

KNOWLEDGE MANAGEMENT PRACTICES IN CONSTRUCTION
COMPANIES:
THE CASE OF HAWASSA CITY

MSc. THESIS

TEMESGEN ELIAS OLOLO

HAWASSA UNIVERSITY, HAWASSA, ETHIOPIA

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KNOWLEDGE MANAGEMENT PRACTICES IN CONSTRUCTION
COMPANIES:

THE CASE OF HAWASSA CITY

TEMESGEN ELIAS OLOLO

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SCHOOL OF GRADUATE STUDIES
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This is to certify that the MSc thesis entitled “**Knowledge Management Practices In Construction Companies: the case of Hawassa City**” submitted in partial fulfillment of the requirement for the degree of Master’s with specialization in Construction Technology and Management at the Department of Construction Technology and Management, and has been carried out by **Temesgen Elias Ololo**, Id. No. GPCoTMR/044/11 under our supervision. Therefore we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

Desalegn Girma (PhD)

Name of the Main Advisor

Signature

Date

Bruk Solomon (MSc)

Name of the Co-Advisor

Signature

Date

EXAMINER’S APPROVAL SHEET-I
SCHOOL OF GRADUATE STUDIES
HAWASSA UNIVERSITY EXAMINERS’ APPROVAL SHEET
EXAMINERS APPROVAL SHEET

We, the undersigned, members of the Board of Examiners of the final open defense by Temesgen Elias Ololo have read and evaluated his thesis entitled “**Knowledge Management Practices In Construction Companies: the case of Hawassa City**” and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree.

Desalegn Girma (PhD)

Name of Major Advisor

Signature

Date

Name of External Examiner

Signature

Date

Name of Internal Examiner I

Signature

Date

Name of Internal Examiner II

Signature

Date

SGS Approval

Signature

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I hereby declare that this MSc thesis titled “**Knowledge Management Practices In Construction Companies: the case of Hawassa City**” is my original work and has not been presented for any kind of degree award in any other universities and all sources of materials used for this thesis have been duly acknowledged.

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Table of Contents

ACKNOWLEDGMENT	i
ABBREVIATIONS	vi
LIST OF TABLES	vii
LIST OF FIGURE.....	viii
ABSTRACT	ix
CHAPTER ONE	10
1.INTRODUCTION	10
1.1 Background	10
1.2 Statement of the Problem	11
1.4 Research Questions	13
1.5 Objectives.....	13
1.5.1 General Objective	13
1.5.2. Specific Objectives	13
1.6 Significance of the Research.....	13
1.7 Scope and limitations of the study	14
1.8 Organization of the study	14
CHAPTER TWO	16
2 LITERATURE REVIEW	16
2.1 Concept of Knowledge Management (KM).....	16
2.2 Components of Knowledge Management.....	17
2.2.1 Organizational Knowledge	19
2.2.2 Organizational Culture	20
2.2.3. Information Technology	21
2.3 Knowledge Management in Construction Industry	25
2.4 Barriers associated with the adoption of KM practices	33
2.5 Knowledge Management Processes (KMP)	35
2.5.1 Knowledge Acquisition and Generation	35
2.5.2 Knowledge Capture.....	35
2.5.3 Knowledge Organization	36

2.5.4 Knowledge Storage	36
2.5.5 Knowledge Sharing.....	36
2.5.6 Knowledge Application	37
2.6. Factors Influencing Knowledge Management	39
2.7 Knowledge Management and Organizational Performance	40
2.8 Framework Development.....	41
2.8.1 Conceptual Framework of the Study.....	42
2.9 Summary	43
CHAPTER THREE.....	44
3. MATERIALS AND METHODS.....	44
3.1 Description of the Study area.....	44
3.2 Study Subject	44
3.3 Study Design	45
3.3.1 Sampling Technique and Sample Size for the study.....	45
3.4 Study Methodology	46
3.4.1 Quantitative Approach	46
3.5 Questionnaire Design	47
3.6 Pre-testing the Questionnaire	47
3.7 Interview	48
3.8 Participants Selection and their Background	48
3.8.1 Selection of Interviewees	48
3.9 Interview Format and Structure.....	49
3.10 Case study	51
3.10.1 Selection of case study Projects	51
3.11 Data Management and Analysis	52
3.11.1 Correlation Analysis	52
3.12 Triangulation.....	53
3.13 Reliability and Validity of the research Design	55
3.14. Ethical consideration.....	56
3.15 Summary	57
4.RESULT AND DISCUSSION	59

4.1. General Information of Questionnaire Response.....	59
4.2. Profile of Survey Respondents.....	59
4.3 Respondents' views on Knowledge Management	63
4.4 Knowledge Management Process-Practice in the Construction Companies	63
4.5 Interview	72
4.6 Data Interpretation and Analysis	73
4.7 Interview Results and Discussion	73
4.7.1 Knowledge Attitude in the Construction Sector	73
4.7.2 Current Practice in Managing Knowledge	74
4.7.3 Barriers of knowledge management practices in Hawassa City	74
4.8 Important Enablers for Successful Knowledge Management	75
4.8.1 Leadership	76
4.8.2 Policy and Legislation.....	76
4.8.3 Practitioners with Multi-disciplinary Knowledge.....	76
4.8.4 Network of Subject-matter Experts.....	77
4.8.5 Post Project Reviews (PPRs)	77
4.8.6 Education and Training.....	78
4.8.7 Community of Practice (CoP).....	79
4.8.8 IT Tools: Intranet, Database.....	81
4.9 Case-based Reasoning.....	82
4.10 Summary	83
4.11 Case Studies	84
4.11.1 Key Findings from Case Studies.....	93
4.11.2 Problems on Construction Site.....	95
4.11.3 Approaches to Problem Solving	95
4.11.4 Approach Taken When a Mistake is Made	95
4.11.5 Knowledge Sharing Mechanisms.....	96
4.12 Summary	97
4.13 Knowledge Management Framework.....	98
4.14 Synthesis of the Questionnaire Survey, Interview and Case Study Results	98
4.15 Status of KM Adoption for Managing Knowledge	101

4.16 KM Framework.....	102
4.16.1 Proposing the KM Framework.....	102
4.17 Understanding the KM Framework	103
4.17.1 Managing Knowledge	103
4.17.2 Implications of the Proposed KM Framework.....	104
4.18 Summary	104
CHAPTER FIVE.....	105
5.CONCLUSIONS AND RECOMMENDATIONS	105
5.1 Conclusion	105
5.1.1 Essential Issues of Managing Knowledge in the Construction companies	105
5.1.2 Effectively Managing Knowledge in the Construction Companies.....	107
5.3 Recommendations	107
5.3.1 Recommendation to Construction Companies.....	108
5.3.2 Recommendations for Future Research	108
5.4 Closure	109
REFERENCES.....	111
APPENDICES	117

ABBREVIATIONS

AEC- Architecture, Engineering, and Construction

CRM - Customer Relationship Management

KM - Knowledge Management

KS - Knowledge System

SPSS - Statistical Package for the Social Sciences

CoP - Community of Practice

KMP - Knowledge Management Process

KS - Knowledge System

ECPMI - Ethiopian Construction Project Management Institute

ECotMPA - Ethiopian Construction Technology and Management Professional Association

LIST OF TABLES

Table 2.1 Knowledge Management Factors	24
Table 2. 2 Relationship between KM Process	38
Table 3. 1 Table Structure of the Questionnaire Table	47
Table 3. 2 Full Demographic Profile of the Interviewees	48
Table 3. 3 Interview Questions	50
Table 3. 4 Details of Site Organizations Involved in Case Studies.	52
Table 3. 5 Characteristics of Quantitative and Qualitative Methods	54
Table 3. 6 Reliability Statistics	56
Table 4. 1 General Information of questionnaire response	60
Table 4. 2 Profile of survey respondent	61
Table 4. 3 Job Title	62
Table 4. 4 Education Background.....	62
Table 4. 5 Years of Experience	62
Table 4. 6 Type of Company Professionals working in.....	62
Table 4. 7 Recognize Knowledge as an Asset	63
Table 4. 8 Main KM stages (Process).....	64
Table 4. 9 Challenging KM Stages	64
Table 4. 10 Pearson Correlation Coefficient on Stages that are essential for securing the practice of knowledge management.....	66
Table 4. 11 Current Status of Knowledge Acquisition	68
Table 4. 12 Current Status of Knowledge Creation	69
Table 4. 13 Current Status of Knowledge Storage.....	69
Table 4. 14 Current Status of Knowledge Sharing	70
Table 4. 15 Current Status of Knowledge Application.....	70
Table 4. 16 Key Barriers to Knowledge Management in a company.....	71
Table 4. 17 Technologies preferred by employees in companies for Knowledge Management.....	72
Table 4. 18 Summary of the case studies.....	94
Table 4. 19 Key Elements of the Final KM Framework for Managing Knowledge in Hawassa Construction Companies	100
Table 5. 1 Enablers for Managing Knowledge in the Construction Sector.....	106
Table 5. 2 KM Activities for Managing Knowledge	109

LIST OF FIGURE

Figure 2. 1 Conceptual Framework of the study (Mekonnen, 2017)..... 42

Figure 3. 1 Earth map of Hawassa city (Source Tariku Nigusie) 44

Figure 3. 2Triangulation of Quantitative and Qualitative Data 53

Figure 3. 3 Overall Research Process 58

Figure 4. 1 Knowledge Management Frame Work for Construction Companies in Hawassa
..... 94

ABSTRACT

Knowledge management is a process that transforms individual knowledge into organizational knowledge. The research aimed at assessing the practice of knowledge management, investigate barriers in implementing the system, develop a framework to efficiently practice KM in construction companies of Hawassa city. Although KM is a relatively new and emerging discipline, it has shown its value and promise in existing applications in the construction industry. A holistic KM framework was developed to set the overall context for managing knowledge in construction companies by outlining the main aims and outcomes of managing knowledge, the key knowledge activities, effective KM strategies and instruments, and KM enablers. The sampling frame considered for the study included stakeholders like contractors, consultants, and professional associations. Primary data is obtained from four case studies and questionnaires and interviews conducted from different stakeholders of the construction projects in Hawassa. After that findings are carried out from collected data analysis. Using the result of the analysis found, recommendations and conclusions were drawn. As this study is empirical, secondary data is obtained from reference books and related documents through a literature review. A triangulation of questionnaire survey, semi-structured interviews, and case studies were employed in this research to collect required qualitative and quantitative data. Therefore, the study reveals the shortcomings of the current KM components practices in these selected construction companies for their better efficiency and success of projects. The small level of awareness and acceptance of the concept and practice of knowledge management by the professionals of these construction companies is regarded as a prospect by this research. Besides, owing to the lack of an overall knowledge management policy or strategy, different organizations pursue the practice of knowledge management factors in their way, with some of them barely making use of the knowledge management component system portal. This situation calls for organizational efforts to reinforce the practice of knowledge management by formulating comprehensive knowledge management policy/strategy compatible with organizational strategy, enhance the level of employee awareness regarding the concepts and benefits of knowledge management, implement formal knowledge management means that improves company's performance.

Key Words: Barriers, Construction, Industry, Knowledge, Management, Practice

CHAPTER ONE

1.INTRODUCTION

1.1 Background

According to Mekonnen L., (2017) Knowledge Management (KM) is not a new concept. Managing knowledge; using it to do things better, more effectively or just differently has been a continuing feature of human societies and human culture. Companies, in both the public and private sector, have always managed knowledge in one shape or another. What is new is the development of a separate discipline called ‘knowledge management’; the development of recognized techniques and approaches for effectively managing the knowledge resources of a company.

Wiig (1997) also agreed with the fact that knowledge management (KM) has long-standing practice. As mentioned by Wigg (1997) the study of knowledge dates back to ancient Greece. Even before that, knowledge was at least implicitly managed as people performed work. Early hunters, for example, learned the best skills and practices for a successful hunt. These skills and techniques are transferred from one generation to the next. On the other hand, Uriarte (2008) pointed out KM is a relatively new discipline and therefore has a short history.

As a conscious discipline, it developed from the various published work of academics and pioneers such as Peter Drucker in the 1970s, Karl-Erik Sveiby in the late 1980s, and Nonaka and Takeuchi in the 1990s. It began when the concept of a “knowledge company” was introduced in published literature. It was only in 1995 when knowledge management in its current form first received significant attention among corporations and Companies. This came about as a result of the publication of the seminal book of Ikujiro Nonaka and Hirotaka Takeuchi titled *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*.

The construction industry is a knowledge-based industry that relies heavily on the knowledge input by different participants in a project team (Carrillo et al., 2004). Robinson et al. (2001) found that only a relatively small proportion of construction Companies have implemented KM systems. Oluikpe,P et al. (2011) noted that in his survey of construction Companies, about 40% already have a KM strategy and another 41% plan to have a strategy within a year;

81% perceived KM as having the potential to provide benefits to their Companies, and some have already appointed a senior person or group of people to implement their KM strategy.

The need for change and continuous improvement in the construction industry has resulted in various initiatives, which are aimed at improving the construction process. These initiatives are primarily targeted at reducing fragmentation, and have included: (a) the development of alternative procurement strategies to clarify and improve the communication structure between different participants in the construction process (Ondari-Okemwa, E & Smith, J. G. 2009); (b) the use of computer technology to integrate the construction process through the electronic sharing of data/information in both directions at the design-construction interface (c) the adoption of a wide range of concepts, tools and techniques (e.g. total quality management, partnering, etc.) to enhance collaboration, and improve efficiency and quality; and (d) the development of improved components, materials and construction methods, including standardization and pre-assembly (Gaffoor, S. 2008). However, it is now being recognized that the management of project knowledge (especially within the construction industry where projects are implemented by temporary 'virtual' organizations) is open to considerable improvement, both within construction companies, and between firms in the supply chain

The emphasis on Knowledge Management (KM) reflects the growing realization that it is a core business concern, particularly in the context of the emerging knowledge economy, where the know-how of a company is becoming more important than the traditional sources of economic power (capital, land, etc.) (Drucker, 1993; Scarbrough & Swan, 1999). Within the construction industry, it is increasingly being acknowledged that KM can bring about the much-needed innovation and improved business performance the industry requires (Webb, 1998; Egbu et al. 1999).

Failure to capture and transfer knowledge generated within one project, which is usually buried in unread reports and arcane filing systems, or lost because people move on, leads to wasted activity and impaired project performance. This paper explored the practice and contextual issues involved in the practice of knowledge management in construction companies which are located in Hawassa city.

1.2 Statement of the Problem

The practice of KM is a recent phenomenon in Ethiopia. So far, only limited local researches were conducted in hospitals, banking, and airline industries. However, as per the knowledge of the researcher, not much has been done on the area of KM locally when it comes to the

construction industry though the issue is addressed in different kinds of ways both formally and informally without stating the term knowledge management. Besides, their focus was on service giving private or governmental Companies and hence the researcher identified a gap in revealing the practice with the construction Industry. Hence, this research aimed to look into the practice of KM influencing organizational performance in selected construction Companies in Hawassa.

In general, little empirical research has been conducted to investigate the relationship between KM and performance (Kalling, 2003). In an organization where there is a lack of proper knowledge management, two main problems are highlighted: organizational memory loss and brain drain (Kalling, 2003). Organizational memory loss occurs when one part of the organizational brain is oblivious to the knowledge that other parts possess. Memory loss is also noted when the same department or division forgets the knowledge it gained from previous experiences or projects. Thus, Companies tend to reinvent the wheel every time a new, yet in many respects, similar project is undertaken. This also means the organization will repeat the same mistakes, given that it has not learned from previous experiences. The brain drain happens wherein valuable knowledge resources are lost with employees leaving the organization (Al-Ali, 2003).

The primary goal of KM initiative is to creation, codification and sharing knowledge more efficiently inside an organization. (Bartholomew,2008) points out that “In practice, ‘knowledge management systems’ often turn out to be little more than old information management systems rebranded with a fashionable name, or a collection of procedures and Information and Technology tools that hardly anyone uses. It is hardly surprising that many initiatives fall short of high aspirations such as ‘making the best use of the knowledge the organization has got (Bartholomew, 2008).

Al-Ali (2003) pinpointed that strategy is the mind of an organization; without it, the organization’s actions will lack direction, consistency, and hence impact. Probably, leadership’s failure to adopt knowledge strategies suited to their business needs is the cause of the setback of many KM initiatives. Knowledge strategies define how KM is used to sustain the organization’s competitive performance by creating new knowledge.

Knowledge Management in Hawassa City faced many barriers on the way to being identified, shared, and applied by the industry to real projects. As the management of

knowledge is the focus of this study, barriers having a negative impact on knowledge management are mainly lack of awareness, Deficiency of current education and Lack of guidelines,

1.4 Research Questions

The key research questions are:

1. What are the barriers in practicing Knowledge Management in the construction companies of Hawassa city?
2. What are the practices of knowledge management in construction companies of the city?
3. What are the factors that should be included in the framework that improves Knowledge Management practice?

1.5 Objectives

1.5.1 General Objective

To assess the practice of knowledge management in construction companies and identifying the associated barriers.

1.5.2. Specific Objectives

1. To assess Knowledge management practices in construction companies of Hawassa city.
2. To Identify the barriers to knowledge management practices in Hawassa City.
3. To propose a framework that improves knowledge management practice in construction companies in Hawassa City.

1.6 Significance of the Research

After the research is undertaken the findings that are obtained are applicable for the amelioration of the construction companies' performance knowledge Management. Many Stakeholders of the construction industry could be benefited from this research. From the stakeholders, Parties like Contractors, Consultants, Professional associations, and government bodies specifically connected to construction works are the main beneficiaries of this study.

This research has described how knowledge is managed in Hawassa Construction

companies along with the main associated issues. Thus, this research has tried to contribute a new dimension of knowledge to the disciplines of Construction sites and project management, by illustrating the main forms of knowledge, investigating the main knowledge activities, and suggesting effective strategies for managing knowledge. The development process and results of this specific KM framework may have a good impact on those who want to adopt it.

This research involved industry participation during the data collection phases. KM is a relatively new area to the construction industry, and many of the participants were found to have limited knowledge of KM. This research provided a chance for the researcher to introduce KM to the industry, by explaining research objectives, answering questions during data collection, and sharing research outcomes after surveys and interviews.

1.7 Scope and limitations of the study

The focus area of the research undergone is limited in studying the practice of knowledge management in the AEC companies of Hawassa city.

The results of this research are constrained by the available resources and, this research investigated the issues relevant to the management of knowledge in Hawassa Construction companies generally on Grade One, Grade Two and Grade Three Construction companies without considering the unique characteristics of different types of Construction companies, various perceptions of individual stakeholders, or a specific type of knowledge. Individual Companies and projects may need verification of the findings for their specific circumstances. In addition, as the research aimed at proposing a holistic KM approach that addresses the management of knowledge in Hawassa Construction companies, studies conducted in this research focused on identifying the barriers, main enablers, key processes, and problems associated with the practice. These individual issues were explored and discussed; however, not thoroughly and deeply enough to make very detailed recommendations. For example, policy and guidelines were introduced as a KM strategy in the Construction companies. This research discussed the current status of the practices along with its problems; however, it did not give step-by-step instructions on how to design and conduct policy and guidelines.

1.8 Organization of the study

The research is organized into five chapters. The first chapter includes an introduction that encompasses the background of the study, statement of the problem, research question, the objective of the study both general and specific, and significance of the study, scope, and

limitation of the study. The next chapter explores the different kinds of literature that are related to the topic includes the concept of professional turnover, causes of professional turnover, effects of professional turnover on building project performance, strategies to minimize professional turnover in building construction projects, conceptual framework, and research gap. The third chapter explains the material and method applied to make the research includes a description of the study area, the research design, the research approach, data collection procedures, data analysis technique methodology for framework development, validity and reliability, and ethical consideration of the study. In the fourth chapter, the researcher presents, analysis of the data collected and interpreted and discuss the findings briefly. Finally, the last chapter which is chapter five concludes the paper by proving a summary and recommendation.

CHAPTER TWO

2 LITERATURE REVIEW

This section covers a review of the relevant literature to frame the study concept and identify the research gap. This chapter examines the current literature on knowledge management with respect to construction companies. It starts with the key concepts and characteristics of knowledge in construction. The characterization of knowledge flows, factors influencing knowledge management are also discussed. The chapter then reviews knowledge management processes and knowledge management tools intending to identify applicable KM processes and relevant KM tools to be integrated into construction companies.

2.1 Concept of Knowledge Management (KM)

KM has been defined in different ways and from different aspects; interestingly, no sole definition can explain the whole picture, as different authors viewed KM from several perspectives, which dictates the way they define it. However, the study of knowledge dates back to ancient Greece. Even before that, knowledge was at least implicitly managed as people performed work. Early hunters, for example, learned the best skills and practices for a successful hunt. These skills and techniques are transferred from one generation to the next. This illustrates the transfer of knowledge, a KM activity (Wiig, 1997). The actual study of KM as a separate discipline is much more recent. Like the study of communication, it has roots in many other areas of disciplines like business, management, sociology, economics, and others. Knowledge Management (KM) refers to a range of practices and techniques used by Companies to identify, represent and distribute knowledge, know-how, expertise, intellectual capital, and other forms of knowledge for leverage, reuse, and transfer of knowledge and learning across the organization (Mekonnen, 2017).

Knowledge management is the set of proactive activities to support an organization in creating, assimilating, disseminating, and applying its knowledge. Knowledge management involves a strategic commitment to improving the organization's effectiveness, improving its opportunity enhancement through the improvement and sharing of organizational knowledge throughout the organization (i.e., the aim is to ensure the organization has the right knowledge at the right time and place. It has got four broad objectives in practice: create a knowledge repository, improve knowledge assets, enhance the knowledge environment, and manage knowledge as an asset. The key to knowledge management is capturing intellectual assets for the tangible benefits for the organization. As such, imperatives of knowledge management are

to (Dasgupta & Gupta, 2009) Transform knowledge to add value to the processes and operations of the business leverage knowledge strategic to business to accelerate growth and innovation; (2) Use knowledge to provide a competitive advantage for the business.

2.2 Components of Knowledge Management

Components supporting the accomplishment of knowledge management implementation can be recalled from authors who have looked into and composed specifically regarding this matter. For example, Jelena Rasula, et al., (2012) defined a framework for understanding elements that impact the success of knowledge management activities in an organization. Their study has identified and described key elements in three levels; management, resource, and environmental aspects. Jelena Rasula, et al., (2012) established an extensive list of knowledge management success factors comprising knowledge sharing processes, organization policy frameworks, measuring performance, training initiatives, and benchmarking processes. Jennex and Olfman (2006) proposed a knowledge management success model derived from a longitudinal study of an engineering organization. This model provides a definite link between knowledge usage and organizational effectiveness. Key dimensions of the model are system quality, knowledge quality, service quality, user satisfaction, perceived benefits, and the net impact on individuals and organizations. Teelken, C. (2008) examined knowledge management practices at the project level in Thai construction projects.

The main objective was to identify whether or not knowledge factors influence the on-site execution of works. Some of the key factors include established information technology, teamwork, trust and leadership, incentives for knowledge sharing, individual and group level skills, and competencies. The success of knowledge management implementation is determined by identifying influencing elements and understanding their nature. Several elements as identified from a review of literature are grouped under five factors. The factors are: (1) knowledge culture: Some of the key elements are - possessing adequate leadership skills and adopting organization leadership policies, emphasis given on communication strategies, providing incentives for knowledge sharing processes, storing and using knowledge assets in the organization; all these factors benefit in developing a knowledge-based culture in the organization; (2) organizational knowledge: variables concerned with the management role for providing necessary commitment to work, managing knowledge with strong vision and objectives for managing future knowledge to improve performance are considered under

organization factors; (3) effective and systematic approach towards knowledge management: creating a knowledge environment to update employees, managing human resources, designated roles and responsibilities for employees, providing adequate training and development, effective documentation process of knowledge activities, motivational aids for enhancing productivity and usage of proper systems and resources to effectively manage knowledge management processes within the organization; (4) knowledge management measures: knowledge management success can be achieved by setting participative goals, individual commitment of employees and their appreciation.

Alkatheri A. (2018) stated in his dissertation that the factors that lead knowledge management to be effective are Organizational Culture, Structure, Strategy, and Technology. In addition to the above-listed scholars (Mekonnen, 2017) in her research wrote that Knowledge management has three components. These are (1) information technology (the ability of technology to capture knowledge and usage of information systems), (2) organizational culture (people, organizational climate, and processes), and (3) organizational knowledge (knowledge accumulation, utilization, sharing practices and knowledge ownership identification). These are some of the key elements concerning the implementation of knowledge management that have an effect on its benefits. As per the opinion of the researcher. The understanding of these knowledge management factors acts as a basis in determining the type of knowledge management components strategies and initiatives for an organization's enhancement of performance. She also emphasized that the success of KM implementation will not take place without the collective work of various enablers in the Companies. KM enabler refers to the key factors which are listed above that determine the effectiveness of executing KM within the organization.

To ensure the success of KM implementation, it is crucial to acquire the key enablers. To make it possible to effectively utilizing an organization's limited resources, reduce the use of workforce, material, time, and still be able to achieve the expected results. For effective KM to take place, Companies should create a conducive KM environment. Besides, Companies are required to improve the organizational culture that enhances collaborative teamwork culture; network and virtual organization; learning, research, and discovery culture. Moreover, Companies should give encouragement and promotion for creativity rather than mere adaptation and emphasis on leadership roles rather than administrative positions. Organizational enablers: The first phase of implementing KM is working to gain the support of the senior managers and to reach a common understanding of the concept of KM. An

organizational structure reflects the organization's policy in discussing with its employees and in absorbing new ideas and experiences within and outside its capacity. Companies have to maintain a balance between intrinsic and explicit rewards to encourage employee's behavior of knowledge system (KS).

The most effective use of explicit rewards has been to encourage sharing at the onset of a KM initiative. Adequate training in KM implementation enabled by adequate technology and people who know how to use it. Financial support, human resources, and time are significant resources for successful KM adoption. The following are the major components that affect knowledge management.

2.2.1 Organizational Knowledge

Successful knowledge management applies a set of approaches to organizational knowledge including its accumulation, utilization, sharing, and ownership. Accumulation: the higher the effectiveness of knowledge accumulation (internal, external; through internalization or externalization) in an organization, the greater the KM effect; Utilization: the higher the effectiveness of utilizing the (existing) knowledge in an organization, the better the KM result as stated by Deepak M.D; Sharing: the improvement of sharing of knowledge (formal or informal) affects the KM positively; Strategic management literature suggests that organizational knowledge is a source of sustainable competitive advantage and superior performance. This perspective has led to the development of the knowledge-based view of the firm, which is an extension of the resource-based view of the firm (Chang T. & Chuang S. (2011)). Rather than seeing Companies as systems that integrate the use of all kinds of physical, financial, and human resources, knowledge base view of the firm emphasizes the organization as a site for the development, dissemination, and use of knowledge and other forms of intellectual resources to create competitive advantage.

Thus, knowledge-based view of the firm holds that performance differences between Companies are a result of their differing capabilities in creating and utilizing knowledge. Knowledge management strategy is a relatively new concept in knowledge literature. Knowledge strategy refers to the overall approach an organization intends to take regarding the focus of its resources on two knowledge domains: knowledge exploration and knowledge exploitation. Thus, knowledge strategy describes a firm's strategic choice on whether the firm focuses more of its resources on knowledge exploration, which deals with the creation, discovery, or acquisition of new knowledge; or knowledge exploitation, that is incremental

refinement or reuse of existing knowledge. Knowledge exploration is more innovation-oriented and knowledge exploitation aims at attaining efficiency (Levinthal and March , 1993). Despite the theoretical link between knowledge strategy and organizational performance, empirical studies testing the relationship is scanty. Further, the few empirical studies that have been conducted to examine the linkage between knowledge strategy and organizational performance have been conducted in developed and developing countries. Developing an effective KM system in an organization is related to the appropriate organizational strategies. Without strategies for capturing knowledge, Companies might face problems in acquiring the right information. Hence, today most Companies consider KM as a key strategy for them to survive and to be competitive (Henderson, et al.2003). Appropriate strategies should be made allowing sufficient link between KM and the corporate strategy (Lang, 2001). Strategies such as knowledge creation strategy, knowledge transfer strategy and customer focus strategy are some of the strategies which Companies consider as KM adopting strategies (Wiig, 1997; Manasco, 1996). KM is also considered as a strategic resource, giving a competitive advantage and acting as a driver for the implementation of an organizational strategy. Understanding the link between KM and organizational performance helps the implementation of KM into organizational strategy (Carlucci and Schiuma, 2006).

2.2.2 Organizational Culture

Organizational culture consists of the shared values and beliefs that give members of an organization meaning and provide them with rules for behavior. The culture of an organization is seen in the norms of expected behaviors, values, philosophies, rituals, and symbols used by its employees, and it evolves over a period. (Mathis and Jackson, 2010).

Organizational culture has a great contribution to knowledge management because culture determines the basic beliefs, values, and norms regarding the why and how of knowledge generation, sharing, and utilization in an organization. Corporate culture: In the process of carrying out KM, enterprises have to face the varying conditions of corporate culture, workflow processes, and the integration of group members' knowledge, corporate culture is the combination of value, core belief, behavioral model, and symbol. It represents the value system of the company and the employees' behavior and norm. Corporate culture is an important part in forming a culture of knowledge sharing (KS). It might need to be supplement by IT. Thus, management should promote a corporate attitude that focuses on co-operation and KS across the organization.

An organization can achieve a competitive edge by creating and using knowledge about its' processes and by integrating its' knowledge into business processes. When one treats KM in terms of compliance, it gives the impression that there is a top-down, tiered division of labor, under which only part of the organization is responsible for learning, and another part is responsible for providing information for harvesting and generating knowledge. In reality, however, successful KM depends on every individual embracing their role as a 'knowledge citizens' whose value proposition to the organization is the extent to which she/he is engaged in the entire knowledge cycle: keeping oneself abreast of, process and aggregate evidence, innovations and developments in one's subject matter area, sharing ongoing work, questions and learning points with peers and actively injecting oneself in conversations to shape development thinking, policies, and solutions. This is explicitly not an internal and compliance-driven process but requires an open and external view that builds on soft incentives such as mutually beneficial peer support, reciprocity, reputation, career development, and individual professional learning in the public realm of the development sector.

(UNDP, 2014) Adoption of KM in an organization is not a complicated process because employees are one way or another, already got into the habit of using undefined KM in their daily official undertakings. Thus, organizational culture is in a close position to assimilate KM. During KM adoption within an organization, the cultural setting must be a concern in the context of the ability and acceptance by the employees. Furthermore, the approach of adopting KM is somewhat extent related to the internal culture of an organization.

Therefore, when organizational cultures are rigidly bureaucratic, interactions are formal and hierarchical with limited participation that leads to the exchange of knowledge within a paradigm that is forced from the top management. Per Drucker (1998), knowledge is more concentrated in service staff; knowledge tends to be floating between the top management and the operational staff. The culture must be changed to infuse knowledge at all levels of an organization to obtain efficient human resources. Hence, to make KM effective, Companies need to adopt such a culture that provides an environment of sharing knowledge to accelerate the success of organizational performance (Robbins, 2003).

2.2.3. Information Technology

Technology is an important aspect to successfully organize and share knowledge. With the help of technology, Companies can build Construction sites and tools to support the expansion

of KM (Mathi, 2004). IT facilitates Companies to use knowledge for organizational efficiency and effectiveness (Lin, Z.). Furthermore, IT provides a suitable environment for learning and interaction among the employees of an organization. Systems like expert systems are used in Companies to capture and manage knowledge (Gumbley, 1998). Although the technologies exist to manage knowledge, technology is not the key success factor in creating a successful KM environment in Companies. (Davenport and Prusak 1998) support them by arguing that the emphasis on the role of IT in KM is somewhat exaggerated (Hwang 2003; Davenport and Prusak, 1998). However, the above studies reveal that KM could partially accelerate obtaining a competitive advantage for an organization by assimilating the skill and application of IT knowledge. It is a key tool to facilitate KM practice in an organization for better performance. It is a basis for effective KM progress and implementation in Companies. IT is a vital factor to support the process of storing and distributing knowledge for sharing among employees.

Technology provides tools and techniques to capture, create structure, communicate and effectively exploit knowledge. The main role of technology is an enabling and facilitating interaction among people for KS. When we say technology, it includes e-mail, bulletin boards, chat rooms and whiteboards, audio, and video-conferencing. It also covers various specialized groupware applications: Customer Relationship Management, data mining, integrated portals, e-learning, intranets, and extranets.

The value that knowledge management adds lays in increasing individual, team, and organizational efficiency through the use of knowledge management tools, that is, information technology. The information technology component of the knowledge management by and large means: a) Capturing knowledge: the higher the level of capturing knowledge (explicit or tacit) with information technology tools, the better the KM result; and b) Usage of IT tools: the higher the quality of tools, quality of information, user satisfaction, usage, and accessibility, the greater the KM effect on organizational performance.

KM tools run the gamut from standard, off-the-shelf e-mail packages to sophisticated collaboration tools designed specifically to support community building and identity. Generally, tools fall into one or more of the following categories: knowledge repositories, expertise access tools, e-learning applications, discussion and chat technologies, synchronous interaction tools, and search and data mining tools.

There is a difference between information and knowledge management. Information and information management focuses on the collection, structuring, and processing of data.

Reliable and timely data is important for effective knowledge management, but it is only one part of the picture. Knowledge management may be derived from information, but it also implies an analysis of the information and data and an understanding of that analysis. It also enables the application of that understanding in future practice. This last point is critical. It is not enough for an organization to simply know; it must be able to harness and apply that knowledge to bring better results.

In the age of e-economy, business Companies need to reconsider the process of doing business as well as incorporating KM practices into it to be more competitive. Mathi, (2004) and Awad and Ghaziri (2004) support this statement by saying that KM is the ultimate competitive advantage for today's Companies. KM is embedded in many key areas such as economics, information management, and business environment and the human psychology. Besides, Hwang (2003) in his article quotes "Managing knowledge is a skill, like financial acumen, and managers who understand and develop it, will dominate competitively". To create a KM environment and to be a competitive organization, it is necessary to choose the appropriate desirable environment in which the organization can adopt the changing concepts. Assimilation of KM and adopting a culture that supports knowledge sharing can bring change in organizational performance.

The overall objective of knowledge management is to create value and to leverage, improve, and refine the firm's competencies and knowledge assets to meet organizational goals and targets of performance. Implementing knowledge management thus has several dimensions including: a) Organizational: The right processes, environments, culture, and systems, b) Managerial: The right leadership, and strategy, and c) Technological: The right systems, tools, and technologies - properly implemented. Political: The support to implement and sustain initiatives that involve virtually all organizational functions; that may be costly to implement (both from the perspective of time and money); and which often do not have a directly visible return on investment (Sunil Kumar Agrawal, 2013). Generally, the following table shows the list of knowledge management factors (Components) that affect knowledge management in one way or another as it is looked by different scholars.

Table 2.1 Knowledge Management Factors

Factors	Selected references
Knowledge culture (KC)	✓ Andreeva&Kianto,2012; ✓ Burstein et al.,2010; ✓ Carrillo&Chinowsky,2006; ✓ Davenport& Völpe,2001; ✓ Hasan Ali,2002; ✓ Jennex&Olfman, 2005; ✓ Jennex,&Olfman,2006; ✓ Leibowitz,1999; ✓ McDermott&O'dell,2001;
Individual Leadership Skills	
Organizational Leadership Policy	
Knowledge Sharing and Storage	
Incentives for knowledge sharing	
Managing knowledge assets	
Intra-team communication	
Management behavior	
Organizational knowledge (KO)	✓ Davenport&Völpe,2001; ✓ Hasanali,2002; - Holsapple&Joshi,2000; ✓ Jennex&Olfman,2005; ✓ Jennex,&Olfman,2006; ✓ Skyrme&Amidon,1997; ✓ VonKroghetal.,2012; ✓ Yahya&Goh,2002;
Managing individual knowledge	
Performance measurement	
Management commitment	
Establishing necessary KM practices	
Clear vision and objectives of KM	
Systematic assessment of future knowledge	
An effective and systematic approach towards knowledge management (KS)	✓ Andreeva&Kianto, ✓ 2012; ✓ Bursteinetal.2010; ✓ Ho,2009; Jennex& ✓ Olfman,2005; ✓ Jennex,&Olfman,2006; ✓ Jennex,2017; ✓ Karagoz,2017; ✓ Wang&Noe,2010;
Update employee with the latest information	
Human Resource Management	
Specific roles and responsibilities	
Training and development	
Effective documentation process	
Motivation aids	
Proper KM system and resources	
Knowledge management measures (KM)	✓ Burstein et al.,2010; ✓ Davenport&Völpe,2001; ✓ Holsapple&Joshi,2000; ✓ Jennex,&Olfman,2006; ✓ Kroghetal.,2012;Rivière&Sitar,2003; ✓ Wang&Noe,2010;
Participation and feedback from employees	
Individual commitment	
Constant flow/generation of new knowledge	
Information Technology	✓ Wang & Noe, 2010; Yeh et al., 2006; Yu et al.,2004; ✓ Yahya & Goh, 2002; - Yew Wong & Aspinwall, 2005 ✓ Jennex,2006;

2.3 Knowledge Management in Construction Industry

According to Deepak (2019), construction is a project-based industry where the common practice is to capture lessons learned through project reviews that happen at the end of the project. Reuse of existing knowledge picked up through past experience can enormously decrease the time spent on critical thinking and will boost the quality of work. Knowledge management practices are being increasingly acknowledged for much-needed innovation and to improve business performance. Knowledge management is defined as “the practice of selectively applying knowledge from previous experiences of decision-making to current and future decision-making activities with the express purpose of improving the organization’s effectiveness.

Two types of knowledge are present in Companies: tacit knowledge and explicit knowledge. Examples of tacit knowledge include individual experience, rules of the thumb, intuition, etc., and explicit knowledge are codified into regulations, instructions, standards reports, guidelines, manuals, databases, etc. Substantial efforts have been made by numerous industries to manage, implement and improve systems to capture, store and retrieve project-related explicit knowledge. However, ample consideration has been paid towards managing tacit knowledge. Managing tacit knowledge is extremely important in the construction industry due to its uniqueness and fragmented nature which creates an exceptional amount of knowledge amid its execution. Also, due to these qualities, new barriers emerge every day for which the project team reacts to these issues with possible solutions. In any case, this knowledge mostly remains in the minds of project staff and does not get exchanged within the organization for reuse in upcoming activities. The main purpose of knowledge management activities is to transform individual and group knowledge to build organizational knowledge that leads to the development of the knowledge management process in the organization. Successful implementation of knowledge management activities in construction creates business performance and ultimately for collective learning. Hence, there is a need to identify the factors influencing knowledge management strategies that construction firms consider for continuous improvement (Deepak,2019).

2.3.1 Role of Knowledge on Construction Site

The Project Management Institute (PMI, 2004) defines knowledge as 'knowing something with the familiarity gained through experience, education, observation, or investigation: it is

understanding a process, practice, or technique, or how to use a tool'. in construction organizations, knowledge often becomes embedded not only in documents and repositories but also in organizational. routines, processes, practices and norms. Knowledge can be considered as a production resource with a specific economic value and it needs to be managed in a professional manner (Nonaka and Takeuchi, 1995; Schaefer, 1993). It is recognized that an accumulation of experience and knowledge on the nature of projects assists the site manager to clearly understand site management problems and related issues.

In the site management context, site managers or project managers solve technical and complex problems by using their experience and intuition to find prompt solutions. These complex problem-solving events are mainly involved with tacit knowledge that is mainly people-bound and difficult to formalize and therefore difficult to transfer or spread (Egbu et al., 2005). According to Styhre and Josephon (2006), site managers are the best personnel to optimize KM initiatives in site organizations. This is attributable to the fact that they play the role either of knowledge broker or of technical experts capable of dealing with practical problem solving. The expertise and experiences, both administrative and technical, can certainly be utilized for managing knowledge on the construction site.

2.3.2 Knowledge: Key Concepts and Characteristics

Knowledge management has become an important strategy for improving organizational competitiveness and performance (Wong and Aspinwall, 2006; Liao, 2003; and Gray, 2001), Over the last five years there has been significant growth in the adoption of knowledge management (KM) in construction organizations. Knowledge management could be defined as the identification, optimization and active management of intellectual assets to create value (Nemati et al., 2002 and Liebowitz, 2001), increase productivity (Webb, 1998) and gain and sustain competitive advantage (Hicks et al., 2002). Furthermore, KPMG (1998) describes knowledge management as a systematic and organized attempt to use knowledge within an organization to transform its ability to store and use knowledge to improve performance.

From an integrated perspective, knowledge management can be defined as:

A systematic method for managing individual, group and organizational knowledge using the appropriate means and technology. At its roots it is to do with managing people, what they know, their social interactions in performing tasks, their decision making, the way information flows and the enterprise's work culture. (Sallis and Jones, 2002)

Before implementing KM in construction organizations, it is important to examine the variety of definitions of knowledge which come from a number of different perspectives (e. g. information systems, human resources, management and construction). Davenport and Prusak (1998), from an integrated perspective (information systems and human resources), define knowledge as a fluid mix of framed experiences, values, contextual information, expert insight and grounded intuition that provides an environment and framework for evaluating and incorporating new experiences and information. In organizations, knowledge becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms. A definition to illustrate the importance of knowledge to the organization is presented by Drucker (1993): Knowledge is not impersonal, like money. Knowledge does not reside in a book, a databank, a software program - these contain only information. Knowledge is always, embodied in a person; carried by a person; created, augmented, or improved by a person; taught and passed on by a person, used or misused by a person, applied by a person. (Drucker, 1993). Furthermore, Turban and Aronson (1998), from a knowledge engineering (KE) perspective, view knowledge as a productive application of data and information to make decisions and which is sometimes used interchangeably with the term decision support system:

2.3.3 Knowledge Types Relevant to Construction Site Management

Based on the preliminary synthesis undertaken, several knowledge types are relevant

for integration into site management practices. It is crucial to assess the knowledge embedded in construction site management practices in a structured and systematic manner. However, the nature and problems of construction site management also present challenges for the integration of knowledge management within the site management context. These problems can be addressed by the development of an effective framework for integrating applicable knowledge management processes into site management practices. It is equally important to recognise that the integration of KM processes may not completely resolve current site management problems, but it should minimise the number of problems on site. Before integrating KM processes into site management practices, it is important to synthesise KM processes with a focus on establishing the most viable processes for use in construction site management practice. However from the above discussion, it is clear that construction knowledge is made up of tacit and explicit knowledge. The type of knowledge determines which knowledge management processes will be mapped onto the various aspects of site management practices.

2.3.4 KM Technologies to Support Construction Site Management

Dent and Montague (2004) are of the view that the primary role of KM technologies within a KM strategy is not as a driver, but as an enabler. The KM technologies implemented should be led from the perspective of technology enabling knowledge sharing rather than on the basis of technical compatibility. In general, KM technologies can support the storing and distribution of information and facilitate the sharing of knowledge. However, it must be remembered that a complete knowledge management solution should also be considered in bringing people together to share and leverage the knowledge. There are several KM technologies for supporting knowledge management in construction. However, most software cannot provide a complete solution to KM. These software systems often integrate a variety of off-the-shelf products - electronic mail, groupware, document management systems, relational databases, search engines and workflow. Some of the available KM technologies are described below:

Case-based reasoning systems: Some organisations have collective knowledge and expertise built up over a long period of time. This can be effectively captured and stored using a case-based reasoning system (Laudon and Laudon, 2002). These systems use artificial intelligence technology to represent knowledge as a database of "cases". A "case... describes the experience of human specialists in a particular situation. When a user enters a new case, the system searches for stored cases with similar parameters. The system can infer a number of solutions from a mass of experience, as well as the probability of success of each solution. The stored case with the best fit to the new case provides a solution based on past experience. Case-based reasoning is an excellent tool for customer service knowledge management.

Databases and data warehouses: Group and corporate memory is a valuable resource. Whether centralised or distributed, stored in databases or a data warehouse, all knowledge management systems should offer access to it where required. A database is

simply a collection of structured data that may be used by one or more applications. Depending on the size and function of an organisation, they will probably store data in multiple databases (Turban and Aronson, 1998). In some organisations, it is necessary to integrate key data and store them in a consistent form that facilitates easy analysis and reporting. The data are standardised and consolidated before being made available across the organisation. As the warehouse contains both current and historical data, the contents may not be altered. Data warehouses come with a set of query and analytical tools with which to "mine" the data and allow them to be modelled and remodelled at will. Final results are often presented through a graphical reporting facility for easy

assimilation (Handzic and Zhou, 2005). Data mining: Data mining is a technology for knowledge discovery in databases (Liao, 2003). It provides different methodologies for decision-making, problem solving, Cý analysis, planning, diagnosis, detection, prevention, learning and innovation. Data mining is a process of analysis, undertaken by special software tools, to uncover patterns in pools of data. Data stored in warehouses, databases, and on the Web, can be mined to produce insights which are then used to guide decision making. Common applications of data mining include direct marketing, trend analysis, new product development, market segmentation and customer retention analysis (Jashapara, 2004). Document management systems: Document management systems are used to store a- wide range of documents, files and images, including computer generated reports, word processed documents and spreadsheets, records of business transactions, customer statements, credit card transactions, photographs and even audio recordings (Jashapara, 2004). Indexes are used to identify and retrieve the required documents. Index data are recorded when the document is input in the system so that it may be retrieved in a variety of ways. Indexing allows documents to be cross-referenced and grouped according to relevance (Laudon and Laudon, 2002). An "industrial strength" document warehouse can store billions of documents which are instantly available to authorized users internally and, via the Internet, externally to customers and suppliers. These systems can generate sufficient savings on paper, microfiche and processing time that implementation can be easily cost-justified in most medium to large organisations. Expert systems: An artificial intelligence method for capturing knowledge, these are knowledge-intensive computer programs that capture human expertise in a limited domain of knowledge (Laudon and Laudon, 2002). According to Liao (2002) the basic principle of an expert system is that human knowledge must be modelled and presented in a way that computers can process. Knowledge is stored in a knowledge base along with a set of rules for manipulating that knowledge. Expert systems can enable the problem solving and decision making process in a very limited domain by asking relevant questions and offering explanations for a particular course of action. Intranet and Extranet- An intranet is a private Web that exists within an organization and uses the same technology as the internet. It is protected from third parties by a firewall; this is a security system with specialized software to prevent outsiders from invading private networks (Laudon and Laudon, 2002). Dent and Montague (2004) state that the intranet is regarded as the primary IT platform for KM as it provides for an integration of business critical applications and tools, and basic facilities such as a standardized resource to assist operational practices and tasks. An extranet is a private internet to which selected outsiders have access. Access is also controlled by a "firewall"

which ensures that internal data remains secure and that external users can only access certain areas of the network. Groupware: Groupware, along with Web-based tools, promotes information sharing by allowing groups of users to work together. This collaborative working could take many forms; sharing documents or applications, scheduling meetings, building virtual communities, participating in virtual teams, developing shared databases, managing projects and routing electronic forms (Al-Ghassani et al., 2005). According to Jashapara (2004), groupware products combine tools that support knowledge sharing through threaded discussion databases, document repositories, shared calendars and applications, built-in email and a customizable Web interface. Videoconferencing: "Cyber meetings" are an effective way of encouraging and enabling people to share tacit knowledge. These forms of electronic conferencing are growing in popularity because they save travel time and cost (Laudon and Laudon, 2002). Although the picture quality is still not brilliant, the current desktop systems are well suited to individuals and small groups. Workflow management system: Workflow software controls the movement of documents, information and tasks around an organization via approved routes (Turban and Aronson, 1998). It also sets rules for who can see what information and who needs to authorize certain procedures. Workflow software is often used in conjunction with document management systems to streamline paper-based business process. According to Kamara et al., (2005) a workflow management system should also have filtering capabilities to ensure that only relevant learning is captured to prevent knowledge/information overload. Examples of workflow management systems include customer orders, insurance claims, university applications and tax returns (Jashapara, 2004).

2.3.5 The Application of KM Tools on Construction Site Management Practices

Construction organizations, have a variety of mechanisms for managing their tacit and explicit knowledge (Mohamed and Anumba, 2006). Although the label of KM is often not used, knowledge is being managed through content management (e. g. central project file and business management system), experience management (e. g. quality register, communities of practice, and seminars) and process map and project procedure. According to Robinson et al (2005) an intranet is the backbone of the IT infrastructure to support the above knowledge management activities in construction organizations. The intranet is a useful tool for collaborative work, facilitating knowledge sharing within project team and the entire construction supply chain. The KM techniques and technologies described in the previous section provide valuable support for knowledge management. However, the dynamic nature

and continual evolution of software systems create problems for selecting the most appropriate tools to be implemented in construction organizations. The KM tools can be effectively used on the construction site to enable knowledge to be captured and reused in the future. Tserng and Lin (2004), in a survey of construction organizations, identified several key benefits for construction organizations, of implementing knowledge management:

- Increased innovation ability (23%);
- Decreasing the probability to repeat problems (23%);
- Improved training effectiveness (17%);
- Experience reused (13%);
- Improved job effectiveness (13%); and
- Increased knowledge asset (12%).

The benefits of knowledge management can be appreciated only if construction site organizations employ systematic and effective KM strategy on the construction site. Construction site organizations, can take advantage of KM tools for its implementation as site management practices involves several knowledge-intensive activities. These activities (e. g. site investigation, site planning and layout, material handling, planning and managing the construction) are influenced by factors that are linked to human intelligence and knowledge, such as experience and engineering judgments (Al- Hassan et al, 2006). For example, the implementation of an intranet system in construction site management facilitates knowledge sharing and helps site managers to find the right solution for specific problems based on the response from experts in different geographical areas (Mohamed and Anambah, 2005). Therefore, it is important to identify the techniques (non-rF tools) and technologies (IT tools) needed, including their appropriateness in a specific problem-context within construction site management practices. The next section examines the potential for implementing a knowledge management system on the construction site, including its potential benefits for construction site management practices.

2.3.6 Knowledge Management System on the Construction Sites

In the construction site management context, very little research has been undertaken on managing knowledge in a systematic manner, which includes exploiting the potential benefits of KM techniques (non IT tools) and KM technologies (IT tools). The need for an effective knowledge management system on the construction site was indirectly addressed by Boyd et al (2004). They developed a KM initiative called 'Audio Diary and Debriefing' which aimed to capture, store and disseminate knowledge on the construction site using a Dictaphone. This approach involves two operations: recording and debriefing. The first is based on recording events (i. e. audio diary) and the second is based on personal reflection and abstract conceptualization of the events (i. e. debriefing). In addition, Egbu et al (2005) used storytelling and graphical representation as mechanisms for managing the tacit knowledge of experienced site managers. In this research, storytelling was observed to be a useful tool for capturing tacit knowledge and graphical representation of the information assisted the sharing of tacit knowledge. Unfortunately, this does not adequately fulfill the KM needs of construction site management practices. From a site management context, there is the need for a robust KM system that will enable the site manager to capture, store, share, and reuse the different types of knowledge, whether tacit or explicit. According to Mohamed and Anumba (2006) there are several important needs to be considered in the development of a KM system on the **construction** site. These are:

- To identify what knowledge is to be managed;
- To identify the characteristics of the knowledge; and
- To develop detailed strategies of 'how their KM initiatives would be implemented.

These findings were supported by the work of Kamara et al (2005) which revealed that the management of knowledge in construction organizations should include the following two elements. These are: The use of formal and informal feedback between providers and users of knowledge as a means to transfer learning and best practice; and A strong reliance on informal networks and collaboration, and 'know-who' to locate knowledge' to better focus on the exploitation of the knowledge management approach by construction site organizations. The main reason is that informal networking systems are better able to create and transfer tacit knowledge, know-how and innovation because human relationships are necessary to share knowledge that is unclear and difficult to document (Dent and Montague, 2004). A clear identification of 'source' and 'destination' of knowledge is also crucial to determine the best

mechanism for knowledge sharing, whether it is from people-to-people, people-to-paper, etc. However, Egbu et al (2005) stressed that the implementation of any technological infrastructure to support KM on the construction site must be adapted to the organization's needs and not the other way round. It is particularly important, in developing a KM system at site management level, to recognize two major misconceptions of knowledge management systems in any construction organizations, (Carrillo and Chinowsky, 2006) 9 Lesson learned as KM system: Many construction organizations claim to undertake 'lessons learned' sessions at project closeout. While these contribute to knowledge sharing, lessons learned are only one specific mechanism to share knowledge. The lessons learned are also not conducted in a systematic manner, many of the relevant stakeholders are absent and there is ad hoc dissemination of findings; and Intranet KM system: Intranet is crucial KM tools for both communication and access to data.

2.4 Barriers associated with the adoption of KM practices

Several barriers hinder the implementation of knowledge management practices within Companies. Culture has been a recurrent theme in the knowledge management literature as it can enable or inhibit an organization's knowledge management strategy. Coopers and Lybrand explained that culture concerns the values, beliefs, history, and traditions, which reflect the deeper foundations of an organization. It has also been identified as one of the most crucial factors that contribute to the success of a knowledge management design and perhaps the most difficult constraint that knowledge managers must deal with. Culture has been identified as the most significant barrier in the implementation of knowledge management practices in construction Companies, especially civil engineering construction firms. The culture of formal and informal sharing of knowledge is important. However, highlighted that culture cannot be changed directly but only through indirect means such as incentives, role models, and the likes. The lack of standard work processes has also been identified as a key barrier. The significant merger and acquisition activities over the past decade have transformed many construction Companies, and the implication is that Companies have inherited new processes.

Many construction Companies now suffer from having too many different processes for performing similar activities. The lack of standard processes and systematic procedures, combined with the lack of awareness of the importance and future benefits of knowledge management causes the need for a more coherent and structured approach for managing and

utilizing the different types of knowledge within Companies. Gann(2012) argued that construction Companies may have strong capabilities in project management but are often much weaker in organizing their internal business processes. However, preliminary evidence from on-going case studies with selected Companies reveals that there is a new recognition in some Companies for rationalization or synchronization of some processes to improve the possibility of re-using knowledge of best practice and sharing experience.

Time constraint is also considered as a barrier in construction Companies given that projects are characterized by fixed time scales, associated with clients' need to deliver at particular times. Many construction Companies consider their organizational structure too lean -to exploit knowledge management to the fullest, as people want to share knowledge but the pressure to deliver under a tight project schedule does not often permit the recording of experience and sharing of knowledge before, during, and after projects. Furthermore, poor organization of internal business processes means that project-based construction Companies often struggle to learn from one project to another. This means that the scope for reduction in project duration and the subsequent time available to document lessons learned from previous projects are often very limited. Sharing knowledge demands additional effort and may be minimized by work practices and the introduction of better knowledge-sharing tools. Construction projects are always working to tight deadlines. Anything that detracts from the main business is seen as of diminished importance according to (Dasgupta & Gupta, 2009).

Another barrier to the implementation of knowledge management is employee resistance, which is closely associated with cultural factors. Cultural factors tend to be either negative or positive in orientation to employees. Positive orientation refers to situations where individuals have a positive attitude to the creation and sharing of knowledge. Negative orientation reflects the reverse situation where there are knowledge inhibitors as people who feel insecure about their job situation, do not trust their employers, and are therefore less likely to share knowledge. Other barriers identified include knowledge acquisition, knowledge modeling, knowledge retrieval, knowledge re-use, knowledge publishing, and maintenance. Despite these barriers, stated that knowledge management is a concept that is relatively new to the construction industry and has the fundamental need to manage its knowledge in a formal and structured way from project to project, given that participants must work with various interested stakeholders.

2.5 Knowledge Management Processes (KMP)

Knowledge management processes are series of activities an organization puts in place for the facilitation and use of knowledge. The management of knowledge is a continuous process in which one form of knowledge is transformed into the other. Knowledge management processes support the conversion of tacit knowledge to explicit knowledge and explicit to tacit. Many scholars such as; Dhamdhere (2015), Alegbeleye (2010), Mutula and Mooko (2008) amongst others have identified some processes of knowledge management to involve:

2.5.1 Knowledge Acquisition and Generation

Acquisition in Knowledge management deals primarily with tacit knowledge although it also acquires explicit knowledge. The tacit knowledge can be transferred to explicit knowledge through externalization, that is, the tacit knowledge is converted to recorded form, in documents or databases for reference by others (Alegbeleye, 2010). However, before knowledge is acquired, it is essential to identify the knowledge an organization has and needs to achieve its objective which is called “knowledge identification”. Knowledge generation focuses on knowledge creation for exploration and knowledge exploitation.

Knowledge can be generated through:

- a. Writing both formal and informal.
- b. Research: the whole essence of research (which is a systematic investigation) is to generate knowledge. Examples are: Research institution, tertiary institution, etc
- c. Shared problem-solving: This can be referred to as brainstorming. This has to do with knowledgeable persons in a particular area coming together to share their views about a problem to proffer solutions. Examples are; seminars, conferences, workshop, etc

2.5.2 Knowledge Capture

Knowledge capturing is another important aspect or component of knowledge management in knowledge-based Companies. Knowledge capturing involves:

- a. Technology: Several technologies exist for facilitating the creation and sharing of knowledge. Information technology is a useful instrument in knowledge management and uses for effective services in an organization.
- b. Knowledge Mapping: Knowledge mapping is a method used to identify where knowledge resides within an organization. Knowledge mapping requires the techniques of a questionnaire, interview, and sometimes observations. The questionnaire should identify

persons within the organization with special knowledge or expertise. Mutula and Mooko (2008) described Knowledge mapping as a navigation aid to codify information and tacit knowledge, showing the importance and the relationship between knowledge stores.

2.5.3 Knowledge Organization

The knowledge acquired generated or created needs to be properly organized for easy access and retrieval which is the essence of the organization of knowledge. Librarians as information practitioners organize knowledge in a documented form called information resources through cataloging and classification. Nwalo (2003) defined cataloging as the process of writing descriptive information of a book and non-book material on a catalog card and classification as assigning a class number to a book that corresponds with a subject heading following a chosen classification scheme. Besides, Alegbeleye (2010) identified several aspects involved in the organization of knowledge as identification of messages, identification of texts, and description of the content. Tools for such organization of knowledge include indexing, abstracting, and cataloging techniques.

2.5.4 Knowledge Storage

The knowledge created and acquired needs to be properly stored and preserved for subsequent access and use, and for the sake of posterity. Alavi and Leidner, (2001) pointed to knowledge storage as a process in knowledge management that involves capturing, transcribing, and coding knowledge. While, Alegbeleye (2010) asserted that the idea of knowledge storage, which he also called knowledge “repository” as used in knowledge management is to take documents with knowledge embedded in them and store them so that they can be easily retrieved in the future.

2.5.5 Knowledge Sharing

Knowledge sharing is a key component in knowledge management. Ikenwe and Igbinovia (2015) described knowledge sharing as a fundamental priority of knowledge management and defined it as an act through which, acquired information, knowledge, ideas, skills, and experiences are exchanged and shared among people, companies, and institutions. Knowledge sharing allows for leveraging the knowledge gained by an organization (Alegbeleye, 2010), and the main reason for sharing individual knowledge to the entire organization is that knowledge should not disappear if that employee leaves the organization (Dhamdhere, 2015b). An organization must put certain measures (incentives) in place to ensure knowledge is shared and to discourage knowledge hoarding.

2.5.6 Knowledge Application

Once knowledge is shared among people in the Companies, the shared knowledge should be applied to solve a problem. According to Dhamdhere (2015b) if the gathered, stored, created, and shared knowledge will not be applied properly the whole process would be in vain, and for proper knowledge application, the knowledge management process should be communicated to users. That is, knowledge should be put to effective and efficient utilization to fill a gap or need. Many models and processes of KM covering a wide spectrum of viewpoints exist in the literature. Notable among these are (1) Nonaka and Takeuchi's (1995) model which represents a knowledge creation process; (2) Boisot's (1987) model which considers knowledge as either codified or uncoded and diffused or undiffused; and (3) Demerests (1997) model which highlights the construction of knowledge within the organization not limiting the process to scientific approach alone but also involves the social construction of knowledge.

Table 2. 2 Relationship between KM Process

Knowledge Sharing	How does informal discussion help you solve project problems? Do your work colleagues play vital roles in helping you come to know your job very well? Are there times when you help other colleagues with information on a problem? Do you belong to any informal groups in your project? Do you rely on your project group for information and career goals? What are the external sources of personal improvement
Innovation	Do you come up with new ideas and ways of doing things during discussions? What are your views about group discussions as relating to sharing information with colleagues on the project? Would you say this helps generate new ideas for your project? Since belonging to the project have you witnessed significant changes in the way you work? What major achievements and significant changes have happened on
Completion times	Do you feel your project completes its assignments on time? Explain and give reasons. What factors do you think are responsible for your project completing on time? Do you think an increase in your understanding of the
Project Success	What roles do knowledge sharing and management play in helping your project be succeeded? Is knowledge sharing a major factor in your project's success? If the project is a failure, why do you think it failed?
Generation of new Knowledge	In your estimation, how does your project or project group generate new knowledge? What factors would you say are responsible for new ideas in your project? Do you feel you have learned a lot by sharing knowledge and
Operational Efficiency	Do you think your project operates at maximum capacity because of sharing Knowledge? Does sharing knowledge with colleagues help you utilize staff and

Table 2.2: Shows the relationship between the capture, sharing, reuse, and maintenance of knowledge (Mekonnen L.,2019) According to Table 2.2, knowledge capture encapsulates identifying and locating knowledge, and knowledge representation involve storing and validating knowledge. Knowledge sharing deals with the transfer of knowledge to the right people at the right time as is stated by Lemlem Mekonnen. Knowledge transfer is a transactional process involving the exchange of information between people. Information can be exchanged through media such as computers, word of mouth, writings, visuals, and audio. The next step in the knowledge process is knowledge reuse. This process involves adapting

and applying knowledge gained for problem-solving. Ideas could be reused and applied for innovative ends through developing such ideas fully and re-conceptualizing the problems they are meant to solve. In this way, there is a continual flow of knowledge in a cycle leading to use and reuse, and in each scenario; the knowledge adapted and used emerges in a different and improved form. Knowledge reuse leads to its maintenance which relates to archiving and retiring for subsequent use. It also involves updating and refining it to keep abreast of developments in the area. The following are basic aspects of such a model: Compatibility: Knowledge management requires both a shared language and a good fit with concepts that already exist in the organization, such as Total Quality Management or Business Process Reengineering. Problem Orientation: Knowledge management must contribute to the solution of concrete problems; it must not be allowed to remain theoretical. The ultimate test of ideas is their usefulness in practice. Comprehensibility: The Company must choose terms and ideas of knowledge management that are relevant to its success and readily understood across the company. Action Orientation: Analyses in the field of knowledge management should enable managers to evaluate the impact of their instruments on the organizational knowledge base and should lead to focused action. Appropriate Instruments: Focused interventions need proven instruments. The final goal of a knowledge management concept is to provide a range of such instruments. But the kinds of tools employed are less important than their skillful use

2.6. Factors Influencing Knowledge Management

Deepak, (2019) also defined a framework for understanding elements that impact the success of knowledge management activities in an organization. His study has also described key elements in three levels; management, resource, and environmental aspects. He established an extensive list of knowledge management success factors comprising knowledge sharing processes, organization policy frameworks, measuring performance, training initiatives, and benchmarking processes. According to the above-listed researcher, a proposition of the knowledge management success model is derived from a longitudinal study of an engineering organization.

This model provides a definite link between knowledge usage and organizational effectiveness. Key dimensions of the model are system quality, knowledge quality, service quality, user satisfaction, perceived benefits, and the net impact on individuals and organizations. He examined knowledge management practices at the project level in Thai construction projects. The main objective was to identify whether or not knowledge factors influence the on-site execution of works. Some of the key factors include established

information technology, teamwork, trustworthiness, incentives for knowledge sharing, individual and group level skills, and competencies.

The success of knowledge management implementation is determined by identifying influencing elements and understanding their nature. Several elements as identified from the review of literature are grouped under four factors. The four factors are:

Knowledge culture: Some of the key elements are - possessing adequate leadership skills and adopting organization leadership policies, emphasis given on communication strategies, providing incentives for knowledge sharing processes, storing and using knowledge assets in the organization; all these factors benefit in developing a knowledge-based culture in the organization;

Organizational Knowledge: variables concerned with the management role for providing necessary commitment to work, managing knowledge with strong vision and objectives for managing future knowledge to improve performance are considered under organization factors;

Effective and Systematic Approach Towards Knowledge Management: creating a knowledge environment to update employees, managing human resources, designated roles and responsibilities for employees, providing adequate training and development, effective documentation process of knowledge activities, motivational aids for enhancing productivity and usage of proper systems and resources to effectively manage knowledge management processes within the organization;

Knowledge Management Measures: knowledge management success can be achieved by setting participative goals, individual commitment of employees and their appreciation. These are some of the key elements concerning the implementation of knowledge management that have an effect on its benefits.

2.7 Knowledge Management and Organizational Performance

Before stating how knowledge management and organizational performance are interrelated, a reader needs to consider performance management. It is a strategic and integrated approach to delivering sustained success to Companies by improving the performance of the people who work in them and by developing the capabilities of teams and individual contributors”

It supports the rationale that people and not capital provide Companies with a competitive advantage (Reynolds and Ablett, 1998). The purpose of performance management is to transform the raw potential of human resources into performance by removing intermediate barriers as well as motivating and refreshing the human resource (Kandula, 2006). The competitive capacity of an organization can be increased by building strong people and effectively managing and developing people (Cabrera and Banache, 1999) which is in essence performance management. A major concern for many companies is the need to prove that KM adds any value to production processes. This makes it possible to convert uncertain processes into a scale that measures more certain figures of assets, competencies, efficiency, and profit and loss.

Organizational performance is described as an organization's ability to acquire and utilize its scarce resources and valuables as expeditiously as possible in the pursuit of its operations goals (Griffins, 2006). There have not been much researches done to link organizational performance and KM, but researchers have implicated that the more knowledge Companies can capture the higher is their performance. Managing knowledge does not necessarily improve performance, but the knowledge managed should be linked to the utilization and development of an organization to gain better performance (Kalling, 2003).

Although the concept of KM is well-known, only a small number of companies are capable to link KM to enhance organizational performance (Rowland (2004), report that Companies should transfer knowledge from one unit to another to gain an overall performance. The ability to apply knowledge to perform important activities is viewed as a source of competitive advantage. When knowledge is managed to improve development and subsequently utilized by individuals, only then KM can be used to improve performance. Farshath (2004) concluded his study stating that Maldivian Companies are aware of the concept of KM to some extent and are moving towards better implementation of KM but the extent to which KM is practiced has never been a subject of research in the country. If construction companies develop a link between KM and their activities, they can capture the knowledge of employees.

2.8 Framework Development

The third objective, the development of a framework for improving site management practices based on an integration of KM processes, was achieved through case study findings and supported by an extensive literature review on knowledge management and site management practices. The case studies have helped to identify aspects of KM at the construction site level.

Companies have a variety of mechanisms for managing their knowledge, although the label of KM is often not used. Nonetheless, the site management team has difficulties concerning resolving site management problems. The key findings from the case studies are as follows: Site managers often wait until late in the project, when many problems start occurring, before tackling such problems and related issues and Site organizations do not have any systematic methods and processes to locate/access and share knowledge from experts and senior people in the organization.

2.8.1 Conceptual Framework of the Study

Several pieces literature have been viewed. Figure 2.1 shows the conceptual framework of the study. Independent variables are organizational culture, information technology, and organizational knowledge. The dependent variable is organizational performance improvement.



Figure 2. 1 Conceptual Framework of the study (Mekonnen, 2017)

Based on the framework, the following hypotheses are presented.

H1: Organizational culture (such as management support, sense of belonging organization and participation in decision making, etc.) has a positive impact on the organizational performance of Construction Companies.

H2: Organizational knowledge (such as sharing, accumulation, and codification, processing and exchange systems, etc.) has a positive impact, direct relation with, on organizational performance of Construction Companies.

H3: There is a positive influence of IT application (Information acquisition processes systems, information systems, and information technology management systems, etc.) on the organization performance of Construction Companies.

2.9 Summary

In this chapter, the key concepts of knowledge, Components of Knowledge Management, and established knowledge Management Processes have been reviewed. This chapter has argued for a structured approach involving the development of knowledge management to identify the most relevant knowledge that is needed for construction companies. The relationships between adoption of KM to the construction companies, relevant KM processes, and the potential IT applications are also reviewed as the basis for developing an effective framework to support the integration of knowledge management processes into construction companies. The need to synthesize knowledge management processes was identified and resulted in the identification of relevant knowledge management processes for construction companies. It is observed that knowledge capture, knowledge sharing, and knowledge creation provide an interesting opportunity for KM to be integrated into construction companies. A variety of knowledge management techniques and technologies have also been discussed. It is important for construction companies to carefully select and implement KM techniques and technologies to support knowledge management processes. The needs of KM for any business organization, the major misconceptions of knowledge management systems, and the KM needs of construction company's practices need, to be considered and evaluated before developing KM systems for construction companies.

KM is considered to be a possible solution. The principle and theories of KM and its application in the construction industry are reviewed. Furthermore, KM framework is specifically discussed which can relate the various components of KM (people, process, technology, etc.) to each other and provide a schematic picture of how these various aspects depend on each other. Base on these reviews and discussion, a specific KM framework is developed in later stages of the research.

CHAPTER THREE

3. MATERIALS AND METHODS

This chapter deals with the description of the general process in which the research was conducted. Further, it outlines the research type, study population and sampling techniques, data sources, and method of data collection. In addition, this chapter will discuss the method of data analysis and data management

3.1 Description of the Study area

This research is limited to AEC companies in Hawassa City, located 275 km away from the capital city of Ethiopia, which is the capital city for Southern Nations, Nationalities, and People of Ethiopia. This place is situated in Sidama, Southern, Ethiopia. Its geographical coordinates are 7° 3' 0" North, 38° 28' 0" East.

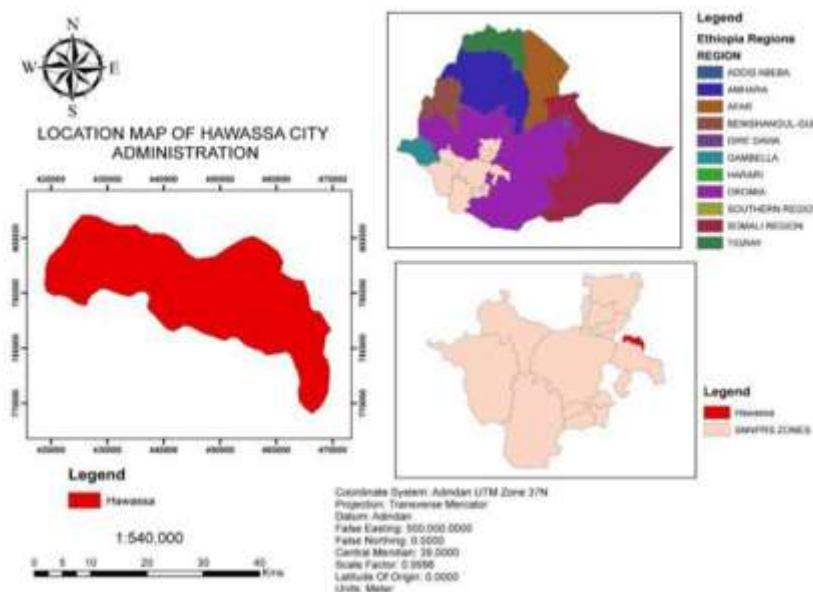


Figure 3. 1 Earth map of Hawassa city (Source Tariku Nigusie)

3.2 Study Subject

The practice of knowledge Management of construction companies is researched by taking the Architectural, construction, and Engineering Professionals that are found in Hawassa city into consideration.

3.3 Study Design

3.3.1 Sampling Technique and Sample Size for the study

To meet the mentioned objectives of assessing knowledge management practices in construction companies of Hawassa city, identifying the barriers of knowledge management practices in Hawassa City, proposing a framework that improves knowledge management practice in construction companies in Hawassa City, the study is more of a descriptive type which is used to systematically identify process or system. Such identification is done from a particular perspective and as objectively or accurately. Commonly, such research is carried out to enable the subject matter to be categorized as the problem involves in-depth investigation and specious description.

In Ethiopia, there are lots of working professionals from different construction companies and hence it is really difficult to collect responses from all these study areas. Hence, a sample that defines the population is considered for this study. The study population considered in this research are individuals operational among stakeholders of the construction companies that are specifically working in Hawassa City who are top-ranked. The reason why the researcher chose top-ranked AEC companies is that they are highly structured and taking them as a sample clearly shows, the researcher, the current status of the construction stage within Ethiopia. An aggregate amount of 290 questionnaires is dispatched among the above-stated stakeholders. The research used purposive sampling; which is a non-probability sampling method for collecting survey responses from some of the stakeholders in Hawassa construction industry. The sampling frame that considered for the study includes stakeholders such as contractors, consultants, and other stakeholders from the industry like professional associations. The unit of analysis is construction professionals and practitioners in Hawassa construction industry. The iterative formulae to ascertain the suitable number of participants for the survey as adopted by Hair et al. (2007) is utilized, and be calculated by Equation 1:

$$SS = \frac{z^2 * P * (1-P)}{C^2}$$

Where: SS = sample size; z = standardized variable (z = 1.80 at 95% confidence interval); p = probability of picking a choice (p = 0.5); c = confidence interval (c = 10%) .The sample size of 290 is estimated based on the above formula. Generally, in construction industry it is difficult to obtain responses for questionnaire-based survey. As a result, a range of 30- 40%

response rate is adequate for research in construction industry (Oyewobi, 2014). The new survey sample size is calculated by Equation 2:

$$\text{New sample size} = \frac{\text{SS responses}}{0.3}$$

3.4 Study Methodology

To generate relevant data for this study, both primary and secondary data sources are used. Primary data is the information that the researcher finds out by himself regarding a specific topic. The main advantage is that the information collected is more consistent with the research problem statement and its objective.

As this study is empirical, secondary data is obtained from reference books and related documents through a literature review. This data is used to get a better insight on the research topic, to establish the viable platform for the theoretical framework constituting the basis of this research, and to design the questionnaire for retrieving the primary data.

Primary data serves is obtained from two case studies and questionnaires conducted from different sectors of the construction projects in Hawassa. After that, findings are carried out from collected data analysis

3.4.1 Quantitative Approach

To collect the quantitative data a questionnaire was developed. A questionnaire survey is preferred as the main method of data collection as it is an effective instrument for acquiring data on approaches toward relationships between variables of interest (Hair et al., 2007). The questionnaire survey covers the following sections: the first section will cover general information about the respondent and about the company which will help us in identifying the character and current condition of the stakeholder along with the respondent. The second section will cover statements for each Existing status of knowledge management which aims at identifying whether the respondents are well acquainted with the term knowledge management and the respondent's opinion with knowledge management. The third section focuses on the training, culture, policies, and strategy of a company. When we come to the fourth section it focuses on the knowledge management practices which organization is adopting which practices were most commonly used in organizations. The last part of the questionnaire deals about) Knowledge Management Technologies which tries to explore the

technologies that are presently being used by employees in their organization for Managing Knowledge

Respondents are asked to rank elements based on the level of importance concerning their organization. Likert's five-point measurement scale is used for assessing these elements between 1 = **Strongly Disagree**; 2 = **Disagree** , 3 = **Neutral**, 4 = **Agree** important and 5 = **Strongly Agree**. Initially, a pilot study is done to check the effectiveness of the survey instrument.

3.5 Questionnaire Design

Research questions, research objectives, research methodology, and the literature review guided the formulation of the questions. Based on the KM framework prototype, 25 questions are categorized into four sections that reflect the three elements in the KM framework, while the other one is set to collect respondent's information. The four sections are:

- ✓ General Respondent's information
- ✓ Knowledge management Process
- ✓ Barriers of KM
- ✓ Questions related to hypothesis

Table 3. 1 Table Structure of the Questionnaire Table

Section	Category	Questions	Remarks
1	General Respondent's information		
2	Knowledge Management Processes		
3	Barriers of Knowledge management		
4	Questions related to hypothesis		

3.6 Pre-testing the Questionnaire

Pre-testing of the questionnaire was done to make sure that the questionnaire is going to deliver the right data and to ensure the quality of the collected data. In other words, pre-testing the questionnaire was an important and necessary step to find out if the survey has any logic problems, if the questions are too hard to be understood, if the wording of the

questions is ambiguous, or if it has any response bias, etc. (Lavrakas, 2008). The pre-testing was conducted in one or more phases by our advisor.

3.7 Interview

This part shows the general structure of the interviews. It first introduces the selection process of the interviewees and their backgrounds. The following section represents the instrument's structure and format of the interview survey. Questions asked revolved around the organizational and project context for the management of knowledge, the current practice of knowledge transfer across companies, projects and the barriers and opportunities for the management of knowledge. Aggregated findings, analysis, and discussions from the interviews are presented in Chapter 4.

3.8 Participants Selection and their Background

3.8.1 Selection of Interviewees

The **Snowball Approach** and a **Purposive Sampling** strategy were employed to select interviewees. At the end of the questionnaire survey, participants were asked to state their willingness to participate in the subsequent interview survey to discuss the research topic at length. 10 out of the 25 questionnaire survey respondents were okay to the interview invitation. The selection of interviewees was based on their current positions, professional background, relevant experience, and availability during the arranged interview period. Finally, 10 were interviewed.

Table 3. 2 Full Demographic Profile of the Interviewees

No.	Position	Stakeholder Type/Role	Company Experience	Years of Experience	Interview Type
1	Chair Holder	Academic Institution	Academics	10	Face to face
2	Construction Supervisor (Site Engineer)	Contractor	Building Construction, Transport, and Water Works	8	Face to face
3	Directorate	Government Engineering Consulting	Building and Water Works	9	Face to face
4	Founder and CEO	Engineering Consulting	Supervision of Buildings	7	Phone
5	Project Manager	General Contractor	Transport, Building and Water Works	15	Face to face

6	Senior Site Engineer	Building Contractor	Building	10	Face to face
7	Senior Contract Administrator	Engineering Consulting	Building and Transport	13	Face to face
8	Department Head	Academic Institution	Academics and Research	9	Face to face
9	Deputy Manager	General Contractor	Transport, Building and Water Works	13	Face to face
10	Development Plan Head (Directorate)	Government (Client)	Contract Administration as a client	12	Face to face

The professional roles of the interviewees are diverse. Four of them are from general contracting companies, two are from consulting firms who are the project designers or project executives, and two are from government agencies (who are typically the clients as well as the regulators of the projects in Hawassa context), and two interviewees are from the academics.

As discussed above, backgrounds of the interviewees covered different professions and stakeholders, from both private and public sectors. They possess various positions in the industry sector (from CEO to project (Site Engineer) and have practical experience in both project delivering and high-level management areas. Furthermore, many of them have rich experience in the Construction Sector. Thus, information, insights, and recommendations provided by the interviewees are highly valuable to this research.

3.9 Interview Format and Structure

The semi-structured interview was formulated on top of the previous questionnaire survey. Questions are qualitative which can increase the potential of collecting insights and concepts and expanding understanding. Questions are generally categorized into five folders which are the main stages of the KM process for managing knowledge in Construction Companies namely: identify the knowledge, obtain knowledge, share knowledge, apply knowledge and maintain knowledge. Important KM enablers are included in these folders as well according to their relevance.

General information about the interviewees and their impression of Knowledge Management were asked. The table below outlines the main questions of a typical interview. As the interview was semi-structured, interview questions were usually changing. For instance, if the interviewee possessed a high executive management position, questions were more strategic from a high management level perspective. On the other hand, if the interviewee is a project manager or site engineer, the interviewer is probed more into the practical issues at project level.

Table 3. 3 Interview Questions

Category	Questions
Apply Knowledge	✓ As identified through my previous survey, people think it is relatively difficult to apply knowledge management into real projects. What can be the reasons? ✓ Could you please give me an example of how knowledge management has been applied in a real project? What was the process? (Where is the knowledge from? Who proposed? Who agreed with the plan? How to secure its application in the later project processes?)
Identify Knowledge	Background information: The main locations of Knowledge is identified as: lessons learned from internal projects, industrial best practice and internal or external experts. ✓ How can we increase the industry practitioners' awareness of knowledge management? ✓ How can knowledge management related industry best practice be noted by practitioners in projects? ✓ How can internal/external experts be easily identified? (Knowledge map? expert index?) How can new knowledge generated in internal projects be noticed and shared?
Obtain Knowledge	✓ Many people feel that knowledge is not always available or easy to get when they need it. What can be the reasons for that? ✓ What are the common forms of industry best practice? How can it be obtained by practitioners across organizational boundaries? (Detailed plan? Technical instructions? Case study publications? etc.) Who should be in charge of obtaining knowledge? (Organization based position? Project based position?)
Share Knowledge	✓ Background information: Colleagues and internal experts are the most popular resources for people to get knowledge. ✓ What are useful methods to share knowledge inside the organization and inter-project? (IT tools? Non-IT methods?) ✓ How about the use of databases and ICT (information communication technology)? From the previous survey, people think knowledge is usually not easy to articulate or comprehend. How can we improve this situation?

3.10 Case study

Through the semi-structure interviews, the holistic environment, general approaches, relevant enablers, and other important issues of managing knowledge in the Construction sector are studied. To further investigate these issues especially at the company level, two cases are conducted. The purpose of the two case studies is first to propose a framework that improves knowledge management practice in construction companies in Hawassa City and to provide and to provide real company examples that demonstrate how those KM factors with in the proposed KM framework may influence and facilitate the management of knowledge during projects are being held.

This subtopic presents and analyzes the data gained from the two cases. It first clarifies the selection of these two cases and the data collection methods used to conduct the case studies. It discusses the characteristics of case project 1 and Case Project 2. General information of the projects is provided firstly, followed by the processes, method, tools, and other issues that the companies used to improve organizational performance practically.

3.10.1 Selection of case study Projects

Renowned companies are selected from companies that are located in Hawassa city to attain the above mentioned objectives.

To obtain more insight into the applicability of KM processes for improving existing site management practices, a five-step descriptive case studies approach (that incorporates qualitative comparators with observations made within four construction sites) was adopted. The main aim of the case studies was to investigate the key problems of site management practices and to observe existing practices in managing knowledge on the construction works. Indeed, the case studies attempt to identify how existing site management practices could be improved through knowledge management. The case studies were based principally on semi-structured interviews with one site-based project manager in each of the companies. Interviews lasted from two to five hours.

Table 3. 4 Details of Site Organizations Involved in Case Studies.

Case	Type of Site	Person Interviewed	Construction Experience	Project Cost (ETB in Millions)	Procurement Method
A	Hospital	Project Manager	13	30.5	DBB
B	Hospital	Project Manager	16	25	DBB
C	Head Quarter	Site Manager (Engineer)	12	27	DBB
D	Mixed-Use Building	Project Manager	10	19	DBB

The interviewees under study were all experienced construction professionals with a range of 10 to 16 years' experience in managing construction sites. The interviews were recorded, transcribed, and returned to the construction organization to ensure the validity of the transcript and also, in some cases, to gain additional information. Additional company information, such as internal KM reports and construction site organization structure, was used for supplementary information. These differences provide the opportunity for exploring variations in knowledge resources within and across construction site management contexts. Based on the results of case studies, this study attempts to develop an appropriate framework to improve the practice of knowledge management within the companies. The case study protocol is designed to be a systematic approach to increasing the reliability of case study research and is intended to guide the researcher in carrying out the case study.

3.11 Data Management and Analysis

3.11.1 Correlation Analysis

Correlation analysis is done by determining the Pearson correlation coefficient to check whether the factors of knowledge management were statistically correlated. This is a measure of determining the strength of the relationship between two variables (Hair et al., 2007). Equation 5 is to compute correlation coefficient (r) and is given by:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

where “x” and “y” are any pair of variables whose level of correlation is being sought. The coefficient value of +1 represents a perfect positive correlation between the variables. On the contrary, the value of -1 represents a perfect negative correlation between the variables.

3.12 Triangulation

Triangulation is the combination of methodologies in the study of the same phenomenon (Amaratunga et al, 2002). Furthermore, Love et al (2002) argue that triangulation is a means of representation based on the logic Z' that we can move closer to obtain a truer picture if we can make multiple measurements, using multiple methods, or at multiple levels of analysis. Typically, the triangulation process involves corroborating evidence from different sources to shed light on a theme or perspective (Creswell, 1998). As triangulated studies employ two or more research techniques, qualitative and quantitative approaches may be employed to reduce and eliminate the disadvantages of each approach whilst gaining the advantages of each, and of the combination, as illustrated in Figure 2.2 (Fellows and Liu, 2003). Amaratunga. et al (2002) analyzed that quantitative data can help with the qualitative side of a study during design by finding a representative sample and locating deviant samples, while qualitative data can help the quantitative side of the study during design by aiding with conceptual development and instrumentation.

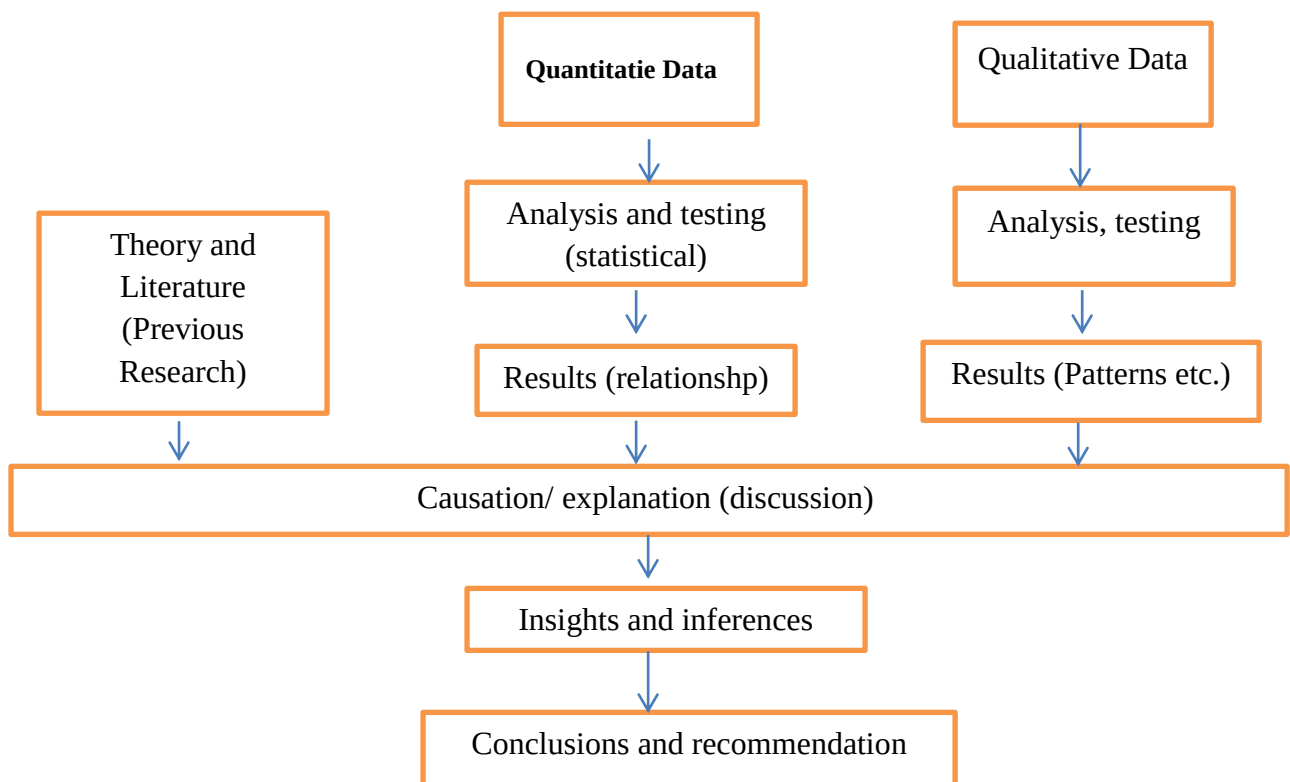


Figure 3. 2Triangulation of Quantitative and Qualitative Data

(Fellows and Liu, 2003).

For example, using a quantitative method such as a questionnaire survey can provide a broad idea on the subject studied, and combining it with qualitative methods such as semi-structured interviews or/and case studies provides a better understanding of the same study. Yin (2003) asserts that there may be problems in implementing triangulation methods in any research. First, the collection of data from multiple sources is more expensive than if data were collected only from a single source. Second, each investigator needs to know how to carry out the full variety of data collection techniques. If any research technique is used improperly, the opportunity to address a broader array of issues or to establish converging lines of inquiry may be lost.

Table 3.5 shows a summary of distinguishing characteristics of quantitative and qualitative research methods including their main strengths and weaknesses. As the research showed, results regarding the practice of knowledge management in Construction Companies of Hawassa are really poor which in turn should be reinforced by several enablers. Barriers like lack of knowledge reuse, lack of knowledge publishing, lack of knowledge acquisition, lack of awareness, deficiency of current education, and lack of guidelines are the major barriers that have been gained from a questionnaire, interview and case studies.

Table 3. 5 Characteristics of Quantitative and Qualitative Methods

Characteristics	Quantitative research	Qualitative research
Purpose	• To explain and predict • To confirm and validate • To test theory	• To describe and explain • To explore and interpret • To build theory
Process	• Focused • Known variables • Established guidelines • Statistic design • Context-free • Detached view	• Holistic • Unknown variable • Flexible guideline • Emergent Design • Context – bound • Personal View
Research Procedures	• Procedures are standard, and replication is frequent	• Research procedures are particular, and replication is very rare
Data Collection	• Representative, large sample Standardized instrument	• Informative, small sample Observations, interview
Theory	• The theory is largely causal and is Deductive	• Theory can be causal or non-causal and is often inductive.
Data Analysis	• The analysis proceeds by using statistics, tables, or charts and discussing how they show relate to the hypothesis	• Analysis proceeds by extracting themes or generalizations from evidence and organizing data to present a

		coherent, consistent picture
Reporting Findings	• Numbers • Statistics, aggregated data • Formal voice, scientific style	• Words • Narratives, individual quotes • Personal voices, literary style
Strengths	• Provide wide coverage of the range of situations • Fast and economical • Where statistics are aggregated from large samples, they may be of considerable relevance to policy decisions	• Data gathering methods seen as natural than artificial • Ability to look at change process over time • Ability to understand people's meaning • Contribute to theory generation
Weaknesses	• Tend to be rather inflexible and artificial • Not very effective in understanding process • Not very helpful in generating theories	• Data collection can be tedious and require more resources • Analysis and interpretation of data may be more difficult. • Harder to control the pace, progress, and end-points of the research process

(Adapted from Neuman, 2006; Abdullah,2003; Amaratunga et al, 2002; and Leedy and Onnrod, 2001).

3.13 Reliability and Validity of the research Design

To ensure that the research findings are based on critically-based investigations, they require to be validated. Validity and reliability of quantitative data can be ensured by conducting a pilot study. The validity is measured by the level of precision of the information obtained (Fink 2009). To improve the effectiveness of the pilot test, it is suggested that the pilot respondents are selected from a similar group to the sample population of the main survey. For this reason, some of the pilot test survey respondents in this study were drawn from the wider research population that participated in the overall survey and the interviews. Each piece of data gathered from official sources was double-checked with data from other secondary sources. The researcher would like to point out other secondary resources; those are research papers and articles from relevant journals and research institutes. The main reason for cross-checking is to nullify errors from data and to have complete confidence over data. This will help in concluding the result that is more

meaningful and reliable. To test the internal reliability of the questionnaire, Cronbach's alpha test was used. Each element of the questionnaire was found to be reliable since the value of α was equal to or greater than 0.7. The Cronbach's alpha for this research found were higher than 0.7, thus the construct has been believed to have adequate reliability.

Table 3. 6 Reliability Statistics

The constituents	Reliability Statistics	
	No.of Items	Cronbach's Alpha Results
Knowledge Management Practices	26	0.899
Knowledge Management Processes	8	0.896
Information Technology	12	0.754
Knowledge Management Barriers	9	.831

3.14. Ethical consideration

In planning and conducting the study, the researcher carefully considered the ethical validity of the proposed procedures. Kumar, (2010) argued that ethics are commonly defined as norms for conduct that differentiate between acceptable and unacceptable conduct. The ethical considerations applied in this study were viewed as part of a system or perspective used in taking decisions on how the study was conducted.

According to (Yin, 2014) adherence to ethical principles by researchers will add credibility to the study and its findings. To this end, the conduct of this study hinged on ethical considerations such as honesty, integrity, informed consent, confidentiality, carefulness and right to privacy (Kumar, 2010).

The ethical issues that need to be considered in scientific research were also considered in this study. The study results depend on the data provided by the respondents and the qualitative data obtained from the interview is realistic and bias-free. In addition, the researcher asked for consent of the interviewees and pledged to keep the confidentiality of the information gathered to conduct this study.

3.15 Summary

This chapter described the detailed adopted methodology of research. It included the primary design for the research, details of research location, target population, sample size, and response rate. The questionnaire design was detailed including the types of questions, question format, the sequence of questions, and the covering letter. Pre-testing the questionnaire was the main step that was used to reach the final amendment of the questionnaire

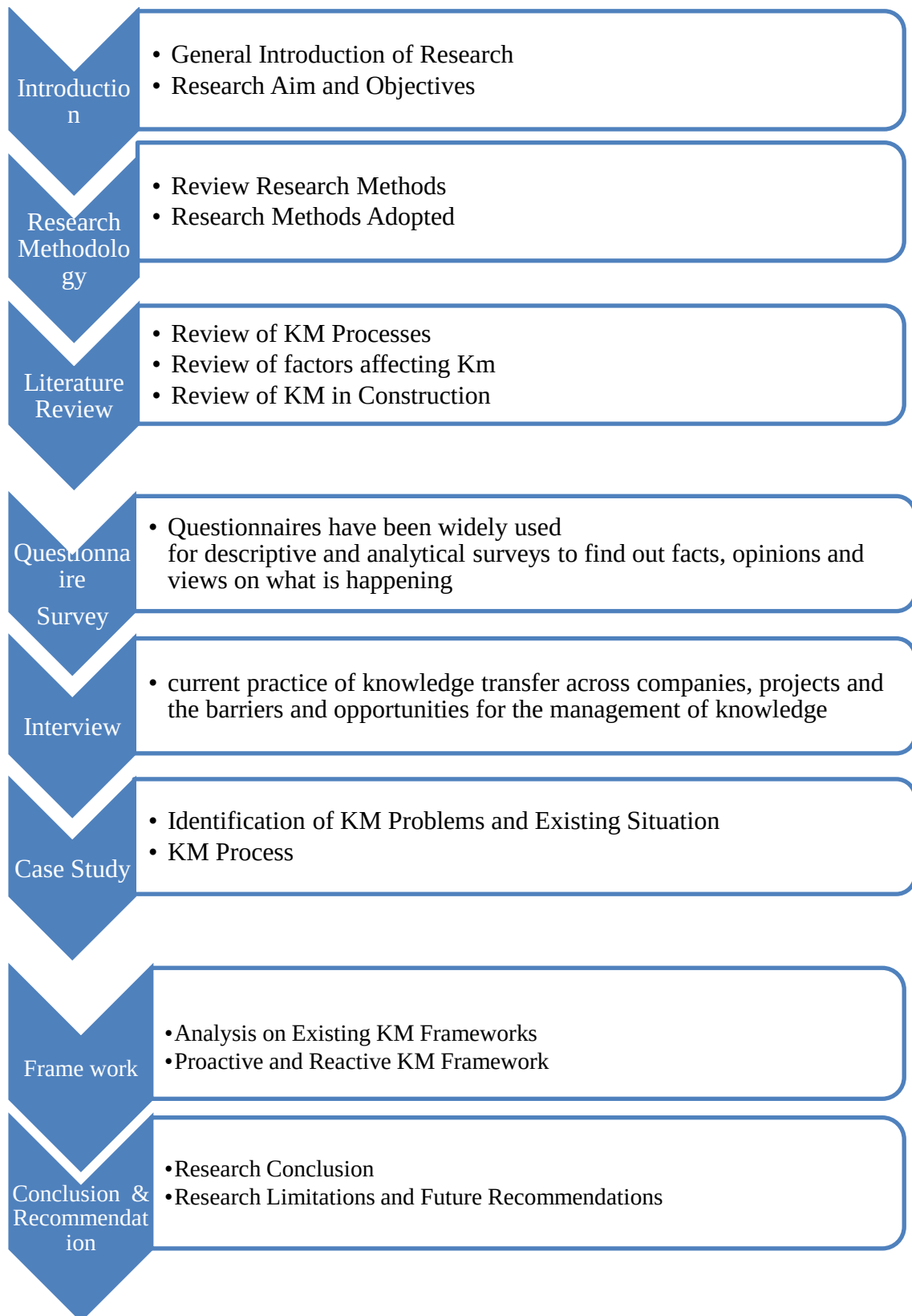


Figure 3. 3 Overall Research Process

CHAPTER FOUR

4.RESULT AND DISCUSSION

The results gained from the respondents are presented, analyzed, and discussed in this chapter; it is categorized into the survey questionnaire, interview, and case study. This chapter summarizes and analyses the data collected by questionnaires completed by the 148 respondents who are working in the construction industry in Hawassa city. The result and discussion chapter focus on meeting the following research objective. These are assessing Knowledge management practices in construction companies of Hawassa city, identifying the barriers of knowledge management practices in Hawassa City, and proposing a framework that improves knowledge management practice in the city. The Statistical Package for Social Sciences (SPSS) is used to analyze and summarize the data. The questionnaire is headed with a definition of KM as “the identification, optimization and active management of intellectual assets to create value, increase productivity and gain and sustain competitive advantage. It involves the capture, consolidation, dissemination, and reuse of knowledge within an organization.

4.1. General Information of Questionnaire Response

In this research, a total of two hundred ninety (290) questionnaires were distributed. The total questionnaires returned were one hundred forty-eight (148) (59.2%). It is more than expected. All the questionnaires were found sufficiently completed and therefore all included in the data analysis. Table 4.1 below shows the summary of questionnaires distributed and the responded rate.

4.2. Profile of Survey Respondents

The profile of the respondents has three components: level of education, position in the company, and experience in the construction site. Table 4.2 shows the number of construction industry professionals in the study and the educational level of the respondents.

Table 4. 1 General Information of questionnaire response

Category	Number of Questionnaires Distributed		Number of Questionnaires Returned		Response rate
	Number	Percentage (%)	Number	Percentage (%)	
Academics	35	12.06%	23	15.54%	65.71%
Clients	35	12.06%	11	7.43%	31.42%
Consultant	59	20.34%	50	33.78%	84.74%
Contractor	150	51.72%	58	39.18%	38.66%
Professional Associations	11	3.79%	6	4.05%	54.54%
Total	290	100%	148	100%	51.03%

Table 4. 2 Profile of survey respondent

Profile		Academics		Clients		Consultants		Contractors		Regulatory body	
		F	%	F	%	F	%	F	%	F	%
Education	Diploma	0	0%	0	0%	0	0%	9	12%	0	0%
	B.Sc. degree	7	39%	5	31%	8	31%	42	57%	1	14%
	M.Sc. degree	11	61%	11	69%	18	69%	23	31%	6	86%
Position	Assistant lecture	7	39%	0	0%	0	0%	0	0%	0	0%
	Client representative	0	0%	7	44%	4	15%	0	0%	0	0%
	Consultant representative	0	0%	0	0%	8	31%	0	0%	0	0%
	Contract administration	0	0%	0	0%	0	0%	1	2%	4	57%
	Data collector	0	0%	0	0%	0	0%	5	7%	0	0%
	Deputy manager	0	0%	0	0%	0	0%	3	4%	0	0%
	Forman	0	0%	0	0%	0	0%	5	7%	0	0%
	Junior civil engineer	0	0%	0	0%	0	0%	4	5%	0	0%
	Lecturer	11	61%	0	0%	0	0%	0	0	0	0%
	Office engineer	0	0%	0	0%	0	0%	18	24%	0	0%
	Project manager	0	0%	0	0%	0	0%	17	23%	0	0%
	Resident engineer	0	0%	5	31%	6	23%	0	0%	0	0%
	Site engineer	0	0%	0	0%	0	0%	21	28%	0	0%
	Structural engineer	0	0%	0	0%	3	12%	0	0%	0	0%
	Supervisor	0	0%	4	25%	5	19%	0	0%	3	43%
Experience	0-2 years	7	39%	0	0%	1	4%	26	35%	0	0%
	3-5 years	0	0%	0	0%	5	19%	15	20%	0	0%
	6-10 years	6	33%	5	31%	1	4%	10	14%	4	57%
	10-15 and above years	5	28%	11	69%	19	73%	23	31%	3	43%
F =frequency											

Table 4. 3 Job Title

		Education_ Background	Years of Experience	Job Title	Type of Compa ny
N	Valid	148	148	148	148
	Missing	0	0	0	0

Table 4. 4 Education Background

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Diploma	6	4.1	4.1	4.1
	Bsc Degree	87	58.8	58.8	62.8
	Msc Degree	55	37.2	37.2	100.0
	Total	148	100.0	100.0	

Table 4. 5 Years of Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-2 yrs	21	14.2	14.2	14.2
	3-5 yrs	71	48.0	48.0	62.2
	6-10 yrs	48	32.4	32.4	94.6
	11-15 yrs	8	5.4	5.4	100.0
	Total	148	100.0	100.0	

Table 4. 6 Type of Company Professionals working in

		Frequenc y	Percent	Valid Percent	Cumulative Percent
Valid	Contractor	58	39.2	39.2	39.2
	Consulting	50	33.8	33.8	73.0
	Academics	23	15.5	15.5	88.5
	Clients	11	7.4	7.4	95.9
	Profesional Associations	6	4.1	4.1	100.0
	Total	148	100.0	100.0	

Table 4. 7 Recognize Knowledge as an Asset

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	147	99.3	99.3	99.3
No	1	.7	.7	100.0
Total	148	100.0	100.0	

4.3 Respondents' views on Knowledge Management

Section B of the questionnaire aims at seeking information on the views of respondents whether companies recognize knowledge as part an asset that gives value to the company. The key question is if KM companies recognize knowledge as part of their asset that gives value. The statements that receive the strongest support are that KM is part of their asset that gives value to the company. "It is difficult to assess the impact of KM where there is no policy to guide the practice". A respondent commented that "KM status cannot be generalized but needs to be validated through research." The researcher showed that her study might form part of the recommended research. The table shows that 99.3 % of the respondents recognize that Knowledge is part of an asset that gives value to the company.

4.4 Knowledge Management Process-Practice in the Construction Companies

Table 4.8 shows the main stages of managing knowledge in a typical KM cycle, while Table 4.9 indicates the relative difficulty of these KM stages. Knowledge application is seen as the most important phase (3.36/.720); this is, however, the most challenging task ranked by the respondents (3.19/.936). To promote and deliver tangible results, knowledge application at the actual project level is the critical stage and links talks to actions; other stages may happen at the organizational level.

Table 4. 8 Main KM stages (Process)

(Level of Importance: 1 Low - 5 High)

	KM stages	N	Mean	Std. Deviation
1	Apply Knowledge	148	3.36	.720
2	Obtain Knowledge	148	3.28	.710
3	Create Knowledge	148	3.25	.799
4	Store Knowledge	148	3.18	.855
5	Share Knowledge	148	3.14	.710
6	Measure Knowledge	148	3.13	.835
7	Identify Knowledge	148	3.07	.822
8	Search Knowledge	148	3.05	.637
	Valid N	148		

Table 4. 9 Challenging KM Stages

(Level of Difficulty: 1 Low —> 5 High)

	N	Mean	Std. Deviation
Apply	148	3.19	.936
Create	148	3.16	.881
Obtain	148	2.89	.850
Search	148	2.89	.813
Measure	148	2.88	.764
Identify	148	2.83	.906
Store	148	2.68	1.005
Share	148	2.55	.985
Valid N (listwise)	148		

According to the rating, eight tested KM stages can be put into the following four categories: (relatively) important and challenging, (relatively) important but not challenging, (relatively) not important but challenging, and (relatively) not important nor challenging. In the preliminary KM frameworks, identify the knowledge, obtain knowledge, share knowledge, apply knowledge is considered in the KM cycle. Of these, apply knowledge and share knowledge is given extra focus in the later research stages.

Furthermore, it is interesting to see that knowledge creation is seen as the second challenging task (3.16/.881); however, it is ranked the third in regards to its importance to the respondents (3.25/0.799), Hawassa building and construction industry, in general, is very

slow to innovate and it is well and truly lagging (Price water house Coopers, 2002). Seven years later, in regards to, the industry still hasn't changed much as most of the respondents did not recognize the importance of knowledge creation or, at least, it was not high on their agenda. From the survey, a brief KM cycle for knowledge management can be proposed which integrates identify the knowledge, obtain knowledge, share knowledge, maintain knowledge and apply knowledge. Meanwhile, knowledge application in the actual projects should be especially emphasized. Questions are also asked to gauge the current practices of managing knowledge in the construction sector. Issues related to knowledge acquisition, creation, storage, sharing, and application are investigated and listed in Table 4.13 –Table 4.17. It can be found that currently there is no common practice within the city in regards to better manage knowledge within the construction companies that are found in Hawassa.

Table 4. 10 Pearson Correlation Coefficient on Stages that are essential for securing the practice of knowledge management

		Correlations							
		Search Knowledge	Identify Knowledge	Measure Knowledge	Create Knowledge	Obtain Knowledge	Store Knowledge	Share Knowledge	Apply Knowledge
Search Knowledge	Pearson Correlation	1	.695**	.435**	.482**	.553**	.520**	.480**	.387**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
	N	148	148	148	148	148	148	148	148
Identify Knowledge	Pearson Correlation	.695**	1	.433**	.513**	.457**	.506**	.462**	.326**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000
	N	148	148	148	148	148	148	148	148
Measure Knowledge	Pearson Correlation	.435**	.433**	1	.625**	.592**	.521**	.554**	.453**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000
	N	148	148	148	148	148	148	148	148
Create Knowledge	Pearson Correlation	.482**	.513**	.625**	1	.570**	.533**	.513**	.479**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000
	N	148	148	148	148	148	148	148	148
Obtain Knowledge	Pearson Correlation	.553**	.457**	.592**	.570**	1	.579**	.622**	.568**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
	N	148	148	148	148	148	148	148	148

		Search Knowledge	Identify Knowledge	Measure Knowledge	Create Knowledge	Obtain Knowledge	Store Knowledge	Share Knowledge	Apply Knowledge
Store Knowledge	Pearson Correlation	.520**	.506**	.521**	.533**	.579**	1	.665**	.569**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000
	N	148	148	148	148	148	148	148	148
Share Knowledge	Pearson Correlation	.480**	.462**	.554**	.513**	.622**	.665**	1	.603**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000
	N	148	148	148	148	148	148	148	148
Apply Knowledge	Pearson Correlation	.387**	.326**	.453**	.479**	.568**	.569**	.603**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
	N	148	148	148	148	148	148	148	148

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

Table 4.10 above indicates that Searching of Knowledge correlates with Obtaining of Knowledge ($r=0.553$, $p=0.000$). This implies that when Searching for Knowledge increases Obtaining of Knowledge increases. Knowledge creation positively correlates with sharing Knowledge ($r=0.513$, $p=0.000$). This implies when identifying Knowledge increases sharing of knowledge also increases. An increase in Knowledge creation positively correlates with Knowledge Application ($r=0.479$, $p=0.003$).

Table 4. 11 Current Status of Knowledge Acquisition

(1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree)

	N	Mean	Std. Deviation
Being informed of knowledge (new concepts) from an external organization	148	3.01	.849
Gathering lessons learnt throughout work proceeding during project closure	148	3.00	.747
Gathering emerging knowledge from external sources	148	2.99	.738
Assigning senior staffs to deal with knowledge needs	148	2.98	.675
Acquiring knowledge management related technologies and follow the best practice	148	2.95	.794
Recruiting external staffs to induce new concepts	148	2.82	.839
Encouraging staffs to participate in conferences, seminars,exhibition to get new knowledge	148	2.82	.783
Specific Staff is responsible for obtaining knowledge from External Resources	148	2.76	.883
Valid N (listwise)	148		

Table 4. 12 Current Status of Knowledge Creation

(1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree)

	N	Mean	Std. Deviation
Creating new knowledge to solve specific problems during the undertakings of company duties	148	2.97	.903
Encouraging staffs to find alternative solutions to promote the project for existing assignments	148	2.89	.671
Researching different issues internally that are related to the construction industry	148	2.84	1.028
Valid N (listwise)	148		

Table 4. 13 Current Status of Knowledge Storage

	N	Mean	Std. Deviation
Selecting and organizing information (data) before being stored	148	2.99	.825
Preparing specification for storing knowledge	148	2.80	.816
Staffs that possess knowledge on a specific issue can easily be identified	148	2.64	.888
Knowledge on different aspects are well indexed and staffs know where to find it by the time they need it	148	2.60	.939
Valid N (listwise)	148		

Table 4. 14 Current Status of Knowledge Sharing

(1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree)

	N	Mean	Std. Deviation
Encouraging experienced staffs to mentor new or less experienced staffs	148	3.14	.639
Conducting Repetitive training to distribute knowledge	148	3.06	.875
Making knowledge accessible to all that is gained from different projects	148	3.03	.746
Providing access to the company's database	148	2.82	.833
Appointing Specialized (Specific) staffs for regularly updating the knowledge in the database	148	2.58	.990
Knowledge sharing is a measure of employee's performance	148	2.40	.771
Valid N (listwise)	148		

Table 4. 15 Current Status of Knowledge Application

(1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree)

	N	Mean	Std. Deviation
Encouraging Staffs to apply knowledge learned from previous projects to new (Subsequent) project	148	3.02	.685
Doing Pilot projects(experiments) in order to test knowledge	148	2.69	1.036
Conducting externship programs that staffs could apply knowledge	148	2.53	1.209
Valid N (listwise)	148		

Table 4.10 shows the main stages of managing knowledge in a typical KM cycle, while Table 4.11 indicates the relative difficulty of these KM stages. Knowledge application is seen as the most important phase (4.65/0.60); this is, however, the most challenging task ranked by the respondents (3.86/1.00). To promote Construction sites and deliver tangible results, knowledge application at the actual project level is the critical stage and links talks to actions; other stages may happen at the organizational level

Table 4.16 highlights the main barriers to applying knowledge management. Lack of Knowledge Publishing is ranked second in Table 4.16, showing that is greatly promoted if the Companies can see tangible results from its application. However, as shown in Table 4.16, the biggest barrier in this regard is the difficulty of Knowledge reuse. As knowledge management application in construction companies is still at the infant stage, industry best practices are rare. The body of knowledge provides a limited underpinning for the industry to tangibly measure the input and output of considerations. Easy-to-follow frameworks and examples should be put at the top of the development agenda. The limited understanding of concepts and the lack of consensus among stakeholders are the second hurdle that may strongly limit people's ability to understand and choose more sustainable designs and activities. Better decisions can only be made if all the stakeholders had abundant and up-to-date knowledge and care. Time constraint for project delivery is placed as a 4th barrier which has got a strong effect on the practice of knowledge management. As it is known most of the companies suffer from delayed project delivery. This in turn has got a greater effect in only focusing on the delivery than on the knowledge that could be gained from delivering that specific project.

Table 4. 16 Key Barriers to Knowledge Management in a company

	N	Mean	Std. Deviation
Lack of Knowledge reuse	148	3.16	.756
Lack of Knowledge Publishing	148	3.15	.836
Lack of knowledge acquisition	148	3.12	.824
Time constraint	148	3.11	.919
Employee Resistance	148	3.09	.777
Lack of company culture	148	3.07	.814
Lack of Knowledge Retrieval	148	3.02	.742
Lack of knowledge modeling	148	3.00	.738
Lack of good perception	148	2.66	.804

According to Table 4.17. Email takes the lion's share of the first and foremost technology to be preferred by employees in construction companies.(Lichtenstein S & Swatman,2009) on their paper by the title Email and Knowledge Management stated that email plays a great role in High likelihood of useful knowledge work outcome, Knowledge development lifecycle - initiation, crystallization, sharing, qualification, and combination, Highly attention-attracting, Integration of KM with everyday work practices, Accessibility and accountability of knowledge workers, Cooperation and collaboration, Economical involvement of experts, Sense-making through contextualization and personalization, Access to work objects, Just-in-time knowledge work.

Table 4. 17 Technologies preferred by employees in companies for Knowledge Management (Level of influence: 1 Low — 5 High)

	N	Mean	Std. Deviation
Email	148	3.56	.641
Browsers	148	2.60	.855
Expert Networks	148	2.14	.849
Customer relationship management	148	1.90	.909
Video conferencing	147	1.70	1.003
Data warehousing	148	1.46	1.151
Valid N (listwise)	147		

4.5 Interview

According to the research plan, semi-structured interviews were conducted with selected industry practitioners with good knowledge and experience in terms of construction works, to explore the highlighted issues at length to gain in-depth understandings, insights, and suggestions.

This part reports on the findings of the interviews. It first introduces the selection process of the interviewees and their backgrounds. The following sections represent the instruments, structure, and format of the interview survey. Questions asked revolved around company and project context for the management of knowledge, the current practices of knowledge transfer across companies, projects, and practitioners, and the barriers and opportunities for the management of knowledge Aggregated findings,

analysis, and discussions from the interviews are then presented.

4.5.1 Data Interpretation and Analysis

Interview records were fully transcribed into a text document. A 45 minutes interview took around Five hours of work on average to be fully transcribed. Then a categorization scheme started to appear. As the main aim of the interview study was to identify the effective KM strategies and tools that facilitate the management activities for knowledge in the Construction sites sector, current KM practices were highlighted in the categorization structure. The interview was also used as one way of Validating the above questionnaire

4.5.2 Interview Results and Discussion

4.5.2.1 Knowledge Attitude in the Construction Sector

In the construction industry, people tend to have different opinions on describing the body of knowledge. On the one hand, most interviewees agree that is still a vague concept, especially for the Construction sites sector, as there is neither solid systematic supporting scientific knowledge nor demonstrative projects that have delivered real outcomes. The lack of a widely accepted definition and indicator system makes it difficult for industry practitioners to apply the knowledge in actual projects.

On the other hand, many interviewees believe that, in general, knowledge is no different from any other knowledge domain. There is a lot of knowledge recorded in books, articles, online forums, and other mediums. Well-designed training resources are also available. People just need to be motivated to start the knowledge cycle: learning knowledge, sharing knowledge, processing knowledge, and creating new knowledge through its application and innovation in real projects. Some interviewees even argued that the industry is using the claim that knowledge is immature or too hard to get as an excuse. There is plenty of knowledge in terms of technology; however, there are more attitudinal reasons and institutional barriers that are stopping practitioners from utilizing the technology to improve Construction sites. Nevertheless, a consensus has been reached on the fact that properly managing the body of knowledge to maximize, share and maintain it, and to provide it with an innovative base is an urgent requirement because of the serious issues the sector is facing right now.

4.5.2.2 Current Practice in Managing Knowledge

The other aim of the interviews was to investigate the current practices of KM within the Hawassa Construction sector. Although KM is still a new concept for the relatively traditional construction industry, evidence and past research have shown that industry practices are being conducted to facilitate the flow and application of knowledge for companies. These practices may not be given a formal KM title, but they reflect the thinking and management of the body of knowledge, albeit with differences in emphasis and extent of implementation.

Through the interviews, several KM tools that currently exist in the Construction sites sector for managing knowledge were identified; however, most of these are not treating knowledge significantly differently from other knowledge domains, nor are they being used with full awareness. The following findings from the interviews outline the current practice of KM within the sector in regards to Construction sites

4.5.2.3 Barriers of knowledge management practices in Hawassa City

Knowledge Management faced many barriers on the way to being identified, shared, and applied by the industry to real projects. As the management of knowledge is the focus of this study, barriers having a negative impact on knowledge and its management (creating, sharing, learning, application, maintenance, etc.) were foregrounded in the interviews. These barriers are discussed below.

Lack of awareness

Construction corporations, mainly the large and leading Companies, are reacting to a set of trends and market forces and changing the way they compete and deliver projects. However, construction projects are still mainly driven by economic benefits. Is still a new pattern of doing business that, at this moment, is not highlighted in the Construction sites sector, as it should be. None of the interviewees think there is yet total awareness of the seriousness of the crisis and the urgent need for the Construction sites sector to act in this regard.

The Construction sites sector is starting to make changes to incorporate a more sustainable approach. However, at the early stages of the changeover, support from industry practitioners is usually not forthcoming, at least not unless the client of a certain project has a strong focus. Thus, the current situation allows little room and motivation for practitioners to seek knowledge. There are a few champions in the industry sector

who are making some changes. However, overall in this Construction sector, there is still a long way before principles and knowledge can penetrate the whole industry. This will not happen until there is awareness of the need and all stakeholders want to achieve the competitive edge of being able to deliver projects.

Deficiency of current education

According to the interviewees, current education is not effective in helping the industry practitioners establish their knowledge, skill, attitude, and confidence in delivering in practice. This affects both the young graduates and the senior practitioners. Practitioners do not have the confidence and knowledge that they need for implementing across real projects, as the knowledge that is currently understood by industry practitioners is limited.

Existing practitioners need to be trained through continuing professional development, through programs run by Companies and industry associations as well as by the universities, training institutions, and so on. Although there are currently some related training courses, these courses are not delivering enough and effective education to the practitioners.

Lack of guidelines

In regards to, industry practitioners are facing extensive barriers to move from talking to action. It is a common issue that practitioners do not know where to start, as definitions are sometimes vague and conceptual; thus numerous efforts need to be made to interpret the meaning of individual contexts. Construction site frameworks and indicator systems are used to address this barrier, which is discussed in the following sections. However, existing criteria are not presented in a way that project managers can readily identify with and deliver projects accordingly.

4.8 Important Enablers for Successful Knowledge Management

Several important enablers are necessary for the success of KM initiatives in project teams and Companies by helping to formulate a positive and motivating environment for KM success. Important enablers for managing knowledge were identified and were further discussed in the interview surveys, and the following issues were highlighted.

4.8.1 Leadership

Leadership can be broadly described as the processes of influencing the choices and actions of others (Politis, 2001) Nowadays, it is a term which is usually used in the context of change management. Managing Knowledge is not a destination but a process which requires the industry section to progressively change its current business model to address not only economic benefits but also social and environmental outcomes. It also requires a change in people's judgment and knowledge settings. As the result from the interviewees depicts; they did nominate different stakeholders to take the leadership role. Main suggestions from the interviewees include:

- ✓ The government should take the leadership by advocating, regulating standards, publishing guidelines, awarding good practices, punishing bad practices and promoting knowledge sharing and communication.
- ✓ The real leaders of the project (such as the client, project manager, and design director) should take the leadership role by embracing principles in their decision-making process.
- ✓ Everyone who really believes and reasonably understands Construction sites and the related technical knowledge can take the leadership role by continuously talking to people about it, and always trying to act beyond compliance.

4.8.2 Policy and Legislation

Most interviewees agreed that legislating will push the industry sector to raise the bar on project performance and push the Companies and projects to comply with higher standard requirements. This will inevitably trigger the sharing, obtaining, maintenance, and application of relevant knowledge.

4.8.3 Practitioners with Multi-disciplinary Knowledge

Knowledge Management is an area that requires system thinking and the integration of people from different disciplines. Many interviewees (especially the managers) confirmed that having multi-disciplinary knowledge is critical for industry practitioners to communicate with team members from other disciplines and integrate the knowledge into practice.

4.8.4 Network of Subject-matter Experts

Almost all the interviewees agreed that there are not many people who can claim to be an expert in the area of Construction sites. However, there are experienced practitioners or more formally entitled managers, for example – who are more knowledgeable and experienced on. Frequent communication and collaboration among those people will greatly facilitate the transferring of industry good practice.

4.8.5 Post Project Reviews (PPRs)

Post Project Reviews (PPRs) can be seen as debriefing sessions that are commonly used in project-oriented industries to highlight and capture the lessons learned during a project. Usually, PPR can be conducted formally or informally, in the form of ongoing reviews or post-project evaluations (Robinson *et al.*, 2010; Tan *et al.*, 2010).

In the construction industry, PPR is a common practice to facilitate the capture of important project knowledge and lessons learned, and the creation of shared understandings among stakeholders. It is usually conducted at the end of a project to obtain the whole story of a project, and considerations of issues are part of its concern. It is a valuable tool for whole project teams and Companies to capture and store the achievement of the project.

The following issues undermine the current practice of using PPR to capture knowledge:

- ✓ Lack of format for representing knowledge: Lessons learned on a project, if they exist, are usually fragmented and submerged by the massive volume of information. Some parts of the information are hidden in technical documents, and some are just too general to be useful in the future.
- ✓ Time constraints: Teams are dissolved during or right after the project completion; this may cause valuable information to be lost before the PPR session. Furthermore, PPR sometimes is seen as a burden to the project team and is rushed through if not enough time is allocated to such activity, in which case issues have no chance of being considered.

“Yes we do post-project reviews sometimes; however, we didn’t have any session particular for issues.” Remark by an interviewee

4.8.6 Education and Training

Personal training and education are usually seen as the most important as well as frequently used KM instrument for knowledge acquisition and sharing (Tan *et al.*,2010). Furthermore, as is a new discipline especially for construction practice, many experienced practitioners even understand less than the new graduates as they have had no education or relevant experience themselves. Thus, on-job training is extremely important to facilitate the penetration of a focus in the industry. Training programs have to be organized by Companies, professional associations, or within the project teams, to raise employees' awareness, enhance understandings, and provide assistance especially in linking principles to their professional domains.

"...I think the education is still evolving as there is no certain definition to, but there is certainly a place for internal training, but not many companies are doing it. There are a lot of little things are around, seminars, etc. but for deep understanding, very little. They might do small pieces of it, such as energy efficiency and water, but nothing in a holistic view about principles, environmental designs etc. Universities are doing, but more on researches, the education part is lacking..."

Remark by an interviewee

Importance of education and training for addressing knowledge Management issues include:

- ✓ Raise awareness,
- ✓ Build absorptive capacity
- ✓ Facilitate individual and organizational learning, and
- ✓ Create a solid base for knowledge application and innovation. KM is more than formal education and training which concentrates mainly on explicit knowledge.

In the Construction sector, tacit knowledge is more valuable for the practitioners to solve real problems and deliver higher value projects. However, the main barriers to the industry are still highly rooted in the reality that there are still not many practitioners who understand and care enough. Education and training will help the industry to enhance its absorptive ability and then use the knowledge creatively. That is how real change can be boosted in the industry.

"... I think is a very personal journey that people go on... If it's not something that they care about, it's very difficult for people to start. As soon as people have started that journey, it's easy to get them on board.

Training can be mainly conducted in two ways, through conventional training or training aided by a computer. The former is instructor-led and mainly involves face-to-face interaction, while the latter is usually delivered via downloads from the internet, intranet, or email (Tan *et al.*, 2010). Computer-aided training is more efficient in a modern learning environment; however, all the interviewees agree that face-to-face interactions are more effective in facilitating learning. At the very beginning, people need to develop a feeling of responsibility, care and interest for learning. A passionate and knowledgeable champion in their field is of great value to influence people, especially in helping them to build the link between the big picture and their professional domains. For the industry practitioners, during the process of learning and moving from talk to action, many barriers exist. Education should be delivered in a structured way and provide a sequence of programmed instruction to help the industry practitioner to overcome these barriers.

4.8.7 Community of Practice (CoP)

A Community of Practice (CoP) can be defined as a cluster of people who share a common interest, an area of knowledge, a set of problems, or a passion for a topic. They are organized around a common shared interest and share experience and practice on an ongoing basis to deepen their knowledge and expertise (Wenger *et al.*, 2002). CoPs can be various: informal or formal, natural or supported, structured or unstructured. They capture, organize, share and maintain the body of knowledge by providing a platform for the practitioners in the area to interact around problems, solutions, insights, and best practices. Thus, CoPs are seen as an important KM technique and have an essential role in knowledge sharing and, in turn, can develop a more knowledge-productive culture of learning in Companies (Wenger *et al.*, 2002; APQC, 2001). Usually, new CoPs can form as new issues emerge, and old ones close when their area of interest becomes common knowledge. As knowledge management is still a fresh and subjective issue without an agreed definition and standard solution, the emergence of relevant CoPs is natural.

Wallace (2005) suggests that whatever the case, the important first step of any organization intending to market and deliver sustainable development service is to set up a CoP in sustainable development that crosses all the business lines of the company. Furthermore, to achieve goals, a systematic view should be adopted and all disciplines involved in construction site development should all contribute. As CoPs exist outside the formal organizational structure, they have the advantage of sharing knowledge and

triggering collaboration across functional boundaries. It has been identified from the interviews that CoP is a common KM technique that is being adopted by the practitioners within the industry to spread knowledge; however, most of these CoP-like groups are not recognized as CoPs at all. Construction sites CoPs lie in different levels: industry, organization, project, and inter-project. Similarly, CoPs also exist at the project level if the project has a strong focus and has a high level of commitment from main stakeholders, especially from the clients.

Managers are resourced to drive training and implementation. They bring previous best practices from their mother Companies and, in return, collect the lessons learned from the projects they work on to enrich a mother organization's knowledge assets. Although project-based CoPs are short-term and temporary, they are an important approach to raise awareness among the existing industry practitioners by providing them real project experience. Although only a small portion of potential members can become active participants, they will accumulate knowledge and may be more active in future projects.

At industry level, professional institutions, which are essentially CoPs that have become big and formal, play an important role. In the industry, actively focused associations include ECPMI and ECoTMPA, etc.

These professional associations collect, organize and store knowledge, identify and reward industry good practices, facilitate industry education and training, provide relevant tools, hold relevant conferences and workshops, and more importantly, provide a platform for the practitioners to share ideas.

Although professional associations and conferences continue to contribute to sustainably knowledge sharing, the proportion of people able to take advantage of them is typically small. Moreover, they fail to influence people at a deep and personal level, especially beginners. Usually, contact with peers within people's immediate environment is more comfortable and effective. Thus, different levels of CoPs should be integrated for knowledge sharing.

...I think the role of professional associations is very important... I think it is the only way how industry best practices can be shared. They got a role in terms of facilitating knowledge share, hosting conference sessions on what has happened, internet chat session, etc.... But the problem is that sometimes people are so busy with their day-to-day work.

Remark by an interviewee

4.8.8 IT Tools: Intranet, Database

KM practice can be heavily facilitated by the use of various KM tools to perform the KM processes (e.g. obtain knowledge, share knowledge, maintain knowledge and apply knowledge). The KM techniques discussed in previous sections are mainly soft and not IT tools; there are, however, various IT tools that are used for the management of knowledge, such as the Internet, Intranet, Databases, and ICT tools. Although none of these IT tools are described as KM- specific, they contribute towards the enhancement of communication, networking efficiency, and other issues relevant to knowledge management. Effectiveness of such IT tools depends largely on the extent to which they are used to process knowledge.

An Intranet is an information communication technology (ICT) system based upon Internet technology, which is now widely used in Companies to distribute information (Boersma and Kingma, 2005). It can be seen as a company-wide Internet through which all staff in the company can browse uploaded information and retrieve documents stored in the linked database from a remote office, a project site, or home. Company procedures, templates, standard statements, previous project information, and other explicit knowledge can be stored in the construction industry, many big companies have built up Intranets. They facilitate the management of knowledge in the following ways.

A. Storing Knowledge

Usually, specific storing space is given to each knowledge domain, including knowledge if there is a consideration in the organization. Relevant resources to be stored in the database usually include: 1). Information of internal projects which have a strong focus; 2) Technical papers, news articles, conference papers, discussion papers, and reports on and Construction sites themes; 3) Examples of relevant tools, frameworks, indicators, and checklists that can be used by projects to plan, design, deliver and operate Construction sites projects; 4) Training and education information; 5) Index of external resources, e.g. references, websites, links to national and international companies.

B. Representing Knowledge

On the Intranet, it is common for a knowledge domain to have a homepage. related resources being stored in the database are presented here to facilitate people's search for, and retrieval of, information. knowledge is usually indexed by three means: theme, people, and project.

4.9 Case-based Reasoning

Broadly construed, case-based reasoning (CBR) can be seen as a problem-solving method, relying on previous similar cases to find solutions to current problems. According to Kolodner (1993), a case is a contextualized piece of knowledge representing an experience that teaches a lesson fundamental to achieving the goals of the reasoner. A typical process for CBR consists of four steps, namely retrieve, reuse, revise, and retain.

In the construction industry, which is a highly project-based industry, CBR, as a method, is playing an important role in transferring knowledge through projects. Industry practitioners are doing their jobs based on past cases personal experience. Furthermore, much domain knowledge is shared in the form of project information and case studies. The power of exemplar projects is undeniable. initiatives and lessons learned from actual projects are valuable knowledge assets for the project stakeholders, involved Companies, and the whole industry. Team members will bring the knowledge gained from these projects to future projects and reuse them to solve new problems. Interviewees indicate that industry practitioners who had related experience in previous projects are more likely to be active in pursuing knowledge and apply it wherever possible.

Companies accumulate knowledge from internal projects and this contributes to future projects. An interviewee, an organizational-based manager in an engineering consulting firm, described the process of tracking previous project information for the usage of new projects as follows: At an industry level, industry best practice is seen by most of the interviewees as the best format for transferring knowledge. However, interviewees are feeling nervous about using the term “best practice” as is an area where best practice is still uncertain. They prefer to use –good practice‖ and –better practice‖ instead because there are not many really good projects in the Construction companies where has driven the outcome.

Case studies of such –good practices‖ are highly praised by industry practitioners as a vehicle for knowledge dissemination. Small case studies of individual issues are often more useful than case studies of the whole project which are sometimes too general to give helpful information. Professional associations are supposed to take the role of publishing good quality case studies on Construction sites. However, the current main barrier is still the lack of existing exemplary projects.

Finding it first is challenging in terms of what is best practice. This is fairly a new area and there is no enough information around. It does take a lot of time to get that. It is good if we have more time to do the research, and set the benchmark for the project.

Remark by a manager

4.10 Summary

The semi-structured interview findings presented in this chapter have been used to outline the current status of the management of knowledge in Hawassa Construction companies. The body of knowledge, key constraints for its application, the main enablers for successful knowledge management, and the roles of diverse stakeholders were analyzed. Currently, in the industry, general awareness of and relevant education is still far from satisfactory. These are the main obstacles that are inhibiting the platform for the KM activities of managing knowledge. Moreover, Construction sites are still an area where best practice is uncertain. The lack of practical guidelines and exemplar projects are urgent issues for the industry. Prerequisites to enable successful related KM initiatives are also discussed. A knowledgeable and committed project client can provide the most powerful driver for project sustainably achievement, thus motivating the project team members to actively obtain, share and apply. Furthermore, high but achievable project targets are indispensable for interpreting in project contexts; these also set the scope for knowledge activities. Last but not least, the culture of sharing knowledge is critical to any KM initiatives. Despite KM still being a new concept to the Construction industry, there is evidence to suggest that there are aspects of current practice that broadly reflect current thinking and efforts in this area, albeit with differences in emphasis.

KM tools that are currently used by the industry to manage are identified and discussed. Although these initiatives may not be given a formal KM title, they are addressing the issue that the industry is facing massive barriers to filling the knowledge gap in linking concepts to actions. These initiatives include: a post-project review (PPR), education and training, reporting, staffing, community of practice (CoP), measurement, case-based reasoning, and diverse IT tools. However, the absence of a proactive strategy for the management of the knowledge means that the potential benefits of KM will not be fully realized. It will also make it difficult to measure the impact of any initiatives that are geared towards the management of knowledge.

4.11 Case Studies

This Section outlines case studies of knowledge management practice on four construction companies. Semi-structured interviews were conducted with construction site managers to identify practices that can be improved through the integration of knowledge management processes. The cases are presented individually and then similarities and differences between them are discussed. The key problems on the construction site, procedures used and aspects of knowledge management within the site are presented and analyzed. The chapter concludes with a discussion of the importance of KM for construction practices.

One of the major problems in designing a case study is defining the units of analysis to be used during the research. (McClintock et al, 1979) asserts that although the units of analysis are typically defined as individuals, groups, or Companies, they could almost be any activity, process, feature, or dimension of organizational behavior. Basically, within the case, there are several 'units of analysis', used by the researcher. The interviewees were therefore questioned under five main 'units of analysis' as follows:

- ✓ **Problems on the construction:** This explores the most significant problems that occur on the construction site
- ✓ **Approach to problem solving:** This aims to identify strategies used by site managers to solve site problems.
- ✓ **Knowledge sharing mechanisms:** This aims to identify the tools and techniques used by site managers to share knowledge on the construction site; a
- ✓ **IT tools, software used and roles of intranet:** This investigates the IT tools and software used in managing the construction site and explores the potential of the intranet as a vehicle for disseminating and sharing knowledge.

Case A: Hospital Building Site

A. Background and Problems on the Construction Site

It is a G+5 hospital building with a total gross area of 3,000m² with 100 impatient beds and with a full-out patient and with 6 operation theatres with full surgical wing and full radiology wing room and with full diagnostic facility wing. The construction of this project consists of the following works:

The construction of new buildings for Psychiatric Department (Block 5), Surgical, Laboratory and Service Department (Block 2), Hydrotherapy Department(Block 1b), Kitchen (Block4b), Transformer and Generator Houses, Guard Houses, Ambulance Drivers Building, Helicopter Pad, Lift Shafts, Staircases, Mechanical room for Medical gas supply system and also Site Works.

The Project cost is 30,504,402.96 Birr. The proposed revised total construction period is 912 calendar days including time extended due to delay in the tender evaluation process and selection of nominated sub contractor, insufficient cement supply.

The main responsibilities of the project manager are to control and monitor the construction, with assistance from the construction manager and others. Information and knowledge are relayed to sub-contractors and team leaders through daily and weekly meetings. The purpose of the weekly meetings is to monitor the progress of works, risk assessment, and planning of the program of work. Safety issues, access problems, delivery schedules, problems with construction and cooperation issues are discussed in the daily meeting. Meanwhile, drawings and specifications are provided to the work package subcontractors. Any technical queries from sub-contractors can be submitted to the site engineer. There are several problems faced by the project managers and the site management team on this construction site. These are as follows:

Lack of co-operation and motivation:

People are not prepared to work together and there is a non-existent building of team spirit and co-operation among people such as the site management team, sub-contractors, and general workers on the construction site;

Poor site communication:

People do not try to communicate and liaise with other individuals in the site organization team. General workers (Plasterers, carpenters, etc.) also do not communicate with each other;

Difficulty in monitoring the Health and Safety Plan:

Difficult to make sure everyone on the site is aware of the Health and Safety Plan. There are no monitoring systems for checking that the Health and Safety Plan is being followed.

This plan also needs to be extended, reviewed, and updated as the work proceeds;

Cost-cutting and control:

The sub-contractors do try to save money to maximize the profit. They normally price the job too low and below the profit margin. This might affect the quality of production on the site

Labour shortage:

Problem in lack of skilled workers in many areas of site works. Currently, most of the construction laborers have little training and knowledge of construction work. These problems affect the quality of the building and increase construction costs.

B. Approach to Problem Solving

Several strategies are applied on this construction site. Firstly, an informal discussion is undertaken with workers or sub-contractors. Then a discussion is carried out to give explanations and solutions, and to get them to realize the rationale for each solution. Secondly, discussion and open-mindedness is encouraged at site meetings. Construction workers are given a chance to sort out problems and the solutions shared among the site management team. The concept of autonomy has been introduced to every scope of works but they also need to be responsible to other units, tasks or work packages.

C. Approach Taken when a Mistake is Made

The Project Manager observed that 85% of knowledge is embedded in the minds of the people involved and 15% of the knowledge is from written documents such as drawings, specifications, and method of statements. This was simply based on his perception rather than an empirical study. Construction workers always refer to the drawings and specifications to check the size and location of the buildings. However, people also use knowledge from previous experience embedded in their minds to construct the job and ensure the quality of the

job. Furthermore, if a mistake occurs, the Project Manager holds a meeting to clarify the error and share the lessons learned on the construction site.

D. Knowledge Sharing Mechanisms

The construction knowledge, especially knowledge from experience and training, is shared amongst the people in the company via documentation of the project's procedures and minutes of the site meetings. Besides that, construction knowledge can also be disseminated via site meeting and can be discussed with the site management team

E. IT Tools, Software Used and Roles of Intranet

The implementation of knowledge management strategies is supported by various kinds of Information Technology (IT) tools. These IT tools can be divided into several categories.

- ✓ An e-mail system: For disseminating and sharing knowledge;
- ✓ Intranet: To share project knowledge between the various departments in the organization. Using the intranet, employees can access industry information, best practices, company capabilities, country profiles, archived news, and much more.

Case B: Hospital Site

Background and Problems on Construction Site

The main aim of the project was to extend the services given by the hospital hence for this purpose a new building must be established without demolishing the existing building.

So for this purpose, a new building was designed and approved by an Architect and Consulting office. It's a G+3 building that consists of wards, offices (consulting, working), intensive care units, Pharmacy, etc. in general all the requirements are according to what a standard hospital should fulfill.

For this site management team, the main responsibilities of the project manager were to manage and control the whole of the construction process or the three years duration. The project manager was assisted by the site Engineer and other office staff. A formal meeting is

conducted every two weeks and an informal meeting two or three times each week. The formal meetings discuss the progress of works for each package, design information and amendments, the quality of works, technical problems, and commercial management. The informal meetings involve discussions on the work area, resources leveling and planning, deliveries of material, and planning for the next jobs. The most important step in communicating information from engineers and architects to trade workers is to check ambiguities, especially in drawings and schedules, before passing the drawings or information to the trade subcontractors. During the construction works, the biggest problems that occurred on this site were:

- ✓ Poor design management and information: Incomplete design, lack of details and sequences showing details of how to fix building elements together;
- ✓ Unsuitable specified materials: The need for samples to test the reliability of materials and to meet the supplier's specification;
- ✓ Shortage of labor resources: Unskilled workers affect productivity and also degrade the quality; Lack of control over the quality of work- Need proper checking systems and recording procedures on site. Currently, quality control is ensured by subcontractors appointed by the main contractor to check and physically inspect the construction works; Material damaged or defective: damage occurs on the construction site and affects other works; for example, tiling works and other sensitive subcontract works are often unprotected.

b. Approach to Problem Solving

There was a vital need to have a strategy to handle these problems. The first method of addressing the above problems was to take a more practical approach to quality control. The work needed to be regularly checked and also samples of selected materials had to be submitted. This approach will help the main contractor to identify elementary building problems at an early stage of the project Secondly, the project manager contacted senior people if the problems cannot be resolved at the site level.

D. Knowledge Sharing Mechanisms

Knowledge is shared in various ways. Firstly, knowledge is shared in design meetings conducted every two weeks. Secondly, knowledge is shared in the construction forums between the project teams. After these forums, the project management team assesses the best

issues or problems that can be documented for use in the next project. Thirdly, knowledge is shared in the site organization meetings every week. Lastly, knowledge is shared in the 'crash' meetings which discuss site management problems.

D. Approach Taken when a Mistake is Made

In general, construction expertise is in the form of written documents (explicit knowledge) and in people's heads (tacit knowledge). For a complex project, the proportion between explicit knowledge and tacit knowledge is about 50:50. For example, though tradesmen have (say) 20 years' experience or tacit knowledge of construction, they also need to refer to explicit knowledge (designs, drawings and specifications) because different projects have different characteristics; especially healthcare and hospital projects. Healthcare 'Communities of Practice' are used to capture certain learning events and share ideas and solutions. They also include a mixture of the main contractor's construction personnel, facilities management personnel, a design team, and procurement personnel. If a mistake is made, the causes of the problem are identified and solutions and 'best practice' guides are produced.

e. IT tools, Software Used and Roles of Intranet

The management team has an intranet system to help manage the organization's base of expertise. The main role of the intranet system is for storing information and helping people access the company's policies and procedures. Updates are announced to various people in different regions using the Intranet system. Clients can log in automatically to the intranet to access relevant information about the project and contractor.

Case C: Water Works Site

The construction of Head Office Building project consists of Office Buildings and External site works. The Project Manager leads the site management team and is assisted by the Quantity Surveyor, the Site Engineer and the Project Engineer. Works Managers (i.e. senior foremen) supervise the sub-contractors and general operatives. This organization carries out daily meetings and weekly meetings with sub-contractors and team leaders. Daily meetings are

informal and the progress of work is discussed with sub-contractors. Also discussed are risk assessment and works regulations. The weekly meeting is a formal meeting and the agenda of the meeting normally starts with health and safety, the progress of work, planning, resources planning, risk assessment, and other matters arising. Dissemination of client information (drawings, specifications, and instructions) is based on hard copies given to sub-contractors organizations. Besides that, this organization conducts formal pre-commencement meetings to discuss quality control procedures. Normally, photographs are used to demonstrate to sub-contractors the bad and good quality works on the construction site. However, there were several barriers on the construction site. The most significant area as follows: Services obstruction: Existing underground services can disrupt the progress of construction works and bring uncertainty to the planning and commissioning of the construction project;

Inability to accurately resource, plan and schedule:

The wrong information about selecting resources, especially the labor for the construction works. Proper planning and adequate information on resources will enhance the efficiency of the projects and could save money and improve safety on the construction site;

Poor site communication:

The problems of knowing how much information needs to be communicated to the sub-contractors and to find the most efficient methods of communicating this type of information to the sub-contractors; Unpredictable final cost and hand over The problem of closing out the works and some of the works not being completed properly; and Poor planning of works: For targets to be determined and met, a proper plan is needed when beginning the works at the job site. It is vital to align the planning of the programme of works with procurement planning.

b. Approach to Problem Solving

The types of problems that occur on the construction site were familiar to the site management team because of the organisation's strategy of working with the same clients and on similar types of works. In this context, the organisation's strategy was to keep people and teams

together to allow them to develop knowledge and experiences from previous projects. In parallel to this, ad-hoc meetings were held with the experts if the site management team were faced with particularly complex technical problems (e.g. construction of retaining walls).

Approach Taken when a Mistake is Made

The site manager has observed that construction knowledge such as quality of work, construction site planning and quality management systems are within the worker's experience. This organization did not have any systematic methods or processes to build a knowledge base from experts and senior people in the organisation. However, being structured in client-facing business units, and keeping staff together mitigated the potential shortcomings.

D. Knowledge Sharing Mechanisms

This organization shared safety and environmental knowledge via a very rigorous system that requires the organization's staff to document the safety bulletins of the company. Rewards are given in recognition of best practices and knowledge shared within the organization.

E. IT Tools, Software Used and Roles of Intranet

Not so much is used in terms of Information Technology except for storing data in one exclusive storage unit. The company uses MS Excel and MS word in order to transfer share different documents to the construction crew.

Case D: High School Project

Background and Problems on Construction Site Organisation 'D' is developing and constructing a new high school project. This re-development project was to replace an existing building and demolition works of an existing building are intended to be carried out soon. The site manager's functions are primarily to be responsible for health and safety, to manage the whole site, to control the sub-contractors, to manage all the packages, and to make sure that the jobs are in accordance with the right specifications. In this company, the site managers are

not involved in determining and monitoring the cost and budgeting for this project. The estimation of project costs is the responsibility of the procurement division of the company. The organization conducts weekly informal meetings with subcontractors and team leaders. The function of the weekly meetings is to discuss the progress of work and plan for the next stages. This organization also conducts monthly informal meetings to discuss procurement issues and health and safety issues. Project information, such as drawings and specifications, is issued to the subcontractors immediately on request. However, unnecessary and irrelevant information is not provided to the sub-contractor. In managing the construction site, the main problems faced by the site management team are:

Lack of information on sub-contractors: Information on sub-contractors is not comprehensive and complete;

Low awareness of the Health and Safety Plan: Many sub-contractors do not take action on safety issues seriously;

Inaccurate planning of work commencement: Weather will affect the commencement of work, especially ground works and the installation of a steel roof structure. Planning and programming of the works need to be framed properly to avoid difficulty in starting up;

Labour shortage: Low skill of trade workers. There is also a lack of supervision from the leader of the trade workers; and Poor quality of materials.

b. Approach to Problem Solving

There are two methods used to address site management problems. Firstly, discussion with sub-contractors to give explanations on how to solve particular problems and to improve quality in all aspects of the work being carried out. Secondly, discussions are held amongst colleagues both on-site and off-site, as a means of resolving the problems or issues. For very technical problems (e.g. mechanical, electrical problems), the site manager's approach is to rely on specific people in the company who have expertise in that area.

C. Approach Taken When a Mistake is Made

Most of the construction knowledge is embedded in the specifications and drawings (explicit knowledge) but knowledge of construction also comes from the site management team. When the people working on the construction make errors, the mistakes are registered as 'non-compliance'.

D. Knowledge Sharing Mechanism

Most of the construction knowledge is shared and discussed amongst the site management team in the informal meetings held to discuss specific issues or problems.

E. IT Tools, Software Used and Roles of Intranet

Intranet system

The company has an intranet system to help in managing the organisation's knowledge. The main role of the intranet system is to serve as a platform for accessing information. The main contents are work procedures and policies and staff contact information.

4.11.1 Key Findings from Case Studies

It is vital to examine the knowledge that resides in the construction site processes for the efficient execution of the site management functions. The next discussion concerns cross-case analysis between five main investigated units of analysis' in five construction sites and therefore is structured as follows:

- ✓ Problems on construction site;
- ✓ Approaches to problem-solving;
- ✓ Approach taken when a mistake is made;
- ✓ Knowledge sharing mechanisms; and
- ✓ IT tools, software used and roles of intranet

Unit of Analysis	Case 1	Case 2	Case 3	Case 4
Construction Knowledge	95 % tacit 5% explicit	✓ 50% ✓ 50%	✓ 100%	70% Tacit 30% explicit
Approaches to problem solving	✓ Informal Discussion ✓ Site meeting (open mindedness and no blame approach)	✓ Quality Control Procedure ✓ Refer to senior people and expert	✓ Previous team experience ✓ Informal meeting with experts	Discussion with sub-contractors, Consulting colleagues on site and off site, Refer to expert
Approach taken when a mistake is made	✓ Meeting ✓ Produce report (Cause Analysis) ✓ Disseminate via Intranet	✓ Problem Identification ✓ Lesson Learned documented	✓ Discussion Internally	Document and record in project file
Knowledge sharing mechanisms	✓ Site Meeting ✓ Intranet	✓ Communities of practice ✓ Intranet	✓ Monthly briefing talk ✓ Small seminar	Informal Meeting, Demonstrate example on the job
IT tools, software used	✓ E-mail ✓ Intranet	✓ Email ✓ Intranet	✓ Email	Email, Intranet
roles of intranet	✓ Access Information	✓ Managing Construction knowledge	- Communicate people, training people	

Table 4. 18 Summary of the case studies

4.11.2 Problems on Construction Site

An understanding of construction management problems, including current approaches to problem solving, is important to manage knowledge successfully. For example, lack of cooperation and motivation, poor design management, services obstruction, lack information on sub-contractors and local residents were usually associated with 'management, supervision and administration' construction management processes. These factors were judged to be the most damaging to the more effective management of construction processes. The implementation of KM processes should not completely restructure current company management practices, but should become an integral part of company management practices. It is therefore important to identify which KM processes and which aspects of company management practices can be integrated.

4.11.3 Approaches to Problem Solving

The approach towards addressing the site management problems differed from one case to another. Organizations (1), (3), (4) followed informal approaches, which rely heavily on previous experience, informal meetings and experts to solving problems. organization (2) followed a quality control procedure, which is a more structured approach. It can, therefore, be concluded that the site management uses two methods to address site management problems. These are:

- ✓ Structured methods: These include quality control procedures ; and &
- ✓ Informal methods: These include previous experience e, discussion or informal meetings and reference to experts. It is essential that whatever management strategy is adopted, it can minimize the number of problems that occur on the construction site and reduce their impact.

4.11.4 Approach Taken When a Mistake is Made

Analysis of the site management practices indicates that the main characteristic of site management problems is its reliance on experiential (tacit) knowledge. Experiential knowledge is not codified in books or written documents and is organized in people's heads (Li and Love, 1998). Of the four organizations investigated, all rely on tacit knowledge in managing the construction site. Moreover, when problems arose that required advice from an expert, all the site managers do not seem to attempt to make contact with quite the same speed. They prefer to conduct a formal meeting or informal meeting with sub-contractors and site management team as a primary approach to solve site management problems. One reason for

this could be that sub-contractors are present on site more often, thus they become more familiar with one another and thus more approachable. Another reason may be that the sub-contractors are in a subservient relationship to the contractor (Emmitt and Gorse, 2003). Although the interviewees gave different figures for the percentages of tacit and explicit knowledge involved in construction work, these figures indicate that most of the construction knowledge is embedded in the minds of professional workers (e.g. engineers, architects, quantity surveyors, estimators, etc.) and operative workers (e.g. plasterers, plumbers, Mason, , carpenters, etc.). Therefore, it is important to adopt appropriate mechanisms for capturing tacit knowledge on the construction site. The majority of the site management teams use traditional management methods for capturing mistakes and lessons learned. There are usually two stages: discussion and informal meetings followed by documentation and registration on the project file. Organizations (A), (B), (C) and (D) use an intranet system to disseminate the report to the people on-site and off-site. Basically, workers make the same mistakes and repeat the same errors while carrying out construction work. It was evident during the observations that organizations adopt different strategies for capturing mistakes and lessons learnt.

4.11.5 Knowledge Sharing Mechanisms

Meetings are the most effective mechanisms for sharing knowledge on the construction site. There are many types of meeting: some are relatively informal and organized on an ad hoc basis, while others are formal and scheduled in accordance with contractual demands. Organizations (1), (4) used meetings as a method to share knowledge. Organization (3) uses best practice seminars to share knowledge amongst people in the organization. Organizations (C) and (E) had a structured approach and were more serious about sharing best practices and lessons learned. In contrast, informal meetings have also been used for sharing construction knowledge. For example, Organizations (A) and (C) conducted ad hoc meetings (informal meetings), which sought to demonstrate a particular job on the construction site to the workers. In terms of information and communication technologies, the majority of the sites had an e-mail system and was linked via an intranet system. Organizations (A) and (E) implemented a data store project file on the intranet while Organization (E) had an on-line payment system to sub-contractors via their intranet system. The intranet system in all organizations, was used: to store knowledge, to provide a vehicle for people to seek knowledge, as a directory for each member of staff to share particular skills and experience, and to bring together people with common interests.

IT Tools, Software Used and Roles of Intranet

The organization uses Web-based applications in managing information on the construction site. Drawings and specifications are placed on the project server and Web. - site. An information required schedule, drawing schedules and communication tools are also included on the data base server. Sub-contractors are able to access the internal project Web site at specified levels of navigation to use project information. Subcontractors are able to submit interim payments electronically via the project Web site

The Intranet system allows people in different site locations to communicate information and ideas. In addition, for knowledge sharing and dissemination of lessons learned, the organization has established an on-line knowledge management system called 'Top Tips'. The main objective of the system is to capture organization knowledge on key construction areas (e.g. risk assessment, value management, method of statement, etc.).

4.12 Summary

The main aim of the case studies was to understand the key problems and to observe existing practice in managing knowledge on the construction Companies. The case studies highlighted the key problem areas. The case study findings revealed that management, supervision and administration are the areas where problems occur most frequently on the construction companies. They also identified services obstruction, poor site communication and information, incomplete design, local residents, and cooperation and motivation issues as major problems inhibiting construction performance. Therefore, the site management team should be prepared to deal with on-site problems and risks in a systematic and efficient way. Knowledge management processes can be effectively used on the construction site to enable knowledge to be captured and reused in the future. KM can help to prevent the site management team from repeating past errors and, by capturing best practices, lessons learnt, and especially the solutions to problems that arise on site, similar situations in the future can be dealt with efficiently and effectively. Reducing problems on the construction site has the following advantages:

(a) The cost of problem solving is reduced and

(b) The probability of repeat problems is decreased (Tserng and Lin, 2004). Findings from the case study Companies revealed that site management teams still do not have any systematic methods for the creation, capture, storage, sharing and reuse of a professional's domain knowledge of products, people and processes. The integration of KM into site management

practices will address this and result in significant benefits to the construction project delivery process.

4.13 Knowledge Management Framework

The research reported in this thesis investigated the issues related to the management of knowledge in Hawassa Construction sector. It was carried out with the objectives specified in Chapter 1. Following an extensive literature review, a triangulation of three data collection instruments – questionnaire survey, semi-structured interview and case study – were employed to gain rich data for achieving the objectives of the research. Analyses of the results of these research instruments were reported in Chapter 4 and Chapter 5.

In this chapter, for the formulation of final research findings and recommendations, the data analysis results from the earlier studies are integrated with findings from the literature study, and be further explained. A KM framework for managing knowledge in the Construction sector is formulated to give a holistic view of balanced activities. Furthermore, a guideline for applying knowledge and implementing KM at project level is provided.

4.14 Synthesis of the Questionnaire Survey, Interview and Case Study Results

As specified in Chapter 3, three research methods, which are questionnaire survey, semi-structured interviews and case studies, were employed in this research for data collection. These three studies were conducted in turn after an extensive literature review. Results and findings from these three studies all contribute to the investigation of research questions and the achievement of research objectives.

According to the research plan, in the first phase, a questionnaire survey among industry practitioners in Hawassa Construction sector was conducted to quantitatively test relevant hypotheses and concepts gained from the review of literature. It mainly focused on the what are the main KM stages of managing sustainability knowledge. As reported in Chapter 4, the necessity of adopting KM to promote the capture and implementation of sustainability knowledge in Hawassa Construction sector was confirmed. It has also been confirmed that the process of managing and implementing sustainability knowledge needs to be integrated into the project management process in this project-oriented industry sector.

Five essential stages of the KM cycle were identified: identify sustainability knowledge, obtain sustainability knowledge, share sustainability knowledge, apply sustainability knowledge and maintain knowledge. Furthermore, Several KM enablers were identified

through the survey and were classified into four categories: external environment, organizational environment, project environment, and personal capabilities. The role of stakeholders has also been investigated, with the client, design team, and project manager being identified as the most important stakeholders involved in the KM cycle. Besides, areas such as project performance and organizational performance that can benefit from managing sustainability knowledge were also identified. Based on the results of the questionnaire survey, semi-structured interviews and two real project case studies were conducted to qualitatively investigate –how the industry currently manages sustainability knowledge and how to improve the management process. The semi-structured interviews covered a wide range of issues from industry level, organization level, project level, to a personal level. In the KM cycle for managing knowledge in the Construction sector, knowledge implementation is seen as the most important as well as the most challenging stage. The reason is that the Construction sector is a highly project-oriented industry sector, where sustainability goals can only be achieved project-by-project. To understand the KM cycle for sustainability knowledge, especially to understand its actual implementation in the real project scenario, Four case studies were conducted to complement the interview results. Furthermore, as the questionnaire survey identified the five main KM stages for managing sustainability knowledge, the interviews and case studies could focus on how the cycle is facilitated and realized in the industry.

Table 4. 19 Key Elements of the Final KM Framework for Managing Knowledge in Hawassa Construction Companies

Main Sections of the KM Framework	Main Contents
KM Enabler	External Environment - Sustainability Awareness - Policy & Legislation - Network of Subject-matter Experts
	Organizational Environment - Organizational Vision and Culture
	Project Environment - Leadership - Project Target - Knowledgeable and Committed Client - Support from the Project Management Level
	Personal Capabilities - Communication Skill - Multi-disciplinary Knowledge
KM Strategies	-Education - Sustainability CoP - Knowledge Transfer - Sustainability Measurement
KM Activities	- Identify knowledge - Obtain knowledge - Share knowledge - Maintain knowledge - Apply knowledge (Sustainability Implementation in Project)
KM Outcomes	- Sustainability Knowledgeable and Committed Stakeholders - More full-fledged Construction Projects - Expanded Construction Knowledge Asset

The most important issues that should be addressed to effectively manage knowledge in the Construction sector are identified and these are : KM enablers, KM strategies, KM activities, and KM outcomes. They will also be the main elements of the final KM framework. Detailed discussions on these issues listed are presented in the following sections.

4.15 Status of KM Adoption for Managing Knowledge

KM is a new concept for Hawassa construction companies, but it does not mean that the construction sector is not actively managing important knowledge. Communication of expertise, transfer of information, professional training, and learning is happening extensively every day across the industry. The literature suggests that, in this highly project-oriented industry sector, KM facilitates continuous improvement through project learning and innovation (Robinson *et al.*, 2010). KM initiatives and learning were found at different levels; for example: inter projects (knowledge sharing between projects), intra-project (transferring knowledge during the project lifecycle), and cross-sector (supporting learning outside the project sector environment). In the Construction sector, industry-level associations are working on promoting KM practices through conducting training courses, facilitating networks, rewarding good practices, developing relevant tools, building accessible knowledge databases, and setting rating standards. They are trying to push organizations and industry practitioners to absorb more knowledge and integrate it into practice.

As discussed in the interview and case study chapters, there are considerable initiatives on managing knowledge in the industry sector, and there are also some KM tools adopted; for example: PPR (Post Project Review), Education and Training, Sustainability Reporting, Sustainability Staffing, CoP (Community of Practice), Sustainability Measurement, Case-based Reasoning, and relevant IT tools. However, these practices just exist in some leading organizations and outstanding projects and are still uncommon across the whole industry sector. Furthermore, many of the KM tools are not currently fully consciously or systematically used. Another issue is that there is still a heated dispute in the field of KM on the importance of soft issues versus hard issues and how to place IT tools in KM programs.

As discussed, a lot has to be done for the implementation of IT systems and tools. The majority of industry practitioners involved in this research agree that to promote knowledge application, KM should prioritize attention on soft issues – including attitude and cultural aspects, leadership and change management, new and improved project management processes, communication and collaboration – rather than setting up expensive IT systems, as IT is but one of the tools that can assist the whole process.

4.16 KM Framework

4.16.1 Proposing the KM Framework

Based on the previous discussions the following final KM framework for managing knowledge in Hawassa Construction sector is formulated.

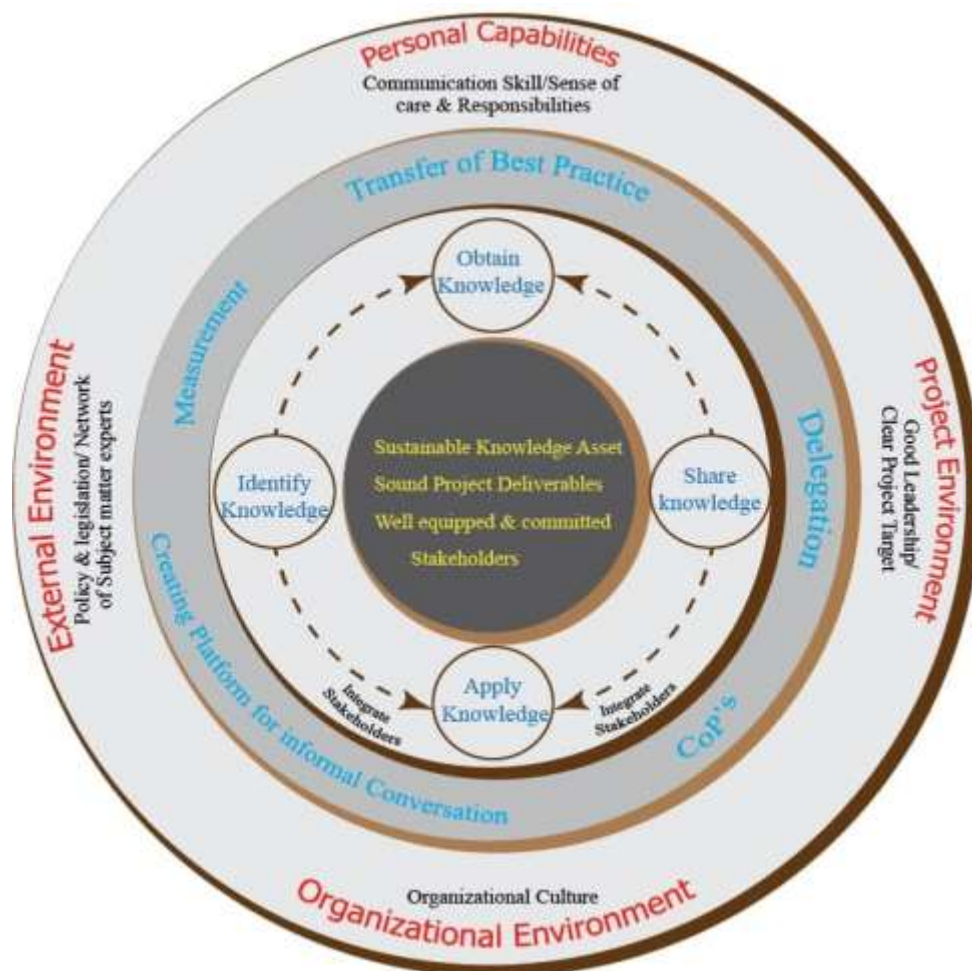


Figure 4. 1 Knowledge Management Frame Work for Companies in Hawassa

4.17 Understanding the KM Framework

4.17.1 Managing Knowledge

The proposed KM framework for managing knowledge in the Construction companies consists of four main sections which are most important for KM: KM enablers, KM strategies, KM activities and KM outcomes. Elements within these four sections are put into different layers of the KM framework.

The first layer points out the aims and outcomes of managing knowledge:

Through proper management of knowledge, Construction knowledge assets can be expanded; more knowledgeable and committed stakeholders is cultivated, and more sound projects will emerge in the industry sector.

The second layer illustrates the five key activities within the Knowledge cycle.

These five key KM activities include: identify knowledge, obtain knowledge, share knowledge, apply knowledge and maintain knowledge. These activities are usually facilitated by various KM strategies and tools.

Among these KM activities, apply knowledge is the most important and challenging activity. However, knowledge can only add value when it is being used, which in the scenario of the Construction sector, means being applied in real projects.

The third layer recommends six effective KM strategies to facilitate the sustainability knowledge cycle.

These KM strategies include:

- ✓ Education
- ✓ Staffing
- ✓ CoP
- ✓ Transfer of best practice, measurement, and Reporting.

The fourth layer points out the important enablers for KM success.

These enablers are categorized into four types based on their level of influence: individual

level, project level, organizational level, and industrial level.

4.17.2 Implications of the Proposed KM Framework

Managing relevant knowledge is essential for this industry sector to build its capacity to implement sustainability and to deliver real achievements. Anecdotal evidence and past academic research has shown that successful KM implementation can provide the industry, organizations, and project teams with multi-disciplinary knowledge sharing, communication, and collaboration, which in turn will boost industry knowledge assets and innovation. Although every organization and project team has its way of obtaining, sharing and applying knowledge in their day-to-day work and activities, conscious knowledge management makes their practice more effective and efficient. KM is a balancing act that involves various competing practices, priorities, processes and solutions. This KM framework sets the overall context for managing sustainability knowledge in the Construction sector. It will help industry practitioners to prioritize attention on relevant important issues at present. These are mainly soft issues – including sustainability awareness, leadership, improved project management processes, education, and networking – rather than expensive IT investment or domain technical details.

This framework also aims to:

- ✓ Provide industry practitioners in Hawassa Construction sector with a practical introduction to understanding KM and using KM to manage sustainability knowledge within the industry sector, organizations or projects;
- ✓ Recommend potentially effective practices in the Construction sector for KM.

4.18 Summary

This chapter starts with an integration of the parts of the research conducted and with a synthesis of the results of the three studies. The second section discusses the main issues arising from the synthesizing of the results to provide an overall understanding of the knowledge management issues in regards to Construction in the sector. This then leads to the formulation of a specific KM framework. The last section of the chapter proposes the KM framework as part of the end goals of this research project.

CHAPTER FIVE

5.CONCLUSIONS AND RECOMMENDATIONS

This chapter draws conclusions based on the work outlined in this research and highlights the research contribution and limitations. It begins with reviewing the research questions raised in Chapter 1 and the research design and the development process described in Chapter 3. This research contains three studies for data collection. The conduct of the three studies and their results are presented in Chapter 4 and Chapter 5 respectively. This final chapter draws conclusions based on the findings from these chapters. The research contributions to academic knowledge, its implications for Hawassa Construction companies, and the limitation of the research are summarized. Enlightened by the research findings and limitations, recommendations for future research are given.

5.1 Conclusions

5.1.1 Essential Issues of Managing Knowledge in the Construction companies

The Construction sector is critical in determining the efficiency and productivity of the nation's economy. However, it is uniquely characterized by its project-based nature, conservative culture, long and complex development processes, enormous financial investment, and significant environmental impact. This industry sector is currently under pressure to respond to the calls to embed knowledge Management principles into Construction site development. However, the lack of relevant knowledge is a big barrier faced by industry practitioners.

Practices related to the management of knowledge are witnessed across the industry sector. They lie in different levels; for example, inter-project (knowledge sharing between projects), intra-project (transferring knowledge during the project lifecycle) and cross-sector (supporting learning outside the project sector environment). However, these practices are mainly conducted in a random and unsystematic manner and are not widely performed within

Companies and projects. Main barriers that prevent knowledge transfer and application in the construction sector include:

- ✓ Lack of awareness of Construction sites across the industry sector
- ✓ Deficiency of current education
- ✓ Lack of guidelines and examples for industry practitioners to move from talk to action
- ✓ Lack of regulation
- ✓ Lack of demand or support from client and
- ✓ Lack of consensus and collaboration among stakeholders.

Various enablers that drive the identification, obtaining, sharing, maintenance, and application of knowledge are identified in four categories according to their influential scope: external environment, organizational environment, project environment, and personal capabilities. Some enablers are specific to the Construction sector's management of knowledge and have not been witnessed in other KM literature.

Table 5. 1 Enablers for Managing Knowledge in the Construction Sector

External Environment (Industry Level)	- Awareness - Policy & Legislation - Network of Subject-matter Experts
Organizational Environment (organizational level)	- Organizational Vision and Culture
Project Environment (project level)	- Leadership - Project Target - Knowledgeable and Committed Client - Support from the Project Management Level
Personal Capabilities (individual level)	- Sense of Care and Responsibility for - Communication Skill - Multi-disciplinary Knowledge

5.1.2 Effectively Managing Knowledge in the Construction Companies

This research has investigated the nature of the Construction companies, the main activities of managing knowledge, and existing effective strategies of industry KM practices for knowledge. The main findings are presented in the proposed KM framework

Firstly, expected outcomes drive the conduct of KM activities in the industry and should be put in the center of the framework to remind practitioners of the purpose of managing knowledge. They are: (1) more knowledgeable and committed stakeholders, (2) expanded Construction sites knowledge assets, and (3) more -sound Construction sites projects

Secondly, main KM activities are identified as: identify knowledge, obtain knowledge, share knowledge, maintain knowledge and apply knowledge. Applying knowledge is seen as the most important and challenging KM activity in this project-oriented industry sector, as knowledge adds no value if not being applied in real Construction site projects.

Thirdly, important KM strategies that facilitate the KM cycle are identified. These strategies are proven to be effective for Hawassa Construction companies as they facilitate the knowledge flow across different functional departments, project phases and disciplines and among various stakeholders, addressing the characteristics of the project-based and fragmented Construction companies.

In Hawassa Construction companies, Companies and projects can use the highlighted KM strategies to facilitate the KM cycle – identify, obtain, share, maintain and apply – in order to deliver the outcomes.

5.3 Recommendations

In the light of the findings and conclusions of the study, the following recommendations are made to companies and for possible future researches ;

5.3.1 Recommendation to Construction Companies

The following are recommendations for companies that this research suggests:

- ✓ Companies should encourage the creation of knowledge by supporting research activities, encouraging collaborations and teamwork.
- ✓ The departments should have a KM strategy /policy which is aligned to the organizational strategy. The strategy will act as a guideline on the sharing of knowledge, as to whom, how, when and where the knowledge should be shared internally and externally.
- ✓ Managers design an incentive program for knowledge sharing and acquiring that will encourage people to share their knowledge. This will mitigate tendencies to hoard information for common good.
- ✓ Organizations should create knowledge repositories that are accessible with user-friendly interface.
- ✓ Organizations should ensure that generated knowledge is applied in solving real-time problems and ensuring innovations
- ✓ Companies should create posts for people who is directly responsible for KM in the department and across departments.
- ✓ Organizations should endeavor to acquire tools and technologies necessary to support people and processes involved in knowledge management

5.3.2 Recommendations for Future Research

In the light of the research findings and limitations, some areas are highlighted for future research and are discussed below.

To identify the key KM activities for managing knowledge, potential activities were rated by industry practitioners during the questionnaire survey. Their ratings were based on an activity's perceived importance and on the extent of the barrier to conducting these activities in the workplace. It is interesting to see that, although creating knowledge is considered to be the second most challenging KM activity, it is seen as being of the least importance. This result is greatly different from the main perceptions in much of the literature, which argue that innovation is critical for sustainable development success (Lemelson-MIT Program, 2003; Vollenbroek, 2002; and Newman

2005; etc.) This issue was raised during the analysis of the questionnaire survey results but has not been thoroughly explored in detail, as this research focuses on addressing the priority issues at present, as identified by the industry practitioners. However, it is worthwhile for future researchers to investigate this issue of innovation and knowledge creation and its implications.

Table 5. 2 KM Activities for Managing Knowledge

	Challenging	Not Challenging
Important	✓ Apply knowledge ✓ Share knowledge	✓ Maintain knowledge ✓ Obtain knowledge ✓ Identify knowledge
Not Important	✓ Contextualize knowledge ✓ Measure knowledge ✓ Create knowledge	✓ Search for knowledge

5.4 Closure

As identified from this research, the fact that knowledge Management is not yet effectively regulated is one of the key constraints that inhibit the adoption of within the industry sector. To tend toward compliance with regulation rather than to act innovatively is a culture of this relatively traditional industry sector. Investigation in the area of public policy for Construction sites can be useful.

Hawassa Construction sector is under pressure to respond to the calls for sustainable development and is seeking measures to embrace principles into Construction companies development. However, the lack of knowledge and industry's capacity is a barrier faced by industry practitioners. In the light of the existing KM research, practices, and tools, the research reported in this thesis has developed a holistic KM framework to outline the important issues and effective strategies in helping the companies better manage knowledge. With an understanding of the unique character of the companies and the nature of knowledge, this research employed a combination of literature review, questionnaire survey, semi-structured interview and case studies to formulate, evaluate, and validate the critical elements, key processes and prior issues of KM for companies. In the end, a holistic KM framework for managing knowledge within the

Construction companies was presented. The formulation of the integrated framework and guidelines will provide industry practitioners a starting point in understanding the balancing act of KM and its link to Construction sites

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APPENDICES

Appendix 1 : A Sample of Collected Questionnaire Response

knowledge management practices in construction companies: the case of Hawassa city

Subject: questionnaire survey about: "knowledge management practices in construction companies: the case of Hawassa city" for submitting a thesis in partial fulfillment of the requirements for the Masters degree in Construction Technology and Management in Hawassa University

Research Aim

To Explore the practice of Knowledge management in construction companies along with identifying the barriers of knowledge management, which in turn leads to develop a framework that improves knowledge management practice in construction companies in Hawassa City. The main purpose of this survey is to collect data from the industry's stakeholder.

NOTE

KNOWLEDGE MANAGEMENT: can be defined as the identification, optimization and active management of intellectual assets to create value, increase productivity, and gain and sustain competitive advantage. It involves the capture, consolidation, dissemination and reuse of knowledge within an organisation. You are kindly requested to return the completed questionnaire.

Temesgen Elias Tel.+251925287471 ,Email: temesgen.elias@hu.edu.et, Address: Hawassa University

For more information and to get summary of the survey result, please contact me through the above

Gender *

- ☒ Male
- ☐ Female

Education Background *

- ☐ Diploma
- ☐ Bachelor Degree
- ☒ Masters Degree
- ☐ PhD
- ☐ Other:

Years of Experience *

- ☐ 0-2 Years
- ☐ 3-5 Years
- ☒ 6-10 Years
- ☐ 11-15
- ☐ Above 15

Type of Company you are working *

- ☐ Contractor
- ☒ Consulting
- ☐ Academics
- ☐ Clients
- ☐ Professional Association

Your Job Title *

Structural Engineer

Does your company recognize knowledge as a part of their asset that gives value *

- ☒ Yes
- ☐ No

Section Three Knowledge Management Process

A wide variety of practices and process are used in knowledge management. Some of the core common ones are illustrated in this section.

Information is collected to identify those processes specific to the practice of knowledge management to enhance organizational performance in companies in Hawassa.

Please give your opinion on how knowledge can be acquired in your company *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Specific staff is responsible for obtaining knowledge from external resources	☐	☐	☐	☒	☐
Recruiting external staffs to induce new concepts	☐	☐	☐	☒	☐
Encouraging staffs to participate in conferences, seminars, exhibition etc in order to get new knowledge	☐	☐	☐	☒	☐
Acquiring knowledge management related technologies and follow the best practice	☐	☐	☐	☒	☐
Gathering emerging knowledge from external sources	☐	☐	☐	☒	☐
Being informed of knowledge (new concepts) from external organization (e.g. Professional Associations, research institutions)	☐	☐	☐	☒	☐
Gathering lessons learnt through out work proceeding during project closure	☐	☐	☐	☒	☐
Assigning senior staffs to deal with knowledge needs	☐	☐	☐	☒	☐

Please give your opinion on knowledge creation in your organization *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Encouraging staffs to find alternative solutions to promote project sustainability for existing assignments .	☐	☐	☐	☒	☐
Creating new knowledge to solve specific problems during the undertakings of company duties	☐	☐	☐	☒	☐
Conducting research on different issues internally that are related to the construction industry	☐	☒	☐	☐	☐

Please give your opinion on knowledge storage in your company *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Selecting and organizing information (data) before being stored	☐	☐	☒	☐	☐
Preparing specification for storing knowledge	☐	☒	☐	☐	☐
Restricting access and keeping Knowledge confidential	☒	☐	☐	☐	☐
Staffs that possess knowledge on a specific issue can easily be identified	☐	☐	☒	☐	☐
Knowledge on different aspects are well indexed and staffs know where to find it by the time they need it	☐	☒	☐	☐	☐

Please give your opinion on knowledge sharing in your company *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Encouraging experienced staffs to mentor new r less experienced staffs	☐	☐	☐	☒	☐
Making knowledge accessible to all that are gained from different projects	☐	☐	☐	☒	☐
Conducting Repetitive training to distribute knowledge	☐	☒	☐	☐	☐
Knowledge sharing is a measure of employee's performance	☐	☐	☐	☒	☐
Providing access to the company's database	☐	☐	☐	☒	☐
Appointing Specialized (Specific) staffs for regularly updating the knowledge in the daabase	☐	☐	☐	☒	☐

Rate the mechanism on how knowledge can be applied in your company *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Encouraging Staffs to apply knowledge learned from previous projects to new (Subsequent) project	☐	☐	☐	☒	☐
Doing Pilot projects(experiments) in order to test knowledge	☐	☐	☒	☐	☐
Conducting externship programs that staffs could apply knowledge	☐	☐	☒	☐	☐

Activate W
Go to Setting

What Stages should be the essential components for securing the practice of knowledge management in the company select and decide the degree of importance (1 -Low to 5-high) *

	Very Low	Low	Moderate	High	Very High
Search Knowledge	☐	☐	☐	☒	☐
Identify Knowledge	☐	☐	☐	☒	☐
Measure Knowledge	☐	☐	☐	☒	☐
Create Knowledge	☐	☐	☐	☒	☐
Obtain Knowledge	☐	☐	☐	☒	☐
Store Knowledge	☐	☐	☐	☒	☐
Share Knowledge	☐	☐	☐	☒	☐
Apply Knowledge	☐	☐	☐	☒	☐

What Stages below may be relatively difficult to implement ?Select and decide the degree of difficulty (1 Low to 5 High) *

	Very Low	Low	Moderate	High	Very High
Search Knowledge	☐	☒	☐	☐	☐
Identify Knowledge	☐	☐	☒	☐	☐
Measure Knowledge	☐	☐	☒	☐	☐
Create Knowledge	☐	☐	☒	☐	☐
Obtain Knowledge	☐	☐	☒	☐	☐
Store Knowledge	☐	☒	☐	☐	☐
Share Knowledge	☐	☒	☐	☐	☐
Apply Knowledge	☐	☒	☐	☐	☐

Which technologies are presently being used and preferred by employees in your company for managing knowledge

	Strongly Disagree	Disagree	Nuetral	Agree	Strongly Agree
Email	☐	☐	☐	☐	☒
Expert Networks	☐	☐	☒	☐	☐
Customer relationship management	☐	☐	☒	☐	☐
Video conferencing	☐	☐	☐	☒	☐
Browsers	☐	☐	☐	☒	☐
Data warehousing	☐	☐	☒	☐	☐

Ac
Go

Which of the following knowledge management barrier is really affecting you as a company.
Please rate on a scale. *

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Employee Resistance	☐	☐	☐	☒	☐
Lack of Knowledge Retrieval	☐	☐	☐	☒	☐
Lack of Knowledge re-use	☐	☐	☐	☒	☐
Lack of Knowledge Publishing	☐	☐	☐	☒	☐
Lack of good employee perception for knowledge sharing	☐	☐	☐	☒	☐
Lack of good company culture	☐	☐	☐	☒	☐
Time constraint to meet project deadline	☐	☐	☐	☒	☐
Lack of knowledge modelling	☐	☐	☐	☒	☐
Lack of knowledge acquisition	☐	☐	☐	☒	☐

Appendix 2: Sample SPSS Output

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.837	.836	8

Item Statistics

	Mean	Std. Deviation	N
Specific Staff is responsible for obtaining knowledge from External Resources	2.76	.883	148
Recruiting external staffs to induce new concepts	2.82	.839	148
Encouraging staffs to participate in conferences, seminars, exhibition to get new knowledge	2.82	.783	148
Acquiring knowledge management related technologies and follow the best practice	2.95	.794	148
Gathering emerging knowledge from external sources	2.99	.738	148
Being informed of knowledge (new concepts) from external organization	3.01	.849	148
Gathering lessons learnt through out work proceeding during project closure	3.00	.747	148
Assigning senior staffs to deal with knowledge needs	2.98	.675	148

Inter-Item Correlation Matrix

	Specific Staff is responsible for obtaining knowledge from External Resources	Recruiting external staffs to induce new concepts	Encouraging staffs to participate in conferences, seminars, exhibition to get new knowledge	Acquiring knowledge management related technologies and follow the best practice	Gathering emerging knowledge from external sources	Being informed of knowledge (new concepts) from external organization	Gathering lessons learnt through out work proceeding during project closure	Assigning senior staffs to deal with knowledge needs
Specific Staff is responsible for obtaining knowledge from External Resources	1.000	.568	.262	.323	.204	.385	.175	.266
Recruiting external staffs to induce new concepts	.568	1.000	.417	.447	.304	.443	.185	.258
Encouraging staffs to participate in conferences, seminars, exhibition to get new knowledge	.262	.417	1.000	.533	.538	.546	.349	.276
Acquiring knowledge management related technologies and follow the best practice	.323	.447	.533	1.000	.649	.647	.482	.366
Gathering emerging knowledge from external sources	.204	.304	.538	.649	1.000	.576	.543	.273
Being informed of knowledge (new concepts) from external organization	.385	.443	.546	.647	.576	1.000	.440	.238
Gathering lessons learnt through out work proceeding during project closure	.175	.185	.349	.482	.543	.440	1.000	.216
Assigning senior staffs to deal with knowledge needs	.266	.258	.276	.366	.273	.238	.216	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item- Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Specific Staff is responsible for obtaining knowledge from External Resources	20.57	14.845	.448	.363	.835
Recruiting external staffs to induce new concepts	20.51	14.456	.551	.435	.819
Encouraging staffs to participate in conferences,seminars,exhibition to get new knowledge	20.52	14.442	.608	.417	.812
Acquiring knowledge management related technologies and follow the best practice	20.39	13.735	.732	.589	.795
Gathering emerging knowledge from external sources	20.35	14.515	.643	.544	.808
Being informed of knowledge (new concepts) from external organization	20.32	13.595	.696	.534	.799
Gathering lessons learnt through out work proceeding during project closure	20.34	15.300	.482	.338	.828
Assigning senior staffs to deal with knowledge needs	20.36	16.163	.379	.172	.838

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
23.34	18.674	4.321	8

Appendix 3: Summary on Thesis Methodology

Methodology	Purpose	Outcome
Proposal	▪ Identify the problem ▪ Define the problem ▪ Establish aim, objectives , hypothesis ▪ Develop research plan /strategy (outline methodology) ✓ Deciding on the research Approach Deciding on the research technique	Research problem Improper Practice of Knowledge Management practices in construction companies: the case of Hawass city <u>Research Objectives</u> 1.Assessing Knowledge management practices in construction companies of Hawasa city. 2.Identify the barriers to knowledge management practices in Hawassa City. 3.To propose a framework that improves knowledge management practice in construction companies in Hawassa City.

Literature Review	Collecting existing knowledge on the subject, reading, and note-taking from different sources such as: • Refereed academic research journals • Refereed conferences • Dissertations/ theses • Reports/occasional papers/ White papers • Government publications	The following points have been compiled and summarized from the previous studies: • Concept of Knowledge Management (KM), • Components of Knowledge Management • Relation of Knowledge management (KM) and organization, Knowledge Management in Construction Industry • Factors Influencing Knowledge Management ✓ Enablers of Knowledge Management ✓ Knowledge Management Models and Processes

	Books	✓ Linking Knowledge Management to Organizational Performance ✓ Performance Measurement
Questionnaire design	Questionnaires have been widely used for descriptive and analytical surveys to find out facts, opinions and views on what is happening, who, where, how many or how much (Naoum, 2007).	Types of questions: Closed-ended (multiple choice) questions and ranking the importance of factors with some open-ended questions. ✓ Question format: Rating scale (five-point Likert scale). The rating scale (five-point Likert scale) was chosen to format the questions of the questionnaire with some common sets of response categories called quantifiers (they reflect the intensity of the particular judgment involved).

Pre-testing The Questionnaire	▪ To make sure that the the questionnaire is going to deliver the right data and to ensure the quality of the collected data. ▪ To find out if the survey has any logic problems, if the questions are too hard to understand, if the the wording of the questions is ambiguous, or if it has any response bias, etc	▪ The pre-testing is conducted by academicians. ▪ The first phase of the pretesting resulted with some amendments to the wording of some words in the questions, in addition to add further explanation to some factors to facilitate the understanding of the questionnaire. ▪ The second phase was sufficient to ensure the success of the questionnaire, where there were not any queries and everything was clear.
Sampling Questionnaire & data Collection	Identify the focus group from which the the sample is to be drawn, where the term “sample” means a specimen or part of a whole(focus group) which is drawn to show what the rest is like	▪ The convenience sample was chosen as the type of sample, where convenience sampling is a non-probability sampling technique. ▪ The population(Focus Group) The population includes the top-ranked(Grade 1 and 2)in the AEC industry in Hawassa. ▪ Size sample

		290 copies of the questionnaire are distributed and 148 copies of the questionnaire are received from the respondents.
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