quality control process is undertaken to ensure research project products and activities comply with relevant quality plans. Project trend data are also analyzed regularly based on metrics data.	3 (3%)	5 (5%)	23 (22.8%)	57 (56.4%)	10 (9.9%)	3 (3%)	101 (100%)	2.74 (0.924)
Quality Management Maturity Level Average Mean (SD)								**2.52 (1.11)**	

Source: Own survey data, 2024

This may be due to less attention to the quality requirements by the institutional consideration although some of the characteristic processes may be informally practiced to manage quality in projects (DyReyes, 2008). Project quality management is not an independent entity rather it is a continuous process that starts and ends with the project. A quality management plan needs to be created in the early phases of the project because of its significant impact on scope, time, cost, and risk (Ross and Shaltry, 2006; Hyvari, 2006).

4.3.6. Human Resource Management

Human resources comprises the process of developing a human resource plan, organizing, managing, and leading the project team. It includes the processes of organizational planning, staff acquisition, and team development (PMI, 2004). The respondents' reflections on human resource management's eight characteristics process knowledge and the practice role of the research projects are shown in Table 4.8. Two of the characteristic processes practices namely ”A recognition process is in place for recognizing outstanding commitments or performance on a research project team.” and ” The formal and informal training and developmental needs of all team members are facilitated and provided to research team members and are documented.” displayed a mean value of 2.23 (1.12) and 2.46 (0.995), respectively. These mean values are lowest compared to the other nine characteristic processes of human resource management practices.

The study participants indicated that the practice of most of of human resource knowledge practice in the characteristics variables processes mean value ranges between 2.62 (1.09) to 2.98 (1.08). The mean value of all characteristics processes of the human resource management knowledge areas and practice was 2.66 (1.04) hence the institute's maturity level towards human resource management belongs to level 2 (Table 4.8). The value may indicate that the human resource management Sub-component of the research project's body of knowledge area was in the basic approach of research project implementation in AHRI **(**Shukla and Sushil, 2022**).**

Table 4.8: Respondents response to aspects of Human Resource Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis (0)	Very low (1)	Low (2)	Aver (3)	High (4)	Very High (5)	Total n (%)	
1	The human resource strategy is linked to the institute's strategy planning (SP) which makes it easy to track individual targets towards the achievement of institutional goals.	3 (3%)	8 (7.9%)	21 (20.8%)	55 (54.5%)	10 (9.9%)	4 (4%)	101 (100%)	2.72 (0.991)
2	A Staffing plan for the acquisition and management of human resources is created and followed for every research project.	3 (3%)	7 (6.9%)	21 (20.8%)	49 (48.5%)	18 (17.83%)	3 (3%)	101 (100%)	2.80 (1.01)
3	Team members are selected to match the skills, roles, and responsibilities of the research project, which are defined and documented for all project positions.	3 (3%)	1 (1%)	28 (27.7%)	42 (41.6%)	17 (15/8%)	10 (9.9%)	101 (100%)	2.98 (1.08)
4	All research project resource needs (such as hardware, software, and space) are documented	--	9 (8.9%)	37 (36.6%)	35 (34.7%)	12 (11.9%)	8 (7.9%)	101 (100%)	2.73 (1.05)
5	The research project skills and developmental needs of all team members are documented.	1 (1%)	8 (7.9%)	31 (30.7%)	46 (45.5%)	10 (9.9%)	5 (5%)	101 (100%)	2.70 (0.965)
6	The formal and informal training and developmental needs of all team members are facilitated and provided to research team members and are documented.	1 (1%)	16 (15.8%)	37 (36.6%)	31 (30.7%)	15 (14.9%)	1 (1%)	101 (100%)	2.46 (0.995)
7	Human resource costs and time are formally tracked and monitored in all research projects.	4 (4%)	8 (7.9%)	33 (32.7%)	37 (36.6%)	15 (14.9%)	4 (4%)	101 (100%)	2.62 (1.09)
8	A recognition process is in place for recognizing outstanding commitments or performance on a research project team.	6 (5.9%)	19 (18.8%)	36 (35.6%)	29 (28.7%)	8 (7.9%)	3 (3%)	101 (100%)	2.23 (1.12)
Human Resource Management Maturity Level Mean (SD)								**2.66 (1.04)**	

Source: Own survey data, 2024

Project human resource management is the other core part of project management. It is complex since it requires the support of the management and employee. In the research projects, the project roles and responsibilities were identified and defined in a standardized manner and documented in the staffing management plan.

Project team development activities are undertaken through training, coaching, and performance improvements to enhance the project team's capability (Zwikael and Unger-Aviram, 2010).

4.3.7. Communication Management

Communication management comprises the approach required to ensure timely and appropriate generation, collection, distribution, storage, retrieval, and ultimate disposition of project information. It includes the identification of stakeholders and managing expectations, planning communication, distributing information, and reporting performance (PMI, 2004).

Table 4.9: Respondents response to aspects of Communication Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis(0)	Very low (1)	Low (2)	Aver (3)	High (4)	Very High (5)	Total n (%)	
1	A Communications plan, analysis, distribution, and documentation are created for each research project and followed by the research project team.	2 (2%)	6 (5.9%)	35 (34.7%)	36 (35.6%)	18 (17.8%)	4 (4%)	101 (100%)	2.73 (1.02)
2	Minutes are prepared and distributed to all participating parties after each formal meeting.	2 (2%)	6 (5.9%)	12 (11.9%)	39 (38.6%)	36 (35.6%)	6 (5.9%)	101 (100%)	3.18 (1.05)
3	Project information is updated and readily accessible to the organization at all times.	2 (2%)	5 (5%)	21 (20.8%)	43 (42.6%)	26 (25.7%)	4 (43%)	101 (100%)	2.97 (1.01)
4	Research project status reporting procedures are established and followed.	1 (1%)	5 (5%)	15 (14.9%)	44 (43.6%)	32 (31.7%)	4 (4%)	101 (100%)	3.12 (0.952)
5	Variance analysis for schedule, budget, and effort is communicated regularly.	2 (2%)	13 (12.9%)	35 (34.7%)	32 (31.7%)	13 (12.9%)	6 (5.9%)	101 (100%)	2.58 (1.12)
6	Project status review meetings are held regularly with the research team, leadership, and partners/stakeholders	1 (1%)	3 (3%)	25 (24.8%)	52 (51.5%)	15 (14.9%)	5 (5%)	101 (100%)	2.91 (0.896)
7	Research project successes are announced, and documented including project close-outs and success stories.	1 (1%)	4 (4%)	37 (36.6%)	31 (30.7%)	22 (1.8%)	6 (5.9%)	101 (100%)	2.86 (1.03)
8	Performance reports prepared and provided to relevant stakeholders.	2 (2%)	5 (5%)	19 (18.8%)	40 (39.6%)	26 (25.7%)	9 (8.9%)	101 (100%)	3.09 (1.09)
CommunicationManagement Maturity Level AverageMean (SD)								**2.93 (1.02)**	

Source: Own survey data, 2024

The assessment results of the communication management practices of the research projects using eight characteristics processes variables are displayed in Table 4.9. The respondents confirmed that there is an effort in the practice of most of the communication management knowledge characteristics variables since the mean value ranges between 2.86 (1.03) to 3.18 (1.05). This showed that the practicing of activities communication process ranged from level 2 to 3.

The only characteristic process that displayed a lower mean value out of the eight characteristic processes of communication management practices was" Variance analysis for schedule, budget, and effort is communicated regularly." Which displayed a mean value of 2.58 (1.12). The overall eight characteristics processes variables for the communication management body of knowledge areas and practice mean values were found to be 2.93 (1.02). This mean value is equivalent to 58.6%. of the total score of five points which is assigned as the maximum achievable point of maturity level. The assessment mean value of communication management practices leads to the alignment of the organization level at level 2 (Table 4.9). This value may indicate that the communication management research project's knowledge area and practice was in the basic approach of research project implementation in the institute **(**Shukla and Sushil, 2022**).** The overall mean value of communication management knowledge areas and practice is the highest compared to the other nine PMBoKs areas assessed in AHRI.

.4.3.8. Risk Management

Risk management comprises the processes of conducting risk management planning, identification, qualitative and quantitative analysis, response planning, and monitoring and control of project risk. It is aimed to increase the probability and impact of positive events and decrease the probability and impact of negative events in the project (PMI, 2004). The majority of study participants indicated that the practice for the risk management knowledge characteristics variables processes practice mean value ranges between 2.13 (1.07) to 2.35 (1.09). The reflections of the respondents as indicated by the mean values ranges of the characteristic process showed that that risks were not consistently identified, documented, or tracked. In addition to this project risks were not always evaluated for priority and probability and action plans (Table 4.10).

Table 4.10: Respondents response to aspects of Risk Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis(0)	Very low (1)	Low (2)	Aver (3)	High (4)	Very High (5)	Total n (%)	
1	A high-level risk assessment is completed at the start of each research project and rated as low, medium, and high probabilities.	3 (3%)	18 (17.8%)	41 (40.6%)	28 (27.7%)	9 (8.9%)	2 (2%)	101 (100%)	2.28 (1.02)
2	Research project risks are documented using a common format.	6 (5.9%)	15 (14.9%)	41 (40.6%)	26 (25.7%)	12 (11.9%)	1 (1%)	101 (100%)	2.26 (1.07)
3	A risk assessment/ handling plan is created for research projects and continuously updated.	7 (6.9%)	13 (12.9%)	38 (29.7%)	30 (29.7%)	11 (10.9%)	2 (2%)	101 (100%)	2.31 (1.11)
4	Research project risks are monitored and evaluated for priority, probability, and impact.	8 (7.9%)	17 (16.8%)	40 (39.6%)	27 (26.7%)	8 (7.9%)	1 (1%)	101 (100%)	2.13 (1.07)
5	The method for managing each accepted risk is documented.	7 (6.9%)	13 (12.9%)	40 (39.6%)	29 (28.7%)	9 (8.9%)	3 (3%)	101 (100%)	2.29 (1.12)
6	Action plans are created for risks to be mitigated or transferred before risks cause adverse effects.	6 (5.9%)	13 (12.9%)	38 (37.6%)	31 (30.7%)	12 (11.9%)	1 (1%)	101 (100%)	2.33 (1.07)
7	Contingency-scheduled research project status meetings include a regular review of a research project's risks.	2 (2%)	18 (17.8%)	43 (42.6%)	24 (23.8%)	9 (8/9%)	5 (5%)	101 (100%)	2.35 (1.09)
RiskManagement Maturity Level Average Mean (SD)								**2.28 (1.08)**	

Source: Own survey data, 2024

The overall mean value of the seven characteristics variables process of the risk management knowledge areas and practice was 2.28 (1.08) hence the institute's maturity level towards risk management belongs to level 2 (Table 4.10). The value may indicate that the risk research project's body of knowledge area was in the basic approach of research project management implementation in AHRI **(**Shukla and Sushil, 2022**).** The overall mean value of risk management knowledge areas and practice is the lowest in comparison to the other nine PMBOK areas assessed in the institute. This may justify that the risk management strategy consideration was weak in the AHRI although there were exitances in the practices of some of the processes. According to PMBOK, a project risk management plan needs to be a vital and integral part of project management that identifies the probability and impact of positive events and decreases the probability and impact of events adverse to the project (PMBOK, 2019).

4.3.9. Procurement Management

Procurement management is the process necessary to plan procurements, purchase or acquire products and services, contract administration, and contract closeout (PMI, 2004).

Table 4.11: Respondents response to aspects of Procurement Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis(0)	Very low (1)	Low (2)	Aver (3)	High (4)	Very High(5)	Total n(%)	
1	A standard agreement that includes research project procurement management requirements is issued for research project goods and services.	4 (4%)	4 (4%)	28 (27.7%)	50 (49.5%)	14 (14.9%)	1 (1%)	101 (100%)	2.68 (0.937)
2	A procurement plan is in place that identifies what to procure and is developed at the start of each research project.	2 (2%)	7 (6.9%)	17 (16.8%)	46 (45.5%)	27 (26.7%)	2 (2%)	101 (100%)	2.94 (0.988)
3	Research project procurement timing and requirements are clearly defined in a formal contract or agreement and documented.	2 (2%)	7 (6.9%)	25 (24.8%)	53 (52.5%)	11 (410.9%)	3 (3%)	101 (100%)	2.72 (0.929)
4	Contract Administration is an integral part of research project procurement management to ensure the delivery of procured items or services as agreed in the contract	1 (1%)	9 (8.9%)	33 (32.7%)	40 (39.6%)	14 13.8%)	4 (4%)	101 (100%)	2.68 (0.989)
5	An evaluation process that meets specific criteria has been formalized to provide a consistent method for procurement proposal review and acceptance.	2 (2%)	12 (11.9%)	19 (19.9%)	56 (55.4%)	9 (8.9%)	3 (3%)	101 (100%)	2.66 (0.972)
6	Contract change control process in place and contract closeout process that records the evaluation of supplier performance in meeting their contact requirements is documented	3 (3%)	11 (10.9%)	40 (39.6%)	32 (31.7%)	11 (10.9%)	4 (4%)	101 (100%)	2.49 (1.06)
7	Training on procurement management is facilitated and provided to enhance the awareness of the research team and project management office members.	3 (3%)	26 (25.7%)	41 40.6%)	20 (19.8%)	7 (6.9%)	4 (4%)	101 (100%)	2.14 (1.10)
Procurement Management Maturity Level AverageMean (SD)								**2.62 (0.995)**	

Source: Own survey data, 2024

Procurement management also includes the contract management issued by the buyer or an external organization or issued by the performing organization or institution to an external organization (sub-contract). Besides, the processes required for change control to develop and administer contracts or purchase orders (PMI, 2004). The mean values of each of the seven characteristic process variables practices were determined and displayed in Table 4.11. The characteristic process practice that showed a lower mean value compared to the other eight characteristic processes of procurement management practices was ”Training on procurement management is facilitated and provided to enhance the awareness of the research team and project management office members.” Which displayed a mean value of 2.14 (1.10).

The study participants indicated that there is an effort in the practice of most of the procurement management knowledge characteristics process variables since the mean value ranges between 2.49 (1.06) to 2.94 (0.998). This showed that the practicing of activities for most of the procurement management process ranged from level 2. The overall mean values of the seven characteristics variables processes for the procurement management knowledge areas and practice were found to be 2.62 (0.995). This mean value is equivalent to 52.3%. of the total score of five points which is assigned as the maximum achievable point of maturity level. The procurement management practices assessment mean value leads to the alignment of the institution level at level 2 (Table 4.11). This value may indicate that the procurement management sub-component research project's body of knowledge area was in the basic approach of research project implementation in the AHRI **(**Shukla and Sushil, 2022**)**.

4.3.10. Stakeholder Management

Stakeholder management is the process required to identify the people, groups, or organizations that could impact or be impacted by the project. It also analyzes stakeholder expectations (PMI, 2004). The assessment values for study participants' knowledge and practices of stockholder management were determined for each of the five characteristic process variables. The respondents confirmed that there is an effort in the practice of most of the stockholder management knowledge characteristics variables which have a mean value ranging between 2.72 (0.991) to 2.92 (1.12). This showed that the practicing of activities communication process was at level 2 (Table 4.12).

Table 4.12: Respondents response to aspects of Stakeholder Management Practice

S. No	Variable characteristics	n (%)							Mean (Std Dev)
		Non-Exis(0)	Very low (1)	Low (2)	Aver (3)	High (4)	Very High (5)	Total n (%)	
1	There is awareness about the importance of stakeholder management by the research project team and project management office members	1 (1%)	13 (12.9%)	14 (13.9%)	46 (45.5%)	19 (18.8%)	8 (7.9%)	101 (100%)	2.92 (1.12)
2	Stakeholder management (planning, analysis, selection, and communication) is performed formally in any research project management.	3 (3%)	11 (10.9%)	32 (31.7%)	36 (35.6%)	13 (12.9%)	6 (5.9%)	101 (100%)	2.62 (1.12)
3	An effort is exerted to recognize and identify stakeholders and react to handle the stakeholder's demand and expectations.	3 (3%)	3 (3%)	22 (21.8%)	55 (54.5%)	12 (11.9%)	6 (5.9%)	101 (100%)	2.87 (0.976)
4	A strategy is developed for managing each key stakeholder's expectations.	4 (4%)	4 (4%)	28 (27.7%)	48 (47.5%)	14 (13.9%)	3 (3%)	101 (100%)	2.72 (0.991)
5	There is a continuous effort to communicate and work with stakeholders to influence their expectations, address their concerns, and resolve issues.	2 (2%)	7 (6.9%)	18 (17.8%)	57 (56.4%)	14 (13.9%)	3 (3%)	101 (100%)	2.82 (0.932)
Stakeholders Management Maturity Level AverageMean (SD)								**2.79 (1.02)**	

Source: Own survey data, 2024

The characteristic process that resulted in a lower mean value out of the five characteristic processes of stakeholder management practices was "Stakeholder management (planning, analysis, selection, and communication) is performed formally in any research project management." Which displayed a mean value of 2.62 (1.12). The grand mean value of five characteristics variables for the stockholder management knowledge areas and practice was found to be 2.79 (1.02). The mean value is equivalent to 55.8%. of the total score of five points which is assigned as the maximum achievable point of maturity level. Assessment of the means value of stakeholders management practices leads to the alignment of the organization at level 2 (Table 4.12). This value may indicate that the stakeholder research project's body of knowledge area was in the basic approach of research project implementation in the institute **(**Shukla and Sushil, 2022**).**

4.3.11. Analysis of Project Management Maturity Level of AHRI

The research project management maturity level of AHRI was determined by employing the judgment-based scoring system as described in the following Likert rating scale. The numeric values assigned to each response to the questions were 0 to 5. The response values of the characteristic processes practices were added per knowledge area and average values were used to determine the maturity level of each project management knowledge practice area. Maturity levels of the grand mean value of the ten project management knowledge areas were evaluated as per the following tables that indicate the benchmarking of the maturity level based on the mean value ranges (Table 4.13) **(**Shukla and Sushil, 2022**).**

Table 4.13: Maturity level value benchmarking (Shukla and Sunhil, 2022**)**

Maturity Level	Maturity Level stage response type	Values range
Level I	Initial process	1.00 to 1.99
Level II	Structured Process and Standards	2.00 to 2.99
Level III	Organizational Standards and Institutionalized Process	3.00 to 3.99
Level IV	Managed process	4.00 to 4.99
Level V	Optimizing process	5.00

In summary, the risk, scope, integration, and quality project management processes practices had a relatively lower score of maturity level with a mean value ranging from 2.28 (1.08) to 2.52 (1.11). Of which the risk management with a mean value of 2.28 (1.08) was the lowest of all mean values. Moreover, procurement, time, human resource, cost, stakeholders, and communication project management processes practices have a relatively higher score of maturity level with a mean value ranging from 2.62 (0.995) to 2.93 (1.02). Of which the communication management with a mean value of 2.93 (1.02) was the highest of all mean values. Cost and stakeholder project management processes practices have an equal mean value, that is., 2.79 (0.965) and 2.70 (1.02), respectively. The overall results of this study showed that the project management maturity levels of AHRI in the ten assessed project management knowledge areas were between 2.28 (1.08) and 2.93 (1.02).

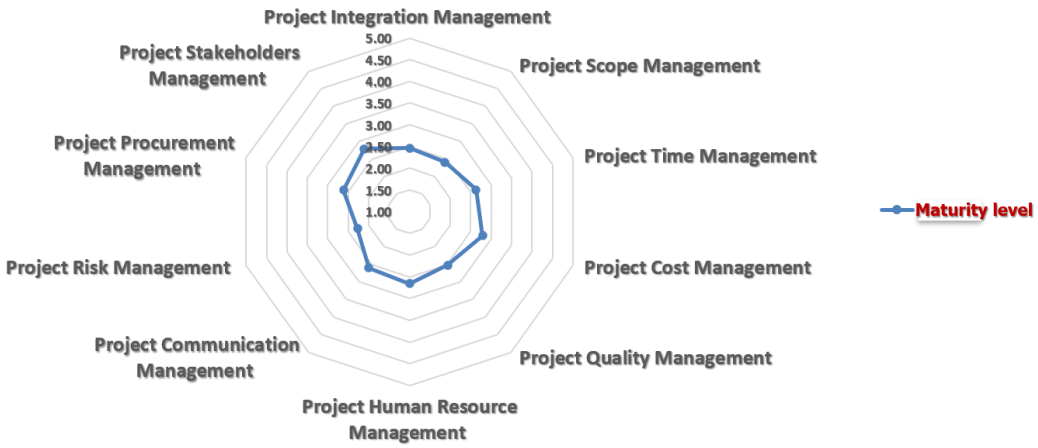
The grand mean value of the ten project management knowledge areas and practice was found to be 2.58 (0.963). This grand mean value is equivalent to 51.7%. of the total score of five points that is assigned as the maximum achievable point of maturity level (Table 4.14 and Figure 4.1).

Table 4.14: Overall Maturity Level of Project Management Knowledge Areas in AHRI.

S. No	Knowledge Areas	Average Mean Maturity Level	Average Standard Deviation
1	Project Integration Management	2.47	0.902
2	Project Scope Management	2.40	1.03
3	Project Time Management	2.63	0.980
4	Project Cost Management	2.79	0.965
5	Project Quality Management	2.52	1.11
6	Project Human Resource Management	2.66	1.04
7	Project Communication Management	2.93	1.02
8	ProjecyRisk Management	2.28	1.08
9	Project Procurement Management	2.62	0.995
10	Project Stakeholder Management	2.79	1.02
	Average Mean and Standard Deviation	2.58	0.963

Source: Own survey data, 2024

Therefore, the project management maturity level of AHRI was concluded to be level 2 which belongs to the "Structured Process and Standards" level of the maturity level stage (Table 4.14).. This value may indicate that the practicing of activities of the ten project management knowledge areas of project management maturity level was the basic foundation of research project management practices or implementation in the AHRI **(**Shukla and Sushil, 2022**).** It should be noted that the process of attaining maturity is not a one-time event, it is a consciously planned and properly managed continuous improvement effort (Supic, 2005). Therefore, AHRI is expected to strive and exert its effort for a continuous improvement process to attain the highest project management knowledge areas of project management maturity level. Maturity is a comparative level of advancement in an institution or organization that has been achieved concerning any given processes or set of activities to accomplish project objectives, thereby meeting the strategic goals (PM Solutions, 2008).



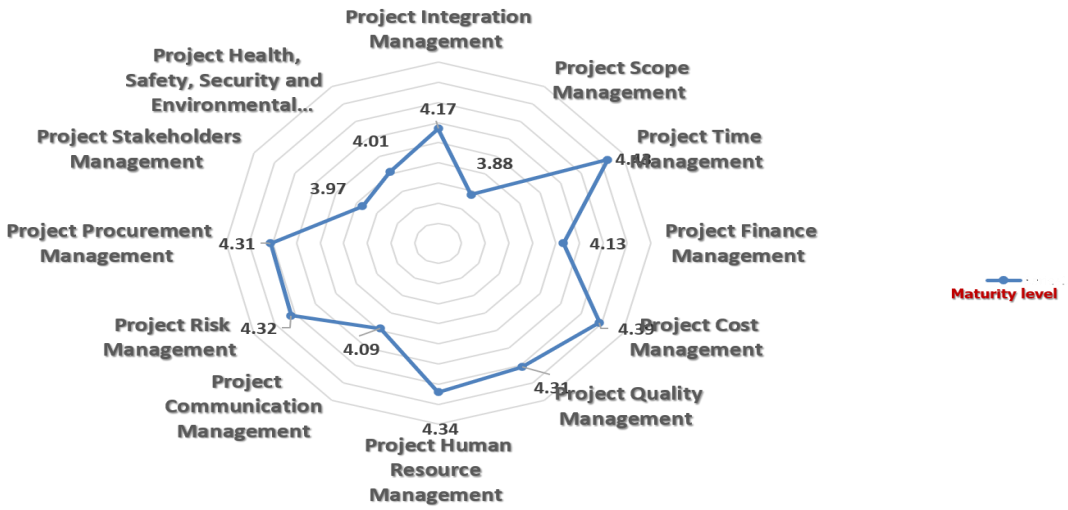
Source: Own survey data, 2024

Figure 4.1: Spider web diagram of the maturity level of Project Management Knowledge Areas in AHRI

Maturity is a comparative level of advancement in an institution or organization that has been achieved concerning any given processes or set of activities to accomplish project objectives, thereby meeting the strategic goals (PM Solutions, 2008). Institutions or organizations with strategic plans and the implementation approaches of projects with well-defined standard operational procedures (SOPs) or guidelines for the knowledge area and processes practices will have a better opportunity to attain a higher project maturity level (DyReyes, 2008).

4.4 Perception of Project Management Knowledge Areas Level of Improtance in AHRI

Assessment of the perceptions and understandings of the relative importance of each of the Project Management Body of Knowledge Areas (PMBOKs) reflected by the respondents in the context of AHRI were displayed in Table 4.15 and Figure 4.2.



Source: Own survey data, 2024

Figure 4.2: Spider web diagram of the maturity level of the relative importance of Project Management Knowledge Areas in the context of AHRI.

The assessment values for the study participants' perceptions and understandings of the project management knowledge area's level of importance were determined for each of the twelve knowledge area variables. The respondents confirmed good perceptions and understandings in almost all knowledge areas with a mean value ranging between 3.88 (0.711) to 4.43 (0.792), respectively. This showed that the perceptions and understandings of the twelve project management knowledge areas were at levels 3 and 4, which belong to the maturity level of stages "Organizational standards institutionalized processes", and "Managed processes", respectively.

The knowledge management areas that resulted in the lowest mean value of perceptions and understandings out of the twelve management areas were "Scope management" and "Stakeholder management". These knowledge areas displayed a mean value of 3.88 (0.711) and 3.97 (0.754), respectively (Table 4.15 and Figure 4.2).

Table 4.15: Respondents' perception of the relative importance of project management knowledge area in the context of AHRI

S. No	Knowledge Areas	n (%)					Total n (%)	Mean (Std Dev)
		Much less Imp (1)	Less Imp (2)	Equally Imp (3)	More Imp (4)	Much More Imp (5)		
1	Integration Management	---	1 (1%)	26 (25.7%)	29 (28.7%)	45 (44.6%)	101 (100%)	4.17 (0.849)
2	Scope Management	--	2 (2%)	26 (25.7%)	55 (54.5%)	18 (17.8%)	101 (100%)	3.88 (0.711)
3	Time Management	--	3 (3%)	10 (9.9%)	29 (28.7%)	59 (58.4%)	101 (100%)	4.43 (0.792)
4	Financial Management	--	2 (2%)	24 (23.8%)	34 (33.7%)	41 (40.6%)	101 (100%)	4.13 (0.845)
5	Cost Management	---	2 (2%)	15 (14.9%)	26 (25.7%)	58 (57.4%)	101 (100%)	4.39 (0.812)
6	Quality Management	--	3 (3%)	7 (6.9%)	47 (46.5%)	44 (43.6%)	101 (100%)	4.31 (0.731)
7	Human Resource Management	--	2 (2%)	14 (13.9%)	33 (32.7%)	52 (51.5%)	101 (100%)	4.34 (0.791)
8	Communication Management	--	2 (2%)	19 (18.8%)	48 (47.5%)	32 (31.7%)	101 (100%)	4.09 (0.763)
9	Risk Management	--	3 (3%)	11 (10.9%)	38 (37.6%)	49 (48.5%)	101 (100%)	4.32 (0.787)
10	Procurement Management	--	2 (2%)	12 (11.9%)	40 (39.6%)	47 (46.5%)	101 (100%)	4.31 (0.758)
11	Stakeholder Management	--	2 (2%)	24 (23.8%)	50 (49.5%)	25 (24.9%)	101 (100%)	3.97 (0.754)
12	Health, safety, security, and Environmental Management	--	--	28 (27.7%)	44 (43.6%)	29 (28.7%)	101 (100%)	4.01 (0.755)
Relative importance Knowledge areaAverageMean (standard deviation)							**4.20 (0.779)**	

Source: Own survey data, 2024 [Note: Much less Imp: Much less important (1**);** Less Imp: less important (2); Equal Imp: Equally important (3); More Imp: More important (4); Much more Imp: Much more important (5)]

Likewise, out of the twelve knowledge management areas assessed, the knowledge areas with the highest mean value of perceptions and understandings were “Cost management” and “Time management”, which showed a mean value of 4.39 (0.812) and 4.43 (0.792), respectively. The grand mean value of the perception and understanding of the twelve areas of PMBOKs was found to be 4.20 (0.799). This mean value is equivalent to 84%. of the total score of five points which is assigned as the maximum achievable point of maturity level (Table 4.15 and Figure 4.2).

The mean value for the assessment of the perceptions and understanding leads to the alignment of the organization at level 4 (Table 4.15 and Figure 4.2). Maturity level 4 indicated that the twelve areas of PMBoKs belong to the maturity level of stage "Managed processes" **(**Shukla and Sushil, 2022**).**

4.5. Comparative analysis of PMBoKs practices maturity levels versus the perception and understanding of the relative importance each of knowledge area

The results of the comparative assessment of the PMBOK's practice maturity level versus the perceptions and understandings of the relative importance of each of the PMBOK areas reflected by the respondents in the context of AHRI were displayed in Tables 4.16 and Figure 4.3.

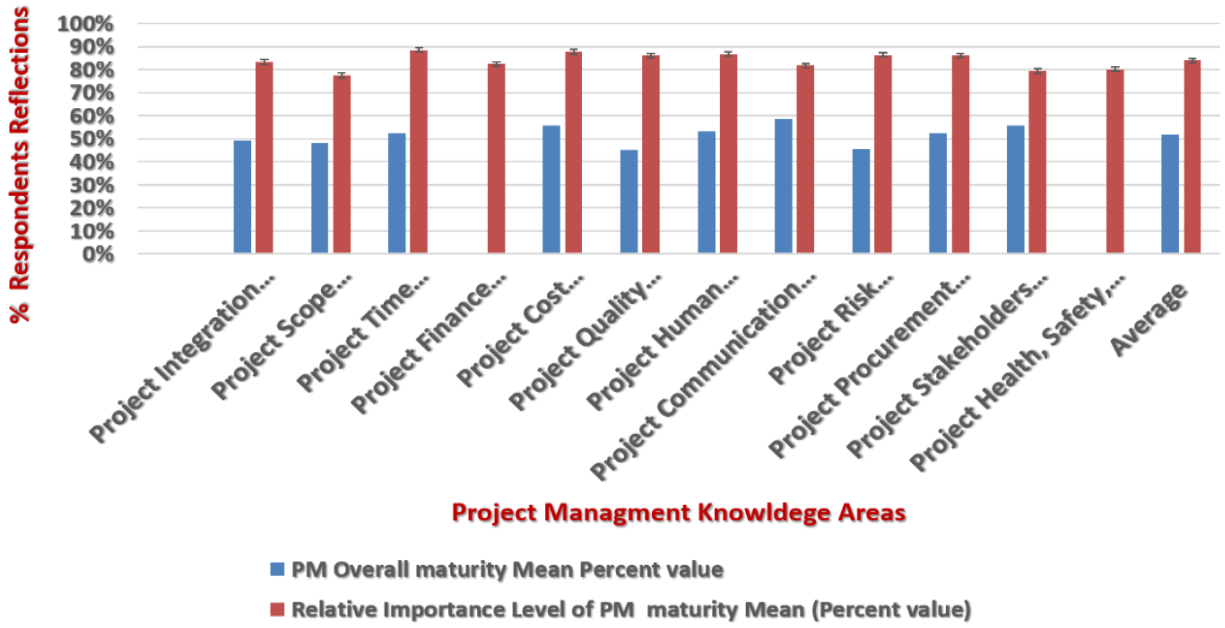
Table 4.16: Respondents' Perception of the Relative Importance of the Level of Project Management Knowledge Area and overall project management maturity levels of knowledge area in the context of AHRI

S. No	Project Management Knowledge Area	Mean (standard Deviation)	
		Project Management overall maturities level of knowledge area	Relative Importance Level of Project Management Knowledge Area
1	Project Integration Management	2.47 (0.902)	4.17 (0.849)
2	Project Scope Management	2.40 (1.03)	3.88 (0.711)
3	Project Time Management	2.63 (0.980)	4.43 (0.792)
4	Project Finance Management	Not assessed	4.13 (0.845)
5	Project Cost Management	2.79 (0.965)	4.39 (0.812)
6	Project Quality Management	2.52 (1.11)	4.31 (0.731)
7	Project Human Resource Management	2.66 (1.04)	4.34 (0.791)
8	Project Communication Management	2.93 (1.02)	4.09 (0.763)
9	Project Risk Management	2.28 (1.08)	4.32 (0.787)
10	Project Procurement Management	2.62 (0.995)	4.31 (0.758)
11	Project Stakeholders Management	2.79 (1.02)	3.97 (0.754)
12	Project Health, Safety, Security and Environmental Management	Not assessed	4.01 (0.755)
Average Mean and standard deviations		**2.584 (0.963)**	**4.20 (0.799)**

Source: Own survey data, 2024

The grand mean for the perceptions and understandings of the relative importance of the twelve areas of PMBoKs was found to be 4.20 (0.799) while the grand mean value of the nine PMBOKs knowledge processes practice was 2.58 (0.963).

Therefore, the project management maturity level for PMBOK knowledge process practice belongs to the maturity level stage of "The basic foundation of research project management practices or implementation" However, the project management maturity level for PMBoK knowledge perceptions and understanding assessment belongs to the maturity level stage of "Managed processes? **(**Shukla and Sushil, 2022**).**



Source: Own survey data, 2024

Figure 4.3: PMBoKs process practices maturity level versus perceived understanding on the relative importance of Project Management Knowledge Area inAHRI.

Among the ten PMBoKs knowledge areas processes practices, the risk, scope, integration, and quality project management had a relatively lower score of maturity level with a mean value ranging from 2.28 (1.08) to 2.52 (1.11). Of which the risk management process practice with a mean value of 2.28 (1.08) was the lowest of all mean values. While the knowledge management areas that displayed lower mean value of perceptions and understandings out of the twelve management areas were "Scope management" and "Stakeholder management". These knowledge areas displayed a mean value of 3.88 (0.711) and 3.97 (0.754), respectively (Tables 4.16 and Figure 4.3).

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The respondents confirmed that good perceptions and understandings in almost all of the twelve knowledge areas have a mean value ranging between 3.88 (0.711) to 4.39 (0.812). The project management maturity levels of the ten assessed project management knowledge areas' characteristic process implementation were between 2.28 (1.08) and 2.93 (1.02) (Tables 4.16 and Figure 4.3).

4.6 Analysis based on interview and secondary data sources

Key informant interviewing and secondary data collection were undertaken to support the data collected using the self-administered questionnaires from the study participants Out of 18 key informants invited and communicated to participate in the study, 13 participants responded by providing pertinent information about the project management processes and implementation aspects of AHRI. The response rate of the key informant was 72.2%. The key informants provide information through interviews using open-ended flexible discussion points. For those who had busy schedules for face-to-face interviews, the interview questions were prepared in Google Sheets and shared through emails for filling out and submission Besides the key informants, data from the secondary sources were also collected from various documents *i.e.*, proposals, manuscripts, policy briefs, reports, strategic documents, etc using a data abstraction checklist. Furthermore, observations made during the secondary data collection were also noted down and summarized to align with the collected data. The interview questions responses and the abstracted information from various documents were organized thematically to summarize the collected information. The major findings of the interview questions and secondary source of data besides the observations made during the secondary data collection were outlined as follows.

4.6.1. Analysis of information from key informants

The open-ended flexible interview questions comprised the main thematic topics that covered research protocol review and approval processes, research project processes and performance, resource requirements for research project implementation, communication, and research output dissemination. The key informant's responses were organized thematically to summarize respondents' reflections, strengths, limitations, and action points (Table 4.17).

Table 4.17: Thematic summary of the key informants' reflections. strengths, limitations, and action points

S.No	Reflections: Strengthen, Limitations and action points	Thematic summary			
		Research protocol review and approval processes	**Research project processes and performance**	**Resource requirements for research project implementation**	**Communication and research output Dissemination**
1	**Reflections (KAP)**	There is a lot of delay in the process of reviewing protocols.	Skilled and competent researchers, and committed leadership	Logistic inputs: Procurement plan prepared annually linked to meet quality & quantity of research items and service needs	The institute possesses regular information dissemination of research findings in conferences, workshops, seminars, and publications.
			The minimum and maximum aggregated research grant is 20 - 120 million Birr. The rough estimate for financial utilization is 60-85%. The estimated timeline for research project completion ranges from 1-7 years depending on the research type.	The procurement plan is monitored & controlled periodically to track the timely delivery of items	Research outputs are also disseminated through social media (Facebook, TikTok, YouTube & telegram) and mass media TV, Radio, and newspapers.
				Stakeholders' engagement (community, universities, collaborative research institute, regional health bureau, hospitals, customs, regulatory, etc) during launching, periodic progress updates, and project close-up disseminations.	There is also community-based education for awareness creation in mass media. E..g for organized programs in the last four years: 55 in radio. 35 using newspapers.

Table 4.17: Thematic summary of the key informants' reflections. strengths, limitations, and action points continued

S.No	Reflections: Strengthen, Limitations and action points	Thematic summary			
		Research protocol review and approval processes	**Research project processes and performance**	**Resource requirements for research project implementation**	**Communication and research output Dissemination**
2	**Strengths**	Online submission requirements of protocols through the e-portal of IRB when applying for ethical review.	Most of the research is funded by competitive international grants.	The Institute possessed the formal standard guideline for procurement and timely delivery of items, financial guidelines to track & reconcile expenditure against the financial plan, and an HR requirement guideline to define skills, experience, and roles, annual HR plan linked with the institute's strategy.	Creating community engagements.
		The institution review board is recognized and accredited by SIDCER-PEBIN' an international independent ethical accreditation organization.	The initiative for Enterprise Resource Planning (ERP) which is a cloud-based for tracking financial and technical aspects of research projects.	The initiative for the Electronic government procurement (eGP) system.	PR acts as a bridge between the researcher and the community.
		Skilled and experienced IRB members.		The institute possesses a strong financial and internal control system and secured a platinum level of Good Financial and Grant Management Practice (GFGMP).	Database availability to document all research outputs.
		The online free ethics course requirements for any research undertakings by researchers.		Research funds are secured through competitive grants or collaborating international partners.	

Table 4.17: Thematic summary of the key informants' reflections. strengths, limitations, and action points continued

S.No	Reflections: Strengthen, Limitations and action points	Thematic summary			
		Research protocol review and approval processes	**Research project processes and performance**	**Resource requirements for research project implementation**	**Communication and research output Dissemination**
3	**Limitations**	Poor follow-up of the technical accomplishment of approved research project protocols.	Poor timely reporting system on performance.	Many complaints of delays of reagents, chemicals, miscellaneous supplies, etc inputs due to different external factors and workloads of procurement staff.	Inefficient information dissemination from researchers to the PR.
		Delay in the reviewing and approval process of research protocols.	The PIs are not transparent in sharing research findings with the concerned office.	Lack of training for awareness creation for efficient project cost management.	Delay in reviewing and approval process.
			Lack of research project management guidelines/policy.	There are poor or irregular motivation schemes and recognitions for outstanding performance.	
4	**Action points (mechanism) for improvement**	Increase the efficiency of the protocol review process.	Strengthen the M&E system for research project technical and process reporting.	Increase the No. of procurement experts	
		Apply the online technical accomplishment reporting as mandatory and set a follow-up system of research progress and status.	Implement a uniform coding system of protocols to track the progress of research projects.	Arrange special agreements with customs & duty, national bank, and others to increase efficiency.	

Table 4.17: Thematic summary of the key informants' reflections. strengths, limitations, and action points continued

S.No	Reflections: Strengthen, Limitations and action points	Thematic summary			
		Research protocol review and approval processes	**Research project processes and performance**	**Resource requirements for research project implementation**	**Communication and research output Dissemination**
4	**Action points (mechanism) for improvement**	Work closely with the PIs or project coordinators to resolve complaints and problems.	Preparation of research project management guidelines/policy.	Financial and physical follow-up routinely. Organization of training and experience sharing on the best experience	Work closely with PIs and the research team on research projects to improve communication and better engagement.
			Training in project management for maximizing the performance of project implementation.	The institute is expected to implement a motivation and recognition scheme for best performance.	

Source: Own survey data, 2024, KAP: Knowledge, attitude, and Practice

The action points may serve for planning to take corrective measures on the limitations and for improvement besides taking lessons on the best performance. The major reflections of the respondents are summarized in Table 4.17. According to the key informants' responses, the major observed problems in the research project protocol reviewing and approval process were the delay in the reviewing process and poor follow-up of the technical accomplishments of approved projects.

The strengths stated were the online submission of all protocols through the IRB website when applying for ethical review for the institutional review board and the requirements for an online free ethics course for the research team members participating in any research projects. In addition to this, the accreditation of the institute's ethical review board by SIDCER-PEBIN' is also a pride for the institute. SIDCER-PEBIN' is a Globalizing Ethics for Health Research; Pan-African Bio-Ethics Initiative for accreditation of ethical board of academic and research institutes review and approve research protocols.

The strengths of research project processes and performance were securing financial resources from competitive international grants. The limitations stated were a lack of research project management guidelines or policy and a poor timely reporting system on performance and financial utilization by principal investigators and project coordinators The current AHRI trends of initiative for Enterprise Resource Planning (ERP) a cloud-line software system supporting automation and processes in finance, human resource, supply chain, procurement, etc. It is useful for tracking financial, technical, and other aspects of research projects and will strengthen the M&E and better follow-up and controls of research projects (ERP, 2024).

The financial utilization of the government source for administrative costs reached 96% while the financial utilization for research project implementation processes from external sources of research grants averages range 60 - 85%. The reasons for the discrepancies in the low utilization of research grants could be attributed to external factors such as international procurement delays due to the national bank's tedious process, customs, and duty working system, and airline delivery delays. The internal factors may be due to the overstretched workload of procurement staff for handling the procurement of 36 mega research project supplies.

The major bottleneck of high concern outlined by the interviewee and reports of secondary data in the research project was a marked delay in the procurement of input materials leading to shortages to undertake various experimental-based researches. The procurement system that meets the quantitative and qualitative requirements is inefficient because of the rigid and bureaucratic government procurement system that creates delays in the project's time and cost overruns (Table 4.17).

Therefore, with the inflexible purchasing system, it may be difficult to expect the research project achievements. This may lead to project weakness, inefficiency, and ineffectiveness since the project cannot move to the planned schedule. The initiative for enterprise government procurement (eGP) a new procurement approach in which the lists of items to be procured are provided with specifications, sources, and estimated costs in soft copy will be uploaded online will possibly hasten the procurement process and may mitigate the challenges of supplies and logistics delay. Electronic government procurement (eGP) is designed with innovative measures using information and communication technology to streamline public procurement with greater efficiency that breaks down the physical barriers of space and time to have a transparent procurement process through wider access to information and markets. eGP is a national electronic government procurement portal that uses an electronic system to handle transactions in the public procurement process. eGP ensures the provision of equal treatment to all bidders, applying the same rule of law, increasing accountability of participants in the procurement process, and at the same time raising awareness among the general public about the expenses of the government. (Electronic government procurement, 2024)

According to the information of the executive office head, AHRI's Finance and Procurement executive office secured the platinum level of Good Financial and Grant Management Practice (GFGMP) for its efficient system in the financial management of research projects. This will add value for enhancing the trust of international competitive grant sponsors since efficient financial management is one of the criteria for global grant sponsors. The GFGMP is the ARS 1651 standard requirement internationally for the financial governance and management of grant funding (Global grant community, 2024; Harste, et al., 2021).

The weak and irregular motivation schemes and recognition of AHRI for outstanding performance were the other challenges stated by the key informants. The informants proposed action points to implement motivation and recognition schemes for best performance. The responses of key informants about communication and research output dissemination include the regular dissemination of research findings in conferences, workshops, seminars, and publications. Research outputs are also disseminated through social media (Facebook, TikTok, YouTube & telegram) TV, Radio, and newspapers. There was also community-based education for awareness creation in mass media and database availability to document all research outputs. The limitations stated are inefficient information dissemination from researchers to the PR (Table 4.17).

4.6.2. Analysis of information from secondary data abstraction

The second strategic plan of the institute, proposals, policy briefs, technical documents, and publications list data in the last four years were reviewed to abstract information from the documents The data abstraction sheet for secondary data collection encompasses the document type and timeline, the scope, objectives, and benefits indicated, core findings, and conclusive statements of the documents.

The secondary data analysis revealed that a total of 224 research proposals were reviewed and approved from 2020/21 - 2023/2024 by the ethical board of the institute. The proposals focused on generating evidence for policy inputs useful for informed decision-making, producing new information, and knowledge that enhances learning that could be scaled up to operational research. In addition to this, some study protocols were emphasized to develop improved methods or technology used for diagnosis and better clinical care for illness. As per the abstracted information from publication data lists, the number of publications in peer-reviewed journals during the last four years was 283.

Seven policy briefs were prepared from the various studies conducted in AHRI, of which three of them were diagnostic technologies and improved tools that may be linked or emanated from the reviewed proposals. Some of the proposals were linked to graduate students pursuing research work as a partial fulfillment of their graduate studies.

This indicated that the institute also made a significant contribution to building the capacity of young researchers through sponsoring and providing training for MSC and PhD students from various universities to undertake research work. The findings from the various publications and policy briefs indicated the alignment of the outcome of various studies with the strategic planning of AHRI. AHRI's distinctive purpose and major focus areas as stated in the strategic plan is evidence-based decision-making on health programs, practices, or policies through the uptake of research outcomes generated by the identification of relevant research agendas. It also engages in improving the medical research capacity and competence of partner higher learning Institutes through the provision of need-based health research training, supervision, and mentoring of postgraduate trainees for best research outcomes, besides promoting collaborative international participatory research. The institute also fosters modern health innovations and technology transfer. This could denote effective ways of solving health sector challenges through conducting basic biomedical research and introducing and/or developing new and improved tools or methods (AHRI, 2020).

Despite the compilation of valuable information in the assessed documents, there are limitations in accessing technical activities status updates, performance, and financial reports during an in-depth assessment of 14 randomly selected protocols to access from the IRB office, Strategic Affairs Executive Office, Procurement, and Finance executive office even some technical directorates. However, it was difficult to track the document to exhaust information such as schedule and cost overruns besides the project performance rate of the research project to compare with the established target. since different document coding systems are employed in different offices for the same proposal. The current ongoing effort of digitalization and setting Enterprise Resource Planning (ERP) which is a cloud line basis for tracking financial and technical aspects of research projects with a permitted password hopefully avert the information accessing challenges since there will be uniform coding systems for a given document. In conclusion, the information collected from the key informants' responses and the secondary source of data triangulate in the majority of cases and substantiate the analyzed and interpreted primary data collected from distributed questionnaires filled responses of the study participants

CHAPTER FIVE

V. SUMMARY, CONCLUSION AND RECOMMENDATION

The main objective of this study was to determine the project maturity level and identify limitations in the process of implementing research project management in AHRI. The study examined the knowledge, perceptions, and practices of principal investigators or co-principal investigators, project managers, and project team members. It also considered ways in which the maturity assessment can be used to direct and improve the project management practice to achieve project management growth and excellence. This chapter includes a summary of the major findings, conclusions, and recommendations that would provide a framework to enable interventions for the improvement of the research project management in AHRI. It could also enlighten preventive actions for the identified limitations that contributed to project delays, cost overruns, and quality issues that will support the desired outcomes in the implementation of the Strategic Planning-II of the institute. Furthermore, the study may also serve as a baseline and the lesson learned could stimulate further studies for benchmarking the best project management practices.

5.1. Summary

A quantitative and qualitative methodology using a survey design approach was utilized for this study. This is because surveys are preferable to demonstrate high validity and high-reliability data (Leedy and Ormond, 2005). The findings of the data analysis of the surveys are summarized below:

- Self-filled online questionnaires were distributed to 118 study participants namely, principal investigators, and project managers, in case of their absence the co-investigators or research team members during the study. Moreover, qualitative data were also collected by interviewing the key participants using open-ended flexible discussion points or by filling out the online shared open and closed-ended interview questions prepared in Google Sheets for the interviewees who were busy for face-to-face interviews.

- The key informants were directors and division heads of the research directorate, executive office heads of the strategic affairs (SAEO), grant management unit within SAEO, competency and human resource development, procurement, and finance, public relations, and communication and ethical review board office manager as well as two IRB members.
- In addition to the primary data, secondary data were collected from documents such as proposals, activity reports, financial reports, technical reports, manuscripts, etc using a data abstraction checklist.
    - Sociodemographic profile analysis revealed that, out of 118 study participants considered for the study, the majority (101, 85.6%) responded and submitted the filled questionnaires. Of which 60% were male and 40 % were female. The age group 31 to 40 years and 41 to 50 years accounted for higher rates of 47% and 31%, respectively. 25 (24.8%) of the respondents indicated a service year of 6 to 10 years, 41(40.6%) of them responded as serving for 11 to 15 years while 23 (22.8%) of the respondents replied with a work experience of 16 to 20 years. Moreover, 17 (16.8%) of the respondents were at the PhD degree level, 14 (13.9%) had an MD with a medical specialty, 42 (41.6%), and 10 (9.9%) had a master's degree level, respectively, Regarding the career positions of the study participants, 3 (3%) and 30 (29.7%) of the respondents were lead and senior researchers levels, respectively who could serve as the principal coordinators of research projects. The majority of respondents 56 (55.4%) responded as associate researchers while a few of the respondents (12 (11.9%)) indicated as junior researchers.
    - The result indicated that the age group 31 to 50 years was the majority of the study participants. In addition to this, more than 10 years of overall work experience was also indicated by most of the study participants.
    - Furthermore, respondents with longer periods of service, educational levels at PhD, MD and medical specialty, MD/DVM, and MPH/MA/MSc who may be at the lead or senior researcher levels, may serve as the principal coordinators of research projects since they could be in a better position to explain project management knowledge areas, processes, and implementation.

- Education and experience are determinantal in dealing with problems and challenges maturely due to accumulated skills that were acquired and developed through the practices of the acquainted knowledge or theoretical concepts (Murithi, et al.,2017).
- Assessment of the study participants' responses regarding the research project's grant sources revealed that 71 (70.3%) of the research projects secured their financial source from international competitive research grants or international partner collaborations research grants.
- The highest grant amount as reflected by 26.7% of the respondents was 5 - 20 million Birr. The remaining 30 (29.7%) grants were not secured from external financial sources. This may be the government-allocated budget through AHRI for the execution of research projects.
- The timeframe for the execution and close-up periods of research projects reflected by the respondents indicated that 21 (20.8%) were less than 3 years, 63 (62.4%) were 3 to 5 years, 1 (1%) was 6-10 years, and 6 (5.9%) were more than 10 years, respectively.

- The study participant's reflections on the project management body of knowledge (PMBOK) ten knowledge areas characteristic processes and practices maturity level values of each project management mean knowledge area and practice as well as the overall or grand mean of the ten PMBOKs are displayed as followed:

    - The mean values for characteristic processes variables practice for integration management range from 2.07 (1.18) to 2.82 (0.963). The overall mean of the integration management area of knowledge and practice collected using eight characteristic process variables was found to be 2.47 (0.992). The value showed that the maturity of the integration management could be considered at level 2.
    - The mean values of the scope process practices variables range between 2.19 (1.05) and 2.79 (1.00) with an overall mean value (standard deviation) of 2.40 (1.03) This value indicates that the maturity of the scope management could be considered at level 2.

- The means values for the characteristics process practices of time management range from 1.98 (1.14) to 2.99 (0.900). The overall mean values of all the process variables practice of time management knowledge and practice were found to be 2.62 (0.980). The scored value for time management implies that all activities were related to Level 2.
- The cost management knowledge characteristics process practices mean value ranges between 2.15 (1.09) to 3.11 (0.847). This implies that the cost activities process practices ranged from level 2 to 3. The overall mean values of all characteristics process practices of cost management knowledge and practice were found to be 2.79 (0.965). The scored average value for cost management indicated that all activities related to Level 2.
- The quality management knowledge characteristics process variables practice mean value ranges between 2.20 (1.04) to 2.82 (1.00). The mean value of all characteristics of the quality management knowledge areas and practice was 2.52 (1.11) hence the institute's maturity level towards quality management belongs to level 2.
- The human resource management knowledge and practice in the characteristics variables processes mean value ranges between 2.23 (1.12) to 2.98 (1.08). The mean value of all characteristics processes of the human resource management knowledge areas and practice was 2.66 (1.04) hence the institute's maturity level towards human resource management belongs to level 2.
- The communication management knowledge and practice in the characteristics variables processes mean value ranges between 2.58 (1.12) to 3.18 (1.05). This showed that the practicing of activities communication process ranged from level 2 to 3. The overall eight characteristics processes variables for the communication management body of knowledge areas and practice mean values were found to be 2.93 (1.02). The assessment mean value of communication management practices leads to the alignment of the organization level at level 2.

- The practice for the risk management knowledge characteristics variables processes practice mean value ranges between 2.13 (1.07) to 2.35 (1.09). The overall mean value of the seven characteristics variables process of the risk management knowledge areas and practice was 2.28 (1.08) hence the institute's maturity level towards risk management belongs to level 2.
- The practice of procurement management knowledge characteristics process in the mean value ranges between 2.14 (1.10) to 2.94 (0.998). The overall mean values of the seven characteristics variables processes for the procurement management knowledge areas and practice were found to be 2.62 (0.995). Therefore, the institute's maturity level towards procurement management belongs to level 2.
- The stakeholder management knowledge and characteristics process practice belongs in the mean value ranges between 2.62 (1.12) to 2.92 (1.12). The grand mean value of five characteristics variables for the stakeholder management knowledge areas and practice was found to be 2.79 (1.02). This showed that the practicing of activities stakeholder process was at level 2
- The results of this study showed that the project management maturity levels of AHRI in the ten assessed project management knowledge areas were between 2.28 (1.08) and 2.93 (1.02). Of which the risk management with a mean value of 2.28 (1.08) was the lowest of all mean values, and communication management with a mean value of 2.93 (1.02) was the highest of all mean values.
- The grand mean value of the ten project management knowledge areas and practice was found to be 2.58 (0.963). This grand mean value is equivalent to 51.7%. of the total score of five points that is assigned as the maximum achievable point of maturity level. Therefore, the project management knowledge and practice maturity level of AHRI was concluded to be level 2.

- This value belongs to the “Structured Process and Standards” level of the maturity level stage. This value may indicate that the practicing of activities of the ten project management knowledge areas of project management maturity level was the basic foundation of research project management practices or implementation in the AHRI **(**Shukla and Sushil, 2022**).**
- It should be noted that the process of attaining maturity is not a one-time event, it is a consciously planned and properly managed continuous improvement effort (Supic, 2005). Therefore, AHRI is expected to strive and exert its effort for a continuous improvement process to attain the highest project management knowledge areas of project management maturity level.

- The study participants' perceptions and understandings of the project management knowledge area's level of importance were also determined for each of the twelve knowledge area variables.
  - The respondents confirmed good perceptions and understandings in almost all knowledge areas with a mean value ranging between 3.88 (0.711) to 4.43 (0.792), respectively. This showed that the perceptions and understandings of the twelve project management knowledge areas were at levels 3 and 4, which belong to the maturity level of stages “Organizational standards institutionalized processes”, and “Managed processes”, respectively.
  - The knowledge management areas that resulted in the lowest mean value of perceptions and understandings out of the twelve management areas were ”Scope management” and ”Stakeholder management”, their mean value were 3.88 (0.711) and 3.97 (0.754), respectively.
  - Cost management” and “Time management”, showed a mean value of 4.39 (0.812) and 4.43 (0.792), respectively, These are the highest mean value of perceptions and understandings out of the assessed twelve project knowledge management areas.
  - The grand mean value of the perception and understanding of the twelve areas of PMBOKs was found to be 4.20 (0.799). This mean value is equivalent to 84%. of the total score of five points which is assigned as the maximum achievable point of maturity level.

- The mean value for the assessment of the perceptions and understanding leads to the alignment of the organization at level 4 indicating that the twelve areas of PMBOKs belong to the maturity level of the stage "Managed processes" (Shukla and Sushil, 2022).

- The analysis results of the interview and secondary data collected from various documents as well as the observations made during data collection are outlined below. .

  - Out of 18 key informants invited and communicated to participate in the study, 13 participants responded by providing pertinent information about the project management processes and implementation aspects of AHRI. The response rate of the key informant was 72.2%.
  - The replies to the interview questions and abstracted information from various documents were organized using the. main thematic topics comprising of research protocol review and approval processes, research project processes and performance, resource requirements for research project implementation, communication, and research output dissemination.
    - ✓ The major observed problems in the research project protocol reviewing and approval process were the delay in the reviewing process and poor follow-up of the technical accomplishments of approved projects.
    - ✓ The strengths stated were the online submission of all protocols through the IRB website when applying for ethical review by the IRB and the requirements for an online free ethics course for the research team members participating in any research projects.
    - ✓ The accreditation of the institute's ethical review board by SIDCER-PEBIN' is also a pride for the institute.
    - ✓ The strengths of research project processes and performance were securing financial resources from competitive international grants.
    - ✓ The limitations stated for project processes and performance were a lack of research project management guidelines or policy and a poor timely reporting system on performance and financial utilization by principal investigators and project coordinators.

- ✓ The financial utilization of the government source for administrative costs reached 96% while the financial utilization for research project implementation processes from external sources of research grants averages range 60 - 85%.
    - The low utilization of research grants could be attributed to external factors such as international procurement delays due to the national bank's tedious process, customs, and duty working system, and airline delivery delays.
    - The internal factors may be due to the overstretched workload of procurement staff
- ✓ The major bottleneck of high concern outlined by the interviewee and reports of secondary data in the research project was a marked delay in the procurement of input materials leading to shortages to undertake various experimental-based researches.
- ✓ The weak and irregular motivation schemes and recognition of AHRI for outstanding performance were also the challenges stated by the key informants.
- ✓ Regular dissemination of research findings in conferences, workshops, seminars, and publications. Community-based education for awareness creation of the research outputs through social media.
- ✓ A total of 224 research proposals were reviewed and approved from 2020/21 - 2023/2024 by the ethical board of the institute. Some of the proposals were from graduate students pursuing research work who were sponsored by AHRI.
- ✓ Based on the abstracted information from publication data lists, the number of publications in peer-reviewed journals during the last four years was 283.
- ✓ Seven policy briefs were prepared from the various studies conducted in AHRI, of which three of them were diagnostic technologies and improved tools that may be linked or emanated from the reviewed proposals.
- ✓ AHRI is engaged in improving the medical research capacity and competence of partner higher learning Institutes through the provision of need-based health research training, supervision, and mentoring of postgraduate trainees for best research outcomes.

- ✓ The major limitations during the secondary data assessment were the difficulty in accessing and tracking technical activities status updates, performance, and financial reports for randomly selected proposals. This problem was attributed to different document coding systems employed by different offices for the same research proposal.
- ✓ The findings from the assessment of the various publications and policy briefs indicated the alignment of the outcomes of various studies with the strategic planning of AHRI.

5.2 Conclusion

The conclusions of the current study as divulged by the results of the descriptive analysis of the study participants' responses were elaborated on below:

- Sociodemographic results indicated that the age group 31 to 50 years and more than 10 years of overall work experience were the majority of the study participants. Furthermore, respondents with longer periods of service, educational levels at PhD, MD and medical specialty, MD/DVM, and MPH/MA/MSc who may be at the lead or senior researcher career positions, could better serve as the principal coordinators of research projects. Because, they are in a better position to explain project management knowledge areas, processes, and implementation. Education and experience are determinantal in dealing with problems and challenges maturely due to accumulated skills, knowledge, and experience (Murithi, *et al.*,2017).

- The project management maturity levels of AHRI in the ten assessed project management knowledge areas were between 2.28 (1.08) and 2.93 (1.02). Of which the risk management with a mean value of 2.28 (1.08) was the lowest of all mean values, and communication management with a mean value of 2.93 (1.02) was the highest of all mean values.

- The grand mean value of the ten project management knowledge areas and practices was found to be 2.58 (0.963). This value signifies that the project management knowledge and practice maturity level of AHRI is level 2. This value belongs to the "Structured Process and Standards" level of the maturity level stage **(**Shukla and Sushil, 2022**).**

- The study participants displayed good perceptions and understandings in almost all knowledge areas with a mean value ranging between 3.88 (0.711) to 4.43 (0.792), respectively. This showed that the perceptions and understandings of the twelve project management knowledge areas were at levels 3 and 4, which belong to the maturity level of stages “Organizational standards institutionalized processes”, and “Managed processes”, respectively.

- The grand mean value of the perception and understanding of the twelve areas of PMBOKs was found to be 4.20 (0.799). This value for the assessment of the perceptions and understanding of the respondents leads to the alignment of the organization at level 4 indicating that the twelve areas of PMBOKs belong to the maturity level of the stage “Managed processes” **(**Shukla and Sushil, 2022**).**

- The information collected from the key informants' responses and the secondary source of data triangulate in the majority of cases and substantiate the analyzed and interpreted primary data collected from distributed questionnaires filled responses of the study participants.

5.3. Recommendation

The maturity assessment is mainly designed to measure the competence of project management knowledge and practices thereby setting directions for improvement. The low level of project management maturity exhibited in the research project management processes of AHRI may be attributed to the weak research project management knowledge and practice:

Therefore, based on the study findings, the following recommendations and action points were proposed at different levels of AHRI to entertain the various constraints factors, strengthen efforts, and attain the highest project management maturity level.

5.3.1 At the Institutional Management Level

- AHRI needs to give more emphasis on recognizing the value of the project management maturity approach and adapt a system across all the research projects to ensure the successful accomplishment of research projects.

- The result reminds the need for enhanced effort to work more focused to correct the project management knowledge areas with the lower maturity level rather than attempting to step up to the next higher maturity level. It should be noted that the process of attaining maturity is not a one-time event rather, it is a determinedly planned and properly managed continuous improvement effort. Moreover, the result further indicated the path to the next maturity level requires a committed, consistent, and comprehensive approach at the management and researcher levels in the whole processes practices of project management in the institute.

- Good governance, timely decisions, and implementing sound procurement management procedures could enhance efficiency, and avoid cost and time overruns of research projects.

- Preparation of research project management standard guidelines or SOPs, creating awareness, digitalization for availing research projects technical and financial performance, consistent monitoring, and follow-up to track progress, identify problems, and provide support for the research team towards improved and efficient research project management capabilities.

- Strengthening the IRB, and Strategic Affairs Executive Office, particularly the project management unit through capacity building, adequate human resources, and administrative support.

- Implementing a motivation scheme and providing a safe work environment to create a conducive working environment to improve the sense of ownership in assigned research project tasks.

- Full engagement and working closely with all stakeholders and partners for the successful accomplishment of all research projects.

- Improve the supply and delivery system of materials (logistics and supplies) which are the core bottleneck for the execution of research projects by anticipating the demand and schedule of research projects.

- Organizing training programs on project management knowledge areas and their effective practices to capacitate project managers, principal and co-principal investigators, the research team, and executive offices.

- Strengthening the initiative for Enterprise Resource Planning (ERP) a cloud-line for tracking financial and technical aspects of research projects will strengthen the M&E and better follow-up and controls of research projects.

- Strengthening the initiative for enterprise government procurement (eGP) a procurement approach to streamline the procurement with greater efficiency.

- Maintaining the Good Financial and Grant Management Practice (GFGMP) Standards to keep up efficient systems in the financial management of research projects.

- Improve the efficiency of the research project protocol reviewing and approval process to improve the delay.

5..3.2 At the technical directorates and executive office levels that support the execution of projects

- Committed, consistent follow-up and support, and comprehensive approach in the whole processes of project management to all research projects of the institute for the path to a higher maturity level.

- Efforts to attain a high level of maturity that depends on the goals, strategies, scope, and the consideration of standards (SOP) requirements of PMBOKs and practices by the technical directorates and executive offices.

- Consistent monitoring, control, and follow-up to track progress, identify problems, and provide support for the execution of the standard requirements of project management by the project management team (principal investigator, project manager, research team members, and others) toward efficient research project management.

5.3.3 At the Principal project investigators, project managers, and research team members levels

- Work closely with technical directorates and supportive executive offices, to improve and enhance the efficiency of research project management thereby attaining the highest possible of project maturity.
- Work collaboratively with the financing bodies or research grant donors and the procurement and financial executive office to facilitate a quick mechanism that minimizes time and cost overrun, and to improve efficient financial utilization.
- Reporting the progress updates, challenges, and problems to seek immediate solutions that could contribute to the efficiency and effectiveness of research project management.
- Continuous communication among the research project teams and stakeholders to improve team spirit, overcome the problems of coordination, and enhance inherent commitment.
- Organize periodic forums to disseminate the lessons learned from best practices on research project management for all stakeholders (project managers, principal investigators, co-principal investigators, the research team, and concerned executive offices).

5.3.4 Proposed action points for Similar study initiatives in health sectors

- Assessment and evaluation trends for the determination of the maturity level of project management are relatively new areas and are not practiced in the majority of health institutions or health-related programs. The current study focused only on AHRI may serve as a baseline to promote similar study initiatives in other health institutions even in the health sector to substantiate and scale up project management practices.

5.4 Limitations of the Study

The limitation is that the study was conducted in AHRI which may be considered as a confined study area and may influence the external validity of the study. There may be a recall bias challenge by study participants although the questions in the questionnaire were designed to be recallable as much as possible focusing more on generalized issues. Some of the questions may not be filled or answered during the interview if the respondent is not willing to respond as per his right reflected in the consent. There was limited access to some information and problems in the traceability of documents due to the challenges in tracking some of the documents. Nevertheless, the current study tried to give baseline information that may pave the way for further extensive study in the area of project management maturity.

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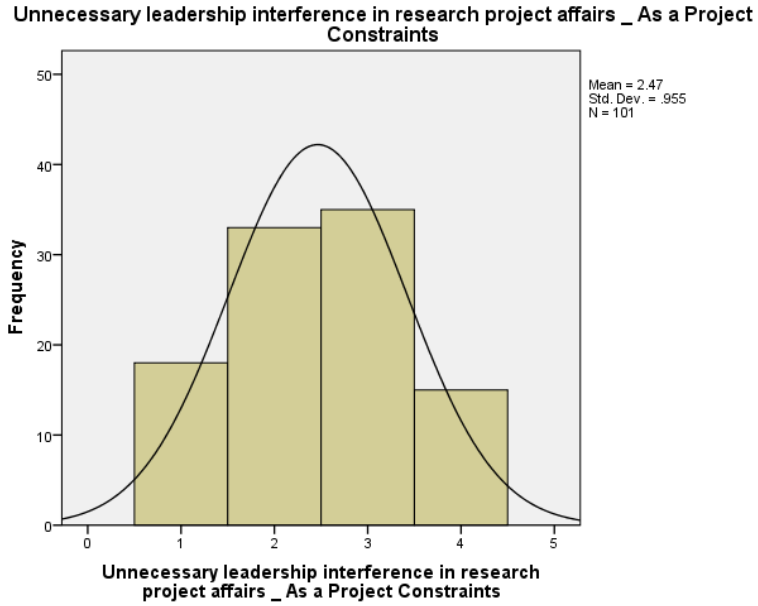
VII. ANNEX

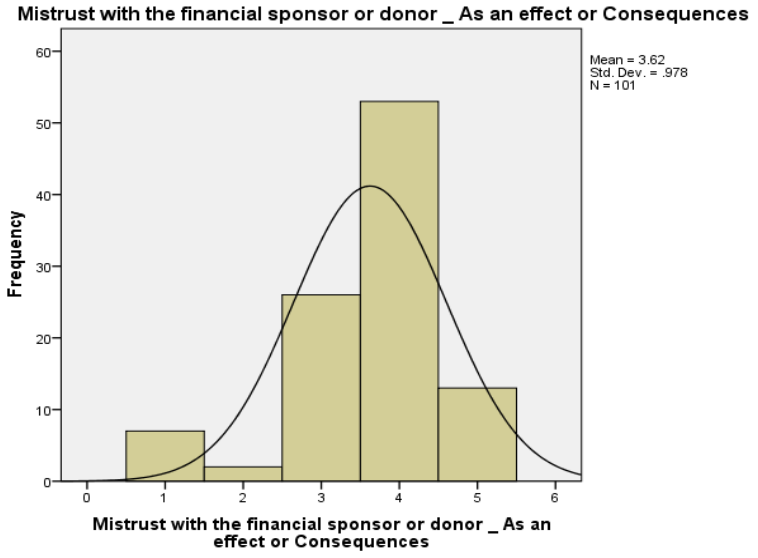
7.1 Some statistical data

I. Some data extracted from SPSS outputs

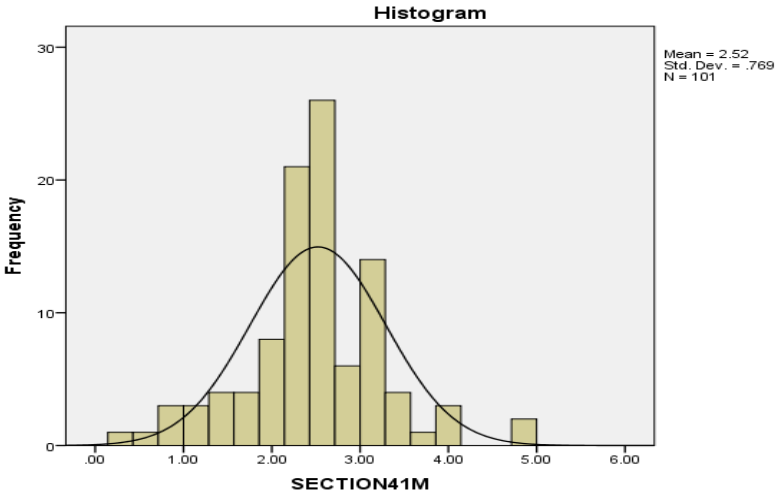
Output histogram section 2 questionnaire



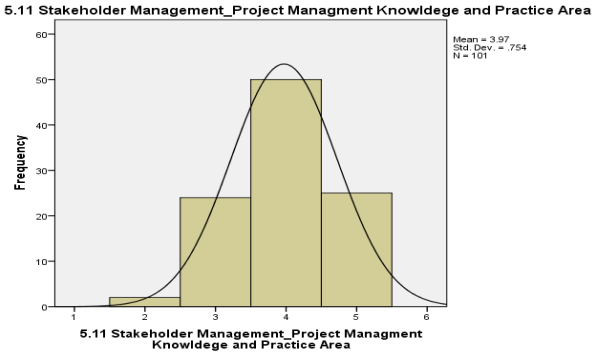
Output histogram section 3 questionnaire



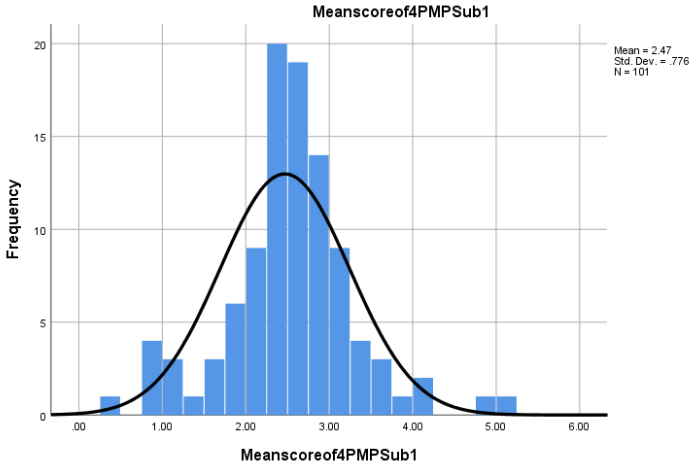
Output histogram section 4.1 to 4.5 questionnaire



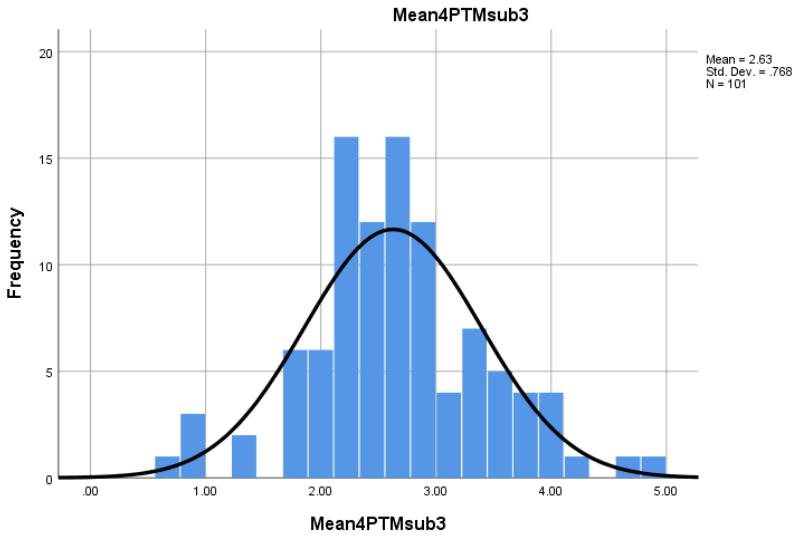
Output histogram section 5.11 questionnaire



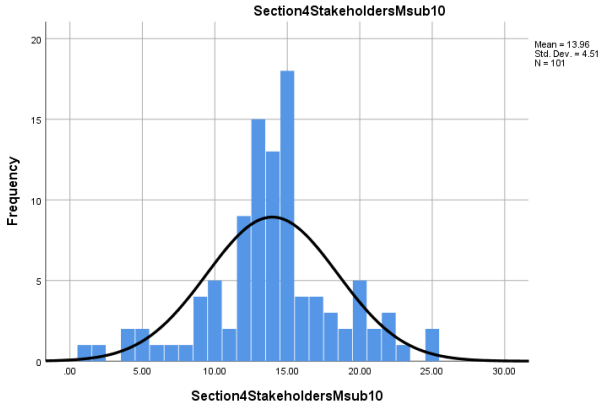
Output Mean square sec PMP histogram



Output Mean square sec PTM histogram



Output Mean square sec stakeholders histogram



7.2 Data Collection Instruments

Instrument No. 001

Information sheet and Consent for study participant

Introduction: Thank you for your willingness to participate in this study as a respondent. My name is Asfaw Debella, I am a graduate student of the School of Commerce, College of Business and Economics, Addis Ababa University, in the Project Management Program, I am currently conducting research in partial fulfillment of my master's thesis in a proposed study entitled "Health Research Projects Management at Armauer Hansen Research Institute (AHRI): Assessment of the Project Management Maturity of Selected Major Research Projects" to collect pertinent information using a self-filled questionnaire and interviewing. The purpose of the study is to assess

the research project management maturity level and identify the gaps in the project management practice in AHRI, thereby proposing means of intervention to improve the research project management maturity level. This questionnaire will take you approximately 40 minutes to complete. You may decline to respond to any question. There are no direct financial or other benefits to be given to you in participating in this study. However, the study may benefit AHRI by generating evidence to improve the research project management knowledge and practice. Your experiences and opinions will significantly add value as an input to this study. The researcher assures you that the information you provide is used only for academic research purposes and anonymity of the respondents is maintained throughout the research process.

Do you agree to voluntarily participate and give your consent to participate in the study?

Yes ☐ No ☐ Note: Please use "✓or **X**" marking for your selected choice

I kindly request you give honest and genuine answers to all the questions without which the research will not be successful. Thank you for your consent and appreciate your support.

Outline of the questionnaire:

- The first section aims to collect the ***background information*** of the respondents, e.g. their age, gender, position, education, work experience, and professional background.
- The second section of the questionnaire identifies the ***Project management maturity of the institute***
- The third section of the questionnaire includes respondents' ***reflections on the knowledge area of project management***.

Self-filled tools by study participants.
Questionnaire No _____

Section 1: Questions on Background Information
Please use "✓or X" marking for your selected choice in the box

Section 1: Background information (Bi)			
Q. No	**Questions**	**Response & Site tailoring**	**Code**
1	Gender	1. Male ☐Female☐	**Bi 1**
2	Age (Years)	----------	**Bi 2**
3	The highest level of Education	1. BA/BSc ☐ 2. MPH/ MSc/ MA ☐ 3. MD; DVM ☐ 4. MD/MPH/MSC; DVM/MSc/MPH ☐ 5. MD + clinical specialization ☐ 6. PhD ☐ 7. Other ☐, Please specify ----------	**Bi 3**
4	Total years of work Experience	1. Less than 5 years ☐ 2. 6 to 10 years ☐ 3. 11 to 15 years ☐ 4. More than 15 years ☐	**Bi 4**
5	Current position /Job title **(Note: More than one answer could be responded)**	1. Junior Researcher ☐ 2. Associate researcher ☐ 3. Senior Researcher ☐ 4. Lead Researcher ☐ 5. Directorate Director ☐ 6. Office head/manager ☐ 7. Division head ☐ 8. Others ☐ Please specify ----------	**Bi 5**
6	Your role in the research project	1. Project manager ☐ 2. Principal Investigator /Coordinator ☐ 3. Research team member ☐ 4. Research project technical support ☐ 5. Others ☐, Please specify ----------	**Bi 6**
7	What is the average research project monetary fund securedinthe research project you coordinate/manage or participate as research team?	1. Less than 5 million Birr ☐ 2. 5 - 20 million Birr ☐ 3. 20 – 35 million Birr ☐ 4. More than 35 million Birr ☐ 5. Not applicable ☐, Please specify ----------	**Bi 7**
8	What is the timeline of the research project that you coordinate/manage or participate, as a research team?	1. Less than 3 years ☐ 2. 3 - 5 Years ☐ 3. 6- 10 years ☐ 4. More than 10 years ☐ 5. Not applicable ☐, Please specify ----------	**Bi 8**

Section 2: Questions on Project Management Practices

The following questions under section 4 are intended to facilitate the investigator in assessing the project management maturity level of AHRI. The questions also facilitate the identification of the existing practices and processes within the institute.

Please use the "✓or X" marking in the box space respective to the scale number to indicate your preferred level of agreement. The following statements explain the different knowledge areas of project management for practices or processes. The descriptions are provided in each perspective.

1. **Project Integration management:** It describes the processes required to ensure that the various elements of the project consisting of project plan development, plan execution, and integrated change control are properly coordinated within the Project Management Process Groups. It links all of the deliverables from the Process Groups into a unified whole

Scale Level of Responses: :0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S. No	1. Statement related to Project Integration Management	Factors rating measure						Code
		0 NE	1 VL	2 L	3 A	4 H	5 VH	
1.1	Project constraints are clearly defined for each research project.							Pmp1
1.2	Formal Organizational standard guidelines exist for research project management processes that include all required resource management, methodology, and control tools.							Pmp2
1.3	Research project planning methodology is documented and strictly adhered.							Pmp3
1.4	A research Project Management Information System (PMIS) is in place.							Pmp4
1.5	There is an overall Research project change control process.							Pmp5
1.6	A Performance measurement criterion has been developed to establish how project progress will be determined and reported.							Pmp6
1.7	Research Project Progress Process follow-up is part of the project management continuous improvement process.							Pmp7
1.8	There is periodic project management training for the research team and concerned office members for efficient and effective research project management.							Pmp8

2. **Project Scope Management:** Describes the process required to ensure that the research project includes all the work or activities required to complete the project successfully. It consists of initiation, scope planning scope definition, scope verification, and scope change control.

Scale Level of Responses: 0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S. No	2 Statement Related to Project Scope Management	Factors Rating Measure						Code
		0 NE	1 VL	2 L	3 A	4 H	5 VH	
2.1	A Project scope statement is created for every research project.							Pmp9
2.2	Project Scope Statements are prepared with end-user or customer input throughout the project development process.							Pmp10
2.3	A Documented Scope change Control Process is in place for managing Change to the research project Scope.							Pmp11
2.4	All research Project participants endorse the Scope Statement.							Pmp12
2.5	Approved changes to the research project scope statement are communicated to the project team and the end user/customer.							Pmp13
2.6	The management, project team, and the end user monitor and review all research project progress regularly.							Pmp14
2.7	A Work Breakdown Structure document (WBS) containing a detailed description of the research project's activities, responsibilities, and resources required is created for each research project.							Pmp15

3. Project Time Management: Describes the process required to ensure timely completion of the research project. It consists of activity definition, and time estimates for both the duration of a project task and the actual effort or labor time, activity sequencing duration estimating. Schedule development, and schedule control to complete the task.

Scale Level of Responses: 0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S. No	3. Statements related to Project Time Management.	Factor rating measure						Code
		0 NE	1 VL	2 L	3 A	4 H	5 VH	
3.1	There is awareness about the importance of time and efforts undertaken in managing research project time is formal.							Pmp16
3.2	The project requirements (deliverables) are reflected in the project's work Breakdown Structure (WBS) which contains a detailed description of the research project activities.							Pmp17
3.3	The research project WBS and resource estimate are used to develop the project's baseline schedule, that is start and finish dates are approved and fixed.							Pmp18
3.4	Activity duration estimates are prepared and research project schedules are updated regularly against the baseline plan.							Pmp19
3.5	All the research project assumptions are documented when developing the project schedule.							Pmp20
3.6	The progress of research project activities is controlled and monitored continuously.							Pmp21

3.7	The research project schedule identifies schedule constraints driven by the end-user or consumer, technology, suppliers or management.							**Pmp22**
3.8	A critical path (the activities that are time and resource-intensive) analysis is performed on the research project schedule during each progress update cycle.							**Pmp23**
3.9	Resource-constrained and resource – leveled schedule is created and maintained							**Pmp24**

4. **Project Cost Management:** Describes the processes required to ensure that the project is completed within the approved budget. It consists of resource planning. Cost estimating, cost budgeting, funding, managing, and cost control.

Scale Level of Responses: 0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S.No	**4. Statements related to Project Cost Management.**	**Factor rating measure**						**Code**
		0 NE	**1 VL**	**2 L**	**3 A**	**4 H**	**5 VH**	
4.1	Research Project Financial Standards processes and procedures are documented and consistently followed.							**Pmp25**
4.2	The research project management environment has formal processes that support the gathering of financial data for periodic reports.							**Pmp26**
4.3	Research project budgets are based on resource estimates and the resource plan.							**Pmp27**
4.4	The research project team and the project management office members receive training and awareness in financial standards and procedures to improve the efficiency of project cost management.							**Pmp28**
4.5	The actual cost is tracked and reconciled with the original estimated plan.							**Pmp29**
4.6	There is a consistent process documenting all estimates and cost assumptions.							**Pmp30**
4.7	A common list of cost categories exists for all research project budgets with regular updates.							**Pmp31**
4.8	A common documented process is in place for completing all financial procedures required to close a research project.							**Pmp32**
4.9	The research project cost is monitored and controlled regularly to track actual project expenditures against the budget on the project schedule.							**Pmp33**

5. **Project Quality Management:** Describes the processes and activities that determine quality policies, objectives, and responsibilities required to ensure that the project will satisfy the needs for which it was undertaken. It consists of quality planning, quality assurance, and quality control.

Scale Level of Responses: 0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S. No	5. Statements related to Project Quality Management.	Factor rating measure						Code
		0 NE	1 VE	2 L	3 A	4 H	5 VH	
5.1	A formal documented procedure exists for creating, planning, managing, and maintaining the research project quality.							Pmp34
5.2	Every research project has a Quality Assurance plan.							Pmp35
5.3	The quality change control process for the research project is established and followed.							Pmp36
5.4	The research project team and project management office members receive training and awareness in quality standards procedures, and requirements to improve the efficiency of research project quality management.							Pmp37
5.5	The research project team reviews all of the processes and procedures that apply before the start of every project.							Pmp38
5.6	Common documented processes and procedures for technical performance and quality, performance is applied to every research project.							Pmp39
5.7	An initial review of the research project plan involving all participants is to devise the quality strategy and set standards before creating the baseline of the research project plan to ensure completeness and consistency.							Pmp40
5.8	Quality variances are reviewed between the current progress status and research project quality against the baseline plan regularly.							Pmp41
5.9	The quality control process is undertaken to ensure research project products and activities comply with relevant quality plans. Project trend data are also analyzed, based on metrics data regularly.							Pmp42

6. **Project Human Resource Management:** It focuses on actions related to the human aspect of the research project. It describes the processes required to make the most effective use of the people involved with the project. It consists of organizational planning, staff acquisition, and team development.

Scale Level of Responses: 0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S. No	6. Statements related to Project Human Resource Management.	Factor rating measure						Code
		0 NE	1 VL	2 L	3 A	4 H	5 VH	
6.1	The human resource strategy is linked to the institute's strategy-planning (SP) which makes it easy to track individual targets towards the achievement of institutional goals.							Pmp43
6.2	A Staffing plan for the acquisition and management of human resources is created and followed for every research project.							Pmp44
6.3	Team members are selected to match the skills, roles, and responsibilities of the research project, which are defined and documented for all project positions.							Pmp45
6.4	All research project resource needs (such as hardware, software, and space) are documented.							Pmp46

6.5	The research project skills and developmental needs of all team members are documented.							**Pmp47**
6.6	The formal and informal training and developmental needs of all team members are facilitated and provided to research team members and are documented.							**Pmp48**
6.7	Human resource costs and time are formally tracked and monitored in all research projects.							**Pmp49**
6.8	A recognition process is in place for recognizing outstanding commitments or performance on a research project team.							**Pmp50**

7. **Project Communication Management:** This describes the processes required to ensure timely and appropriate generation, collection, dissemination, storage, retrieval, and ultimate disposition of project information. It consists of communications planning, information distribution, performance reporting, control, monitoring, and administrative closure.

Scale Level of Responses: 0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S. No	**7. Statement related to project communication management**	**Factors rating measure**						
		0 NE	**1 VL**	**2 L**	**3 A**	**4 H**	**5 VH**	
7.1	A Communications plan, analysis, distribution, and documentation are created for each research project and followed by the research project team.							**Pmp51**
7.2	Minutes are prepared and distributed to all participating parties after each formal meeting.							**Pmp52**
7.3	Project information is updated and readily accessible to the organization at all times.							**Pmp53**
7.4	Research project status reporting procedures are established and followed.							**Pmp54**
7.5	Variance analysis for schedule, budget, and effort is communicated regularly.							**Pmp55**
7.6	Project status review meetings are held regularly with the research team, leadership, and partners/stakeholders							**Pmp56**
7.7	Research project successes are announced, and documented including project close-outs and success stories.							**Pmp57**
7.8	Performance reports prepared and provided to relevant stakeholders.							**Pmp58**

8. **Project Risk Management:** It describes the processes concerned with risk management planning, identifying, risk analysis, and responding to project risk. It is intended to increase the likelihood and impact of positive events and decrease the likelihood and impact of negative events in the project

Scale Level of Responses: 0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S. No	8. Statements related to Project Risk Management.	Factors rating measure						Code
		0 NE	1 VL	2 L	3 A	4 H	5 VH	
8.1	A high-level risk assessment is completed at the start of each research project and rated as low, medium, and high probabilities.							Pmp59
8.2	Research project risks are documented using common factors							Pmp60
8.3	A risk assessment/ handling plan is created for research projects and continuously updated.							Pmp61
8.4	Research project risks are monitored and evaluated for priority, probability, and impact.							Pmp62
8.5	The method for managing each accepted risk is documented.							Pmp63
8.6	Action plans are created for risks to be mitigated or transferred before risks cause adverse effects.							Pmp64
8.7	Contingency-scheduled research project status meetings include a regular review of a research project's risks							Pmp65

9. **Project Procurement Management:** It is the process necessary to purchase or acquire goods, services, or any other requirements needed from outside the project team. It consists of procurement planning, request planning, solicitation; source section, contract administration, and contract close out.

Scale Level of Responses: :: 0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S No	9. Statements related to Project Procurement Management.	Factor rating measure						Code
		0 NE	1 VL	2 L	3 A	4 H	5 VH	
9.1	A standard agreement that includes research project procurement management requirements is issued for research project goods and services.							Pmp66
9.2	A procurement plan is in place that identifies what to procure and is developed at the start of each research project.							Pmp67
9.3	Research project procurement timing and requirements are clearly defined in a formal contract or agreement and documented.							Pmp68
9.4	Contract Administration is an integral part of research project procurement management to ensure the delivery of procured items or services as agreed in the contract.							Pmp69
9.5	An evaluation process that meets specific criteria has been formalized to provide a consistent method for procurement proposal review and acceptance.							Pmp70
9.6	A contract-change control process in place and a contract close-out process that records the evaluation of supplier performance in meeting their contact requirements is documented.							Pmp71
9.7	Training on procurement management is facilitated and provided to enhance the awareness of the research team and project management office members.							Pmp72

10. Project Stakeholders Management: It includes the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, to analyze stakeholder expectations.

Scale Level of Responses: 0= Non-existent (NE) 1 = Very low (VL); 2 = Low (L); 3 = Average (A) ; 4 = High (H); 5= Very high (VH)

S. No	10. Statement related to project stakeholder management	Factor rating measure						Code
		0 NE	1 VL	2 L	3 A	4 H	5 VH	
10.1	There is awareness about the importance of stakeholder management by the research project team and project management office members.							**Pmp73**
10.2	Stakeholder management (planning, analysis, selection, and communication) is performed formally in any research project management.							**Pmp74**
10..3	There is an effort to identify stakeholders and respond to handle the stakeholder's needs and expectations.							**Pmp75**
10..4	A strategy was developed for managing each key stakeholder's expectations.							**Pmp76**
10..5	There is a continuous effort to communicate and work with stakeholders to influence their expectations, address their concerns, and resolve issues.							**Pmp77**

Section 3: Project Management Knowledge Areas level of importance comparison questions

Please compare the relative importance of each of the Project Management Body of Knowledge Areas (PMBoK) considering their relative implementation and contribution to the success of research project Management practice in the context of AHRI.

Please use the "✓or X" marking in the box space respective to the scale number to indicate your preferred level of agreement with the Project Management Knowledge areas.

Scale Level of Responses: 1 = Much less important (Mli); 2 = Less important (Li); 3 = Equally important (Ei); 4= More important (Mi); 5 = Much more important (Mmi)

S. No	Section 5: Project management knowledge areas and practice (Pmkp)	Factor rating measure					Code
		1 Mli	2 Li	3 Ei	4 Mi	5 Mmi	
1	Integration Management						**Pmkp1**
2	Scope Management						**Pmkp2**
3	Time Management						**Pmkp3**
4	Financial Management						**Pmkp4**
5	Cost Management						**Pmkp5**
6	Quality Management						**Pmkp6**
7	Human Resource Management						**Pmkp7**
8	Communication Management						**Pmkp8**
9	Risk Management						**Pmkp9**
10	Procurement Management						**Pmkp10**
11	Stakeholder Management						**Pmkp11**
12	Health, safety, security, and Environmental management						**Pmkp12**

THANK YOU VERY MUCH FOR YOUR CONTRIBUTION AND PARTICIPATION

Instrument No. 002

Discussion Points for the Interview

Information sheet and Consent

Introduction: Thank you for your willingness to participate in this study as a respondent. My name is Asfaw Debella, I am a graduate student of the School of Commerce, College of Business and Economics, Addis Ababa University, in the Project Management Program of the Distance Education Division, I am currently conducting research in partial fulfillment of my Master's thesis in a proposed study entitled "Health Research Projects Management at Armauer Hansen Research Institute (AHRI): Assessment of the Project Management Maturity of Selected Major Research Projects" to collect pertinent information using an interview. The purpose of the study is to assess the research project management maturity level and identify the gaps in the project management practice in AHRI, thereby proposing means of intervention to improve the research project management maturity level. The interview will take you about 30 minutes to complete.

You may decline to respond to any question and choose to stop the discussion at any time. There are no direct financial or other benefits to be given to you in participating in this study. However, the study may benefit AHRI by generating evidence to improve the research project management knowledge and practice.

Do you agree to voluntarily participate in the interview and give your consent for the assessment study?

Yes ☐; No ☐

If yes, continue to ask for consent

If No, Expressyourthankingwordsand skip to the next respondent

We thank you for consenting to participate in this study.

1) From your experience/information, what is the minimum and maximum duration/timeline of any research project in AHRI?

Minimum timeline ----------

Maximum timeline ----------

2) From your experience/information, what is the minimum and maximum amount of aggregated grant or research project fund secured or allocated in AHRI?

Minimum research project or fund ----------

Maximum research project or fund ----------

3) How do you rate (rough estimation) the research projects' accomplishment in AHRI to complete within the planned timeline and deliver the expected outputs stated under the objectives?

1) Greater than 95% ☐ 2) 85-95% ☐ 3) 76-84% ☐

4) 60-75% ☐ 5) 50 -59% ☐ 6) Less than 50% ☐

4) How do you rate (rough estimation) the research project accomplishment in AHRI to complete within the set/allocated budget, and deliver the expected outputs stated under the objectives?

1) Greater than 95% ☐ 2) 85-95% ☐ 3) 76-84% ☐

4) 60-75% ☐ 5) 50 -59% ☐ 6) Less than 50% ☐

5) If your response is "more than 85%" for completion of project activities on time and within the allocated budget to meet the targeted outcomes, could you please state **the three major possible reasons or factors that positively influence** the successful research project's accomplishments?

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6) If your response is "less than 50%" for completion of project activities on time and within the allocated budget to meet the targeted outcomes, could you please give your reflections about **the major bottlenecks or factors that hinder** the smooth conduct and completion of research projects within the planned timeline?

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7) From your experience, what are **the three main internal** and **external related obstacles or opportunities** for **research projects' failure or success** to deliver the expected or planned output?

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8) Who are the major stakeholders for any research project undertakings and accomplishments in AHRI? How should stakeholders engage for the success of research projects?

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9) How do you describe the research project quality system and its role in the successful accomplishment of research projects at AHRI?

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10) In what way will the communication and information exchange among the research team, collaborating partners, etc. contribute to the success of research projects at AHRI?

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11) Do you think that the motivation of staff has alignment with institutional success in the accomplishment of research projects thereby its strategy? If yes, to what extent [Hint: Very highly ------- Highly ---- Somewhat --- Not likely ----- Not sure ---}

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12) What motivational factors do you suggest that could work to bring an effect on research project team **commitment** for the successful accomplishment of a research project? [Hint: Acknowledgment--; Employee of the Month/Year ----; Salary Increase -----; Bonus -----; Promotion ----; Training ---]

Is there any initiative in AHRI for motivating staff, if so, could please state it?

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13) What is the mechanism to determine whether the implementation of research project activities stated in the proposal is as per the schedule within the allocated budget and delivers the expected output and outcome as to the set performance targets of the strategic plan?

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14) How frequently is the monitoring and control done? How does the feedback communicated and followed- for improvement?

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15) Any general reflections about research projects' lessons and directions, or actions to be taken for improvement of research project management?

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16) Would you please provide me a copy of relevant documents or report synopsis abouttheresearchproject'schallenges; challenges/mitigating the challenges; success narration or story; lessons learned; thewayforwardorproposeddirectionornext plan?

Many thanks for taking your valuable time and enthusiastic support in responding to the questions!!

Instrument No. 003

Data abstraction checklist

Information sheet for facilitating the permission

(Note: An official letter for the support is required from the distance education program)

Greetings. We would like to make an assessment study through a collection of pertinent information. From secondary data (strategic and proposal documents, publications, policy briefs, reports, plans, etc.) of AHRI using the data abstraction checklist to get overall information on the research project management maturity. We would like to express our gratitude and appreciation for your kind support for the permission to access the data.

Purpose: The study is mainly to collect information on various aspects *i.e.*, support & facilitation by governmental offices, opportunities, challenges, etc. regarding research projects. The findings of the study will be used for the preparation of a technical report including recommendation points that may serve as input to research project managers, principal investigators/coordinators, research teams, and concerned directorates/offices in AHRI for promoting improved practice, and enhance the efficiency and effectiveness of research project management.

I thank you for your sincere support in availing the documents to facilitate this study.

Instrument No. 003

Format/Document No _____

1) The name/title of the document ----------

2) Who published/produced the document----------

3) Year, Month, and date of publication /preparation of the report----------

Type of the document: [Hint: Proposal; Strategic document; Technical report; Article; Policy brief, etc.)

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4) Ifthedocumentisaproposal; Strategic plan?

Timeline for the start----------

Timeline set for completion ---------- Actual completion time ----------

Plannedestimated cost ----------

Actual cost incurred /Total budget Utilized. ----------

5) What is the scope of the document?

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6) The major information extracted from the executive summary.

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7) The major information extracted from the body of the document (background, objectives, results and discussions, and other components, etc)

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8) The major points extracted from conclusions and recommendations.

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9). Core findings points reported or identified from the document including the expected or actual deliverable output and outcome

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10) Synthesized summarized points from the whole document based on abstracted information that may add value for the improvement of research project management.

