ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCE

SCHOOL OF INFORMATION SCIENCE

DEVELOPING A KNOWLEDGE MANAGEMENT SYSTEM FRAMEWORK FOR WATER RESOURCES MANAGEMENT: THE CASE OF EASTERN NILE TECHNICAL REGIONAL OFFICE (ENTRO)

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Declaration

I declare that this thesis is my original work and has not been submitted for any degree in any other university. I have undertaken the study independently with the guidance and support of the research advisor.

Signature: _____ Date_____

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This thesis has been submitted for examination with my approval as university advisor.

Advisor: _____ Date_____

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Abstract

Nowadays, organizations are realizing that knowledge in the form of expertise and competence is the organization's most important asset and that its quality and availability affects all aspects of the organization. Knowledge has become one of the key resources for Eastern Nile Technical Regional Office (ENTRO) to undertake its Water resources management planning and development. Knowledge management is a process through which organizations create, store, share and use their institutional or collective knowledge assets.

ENTRO realizes the importance of its knowledge resources, but it suffers from under management since the knowledge resources are not well organized and inadequate to support its proper utilization. There is no clear policy or strategy for how knowledge management processes has to be undertaken and use the knowledge resources to achieve overall organizational objectives. Knowledge management technologies play an important role to carry out knowledge management processes quickly, efficiently and cost-effectively, making it an enabling solution.

This study aimed to develop a knowledge management framework that improves knowledge management processes in water resources management of ENTRO. The study used both formal and informal discussion, semi-structured interviews, observations, and document analysis method to collect data for this research by focusing on selective individuals using purposive sampling methods.

The main contribution of this research is a theoretical knowledge management framework that serves as a guide to improve knowledge management processes in the work place. The research identified dimensions of knowledge management at ENTRO: Sensitivity of Information; Political (National) Interest; Organizational Mandate; Disclosure Policy; External Stakeholder Interests; Smooth handshakes of management and consultant transition.

Moreover, the study also recommends that emphasis should be given in the future studies related to knowledge management systems for organizations like ENTRO to support the current KM practices.

Acronyms and Abbreviation

ARCGIS	Aeronautical Reconnaissance Coverage Geographic Information System
CRA	Cooperative Regional Assessment
EN	Eastern Nile
ENCOM	Eastern Nile council of Ministers
ENSAP	Eastern Nile Subsidiary Action Program
ENTRO	Eastern Nile Technical Regional Office
ENWP	Eastern Nile Watershed Project
ERDAS	Earth Resources Data Analysis System (for remoter sensing)
FPEW	Flood Preparedness and Early Warning
IDEN	Integrated Development of the Eastern Nile
IT	Information Technology
JMP	Joint Multipurpose Project
KLC	Knowledge Lifecycle
KM	Knowledge management
KMS	Knowledge Management System
MoU	Memorandum of Understanding
NBI	Nile Basin Initiative
NCORE	Nile Cooperation for Results
RIBASM	River Basin Planning and Management
WRM	Water Resources Management

Chapter One

1. Introduction

1.1 Background to Eastern Nile Technical Regional Office (ENTRO)

The Eastern Nile region includes the countries of Egypt, Ethiopia, South Sudan and Sudan and encompasses the sub-basins of the Baro-Akobo-Sobat, the Blue Nile, the Tekezé-Setit-Atbarah, portions of the White Nile in Sudan, and the Nile proper. The geographical location of the region is shown in figure 1.1 below. The Eastern Nile countries are pursuing cooperative development at the sub-basin level through the investment-oriented Eastern Nile Subsidiary Action Program (ENSAP) (ENSAP, 2001).

Figure 1.1: Eastern Nile Basin

(Adopted from Hydrosult, 2007)

ENSAP seeks to realize and is aimed at poverty reduction, economic growth, and the environmental degradation reversal throughout the region. Towards this end, the Eastern Nile countries have identified their first joint project, the Integrated Development of the Eastern Nile (IDEN). IDEN consists of a series of sub-projects addressing issues related to flood preparedness and early warning; power development and interconnection; irrigation and drainage; watershed management; multi-purpose water resources development; and modeling in the Eastern Nile (ENSAP, 2001).

IDEN projects are divided into fast-track projects and multi-purpose track projects. The fast-track projects consist of Flood Preparedness and Early Warning (FPEW), Eastern Nile Power Transmission Project, Eastern Nile Planning Model, Eastern Nile Irrigation and Drainage Project and Watershed Management whereas the multi-purpose track projects include the Eastern Nile Power Trade, Baro-Akobo-Sobat Multipurpose project and the Joint Multipurpose Project (JMP) (ENSAP, 2001).

The Eastern Nile Technical Regional Office (ENTRO) is a technical regional body supporting the implementation of ENSAP, which has been established in 2002 and located in Addis Ababa, Ethiopia. ENTRO is responsible for providing administrative, financial management, and logistical support in the implementation and management of ENSAP. In general, ENTRO's core functions are: ENSAP coordination and integration; project preparation; financial management; communications and outreach; training; monitoring and evaluation; information exchange; and serving as the secretariat for ENSAP organizations (ENSAP, 2001).

As set forth by the Eastern Nile council of Ministers (ENCOM) in a jointly developed strategy document, promote the shared vision and realize the vision through action on the ground, the goal of the Eastern Nile cooperation is to develop the water resources of Eastern Nile Basin in a sustainable and equitable way to ensure prosperity, security, and peace for all its people (ENSAP, 2001).

ENTRO has been helped on implementing the Nile Cooperation for Results (NCORE) Project, which has US$15.3m in grant financing from the Nile Basin Trust Fund and Cooperation in International Waters in Africa Trust Fund administered by the World Bank. The project intends to facilitate cooperative water resource management and development in the Nile Basin (ENSAP, 2001).

Eastern Nile Technical Regional Office (ENTRO) is a good example of multilateral organizations, and has accumulated a considerable volume of data, information and knowledge through its project preparation activities. These knowledge resources are stored in different systems responsive to the specific needs and scope of the prepared projects. There is also quite a substantial volume of knowledge resources that is not captured in these systems and available in formats that are not easily accessible. The knowledge resources which have been produced by ENTRO with its staffs and consultants are stored in different formats; application like ARCGIS, River Basin Planning and Management (RIBASM), ERDAS Imagine, on its website, Watershed management applications, D-Space and even there are huge volume of knowledge products on Microsoft excel format also. Hence, for organizations like ENTRO, where the management and development of trans-boundary water resources management takes place, a unified approach to Knowledge Management processes is critical to ensure that knowledge is considered a common strategic asset and is broadly accessible among stockholders. Implementing technical services and managing the complexity of regional operations to achieve ENTRO goals depend on effective information and knowledge management, the technologies to support its processes to properly capture, manage, and make available to a wider group of users.

1.2 Introduction to Knowledge Management

Managers are working-hard with the responsibility of leading their organizations to achieve objectives, stated goals and values of their organizations. This does not only require flexibility and ability, but more adequate knowledge management with excellent decision-making. Knowledge has been viewed and defined from different perspectives. Knowledge is defined as a justified belief that increases an entity's capacity for effective action (Nonaka 1994).According to (Davenport and Prusak, 1998), knowledge is a blend of contextual information, framed experience, expert's experience and value that results in innovation and untouched experience.

Knowledge is regarded as organizational culture, skills, reputation, intuition, and codified theory that influences human behavior and thought (Hall & Andriani, 2003). According to Wang and Noe (2010), Knowledge management system is a critical organizational resource that provides a sustainable competitive advantage. However, to gain this advantage the

focus should not simply be on recruiting staff with specific knowledge, skills, or abilities, but also on sharing knowledge between experts and novices which are already part of the organization (Wang &Noe, 2010).

Organizations in today's world are highly realizing that knowledge in the form of expertise and competence is the organization's most important asset and its quality and availability affect all aspects of the organization. More and more executives and managers also realize all available work is centered on knowledge-intensive activities; the organization's success is directly related to the quality and relevance of these activities, particularly through knowledge workers' willingness to use that knowledge to the advantage of the organization. Which means, organizations survival is highly dependent on its intelligent use of the knowledge resources they have due to the emergence of a new economy where knowledge has become a valuable resource and asset.

According to Ming-Yu Cheng, Jessica Sze-Yin Ho and Pei Mey Lau (2003) "The dynamism of the new economy requires us to not only quickly create knowledge, but also to acquire and apply knowledge quickly". However, most organizations tend to over-emphasize on systems and tools, rather than on the core component of knowledge like proper management and knowledge sharing within organization as well as other stockholders of a given organization.

In its passive form, knowledge is useless; however, when activated through creative processes for application, replenishing and sharing, it may lead to outstanding performance. Therein, knowledge management is the process of activating passive knowledge for the benefits of organizations and to gain competitive edge (Duffy, 2000; Van Buren, 1999).

"Knowledge Management means a systematic and organized attempt to use knowledge within an organization to transform its ability to store and use knowledge to improve performance. It involves several elements like human resources practices, technology, culture and organizational structures" (Du Plessis, 2006). Several knowledge management models propose that knowledge management framework should include knowledge management enablers and processes. Knowledge management framework should have a basic understanding of knowledge operations and infrastructures to support the organizational operations. In Lee and Choi's (2003) opinion, knowledge management enablers are mechanisms employed by organizations to foster consistent knowledge usage.

Knowledge management is a process of identifying, capturing, and leveraging the collective knowledge in an organization to help the organization compete (von Krough, 1999). Knowledge management is purported to increase innovativeness and responsiveness (Hackbarth, 1998).

Knowledge management is the discipline that helps spread knowledge of individuals or groups across organizations in ways that directly affect performance. Knowledge management envisions getting the right information within the right context to the right person at the right time for the right business purpose **(**G. Schreiber, H. Akkermans, 1999**).** Knowledge management (KM) is "a systematic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that employees may make use of it to be more effective and productive in their work", *(*M.Alavi and Leidner 1999).

Hence, having an efficient KM initiative is important to understand and utilize organizational knowledge resources as well as to implement the appropriate mechanisms to generate and share existing and new knowledge. Furthermore the analysis of the broad environment where the knowledge resources exist and knowledge sharing occurs is essential to identify and overcome barriers to the success of Knowledge Management/Knowledge Sharing practices.

Knowledge Management System (KMS) is a system for managing knowledge in organizations, supporting creation, capture, and storage and sharing of expertise in the form of information. The objective of KMS is to support creation, transfer, and application of knowledge in organizations. Knowledge and knowledge management are complex and multi-faceted concepts (Maryam Alavi and Dorothy E. Leidner (1999).

1.3 Introduction to Knowledge Management Practice in ENTRO

The basic reason for managing knowledge is to make the organization act more intelligently in the way it conducts business and improve the organization's performance of profitability, viability, relationships to customers, employees, flexibility and effectiveness of internal operations.

The knowledge management in water resources consists gathering of the information about all related elements (hydrological cycle), how they are affected by the human activities, and also includes the activities to ensure information is used by the decision makers and users to improve

the water management in order to use it with sustainability. In the Nile Basin, lack of resources, have made this process of collecting information, analysis and research, a real challenge, and the lack of complete historical data series can make more difficult to conduct the studies to predict the basins behaviors and the future availability of the water. In the last seventeen years, important steps have been taken in order to have more knowledge about the water resources as an elaboration of the Water Balance, the Water Quality Diagnosis, and the hydro-meteorological studies to manage the Early Warning Systems.

ENTRO has taken numerous steps to improve its information systems, and foster region wide knowledge-sharing initiatives, all in support of enhancing the cooperation of the regional countries towards realizing their shared vision ," To be a credible Eastern Nile institution fostering sustainable trans-boundary cooperative boundary cooperative water resource management and development; and promoting regional integration" (ENTRO-Vision Statement). As background to an assessment and identification of determinant factors of knowledge management (KM) in organizations by taking the case of ENTRO, this paper presents an exploration of the literature on the factors that can affect organizational knowledge management practice success.

From the definitions of Knowledge management, it encompasses theories, models, processes and technologies that support the protection, development and exploitation of knowledge assets. By managing intellectual capital that exists in both explicit and tacit forms, The KMS framework which is going to be developed will enhances ENTRO's organization's ability to learn from its environment and incorporate knowledge into business processes as well as create a new value for the organization by improving its efficiency, effectiveness and competitiveness.

In order to help the organization (ENTRO) to be more efficient, innovative and provide a methodology to improve the knowledge management practice the researcher will develop a knowledge management framework. It will also provide a basis for organizations to undertake the design of better policies, modification of actions and delivery of desired results. Accordingly, the framework will present and can be used by any person intending to develop or evaluate knowledge management in any organization. The integration of previous frameworks into this comprehensive framework can aid the acceleration of research in knowledge management.

In other words, framework will serve as a guideline for researchers and practitioners to design, compare, and validate knowledge management systems based on a thorough analysis of current research of influence factors for successful knowledge management in water resources. (Bhagat et al, 2002, CEN, 2004, Maier, 2007) described knowledge management frameworks are created to achieve a common understanding in the domain, to structure approaches and practices (Grover & Davenport, 2001) and to identify research gaps (Alavi and Leidner (2001). Consequently, organizations must be aware of their knowledge resources since it is essential to achieve efficient product development or innovation excellence. It is the responsibility of management to increase the firm's performance by improving the networks for knowledge sharing (Visvanathan Naicker and Nasraldin Omer, 2014).

For effective coordination and institutional performance, water resources management within the basin must be essentially knowledge-driven. As the physical and social characteristics of a river basin system are less visible than in a more visible irrigation system, an effective management effort in a river basin should necessarily rely on a sound database about the physical, social, environmental, economic and institutional parameters of the basin. The different actors and different sectors using land and water resources within the basin should be able to understand and assess the requirements of one another, as well as the limitations imposed on each of them by the overall environmental considerations.

A basin-wide approach to knowledge management particularly aimed at assessing the influences on agricultural water management, needs to be based on a number of key sets of knowledge related to the basin, which the study components seek to gather: present conditions of the physical subsystem, availability of water and its quality, analysis of its social subsystem including who uses water for what purposes, how the uses and users have been organized and their binding rules, and current performance levels of the production systems.

1.4 Statement of the Problem

Over nearly two decades of its existence, ENTRO's has produced a range of Knowledge Products. Each knowledge product is commissioned (e.g. to International Consultants) and produced to support specific Projects. For example, Water Resources Planning knowledge products generate a number of analyses and forecasts that enable managers understand how much rainfall there might be in a specific catchment of Eastern Nile making possible

identification of river reaches and human settlement/economic activity areas that will be at the risk of inundation, making timely evacuation and/or prevention possible. Similar products make possible plan irrigation activities more efficient. There are also knowledge products that support water resources investment planning such as hydropower generation dams; water storage infrastructure; irrigation schemes, etc. In addition to specialized water resources there are knowledge products that make possible accounting the organization financial performance; human resources management; inventories, etc. Maps which identify and demarcate water bodies, water dependent ecosystems like wetlands, deltas constitute part of ENTRO's knowledge products, in addition to routine management records such as correspondences, meeting minutes, etc (ENSAP, 2001).

ENTRO's knowledge products are generated under the responsibility - supervision and management - of specific technical personnel, called Project Managers, such as the IDEN Project Managers. These Knowledge Products are generated using different application systems such as Water resources modeling and analytic tools and software (e.g. RIBASIM, Nile-DSS, Hydro economic Modeling – ENMOS; ArcGIS), financial management and accounting (ENSAP, 2001). ENTRO's knowledge products can come in hard copy and soft copy. This means, there are plenty of knowledge resources acquired in ENTRO and obtained through different phases of the projects. However, most of the resources are bound within the scope of project found in a much-disorganized manner either in shelves and papers or files dispersed over individual computers.

Preliminary analysis on the organization's founding document, policy papers and personal observation indicate that the knowledge resources at ENTRO are not well organized and there exists inadequate system and framework to support its proper utilization. The limited and inadequate knowledge management system has resulted in loss of knowledge resources, difficulties to identify and retrieve and even to know what is currently available. Preliminary assessment and observation indicate that the way of updating, maintaining and quality control, coordination between projects in terms of knowledge resources is very poor. In addition, there is no responsible individual in the organization in charge of managing knowledge to minimize the loss of the knowledge resources.

Multilateral organizations like ENTRO are characterized by such a complex political, social and human factors, which significantly determine the way knowledge is generated, stored and shared. Within ENTRO, there is a vast volume of knowledge products which are done by different institutes, consultants, researchers and other stakeholders without a support of uniform knowledge management systems that are not accessed by the general public. There is also quite a lot of knowledge products available in different format in the hand of staffs and stakeholders.

These visible gaps of knowledge management need to be clearly identified and organized to develop a knowledge management framework for ENTRO in order to efficiently benefit from the wealth of knowledge with uniform enhancing technologies to improve accuracy and knowledge management practices as well as decision making by using knowledge resources effectively. ENTRO's knowledge management problems can be summarized as follows:

- There are plenty of information resources acquired in ENTRO which are obtained through different phases of the projects but most of the resources are bound within the scope of project found in a much disorganized manner
- The current practice at ENTRO with regards to knowledge management is not well organized and inadequate to support flow of information and its proper utilization.
- Lack of data sharing policy as to whom and how knowledge products should be shared to stakeholders and outsiders coupled with lack of responsible individual in charge of managing knowledge resources in the organization.

Accordingly, this research is expected to answer the following two major research questions:

Question 1: What are the knowledge management problems in Water Resources Management in ENTRO?

Question 2: Does ENTRO need a Knowledge Management Framework to address the challenges of its water resources knowledge products generated from various projects/programs?

1.5 Objective of the Study

1.5.1 *General Objective*

The general objective of this research is to develop a knowledge management system framework for water resources management of Eastern Nile Technical Regional Office (ENTRO) with the intention to provide the insights and implementing solutions by enabling technologies for enhancing Knowledge management practice and Knowledge Sharing.

1.5.2 Specific Objectives

The specific objectives of this study are the following:

1. Identifying the knowledge management resources and their processes at ENTRO.
2. Assess and capture the knowledge resources needed as a fundamental aspect of Knowledge management in water resources management research.
3. Develop a knowledge management system framework for water resources management that supports ENTRO to manage its valuable knowledge resources and promote knowledge sharing.

1.6 Significance of the Study

Knowledge management is the concept under which information is turned into actionable knowledge and made available effortlessly in a usable form to the people who can apply it. It can be seen as a framework within which the organization views all its processes as knowledge processes. Effectiveness of knowledge management depends on how knowledge management processes are aligned with an organization's infrastructure and processes, in a manner that supports the achievement of an organization's objectives. This study is intended to develop a knowledge management framework to effectively manage the wealth of knowledge generated in water resources management from different projects and programs the case of ENTRO.

By in large, the research finding will help in making the vast volume of knowledge available in the hand of ENTRO staffs and key stakeholders managed and accessible for wider public. It (the findings) could also be used as an input to enhance knowledge management practice to enable stakeholders to improve knowledge management/sharing practices with in the ENTRO countries and other knowledge based organizations in general.

1.7 Scope of the Study

The scope of this research study was on developing a Knowledge Management System framework in water resources management, together with or pointing out existing opportunities and best practices of knowledge management using technology in the case of ENTRO.

1.8 Organization of the Thesis

This research paper is organized into six chapters. The first chapter, introduction, is discussed here above with sections including the problem statement, the general and specific objective, significance and scope of the study. In the second chapter, literature reviews on theoretical concept and related works are presented. This chapter focuses on reviewing Knowledge, knowledge management, knowledge management processes, knowledge management systems, knowledge management framework, knowledge management and business strategies, knowledge management practices at Eastern Nile Technical Regional Office and summary of related works on knowledge management systems, Knowledge modeling/ framework are discussed.

Chapter Three discusses the research methodology and techniques used for this research to address the research questions stated in chapter one. Chapter four presents the study findings presentation of the data generated from semi-structured interviews and their responses and closes this chapter with summary of the results. The fifth chapter discusses this research domain area for knowledge management framework, data gathering and analysis as well as detail knowledge management framework building processes. This chapter also proposes KMS framework for water resources management in ENTRO. The last chapter, chapter six, presents thesis conclusion and recommendations along with future research directions.

Chapter Two

2. Literature Review

2.1 Overview of Knowledge

Nowadays, organizations are becoming and concerned with their organizational knowledge and their use of knowledge to create and make quality products, deliver quality services, and maximize the efficiency of their internal operational processes. The fact that knowledge is a company's asset no longer lies in the ability to store and retrieve them, but in the management of its usage the complex nature of knowledge and diverse strategy for managing the knowledge resources.

Most of the writings and practices in knowledge management seem to focus on the content of knowledge management systems, overlooking how knowledge is presented or communicated. Managing knowledge occurs within a complex structured social context. There are social and human factors in the creation and exchange of knowledge which are constituted in the organizational culture and nature.

The goal of this chapter is to review key research issues on knowledge management, Knowledge management systems and review previous research on knowledge management frameworks or phenomenon. The literature review is organized into eight sub sections: Overview of knowledge, knowledge management, knowledge management processes/cycles, knowledge management systems, knowledge management enabling factors, knowledge framework and knowledge management practice in ENTRO.

2.2 The Notion of Knowledge

2.2.1 Definition of Knowledge

A review of the literature in strategic management, organizational theory, knowledge management and information systems disciplines indicate that there have been many definitions and viewpoints of knowledge existed in order to understand knowledge. Due to the interdisciplinary nature of knowledge, it is difficult to find a single definition of knowledge.

To begin with the definition adopted by much of the published research to date:

> Nonaka& Takeuchi (1995) defined knowledge as "a dynamic human process of justifying personal beliefs as part of an aspiration to the truth".
>
> Davenport and Prusak (1998) defined knowledge as "a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information" and "it originates and is applied in the mind of the knower". It is a high-value form of information that is ready to apply for decisions making and actions.
>
> Leonard and Sensiper (1998) defined knowledge as "information that is relevant, actionable and based at least partially on experience". Knowledge is a subset of information; it is subjective and is linked to meaningful behavior and experiences.
>
> O'Dell and Grayson (1998) define knowledge as "what people in organization know about their customers, products, process, mistakes, and success".

2.2.2 Data, Information and Knowledge

On the other hand there is a commonly held view, mostly in information science literature, of uses a hierarchy of data, information and knowledge to describe the characteristics of knowledge. The term knowledge has many definitions but it is not a clear concept as it extremely related with the terms data and information. Even though data, information and knowledge are related, they should not be used interchangeably (Blumentritt& Johnston, 1999).

Therefore, it is helpful to differentiate data, information, and knowledge for clarification. Data are the raw material for information, and information is the raw material for knowledge (Zins C., 2007). According to Zins C. (2007), data is a symbol set that is quantified and/or qualified, which are sensory stimuli that we perceive through our senses, while Information is data that has been processed into a form that is meaningful to the recipient. **Knowledge** is what has understood and evaluated by the knower.

The figure on the next page shows the hierarchy of data, information and knowledge.

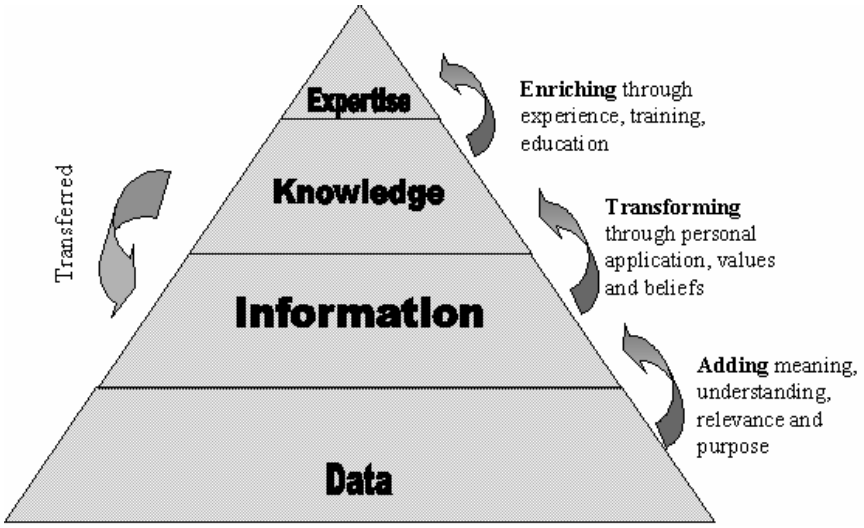


Figure 2. 1: Hierarchy of data, Information and knowledge

Source: Bender and Fish (2000)

Data are raw facts that are recorded and stored. Data do not have much meaning. Data are specific numerical or symbolic representations of facts about the world. According to (Davenport et. el (1998), data is a set of discrete, objective facts about events. Similarly, Klicon (1999) also defines data as un-interpreted material on which a decision is to be based and depends on facts which may include anything known to be true or exist. Data must be sorted, grouped, analyzed, and summarized to have meaning. When data are organized and processed, they become information. Bender and Fish (2000) explained that data become information only when they have meaning, understanding, relevance and purpose.

Information is a useful organization and selection of facts, not the number of facts available. It involves relationships among the represented facts. Information has meaning and value to the receiver. Wiig (1993) define Information as full or partial description of the state or condition of a situation, and he also mention that information is organized data--- organized by someone else. Klicon (1999)also defines information as results from the interpretation of data in a given context. From his definition, single content of data may produce different information contents if the context is different (Klicon, 1999). Information becomes knowledge when it is combined with context and experience. In other word, Information is transformed in to knowledge when the individual processes it and internalize it.

Knowledge consists of data or information that has been organized and processed to give understanding, experience, and expertise in a specific context. Knowledge is organized information, internalized by me, integrated with everything else I know from experience or study or intuition, and therefore is useful in guiding my life and work (Cleveland, Harlan (1985); Wiig (1993). Wiig (1993) describe knowledge as the body of understandings, generalizations, and abstractions that we carry with us on a permanent or semi-permanent basis and apply to interpret and manage the world around us. Information comprises facts that are organized in a structured way, whereas knowledge incorporates values, beliefs, perspectives, judgments, and know-how. Compared to data and information, it is hard to manage knowledge due to the context- dependent aspect of knowledge. Many studies reveal that to distinguish data, information and knowledge is useful to represent them in a hierarchy.

In the hierarchy that shown in the above figure: knowledge is represented at the top with the most value and meaning and data at the bottom with the least value and meaning (Awad & Ghaziri, 2004; Bierly et. al.2000). *"Given the role of technology in transferring and disseminating knowledge, a true picture of knowledge is one where people voluntarily explore, use and adopts knowledge in the best interest of their organization."*Awad, Elias M and Ghaziri, Hassan M (2008).

Wiig (1993) define Skill as the practical ability to perform certain tasks and functions particularly based on knowledge of techniques (know-how). According to Wiig (1993), being highly skilled often means that one is very good at performing tasks in the present environment, without necessarily possessing the knowledge and broad understanding required to be flexible enough to transfer those skills to a new environment when business changes.

The following table summarise definition of data, information by different authors and their view of knowledge (which is shown on the next page):

Authors	Data	Information	Knowledge
Wiig (1993)	---	Facts organized to describe a situation or a condition	Truths and beliefs, perspectives and concepts, journals and expectations, methodologies and know-how
Nonaka and Takeuchi (1995)	---	A flow of meaningful messages	Commitments and beliefs created from these messages
Spek and Spijkevet (1997)	Not yet interpreted symbols	Data with meaning	The ability to assign meaning
Davenport (1997)	Simple observations	Data with relevance and purpose	Valuable information from the human mind
Davenport &Prusak (1998)	A set of discrete facts	A message meant to change the receiver's perceptions	Experience, values and insights and contextual information
Quigley and Debons (1999)	Text that does not answer questions to a particular problem	Text that answers the questions who, when, what, or where	Text that answers the questions why or how
Choo et al (2000)	Facts and messages	Data vested with meaning.	Justified, true beliefs
Chaimzins (2007)	Sensory stimuli that we perceive through our senses	Data that has been processed into a form that is meaningful to the recipient	What has understood and evaluated by the knower; Or Information that has been appropriate by the user

Table 2.1: Some definition of Data, Information and Knowledge

2.2.3 Classifications of Knowledge

There are several types of knowledge classification in knowledge management literatures. These classifications have been emerged and used within the knowledge management literature as a response to the growing interests in managing knowledge and rising awareness of its usefulness and importance. Hence, identifying the type of knowledge is an important issue to help the organizations in managing their knowledge resources successfully by identifying the different types of knowledge with different tools and activities to process and manage it (Tserng& Lin, 2004; Lin et al., 2006).

2.2.4 Tacit versus Explicit Knowledge

In KM literature, tacit vs explicit knowledge is the most common categories of knowledge depending on its use. According to (Polanyi, 1962), tacit knowledge is very hard to communicate or share and is personal i.e. deeply rooted in actions. (Wiig, 1993; Nonaka, 1994) made a distinction between the tacit and explicit type of knowledge. Tacit knowledge refers to the knowledge that has a personal quality that makes it hard to articulate or communicate. It is so well internalized and automated that we take it for granted and cannot readily articulated it (Wiig, 1993).It can be said to be the knowing or the deeply rooted know-how that emerges from action in a particular context, which is embedded in human minds.

The tacit knowledge is based on thinking, experience, and feelings in a specific context, and is comprised of both technical and cognitive components. The cognitive component refers to an individual's mental models, maps, beliefs, paradigms, and viewpoints. The technical component refers to concrete know-how and skills that apply to a specific context (Alavi and Leidner, 2001).Therefore tacit knowledge is highly personal and hard to be managed, shared or formalized since it includes experiences, know-how and perceptions, which normally reside in individuals' mind and memories (Nonaka, 2007; Lin et al., 2006).

According to (Wiig, 1993), Explicit knowledge can be examined and used directly by either being available to our conscious minds or by formalized and systematized in documents, procedures, computer programs, data files, newsletters, audio cassettes, disk and other physical forms.

Explicit Knowledge is the “know-what” which can be extracted from the knowledge holder and shared with other individuals (Nonaka&Takeushi, 1995). Therefore, it can be shared, cumulated, communicated and analyzed.

	Tacit knowledge	**Explicit Knowledge**
Nature	• Within-person knowledge • Difficult to articulate • Hard to share • Can be shared only indirectly	• Easily Identifiable • Relatively easy to share • Requires interpretation
Mechanisms to generate and sharing	• Practice • Personal and team reflection • Drawing mental maps • Apprenticeship • Social interaction and mentoring • Story-telling and metaphors • New codification systems can make some tacit knowledge easier to share, through converting some elements of it in to explicit knowledge	• Codification • Documentation • Database and search engine • Blogs, wikis, and internet
Typical examples	• Intuition and insights • Practical intelligence, skills and practice • Know-how and heuristics • Rules of thumb. • Mental models and beliefs.	• Information • Know-that • Theoretical knowledge

Table 2. 2: Tacit vs. Explicit knowledge

(Adopted from Nonaka &Takeushi, 1995)

2.2.5 Individual versus Group/Collective Knowledge

Individual knowledge is the knowledge possessed by individual in their minds (Arshad Ahmad and Hashim Khan, 2008). This knowledge can be in the form of experiences, abilities and skills of individuals. Similarly, Ahmad and Khan (2008) also define Group knowledge as the kind of knowledge which is present or possessed in working groups. Further, group knowledge can be either tacit or explicit depending on nature.

According to Ahmad and Khan (2008), individual knowledge and group knowledge have same importance because individual experience about past projects, knowledge of culture helps a lot in requirements understanding whereas group knowledge also helps in requirements understanding like organization standards for requirements specification, policies and task division.

2.3 *Knowledge Management*

As organizations strive to improve their business performance and capacity for innovation, their attention is increasingly focused on how they manage knowledge. The fundamental of applying and sharing knowledge is not new. However, important contextual factors make Knowledge Management more relevant today. Knowledge is increasingly recognized as key to socioeconomic development, including water resources.

Managing Knowledge resources helps organizations to provide their people the ability to use systematic methods and procedures that were created or used by others previously to solve similar problems, and to learn from past experiences, while maintaining the new created experiences to be used in the future (Baker et al., 1997; Davenport &Prusak, 1998; Tiwana, 1999).

2.3.1 Knowledge Management Definition

We have seen some definition and conception of knowledge by different scholars in the field. Let us also see some definition and conception of knowledge management. Prior research on knowledge management (KM) indicates that there is also multiple definitions of knowledge management. For instance, O'Dell et al., (1998) define knowledge management as "*a conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that strive to improve organizational performance*".

Alavi and Leidner (1999) define knowledge management (KM) as "*a systemic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that other employees may make use of it to be more effective and productive in their work*". Beckman (1999) define knowledge management (KM) as "*the formalization of and access to experience, knowledge and expertise that create new capabilities, enable superior performance, encourage innovation and enhance customer value.*"

Knowledge management is the conceptualizing of an organization as an integrated knowledge system, and the management of the organization for effective use of that knowledge. Where knowledge refers to human cognitive and innovative processes and the artifacts that support them (Quinn, 1992), KM in its broadest sense, is a conceptual framework that encompasses all activities and perspectives required to gain an overview of, deal with, and benefit from the corporation's knowledge assets and their conditions (wiig, 1993).

The central premise behind knowledge management is that all the factors that lead to superior performance – organizational creativity, operational effectiveness, quality of products and services – are improved when better knowledge is made available and used competently (Wiig, 1994: 16). The management process of ensuring that the organization's knowledge needs are met and exploiting the organization's existing knowledge assets (Taylor, 1996). Knowledge management is the explicit and systematic management of vital knowledge and its associated processes of creating, gathering, organizing, diffusing, using and exploitation. It requires turning personal knowledge into organizational knowledge that can be shared widely throughout an organization and applied appropriately (Demarest, 1997, Davenport, 1997b) Processes of capturing, distributing and effectively using knowledge, Knowledge Management (KM) is a conscious strategy of getting the right information to the right people at the right time so they can take action and create value (O'Dell and Grayson, 1998).

These various definitions of knowledge management tells that, knowledge management is a set of things involving various activities like theories, models, processes and technologies for exploitation, creation, retaining, sharing and using of knowledge. These activities have always been managed historically for organization that has no explicit knowledge management strategies; effective knowledge management needs explicit knowledge management system.

Managing the knowledge resources in given organization will enhance an organization's ability to incorporate knowledge into business processes and organizations to perform intelligently to sustain their competitive advantage by using their knowledge assets. Experience has shown that successful KM implementations in business settings prioritize attention on soft issues - including human and cultural aspects, personal motivations, change management methodologies, new and improved business processes enabling multidisciplinary knowledge sharing, communication and collaboration - and sees technology as an enabler.

2.4 *Knowledge Management Processes*

Although there are inconsistencies about the knowledge management processes, various definitions of knowledge management show that all the process of knowledge management in organizations is much related. Knowledge management process help to share perspectives, ideas, experience and information; To make sure that knowledge management related experience, ideas and perspectives are available in the right place at the right time and improve efficiency knowledge management processes help to enable informed decisions and reducing the need to rediscover knowledge.

According to Gold (2001), knowledge management process classified into four broad dimensions of process capability – acquiring knowledge, converting it into useful form, knowledge application and protecting knowledge. Five basic activities of knowledge management processes are noted by Serrat (2008): capture, create, store, share and use knowledge. Lei et al. (2000) divide the knowledge management process into four high level processes and the processes are knowledge acquisition, knowledge coordination and induction, knowledge transmission and diffusion and knowledge creation.

Most of the definitions of knowledge management explain that knowledge management processes outline all aspects involved in the actual management of knowledge. Most literatures like Wiig (1993; Meyer and Zack (1996); Alavi and Leidner (2001); O'Dell (2003); McElroy (2003); Dalkir (2005); Sagan (2009) and others scholars in KM field reveal that in order to achieve the organizations' goals there are five key processes associated with knowledge management: knowledge creation, knowledge capturing, knowledge storage ,knowledge sharing, and knowledge application.

Knowledge creation is a continuous process whereby individuals and groups within a firm and between firms share tacit and explicit knowledge (Bloodgood & Salisbury, 2001; Bohn, 1994). Alavi and Leidner (1998 and 2001) refer to knowledge creation as the creation of new knowledge that does not exist before from both the organization and from outside. Knowledge creation process includes the transformation (both creation and transferring) of tacit knowledge to explicit knowledge and vice versa. Organizational knowledge creation involves developing new content or replacing existing content within the organization's tacit and explicit knowledge (Pentland, 1995), in which new knowledge is generated within the process of learning.

According to Nonaka and Takeuchi (1995), knowledge creation process includes four distinctive processes as socialization, externalization, combination, and internalization for the conversion of tacit and explicit knowledge. The following figure shows the four mode of knowledge conversion by Nonaka (1994):

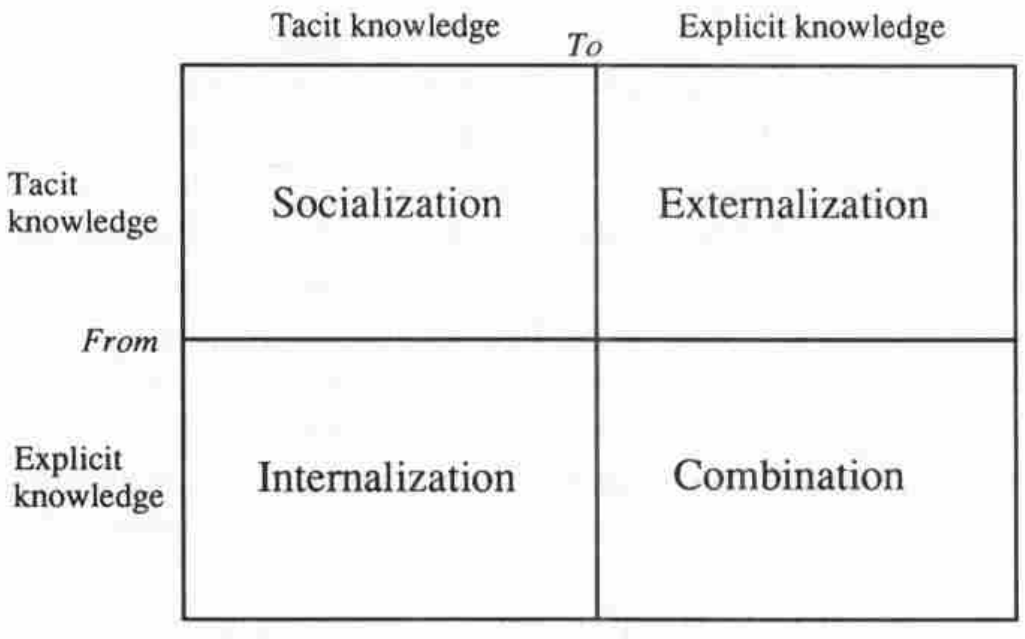


Figure 2. 2: Nonaka's Four Modes of Knowledge conversion

- Tacit-to-tacit (**Socialization**) – where individuals acquire new knowledge directly from others.
- Tacit-to-explicit (**Externalization**) – the articulation of knowledge into tangible form through dialogue.

- Explicit-to-explicit (**Combination**) – combining different forms of explicit knowledge, such as that in documents or databases.
- Explicit-to-tacit (**Internalization**) – such as learning by doing, where individuals internalize knowledge from documents into their own body of experience.

Knowledge capture defined as the process of retrieving either explicit knowledge (that may reside in a manual or similar document or file - but few people might be aware of) or tacit knowledge (that may reside within people, artifacts, or organizational entities) (Becerra-Fernandez et al., 2004).

Knowledge storage/retrieval is the process of storing organizational knowledge for future retrieval and to provide a better understanding of knowledge for workers. Knowledge storage provides coding and indexing of knowledge for later retrieval. Knowledge reside or is stored in different place in the organization: in the minds of people, in organizational processes, in organizational culture, in written documents, or digital storage devices (Davenport &Prusak, 1998).

Davenport &Prusak (1998) reveals that storing the knowledge without losing its distinctive features makes the stored knowledge valuable for the organization. Halawi et al (2005) explain that storage of knowledge reduces the knowledge recreation processes and it also facilitates the job learning.

Knowledge sharing is the process through which explicit or tacit knowledge is communicated to other individuals. Alavi and Leidner (2001) refer to knowledge sharing as knowledge transfer and define it as the process of disseminating knowledge throughout the organization.

Chua (2004) defines or consider knowledge sharing as the flow of knowledge from among individuals in a given organization and will foster the flow of knowledge among organization members. Moreover, an effective knowledge management system isa shared system where individual can access and contribute to the knowledge base as well.

Knowledge Reuse / application: can be described refers to the real use of captured and created knowledge and put into the management of knowledge life cycle (Kim, 2004). It is the process of getting knowledge utilized for making decisions and performing task perfectly for the organizational success. Alavi and Leidner (2001) consider knowledge application as an

important source of competitive advantage than the knowledge itself. Knowledge utilization results in knowledge increase, by gaining expertise and insights. Knowledge application also refers the process of using organizational knowledge for making decisions and performing task perfectly for the organizational success. Only knowledge application can ensure that the organization knowledge represents a viable source of competitive advantage. Without knowledge application, all the other knowledge management processes are useless.

Organization that needs to implement knowledge management system must begin by specifying the necessary knowledge management processes. Organization also needs to understand the knowledge management cycle which helps to successful adoption of knowledge management systems. The knowledge management processes need to be supported by technology to facilitate the knowledge management systems. To have an effective knowledge management in organization, the knowledge management processes must be included in the knowledge management framework.

2.5 *Knowledge Management Systems*

Some definition of KMS has been proposed by some researchers. (Alavi and Leidner, 1998) defined Knowledge management systems (KMS) as class of information systems that have evolved from the need to enable systematic organizational learning and memory by facilitating the coding and sharing of knowledge across organizational entities that previously may have had little occasion for interacting; which means, it is class of information systems applied for managing organizational knowledge. It also helps to facilitate the capture, storage, and sharing of knowledge using information technology by simplifying various knowledge management processes such as knowledge creation, storage/retrieval, transfer, and application.

KMS would consist of hardware, software, people, and organization environment around it. KMS has its own characteristics many KM initiatives rely on IT as an important enabler. Rusli and Mohd et al. (2005) also define Knowledge management system as a collection of computer-based information system applied to managing organizational knowledge. Knowledge management systems (KMS) are applications of the organization's computer-based communications and information systems (CIS) to support the various KM processes. They are typically not technologically distinct from the CIS, but involve databases, such as "lessons

learned" repositories, and directories and networks, such as those designed to put organizational participants in contact with recognized experts in a variety of topic areas.

A significant difference between many knowledge management systems and the organization's CIS is that the KMS may be less automated in that they may require human activity in their operation. While information systems typically require that humans make choices in the design phase and then operate automatically, KMS sometimes involve human participation in the operation phase. For instance, when a sales database is designed, people must decide on its content and structure; in its operational phase, it works automatically. When a "lessons learned" knowledge repository is created, people must make all of the same design choices, but they must also participate in its operational phase since each knowledge unit that is submitted for inclusion is unique and must be assessed for its relevance and important.

KMS are complex socio-technological solutions, providing opportunities for users to create knowledge assets and to share them while interacting with other agents. On the other hand, KMS are recognized to be one major enabler for KM processes within organizations (Antonova A. and Nikolov R.). KMS provide the basic KM infrastructure within organizations, enabling knowledge workers and organizations to better access and use existing knowledge resources.

2.6 *Knowledge Management Framework*

To effectively manage knowledge resources, it is necessary to have an organizing principle to classify the different activities and functionalities needed to deal with all the knowledge-related aspects within the organization. A knowledge management framework is -- a set of systematic approaches to analyzing, organizing, and developing better ways of handling knowledge (Wiig, 1993). As Wiig (1993) says, a Knowledge management framework will be artificial by its very nature and also required to determine how effective available methodologies and approaches are, how and why they should be improved, and which knowledge-related methodologies are still needed. The framework is required to support a coordinated expansion of our understanding the knowledge resources we have and how we are going to deal with it.

J.C. Mostert and Snyman (2007) define knowledge management framework as a matrix that depicts knowledge management as a set of processes, which are defined through the application of the four management functions (planning, organizing, leading and controlling) to each of the organizational knowledge processes.

There are several knowledge management life cycle frameworks that have been developed by many researchers in the fields over last two decades. Some of the most influential pioneers who developed theories, models and frameworks of knowledge management are discussed in the next section.

2.7 Historical Overview of KM Life Cycles and Frameworks

2.7.1 WIIG's Knowledge Management Framework

Karl M. Wiig is one of the pioneers of in the field of knowledge management. He defines KM as a set or series of distinct and well-defined approaches and processes to find and manage positive and negative use of knowledge functions in different kinds of operations. Wiig (1993) further explains the importance of a comprehensive and relevant perspective KM framework to effectively and securely manage the knowledge resources. Wiig's (1993) view of KM framework is based on three mutually supportive pillars that connect KM to its foundation, consist of a number of methods and approaches that can be drawn upon to meet a variety of different demands and challenges: Wiig's (1993) KM framework is based on three mutually supportive pillars which are supported by a conceptual KM base. The base has four processes: knowledge creation, manifestation, use and transfer.

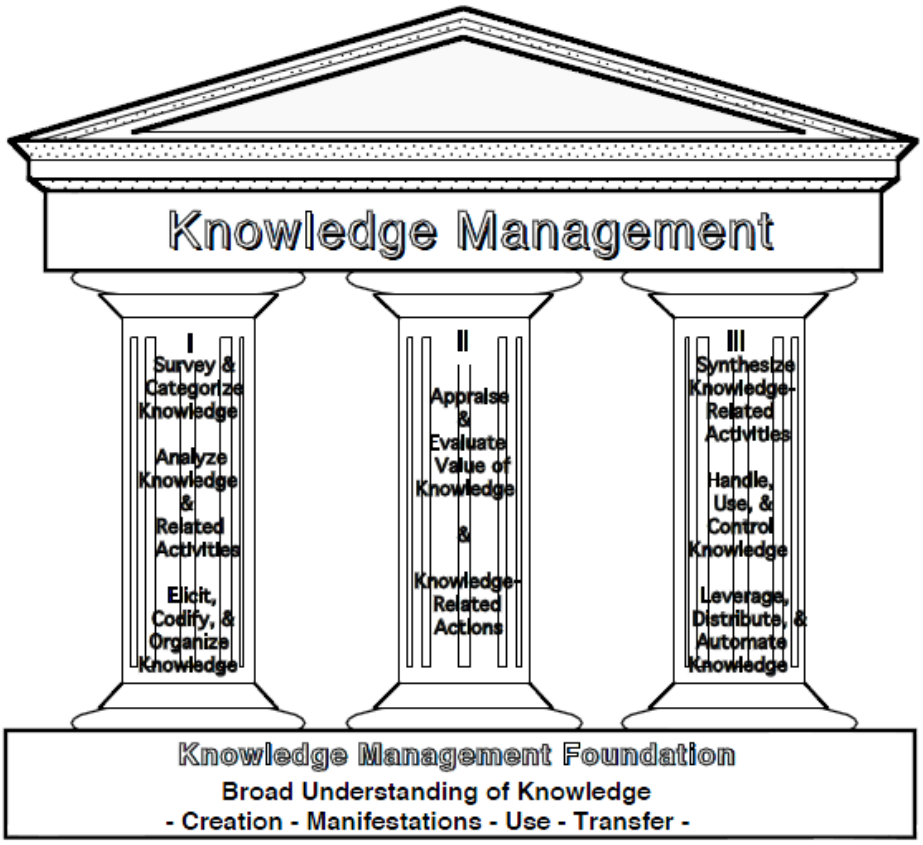


Figure 2. 3: Wiig's Three Pillars of Knowledge Management

As shown on the above figure, each of the three pillars has different functional areas. The first pillar has three functional areas: - survey and categorize knowledge; analyze knowledge and related activities; and elicit, codify and organize knowledge. The second pillar has two functional areas: - appraise and evaluate the value of knowledge and related actions. Similarly, the third pillar has also three functional areas: - synthesize knowledge and related activities; handle, use and control knowledge; and leverage, distribute and automate knowledge. Wiig (1993) reveals that the framework is based on the understanding of how knowledge is created, used, and manifested in people's minds and culture; how knowledge is used to reason, solve problems and make decision; and how it is transferred.

The framework is presented to create a working understanding of the methodologies and approaches, show how they relate to each other and to the overall task of managing knowledge, and to illustrate how the concepts and methods are made useful in business. This KM framework, supported by the three pillars, provides approaches for immediate and higher level managers to look at underlying functions and problems of knowledge-related issues. They can

use these framework approaches to plan their actions based on how well they serve the broader needs and goals of the enterprise.

2.7.2 Bukowitz and Williams's Knowledge Management Processes Framework

Bukowitz and Williams (2000) describes a knowledge management process framework as a simplified way of thinking how organizations create, maintain and deploy knowledge to create value. According to Bukowitz and Williams (2000) framework, knowledge is includes knowledge repositories, relationships, information technologies, communications infrastructure, skills sets, process know-how, environmental responsiveness, organizational intelligence, and external sources. This KM process framework generally divided into two broad processes: the tactical and the strategic.

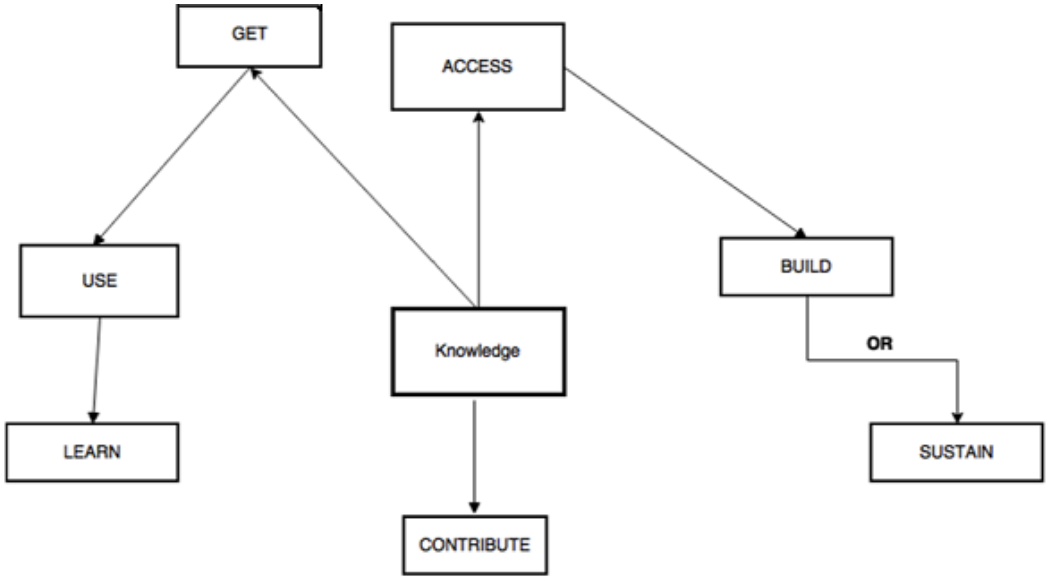


Figure 2. 4: Bukowitz and Williams KM Process framework

The tactical process is triggered by market-driven opportunity or demand, and the strategic process is triggered by shifts in the macro-environment Bukowitz and Williams, 2000; Evans M, Dalkir K and Bidian C, 2014; M. Shongwe, 2016). As shown on the above figure 2.5, the tactical side spans four basic steps: get information, use it, learn from it, and contribute it. The strategic process spans three: assess information, build and sustain an information database, and divest the information. According to Bukowitz and Williams (2000), these processes ensure that organizations use their knowledge to respond to demands and opportunities from the market place.

2.7.3 Alavi and Leidner's Knowledge Management Framework

Alavi and Leidner(2001) views of KM lifecycle from an information systems perspective. This framework explains the roles of information technology in organizational knowledge management and view organization as knowledge systems. It hypothesizes that information systems play very important roles for the sets of KM processes: - knowledge creation, storage and retrieval, transfer, and application. These set of processes are interconnected and inseparable as well as have a dynamic nature for each of KM processes.

Alavi and Leidner (2001) discuss some of information system supports for organizational knowledge management framework, like data warehousing to support knowledge creation; multimedia databases and query languages to support knowledge storage; lotus notes to support knowledge transfer; and decision support systems to support knowledge use.

2.7.4 Birkinshaw and Sheehan's Knowledge Management Lifecycle Framework

Birkinshaw and Sheehan (2002) developed the four stage of KM lifecycle framework so that organizations can modify their knowledge-management techniques to the particular stage of the life cycle they are in and extract greater value from their knowledge assets. The main objectives of this framework is to explain how the KM lifecycle of an idea can be applied to get economic value or in a commercial setting. knowledge is began or started as something in a person's head, and that it takes shape once it is tested, matures as it is applied in real life settings, is diffused into a growing audience, and finally becomes accepted as common practice(Birkinshaw and Sheehan, 2002).

According to Birkinshaw and Sheehan (2002) the four stage of Knowledge progresses life cycle in the framework are: knowledge creation, mobilization, diffusion and commoditization. As knowledge becomes accessible to more and more people — first in one organization, then in many, and finally to the general public — companies must use different strategies to realize its maximum value. They further explain that there are four categories that has to be considered in each stage of the KM life cycle: the informal knowledge systems for mobilizing and sharing knowledge, information technology systems, human resources, and relationships with external parties (Birkinshaw and Sheehan, 2002).

2.7.5 Mark W. McElroy's Knowledge Management Framework

McElroy's (2003) framework suggests that the KM lifecycle begins with the detection of knowledge problems or gap by agents, agents are engaged in the business processes to get experience of the knowledge gaps of how to move from current states to goal states, and ends with the choice of newly validated knowledge claims and beliefs. In other words, agents or people start the KM lifecycle processes with a knowledge gap realization, and end up with desired knowledge. According to McElroy (2003), the Knowledge lifecycle has two major activities: knowledge production and knowledge integration.

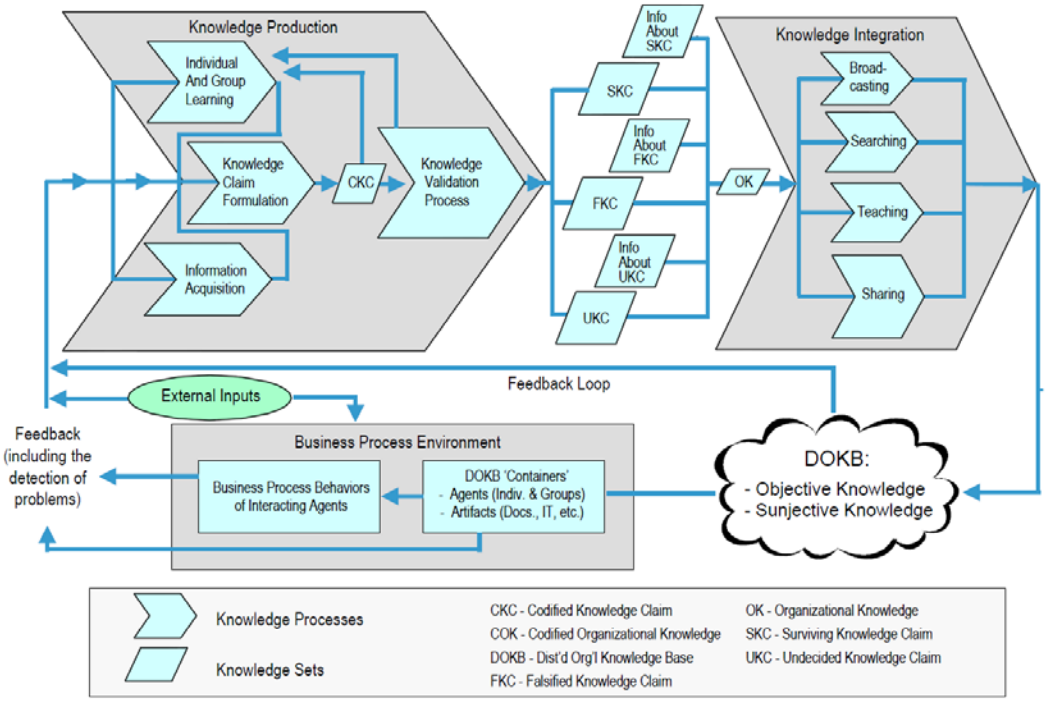


Figure 2. 5: Knowledge Lifecycle

(*Adopted from McElroy, 2003*)

As shown on the above figure 2.6, Knowledge production has the following processes: individual and group learning, knowledge claim formulation, and information acquisition – which leads to a codified knowledge claim, which in turn leads to a knowledge claim evaluation. Knowledge integration processes are knowledge broadcasting, searching, teaching, and sharing. McElroy's framework assumes that KM seeks to produce knowledge and integrate it into the organization to achieve sustainable innovation by choosing learning-related policies and programs that serve only to support, strengthen, and reinforce the KLC.

2.7.6 Dalkir's Integrated Knowledge Management Lifecycle Framework

Dalkir (2005) developed a KM lifecycle framework based on Meyer and Zack's (1996), Bukowitz and Williams' (2000), McElroy's (2003) and Wiig's (1993) frameworks. Dalkir (2005) formulate an integrated KM lifecycle framework that adopted or incorporated most of the above scholarly knowledge framework to simplify the KM lifecycle by combining phases where possible and identifying key activities before linking them to major phases.

According to Dalkir (2005), the KM processes identified in the framework aim to identify and locate knowledge resources within organizations. Dalkir's (2005) integrated KM cycle framework has three major stages: knowledge capture and/or creation, sharing and dissemination, and acquisition and application. The framework shows that the transition of knowledge across these three stages happens through assessment, conceptualization and updating. Dalkir (2005) asserts that organizations need such frameworks to help classify different activities and functions needed to deal with all knowledge-related work. Figure 2.7 below shows Dalkir's integrated KM cycle framework

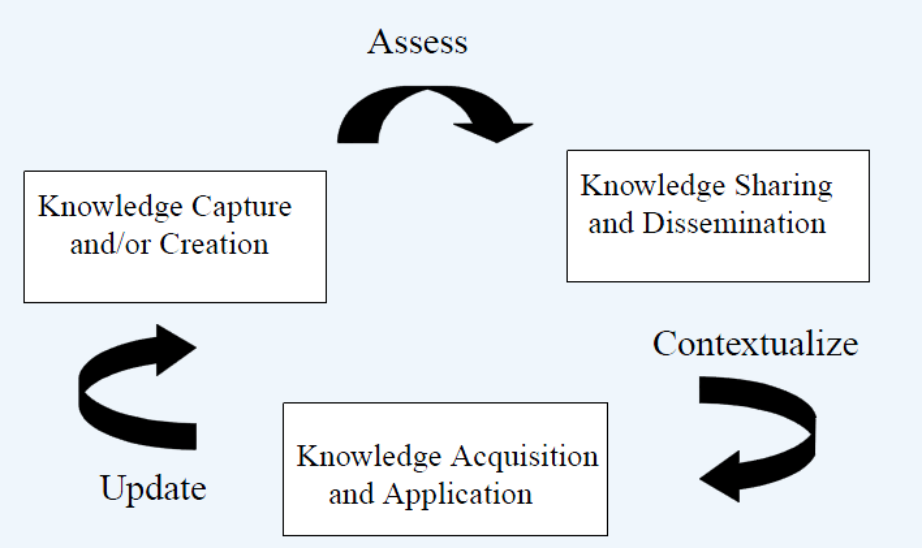


Figure 2. 6: Dalkir's Integrated KM cycle

2.7.7 Sağsan's A New Life Cycle Model for Knowledge Management

Sağsan (2006) has created a KM framework processes with five basic steps in hierarchal order: knowledge creation, sharing, structuring, use and auditing. The process of knowledge begins with individuals' mind and diffuses via technological and social systems throughout the organizations. According to Sağsan (2006), Sagan and Zorlu (2010), knowledge can be created

through the conversion of tacit and explicit knowledge; can be shared through social and technological communications infrastructure; Knowledge can be structured via knowledge mapping techniques and retrieval systems, and then can be used in organizational processes and routines. Knowledge auditing will allow organizations' to control their intellectual capital and/or knowledge assets.

Sağsan (2006) further explains that each steps of the knowledge management processes has sub-processes and a need of a chief knowledge officer to lead the application of knowledge management with a knowledge management team that consists of chief information officers, communication specialist, consultants, web designer and interdisciplinary nature of KM which include at least Information business management, communication and technology. These make KM goes beyond application and defined as a new discipline.

2.7.8 Heisig's Integrated Knowledge Management Lifecycle Framework

Heisig (2009) examined previous research and practice undertaken by various scholars and researchers on knowledge management framework to identifying KM activities used to manage organizational knowledge. Heisig (2009) intention was to find out their similarities and differences among their KM processes and then build a new integrated KM framework by conducting a content analysis of 160 KM frameworks that have been proposed by previous practitioners and researchers in the field (1998-2003).

After detail analysis of various KM frameworks, Heisig (2009) find out that many of KM activities are essentially synonymous, and came up with six frequently or broadly cited KM activities: use, identify, create, acquire, share and store were used to create a new KM Lifecycle framework. These classification of KM processes helps to "overcome conceptual differences between different KM frameworks and serves as a basic common understanding" (Shongwe M., 2016).

2.7.9 Evans's, Dalkir's and Bidian's Holistic Knowledge Management Framework

Evans, Dalkirs and Bidian's (2014) reviewed various KM life cycles and integrated them with Heisig's (2009) findings of KM frameworks and develop a simple, practical, and comprehensive holistic KM framework. This holistic KM framework has seven phases:

identify, store, share, use, learn, improve, and create. Figure 2.8 shows the holistic KM framework of Evans, Dalkirs and Bidian's (2014).

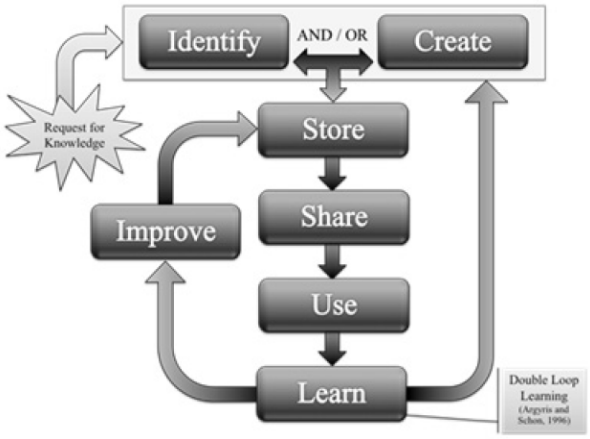


Figure 2. 7: Evans et al Knowledge management cycle framework

According to Evans, Dalkir and Bidian (2014), learn and improve phases will play a very crucial role in the value creation aspect of the knowledge life cycle and provides more flexibility, allowing for feedback and reuse of the other phases; the addition of the double loop learning highlights the learning and improving aspects and shows how the KMC can lead to a cycle of continuous improvement.

2.7.10 Shongwe's Unified Knowledge Management Lifecycle Framework

So far we have seen many KMS frameworks which have been developed or proposed by many scholars in field of knowledge management. For instance Alavi and Leidner's (2001) framework has processes, Dalkir's (2005) KM framework has three major stages, Evans, Dalkir and Bidian's (2014) KM framework has seven phases as mentioned above. These steps or terms are confusing in research and practice since each framework has its own processes.

M. Shongwe (2016) analyzed more than 20 KM frameworks to come-up with more comprehensive framework which reduces such confusion by integrating the most prominent processes into a single KM frameworks. Shongwe proposed a KMS lifecycle framework and call it as a unified KMS framework. This unified lifecycle framework has defined by five

important processes: knowledge transfer, storage, application, creation and acquisition (K-TSACA) framework; and this framework could be used in research and practice for KM initiatives in organizations

2.8 Pillars of Knowledge Management Framework

The Four Pillars of Knowledge Management framework involves four environmental influences, which are: Social, Political, Governmental and Economic (Figure 2.2) (Stankosky, 2005; Calitz, A. P., & Cullen, M, 2017). The four KM pillars of the framework are: Leadership, Organization, Technology and Learning, which represent the major functions needed to manage knowledge. The following figure shows the four pillars of KM framework:

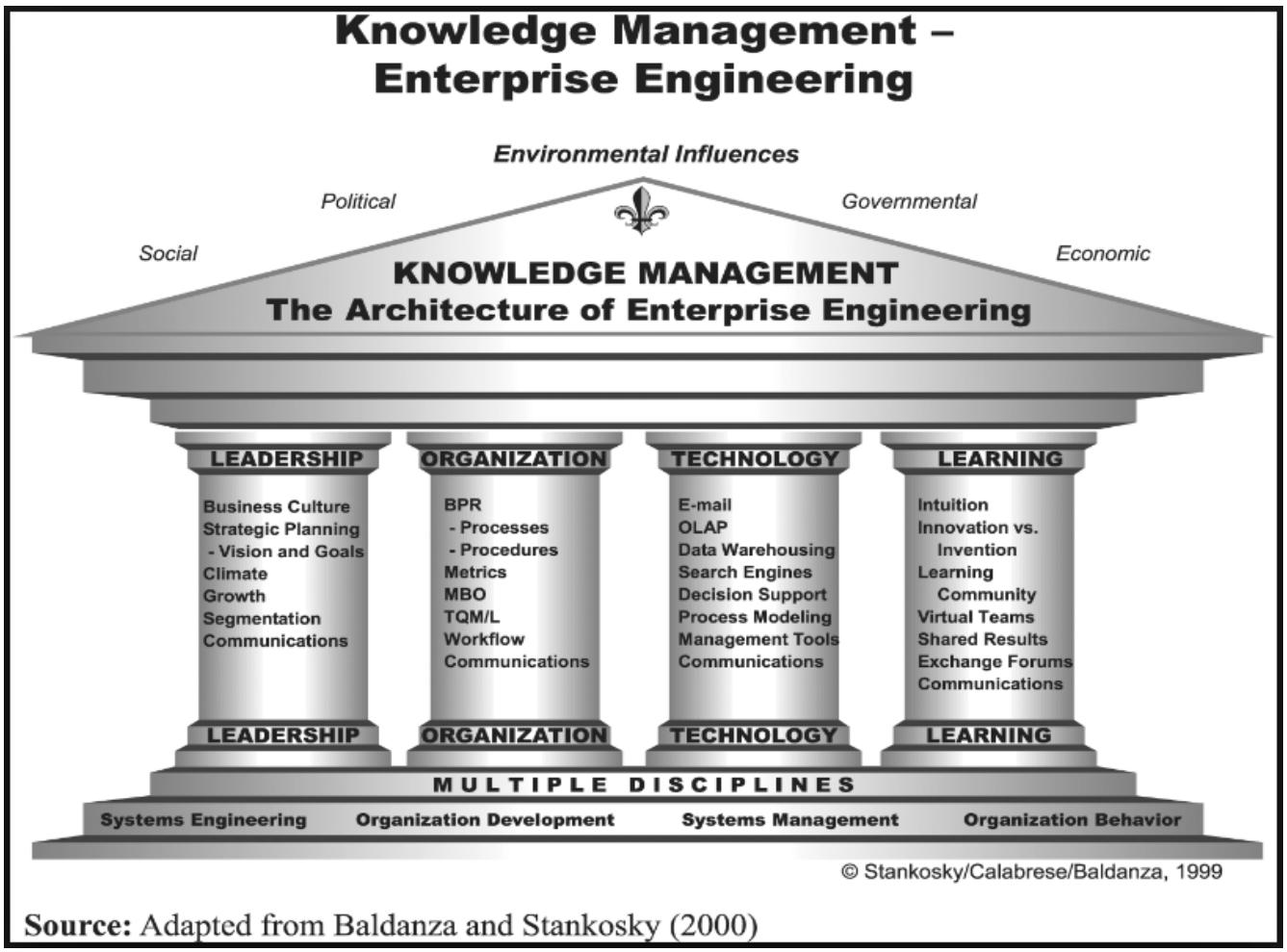


Figure 2. 8: Pillars of Knowledge management Framework

Calitz, A. P., & Cullen, M. (2017) explain each of the four pillars of KM framework as follows:

Leadership: deals with decision-making making and the strategic alignment of KM initiatives with business objectives by: developing a strategic vision, goals and KM strategy, which is aligned with business goals and objectives; staff empowerment to reduce dependency and promote initiative by providing training and development and ensuring availability of the necessary re-sources; and promote an open, encouraging and supportive culture

Organization: emphasizes the strategic redesigning and alignment of operational processes and procedures to ensure the success of the KM initiative throughout the organization, which means ensure flexibility of the organizational and technological infrastructure to meet changes in market demand and establish formal and informal networks along which knowledge can flow.

Technology: establishes the importance of the enabling technological infrastructure, which supports KM within the organization and without which the application of KM in any organization would be near impossible. Which means, ensuring the system is managed to ensure the validity and reliability of information and that information is up to date; and controlling accessibility to the organizational information system throughout the organization is the technological aspect of the KM framework.

Learning: is the fourth pillar of KM framework, is described as the acquisition of knowledge or a skill through study, experience or instruction and emphasizes the fact that the organization must address KM facilitating approaches such as increasing internal communications, promoting cross-functional teams and creating a learning community. This pillar of the KM framework is focused on promoting employee training and development as well as communities practice.

2.9 Knowledge Management and Business Strategy Factors

Knowledge management is a dazzling, multi-faceted, and controversially discussed concept. (Nonaka and Takeuchi, 1995). Knowledge management can be defined as all the activities that utilize knowledge to accomplish the organizational objectives in order to face the environmental challenges and stay competitive in the market place. The attention and importance given to the acquisition of knowledge increased in the past years (Alavi and Leidner, 2001). Knowledge management promises to help organizations to be faster, more efficient, or more innovative than the competition. Also, the term ‘‘management’’ implies that knowledge management deals with

the interactions between the organization and the environment and the ability of the organization to react and act (Maharini, 1999).

On the other Organizations aware of their knowledge resources possess a valuable, unique resource that is difficult to imitate and can be exploited to achieve a sustainable competitive advantage (Alavi and Leidner, 2001). An organization's strategy of knowledge management is not arbitrary but depends of the ‘‘way the company serves its clients, the economics of its business, and the people it hires’’ (Hansen et al., 1999), means KM depends on organizational business activities.

Accordingly, different studies suggest the need to align KM with business strategies. And IT to continuously capture, maintain, and reuse the key information, and arbitrates the strategic knowledge assets that improve business performance (Cedar, 2003). In addition KM should not be implemented because it is just ‘‘nice-to-have’ ’Thus, it should be tightly related to objectives and business strategies of the organization or subunit of the organization (Davenport et al., 1998; Zack, 1999).

Vera (2001) views learning as the core of a knowledge strategy. However, argues that it is not sufficient to learn something new and suggests that learning has to be aligned with the core business activities to ensure that new products, systems, procedures, and structures, are developed in line with the firm's business strategy. In her study she investigates ideal matches between business strategy and know1edge strategy and argues the greater the alignment between both strategies the better the firm's performance. Vera identifies four ideal matches, which she terms "innovative prospector,' the "lone defender,' the "exploring prospector,' and the "exploiting analyzer '.

- **Innovative Prospectors**: Prospectors have the ability to proactively find and exploit new product and market opportunities and to quickly change strategies to outperform competitors.
- **Exploring Prospectors:** These types of prospectors have limited resources and pursue more focused approaches to business strategy by offering fewer but very innovative products and services.
- **Lone Defenders:** Defenders emphasize a limited number of products and services at a more narrowly defined market, and offer higher product and service quality or lower prices to defend their current market position against competitors.

- **Exploiting Analyzers:** Analyzers combine elements of both prospectors and defenders. They pursue an advanced differentiation or cost leadership business strategies. Analyzers focus on a defined scope of products and services offered to customers.

According to Jones (2002), technology-focused knowledge management solutions offer little more than the implementation of groupware and documentation management. In his study, he recommends that knowledge strategies have to focus on knowledge resource development to support the firm's business strategy. Firms need to identify, which knowledge supports best strategic business goals. Jones (2002) argues that knowledge strategy follows business strategy and technology follows both. Furthermore, Jones identifies three strategic domains firms typically engage a) growth and value b) operational effectiveness and c) customer intimacy. Within these strategic domains, firms pursue a number of strategic relevant core business and knowledge activities to achieve defined corporate goals.

The possible relationships of these activities are graphically represented in the table below.

	Growth & Value	**Operational Effectiveness**	**Customer Intimacy**
Knowledge Strategy	• Product Innovation • Process Innovation • Intellectual Capital	• Process innovation • Knowledge sharing • Developing knowledge Culture	• Product Innovation • Customer knowledg • Integration • Branding Knowledge
Business Strategy	• Product sales • Time to money	• Process Streaming • Supply chain management	• Customer relation • Customer product needs

	• Distribution networks • Pricing strategy • Patent and product leverage	• Accounting and finance	• Revenue growth • Partnering /Alliance

Table 2. 3: Domains of Knowledge Strategy and Business Strategy

(*Adopted from Jones, 2002*)

Consequently, the KM literature like to underline the need to evaluate and understand the factors that create gap or the lack of matching between business and KM strategies to succeed in knowledge management as well as knowledge sharing initiatives of organizations.

Furthermore implementing the appropriate KM strategy through careful analysis and understanding of the business needs and its relation to knowledge management helps in improving business performance. In addition, organizations must be aware of their knowledge resources since it is essential to achieve efficient product development or innovation excellence.

For this study, the researcher reviewed different studies and journals on knowledge management, knowledge management systems, knowledge management framework, knowledge management modeling and knowledge sharing as well as water resources management to get appropriate background for his research.

In addition to the above areas of studies, the researcher also reviewed thesis and dissertation reports on: - A Framework and Methodology for Knowledge Management System Implementation by Hanlie Smuts & Alta Van der Merwe (2009); The Global Knowledge Management Framework: Towards a Theory for Knowledge Management in Globally Distributed Setting by Jan M. Pawlowski, Markus Bick (2012); Proposing a Knowledge Management System (KMS) Architecture to Promote Knowledge Sharing among Employees (In-case of Commercial Bank of Ethiopia) by Dr. Temtim Assefa, and Dr. Million Meshesha (2014); A Holistic View of the Knowledge Life Cycle: The Knowledge Management Cycle (KMC) Model by Evans M., Dalkir K. and Bidian C. (2014); Building a Knowledge Model: The Case of Ethiopian Revenue and Customs Authority by Minwiyelet Fiseha (2015);

Knowledge Management Maturity at Ethiopian Airlines (EAL) by Seble Abera (2015); and An Analysis of Knowledge Management Lifecycle Frameworks: Towards a Unified Framework by Shongwe M. (2016) and explore these research papers to get relevant information for this research area.

Even though the researcher reviewed many literature on knowledge management areas mentioned above, there is no relevant literature found on developing a knowledge management framework in water resources management specifically in a trans-boundary water resources management and planning. This make this research area is very unique and the researcher used the conceptual information from the literature reviewed in this chapter and developed a KMS framework in water resources management by using the semi-structured interviews finding results in the research area to address the research objectives and problems stated in chapter one.

Chapter Three

3. Research Methodology

3.1 Research Design

The research method is a strategy of enquiry, which moves from the underlying assumptions to research design, and data collection (Myers, 2009). The research methodology is the heart of a research since it helps researchers to decide how they are going to achieve their stated objectives, what new data they need to address the problem areas of the study, how they are going to collect and process the data. For the purpose of developing and formulating the framework of KM system for any domain areas such as in water resources, the researcher will study the documentation of previous research and design interview questions to be used for this research. The research methodology for this research is qualitative research methodology.

Figure 3.1 on the next page simplifies and schematizes the research design process used for this research.

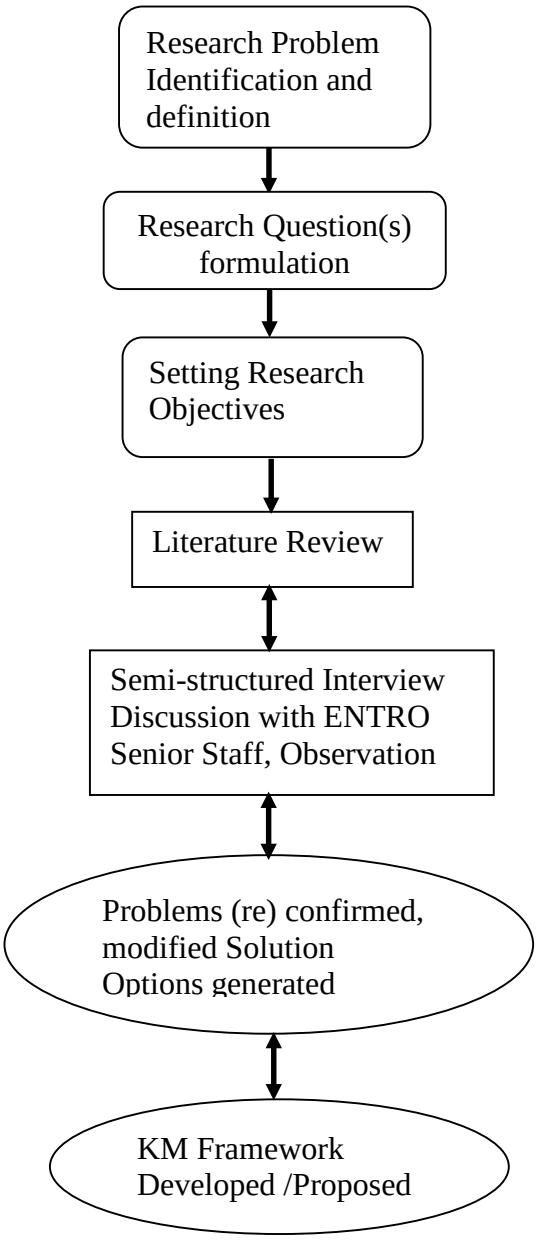


Figure 3. 1: Research Design approach

3.2 Research Area

Eastern Nile Technical regional Office (ENTRO) is the organization selected for the research. Developing a knowledge management system framework is important for ENTRO to manage knowledge, advance its information systems and knowledge management activities by realizing the importance of proper understanding and management of knowledge resources. As attempted

to state in the problem statement, there is a huge volume of important knowledge products available related to water resources management which needs to be efficiently captured, codified and shared of those EN countries and stakeholders.

3.3 Study Population

There are a total of forty-one employees working at ENTRO as permanent staff which includes support staff and regional/national consultants and professionals. Among the population, this study used senior staffs at Water Resources study unit, Project planning, Monitoring and Evaluation, Social and Communication Unit, Dam Safety expert, Finance and administration Unit, Procurement unit and IT Unit. These are interviewed to get detailed and relevant information about the Knowledge Management practice at the individual as well as organizational level. Apart from the semi-structured interview, reviews of related documents on how to develop a knowledge management framework, observations and preliminary studies had been conducted to support this research study.

3.4 Sample Selection

This research used purposive sampling which allowed the deliberate choice of an informant by focusing on selective individuals that are directly involved in the research topic. A shown on Figure 3.2 shows the organization structure of ENTRO and the sample population selected deliberately among the organization employees. The sample population for the study are from the categories of office employees in Water Resources study unit, Project planning, Monitoring and Evaluation, Dam Safety, Social and Communication unit, Baro-Akobo Sobat project manager, Finance and Administration unit, Procurement unit, IT Unit and other consultants in the organization. Since these individuals are the one who are involved in the creation, development and exchange of knowledge, they provided more reliable information for this research.

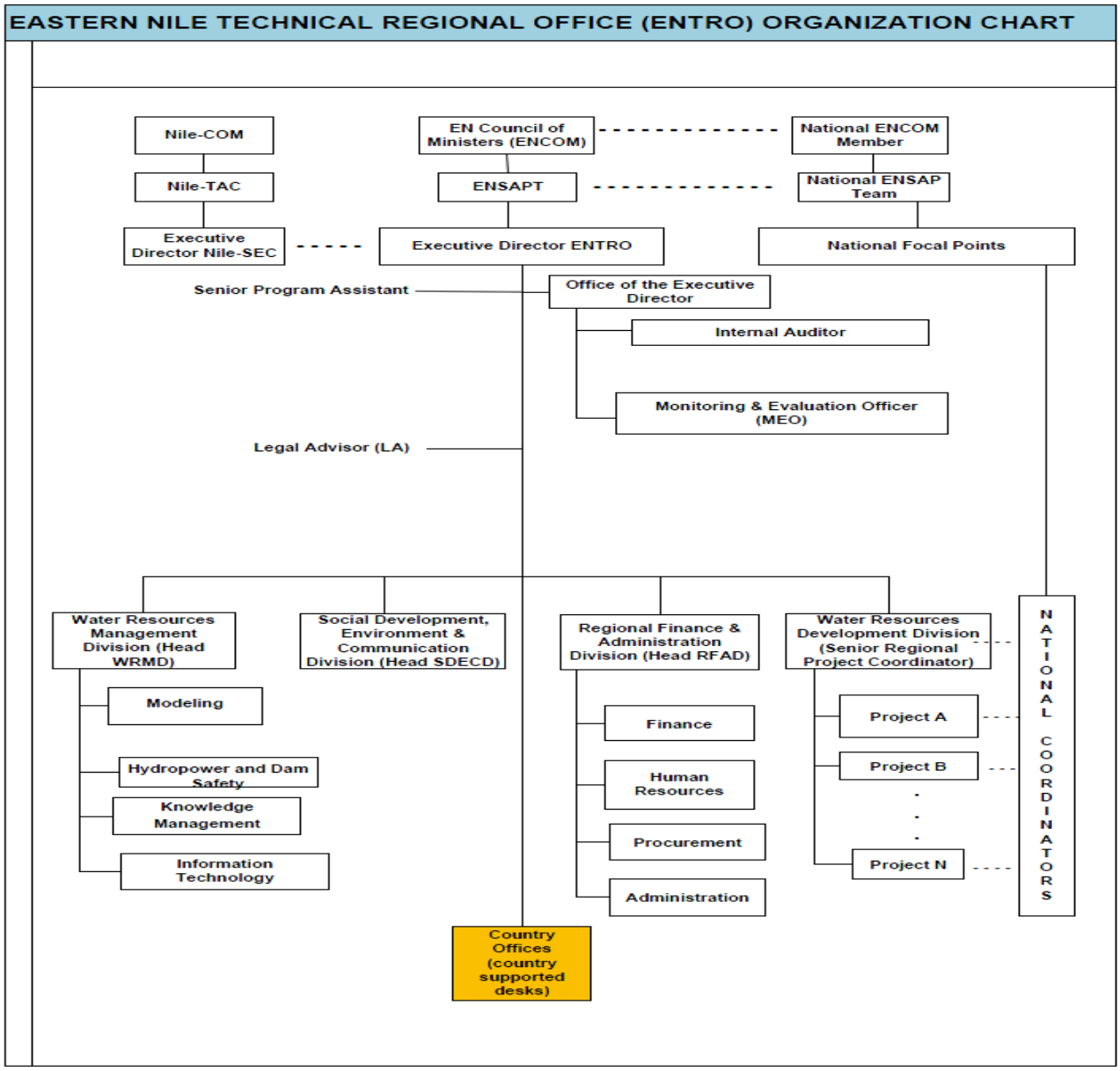


Figure 3.2: Organizational structure of ENTRO

3.5 Sample Size

Among the target population, 10 or 24.4% are management groups and senior staffs while the remaining 31 (75.6%) are non-management staff. In addition to the office employees, the researcher included some of the consultants who worked in different projects of ENTRO to participate informal discussion as well as Semi-structured interview in the areas of knowledge management. For this research, the researcher conducted ten (10) interviews to collect relevant data for his research.

3.6 Data Collection

The data collection mechanisms used in the research are: semi-structured interviews, personal observations, informal and formal discussions and interactions with experts and consultants.

- Semi-structured interviews: - As indicated in Appendix 1, the researcher also conducted guided interview-discussion with key informants – senior technical staff of ENTRO who were able to frankly exchange their views and experience regarding how they handle data, information and knowledge products their respective units produce; the challenges they get in inventorying and acquiring data and in identifying gaps before as part of their preparation to commission studies. The researcher was also privileged to examine specific study reports, consultant reports, and workshop and evaluation reports, assisted by the Monitoring and Evaluation Officer while conducting the interview sessions. The process of analyzing the qualitative data thus obtained was iterative, sometimes going back to ask and clarify some answers, and checking and rechecking linkage to the initial research questions and problem statement set forth.
- Personal Observations: - The researcher, because of his close proximity as IT officer, to this data and information in the organization, was privileged to make detailed personal notes of his own observations as he routinely deals with the technical aspect of the current information management at ENTRO.
- Document analysis through literature review of knowledge management journals, knowledge sharing, water resources management documents (research documents, journal articles, reports, and websites) is also used to support the semi-structured interview and informal/formal discussion data collection methods to understand and address the nature of problems which are related to development and implementation of integral knowledge management system framework.

3.7 Data analysis and presentation method

The researcher was used semi-structured interviews to collect qualitative data from his sample populations. Interview questions designed to capture and subsequently interpreted by using content analysis method of data analysis. The participants' response of the interview result presented fully in description and proper interpretation. In addition, related works of the literature review, observation and secondary documents used to support the findings.

Chapter Four

4. Findings and Discussion of Results

4.1 Introduction

The general objective of this research was developing a Knowledge Management System Framework for water resources management of Eastern Nile Technical Regional Office (ENTRO) with the intention to provide insights and implementing solutions by enabling technologies for enhancing knowledge management practice in the organization. In this chapter of the thesis, research results from data collected through semi-structured interviews and observation are presented in a way to address the research questions stated in chapter one. The researcher further categorized the interview discussion responses into themes to summarize the findings.

4.2 Discussion and findings of the survey

The participants for this research included Regional Project Coordinator, Water Resources Engineer/modeler, Monitoring & Evaluation expert, Senior Water Resources Specialist, IT Officer , Senior Social and Communication Officer, Procurement Officer, Hydrodynamics, Metrology expert and Executive Director of the organization.

The semi-structured interview discussion findings with the selected senior staffs and consultants in the organization helped to structure the interview on the respondents' opinions about the knowledge management practices and show the status of awareness of managing knowledge at each unit of the organization (ENTRO). In order to get high level perception and detail feedback on KM practices for this research area, the researcher conducted ten (10) interviews with senior staffs in the above stated field of work in line with the interview questions outlined (Appendix 1).

Each of the participants' responses for each interview questions were captured and interpreted to associate with the research findings and objective. This section continues the description of semi-structured interview discussions with the sample population and the researcher findings based on: - type of knowledge products at each unit, Knowledge management processes related activities, accessibility of knowledge products, Responsibility of managing knowledge

products, Knowledge product uniformity and storage location and Knowledge transfer, storage, sharing and disclosure policy presented as follows:

4.2.1 Type of knowledge products at each unit

There is a variety of knowledge products in the organization scattered under several units without the proper knowledge management system in place in the organization. Majority of the respondents said that they have or expected to have hydrologic, rainfall, river flow, sediment, water quality, socio-economic-demography, cropping pattern, dam parameter knowledge products from each projects undertaken in the organizations. Although, the finance unit does not necessarily produce domain related knowledge products, they receive the final project deliverable reports from each unit and projects to reconcile or settle the cost of the services for project activities.

4.2.2 Knowledge management processes related activities at each unit

The research found out from the respondents that each project activity started form designing a project activity. Then, developing a ToR follows, which required accomplishing the tasks specified on the project activity. This is followed by hiring a consultant firm or individual/ international consultants to undertake the project activities usually from the member states' affiliated ministries, participants of the interview-discussion groups replied for this questions. The consultant works closely with the head of each unit and, reports to a management group containing heads of each unit every quarter apart from the report to the donors. Furthermore, final report is presented to all the management and donor members.

Although these consultants are expected to hand over all the knowledge resource at their hand exhaustively, there is no clear mechanism as to how to ensure the knowledge generated during the tenure of consultants is all but transferred to the organization. Clear mechanism as to how a knowledge product delivered to the organization is handled, disseminated, shared and transferred, does not exist.

These gaps expose the unhandled organizational knowledge to be left at the hands of consultants, exposed to individual/national interests, loss, and damage. Furthermore, this

disposes the knowledge product to be prone to misuse against the interest of the organization and member states according to the shared vision.

4.2.3 Accessibility of knowledge products

All the participants' responses in relation to how knowledge products are created, captured, stored, shared and used in the organization are similar. Mostly the knowledge products are displayed on shelf of a small library in the compound, stored in personal computers and external storage drives in a disorganized manner. That makes accessibility of a specific knowledge product very difficult, and requires unnecessarily extra effort to extract the knowledge resources by the organizational units and by the organizations as a whole. Individuals and stakeholders who look for knowledge products can only be able to acquire them through the individual only leading to the dependence on the individual and their interest on the knowledge product.

4.2.4 Responsibility of managing knowledge products

The research found out that there is no responsible individual at ENTRO in charge of managing knowledge products, which could have minimized the loss of the knowledge resources. They all keep their respective knowledge products at their personal computers, storage disks and over the shelf. As the respondents said, most of the time, after the completion of a given project activity, they may probably forget what knowledge resources they already have at their respective repositories. The mechanism of updating, maintaining quality control and coordination between projects in terms of knowledge resources is very poor in the organization.

4.2.5 Knowledge product uniformity and storage location

These knowledge resources are stored in different types of systems irrespective of the specific needs and scope of the prepared projects. There is also quite a substantial volume of knowledge resources that is not captured in the systems and available in formats that are not easily accessible by many stakeholders and employees on the organization.

Knowledge products which have been produced by ENTRO with its staffs and consultants are stored in different formats; application like ARCGIS, River Basin Planning and Management (RIBASM), ERDAS-Imagine, on its website, Watershed management applications, D-Space

and even there are huge volume of knowledge products and applications available in Microsoft excel format.

4.2.6 Knowledge transfer, storage, sharing and disclosure policy

The research found out that the knowledge acquired in the organization are scattered in different forms across the organization units and consultants. Some of the knowledge products developed, captured and generated are stored on PCs, external disks, on shelves of offices and organization's mini library. There is no clear policy that can be used as guidance on how to share knowledge by keeping the sensitive of knowledge products for internal and external stakeholders. There is a challenge on sharing knowledge products since the staffs mostly put on shelf or leaving them behind on person computers. The respondents mentioned that lack of proper knowledge management system, sensitivity of information and policy is the biggest challenge in knowledge sharing and dissemination.

The following tables (Table 4.1) presented the result of the semi-structured interview discussion findings for this research.

Code	Results	Findings
Q1. What type of data, information/ Knowledge Product is typical of your Unit? Key Words/Theme: Type of data/information/ knowledge products	• Socio-Economics, environmental, water resources • Stakeholder identification • Hydrology (rainfall, river flow, water quality, river water level, water use and land use, evaporation/evapotranspiration • Dam safety parameters/characteristics, hydropower generation/, sediment load • Satellite images, DEM, maps • Settlement Survey data, • Consultants/contractors and suppliers professional fees • Progress reports of on-Going projects • Human resources • Technical data related to projects	The respondents in this research within the organization deals with more diverse data, information and knowledge products than the researcher had anticipated and listed. This might be an indication of the diversity of the knowledge in the organization that is not also been handled properly, due to lack of a proper knowledge management system. Furthermore, the diversity of the knowledge products obtained from the respondents vary significantly citing the need for proper framework and detailed policy in the organization
Q2. Do you commission local, regional and international consultants to undertake new or supplementary studies? Why do you commission such studies? Key Words/Theme:	• To develop stakeholder database for specific projects • To prepare projects preparation manuals • To fill knowledge gap related to identify investment options • To assess dam safety situations • To develop guidelines and standards • to undertake different consultancy services • to bring knowledge and international experience	Predictably, not every respondent in the researcher's sample population commission works through consultants. However, the respondents who commission (70% of the total respondents) deal with the commissioning solely and are responsible for it. The commissioning of consultants is to deal with the works like developing different knowledge products (project preparation manuals, identify investment options, assess dam safety situations, develop guidelines and standards, automation of models,

Code	Results	Findings
Commissioning related to Specific unit Consultancy services	• automation of models/workflows and develop operational models/ projects • to undertake different studies related to water resources management in Eastern Nile	workflows, conduct studies related to water resources and management)
Q3. What are the major challenges you encounter in commissioning for such studies? Key Words/Theme: Challenges on commissioning studies	• calibrate the knowledge gap / inventorying of existing data • some areas of studies are not monitored • Availability of required data and institutional capacity gaps • data format inconsistencies ; • Absence of data sharing agreement • redundancy of some studies which could incur unnecessary cost for the office • challenges to get capable and adequate consultants to conduct on water resources studies • Lack or challenges on infrastructure and KM platforms/frameworks for proper KM creation, capturing and sharing	The respondents revealed different challenges that the organization could overcome had there been a proper knowledge management practice in place. These challenges include inventory of existing knowledge, data format inconsistency, lack of data sharing agreement (which we call disclosure policy), duplication of efforts on studies among stakeholders, getting adequate and capable consultants) Furthermore some respondents raised the challenge of adequate infrastructure and KM platforms and frameworks.
Q4. Once you get the results from studies, how do you capture, store, disseminate, and retrieve the data, information and knowledge products? What challenges do you	• Information and knowledge products has been disseminated to stakeholder through a workshop, report and conference • hard copies of the project reports mostly kept at library • Lack of established standard KMS	There is a challenge on sharing knowledge products since the staffs mostly put on-shelf or leaving them behind on person computers. The research found out that the knowledge acquired in the organization are scattered in different forms across the organization and consultants. Some of the knowledge products developed, captured and generated are stored on PCs,

Code	Results	Findings
face when it comes to knowledge sharing? Key Words/Theme: Techniques to undertake knowledge management processes and its challenges	• Lack of policy what kind of knowledge products to share to stakeholders by considering sensitivity of some knowledge products • disorganization of the knowledge products • during turnover of staffs/consultants there is a challenge on sharing knowledge products (	on the shelves of staff and organization's library. The respondents mentioned that lack of proper knowledge management system, sensitivity and policy is the biggest challenge in knowledge sharing and dissemination.
Q5. How difficult or easy is it for you to locate data/information/knowledge product whenever you need it in the event you face challenges? What do you think is the cause for your difficulty/challenge? Key Words/Theme: Challenges on Accessibility of data/information/Knowledge products	• Very difficult to locate the available data/information/knowledge products since the resources are stored in disorganized manner at national / regional level • Lack of standardized KMS and framework to facilitate KM practice • Diversity of data format • Lack of policy to follow what kind of Knowledge products and to whom it can shared to protect the Sensitivity of knowledge products • Duplication of efforts	All respondents unanimously agree that locating a knowledge product or information in the organization is very difficult. As indicated by some respondents, this is due to the fact that there is no proper knowledge management framework in the organization that facilitates standardized knowledge management practice and system. Furthermore, some respondents iterate that duplication of contents and lack of knowledge sharing policy contributes to the challenges managing the knowledge in the organization.
Q6. Are you responsible for keeping, maintaining, updating data and knowledge product produced under your supervision? When you	• Water resources modeler, Senior Project coordinator, partially by MoE and Procurement officer and the owner of a specific projects and stored at their personal computers	Majority of respondents in this research revealed that they store the knowledge products under their supervision on random, local storage locations such as PCs, drives and shared folders indicating lack of prope Knowledge Management Systems in the organization.

Code	Results	Findings
are not there, who else will take this responsibility? Key Words/Theme: Responsibility on maintaining and updating data/knowledge products	• IT unit is responsible to manage storage, accessibility and maintenance of knowledge products	Furthermore, some of the knowledge products developed under supervision of these respondents are stored on shared drives without control of who accesses them. These knowledge products are not regularly updated and contain outdated information.
Q7. Is there a centralized data and knowledge product center? Is there any technology, knowledge management system in place to facilitate knowledge creation, capturing and transfer as related to your work? Key Words/Theme: Existence of Central Data/ knowledge product center/ KMS	• Some of the participant consider Shared Documents/folders as central KMS • Data/Information/Knowledge are scattered on the user computers. Servers and storage • There is no centralized data and knowledge products center / KMS	The respondents made it clear that there neither exists a data and knowledge product center nor a workable knowledge management system in the organization. According to information from some respondents the organization has started working toward developing an Integrated Knowledge Portal (with the aim to integrate the three NBI centers and data will be made available and accessible from one point/portal). However, the organization has yet to work on data sharing/ integration and other policy apparatuses.
Q8. In general, what are the major constraints to make your data, information and knowledge product accessible to stakeholders within ENTRO and outside? Is there any workable disclosure policy in the organization? Key Words/Theme:	• There is no knowledge center built as a strong and easily accessible and workable conditions • Sensitivity of knowledge products • There is no disclosure policy in place • Sometimes the governance prohibited in case wher a country to object	Recently, to curb this challenge, Interim Disclosure policy and Implementation guideline is prepared and approved There is a general consensus that these knowledge products have to be sent to government line offices at Federal, regional, zone and woreda levels where the sensitivity of the information contained is verified by government bodies. Mostly the governance prohibits

Code	Results	Findings
Constraints to make data/information/knowledge products available to stakeholders and availability of disclosure policy		sharing of sensitive knowledge products especially in case a country objects We do not have disclosure policy which specifies what and which type of data can be made publicly accessible, which ones restricted, etc.
Q9. Does your work entail use or application of diversity of software and applications to generate hydrologic, water resources, etc. data? Do you face challenges in terms of data harmonization and standardization? Key Words/Theme: Diversity of software to generate knowledge products / challenges on data harmonization	• Different users, consultants and units of the ENTRO uses various tools and models resulting diverse contents and bring difficulties in data harmonization	There are different varieties of software products including hydrologic modeling software, hydraulic/hydrodynamic modeling software, and tools like ArcGIS, Global mapper, quick terrain modeler, office and productivity tools generating diverse data and information posing difficulty in data harmonization. The research found out that the data harmonization problem could have been solved had there been a proper KMS in the organization.
Q10. Does ENTRO have standardized policy and procedure you have to follow to manage data, information and knowledge produced under your supervision? Or, you have to create your own individual system to manage the data you generate? If yes, what challenges does this pose to you and	• Lack of standardized policy and procedure in the organization with respect to knowledge management • Each consultant create individual system to manage specific projects knowledge products which is a challenge to find the stored knowledge products very easily	The respondents unanimously agree that ENTRO needs to have standardized policy and procedure to follow in order to manage data, information and knowledge produced in-house and by consultant apart from globally available data and other knowledge products the head quarter at ENTEBBE, Nile Basin initiative

Code	Results	Findings
your colleagues and in general for ENTRO? Key Words/Theme: Availability of Standards and procedure to follow for managing data/information/knowledge products	• Result based monitoring and evaluation system in placed but it is not institutionalize in each projects	According to the respondents in the research the organization is collaborating with the other two NBI centers to harmonize, standardize our information, data and knowledge management systems. For now we are storing the data and information we generate either in hard copies, or in soft versions within each unit. Lack of standardized policy and procedure in the organization with respect to knowledge management is a critical weakness and gap. A uniform standard solution and framework is a critical and essential strength in an organization that generates significant volume of knowledge product at a high cost
Q11. Finally, do you think ENTRO needs to standardize the management of its knowledge products? Key Words/Theme: Importance of Building KM standards / framework	Yes	Majority of the respondents in this research agree that the organization should have a standardized knowledge management system to properly deal with the knowledge products it generates stores and disseminates.

Table 4.1: Findings

Some of the knowledge products developed under supervision of these respondents are stored on shared drives without control of who accesses them. Each units of the organization are storing the data and information or knowledge products either in hard copies, or in soft versions within each unit. These knowledge products are not regularly updated and contain outdated information. Furthermore, some respondents iterate that duplication of contents and lack of knowledge sharing policy contributes to the challenges managing the knowledge in the organization.

As indicated by some respondents, this is due to the fact that there is no proper knowledge management system/ framework in the organization that facilitates standardized knowledge management practice, sensitivity and policy which are the biggest challenge in knowledge sharing and dissemination.

According to the respondents of this research, the organization has to create a mechanism to harmonize and standardize ENTRO's knowledge management processes with high sensitivity care for its knowledge products and policy in-place to overcome the challenges in knowledge management processes, knowledge sharing and knowledge products retrieval. Hence, the finding of this research proposed a knowledge management framework to manage the organizations valuable water resources knowledge products and facilitates knowledge management practices or/and knowledge sharing within ENTRO and other stakeholders of the organization as well as promote collaboration with the other two NBI centers to harmonize, standardize ENTRO's information, knowledge products and knowledge management systems.

The findings of this research stated above guide the researcher to the need in the organization to develop a knowledge management framework that can specifically deal with the issues raised by the respondents in this research. Hence, the following chapter will deal with the proposed knowledge management framework for ENTRO.

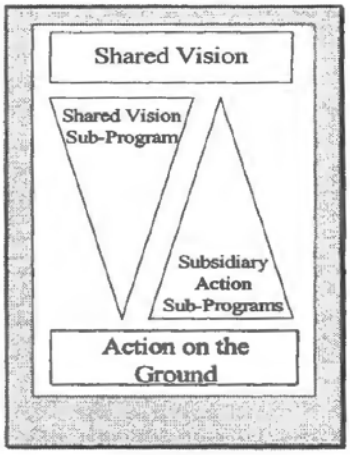
Chapter Five

5. Developing a Knowledge Management Framework for ENTRO

5.1 Overview

The Eastern Nile Technical Regional Office (ENTRO) is a technical regional body supporting the implementation of the Eastern Nile Subsidiary Action Program (ENSAP). Established in 2002 and located in Addis Ababa, Ethiopia, ENTRO is responsible for providing administrative, financial management, and logistical support in the implementation and management of ENSAP. In general, ENTRO's core functions are: ENSAP coordination and integration; project preparation; financial management; communications and outreach; training; monitoring and evaluation; information exchange; and serving as the secretariat for ENSAP organization (ENSAP, 2001).

The strategic action program (Figure 5.1) comprises two complementary sub-programs. These promote the Shared Vision and realize the vision through action on the ground. The main task of the shared-vision program is the creation of an enabling environment for investments and action on the ground, within a basin-wide framework. This program will promote the shared vision through a limited, but effective, set of basin-wide activities and projects (ENSAP, 2001).



1. ***The "Shared Vision Program"*** comprises a limited range of essential but effective activities to create a coordination mechanism and an "enabling environment" for the implementation of the shared vision through action on the ground.

2. ***"Subsidiary Action Programs"*** plan and implement action on the ground at the lowest appropriate level, taking into account benefits and effects of planned activities on other countries.

Figure 5. 1: Strategic Action Program (*Adopted from -ENSAP, 2001)*

These projects address the major water-related sectors and crosscutting themes deemed critical by the Nile riparian's to ensure an integrated and comprehensive approach to water resources development and management, and that this development serves as a catalyst for broader socio-economic development and cooperation in the region (ENSAP, 2001).

Subsidiary action programs (as shown in the above Figure 5.1), within the basin-wide framework, comprise actual development projects at sub-basin level, involving two or more countries to allow the move from planning to action by overcoming the challenge of regional cooperation to address development opportunities with trans-boundary implications. Action on the ground will take place at local, national and sub basin levels, and will integrate upwards within a basin-wide framework (ENSAP, 2001).

The type of projects, which could be bundled into subsidiary action programs are: Eastern Nile Subsidary Action Program, Integrated Development of the Eastern Nile, the Eastern Nile Watershed Project, are discussed as follows.

5.1.1 Eastern Nile Subsidiary Action Program (ENSAP)

The Eastern Nile region includes the countries of Egypt, Ethiopia, South Sudan and Sudan; and encompasses the sub-basins of the Baro-Akobo-Sobat, the Blue Nile, the Tekezé-Setit-Atbarah, portions of the White Nile in Sudan, and the Nile proper. The Eastern Nile countries are pursuing cooperative development at the sub-basin level through the investment-oriented Eastern Nile Subsidiary Action Program (ENSAP). ENSAP seeks to realize the Nile Basin Initiative (NBI) shared vision for the Eastern Nile region, and is aimed at poverty reduction, economic growth, and the environmental degradation reversal throughout the region. Towards this end, the Eastern Nile countries have identified their first joint project, the Integrated Development of the Eastern Nile –IDEN (ENSAP, 2001).

5.1.2 Integrated Development of the Eastern Nile (IDEN)

Integrated Development of the Eastern Nile (IDEN) consists of a series of sub-projects addressing issues related to flood preparedness and early warning; power development and interconnection; irrigation and drainage; watershed management; multi-purpose water resources development; and modeling in the Eastern Nile. IDEN projects are divided into fast-

track projects and multi-purpose track projects. The fast-track projects consist of Flood Preparedness and Early Warning (FPEW), Eastern Nile Power Transmission Project, Eastern Nile Planning Model, Eastern Nile Irrigation and Drainage Project and Watershed Management whereas the multi-purpose track projects include the Eastern Nile Power Trade, Baro-Akobo-Sobat (BAS) Multipurpose project and the Joint Multipurpose Project (ENSAP, 2001).

5.1.3 The Eastern Nile Watershed Project (ENWP)

Many resource degradation processes have impacts not only locally, but downstream within and beyond the borders of the country within which they occur as well as impacting on the global community. The most significant impact of land degradation in the Eastern Nile Basin are the loss of soil productivity from Ethiopian Highlands because of accelerated erosion of the top soil, and deteriorating water quality due to increased sedimentation. In the absence of adequate and integrated watershed management interventions, soil erosion and degradation is an eminent danger (ENSAP, 2001).

Poverty and degrading natural resources base are inseparably linked and effective poverty reduction depends on successful addressing of the underlying causes of environmental degradation. In the absence of adequate and integrated watershed management interventions soil erosion and degradation and deforestation will continue at accelerating rates, reducing agricultural productivity and increasing the numbers of households living at and below the poverty line (ENSAP, 2001).

In line with ENSAP objective, the ENWP aims at providing continued and enhanced support to sustainable watershed management of the Eastern Nile Basin in order to improve the living conditions of the people, create alternative livelihoods, enhance agricultural productivity, protect the environment and in the long term reduce sediment transport and siltation of infrastructure and prepare for sustainable development oriented investments.

Towards meeting its objective, the watershed project undertook two sets of activities in parallel between 2004 -2008: preparation of investment ready projects for national implementation (fast track projects) and a Regional Cooperative Assessment (CRA) study. Both sets of activities were successfully completed.

While implementation of fast track projects at national level is initiated, the CRA study has developed a long term watershed management program for the basin. The main objective of the program is to provide continued and enhanced support to sustainable watershed management of the Eastern Nile Basin. Program activities will include, among other things, establishing a watershed management data and information system; and undertaking a coordinated sediment and water quality monitoring for the Eastern Nile Basin (ENSAP, 2001).

The basin-wide environmental and river related problems such as erosion, sediment & water quality monitoring issues drive ENTRO and the member states to envisage and establish a system to systematically collect and store relevant data and information undertaking environmental, social and economic impact studies for effective watershed management planning, monitoring and evaluation. Assessment of impacts will include physical, social and economic characteristics. The monitoring system will establish a long-term coordinated system of monitoring of erosion and erosion control; sediment loads and land cover change at various catchment scales, (ENSAP, 2001).

5.2 The Nature of Knowledge in ENTRO

An integrated approach towards knowledge management for water resources management at ENTRO has to be in place by creating awareness among decision-makers regarding the need to develop an enabling environment to organize and manage its knowledge resources. Currently, ENTRO neither have effective knowledge management system that could potentially benefit the stakeholders from the knowledge resources the organization generates through the different projects, nor does the knowledge resources are properly captured, organized, stored, shared and utilized.

Due to the unique and diverse nature of the knowledge resources created, developed and acquired from the projects and activities in ENTRO, a specialized Knowledge Management Framework needs to be developed and implemented that can address the special needs of the organization.

Knowledge management systems can improve the understanding of the need for inter-sector collaboration to foster integrated water resources planning and develop the water sector to reduce various threats, such as environmental degradation and climate change issues. To

support this process, ENTRO has to create a knowledge management framework to increase knowledge sharing, dialogue, networking, and communication as key drivers for strengthening stakeholder engagement in formulating policy and implementing water sector development plans.

ENTRO needs to take action to improve its knowledge management processes by developing KMS framework by revising and formulating policies, laws, and regulatory frameworks to create an enabling environment for a more integrated approach to water resources management (WRM).

The cross-boundary, collaborative and shared-vision nature of ENTRO influence the way the organization creates, captures, acquires, organizes, stores, utilizes and shares knowledge and information within and outside. The trans-boundary projects that affect several countries deal with sensitive contents of knowledge products (project proposals, project designs, reports, water resources development agreements, strategic plans, infrastructure development plans, funding organizations, partnerships with donor agencies, memorandum of understanding (MoU) documents and other sensitive information) that have national security implications.

Further, senior level-management and consultants change frequently and the employment positions get occupied by staff from the member state countries. This change of senior management and consultants, will indirectly affect the concentration of the knowledge production and management towards the interest of the countries of the top management and consultants. Furthermore, the frequent turnover of employees drives towards the mishandling of important knowledge products without proper Knowledge Management System in place. This drives the intent to develop a specialized knowledge management framework to address the specific dimensions of the knowledge products and organizational interest.

5.3 The Need for a Specialized Knowledge Management Framework in ENTRO

According to Mostert and Snyman (2007), knowledge management framework, is a matrix that depicts knowledge management as a set of processes and defined through the application of the four management functions (planning, organizing, leading and controlling) to each of the organizational knowledge processes.

A framework is required to determine how effective available methodologies and approaches are; how and why they should be improved; and which knowledge related methodologies are still needed. By its very nature, a Knowledge Management Framework should be flexible to accommodate the specific organizational knowledge management needs and practices. A framework is needed to properly handle the basic dimensions of a knowledge management system and address specific organizational needs to ensure the handling of knowledge products. This will in turn, enables organizations to focus on generating, capturing, storing and sharing knowledge products with proper knowledge transfer bridges in order to achieve long term organizational objectives.

Without a framework, it will be difficult to help interested and motivated people build a coherent overview of the important aspects of knowledge that are needed. Even more importantly, without a framework it is almost impossible to induce importance of knowledge individuals and make employees understand the need to pursue Knowledge Management practices and systems. In other words, a framework is needed to support a coordinated expansion of our understanding of knowledge and how to deal with it.

The absence of knowledge management strategy in the organization further complicated the consolidated management and proper utilization of knowledge products generated. The management and regional consultancy positions of ENTRO are required to be circulated among member countries every three years. This creates a significant challenge in knowledge creation, storage, sharing and transfer in the organization.

For instance, when an executive director from a member country with more interest on knowledge and development research related to hydropower generation leaves his position and replaced by another executive from a member country whose main interest is development and research on irrigation, the knowledge transfer is weakly handled and the works in progress and the activities of previous team are given little attention.

Similarly, when a project closing with an interest on watershed management or multipurpose water resource utilization closes, and the management team (or the corresponding country) interest for that specific area is insignificant, the knowledge acquired remains stranded despite the benefit for other member countries.

5.4 Dimensions of Knowledge Management in ENTRO

There are dimensions of Knowledge Management that are not handled in the commonly available knowledge management practices, frameworks and systems. The knowledge products in ENTRO and the management have dimensions that are deeper and need especial consideration to be dealt with, such as sensitivity of information; political (national) interest; external stakeholder interests; smooth handshakes of management and consultant transition; and the likes. This requires thorough understanding and vigilant handling of the missing dimensions which leads to the need for a new framework for the knowledge management in ENTRO. The following illustration attempts the dimensions and components of each dimension to consider for a framework that possibly works for ENTRO and address the knowledge management gap in the organization.

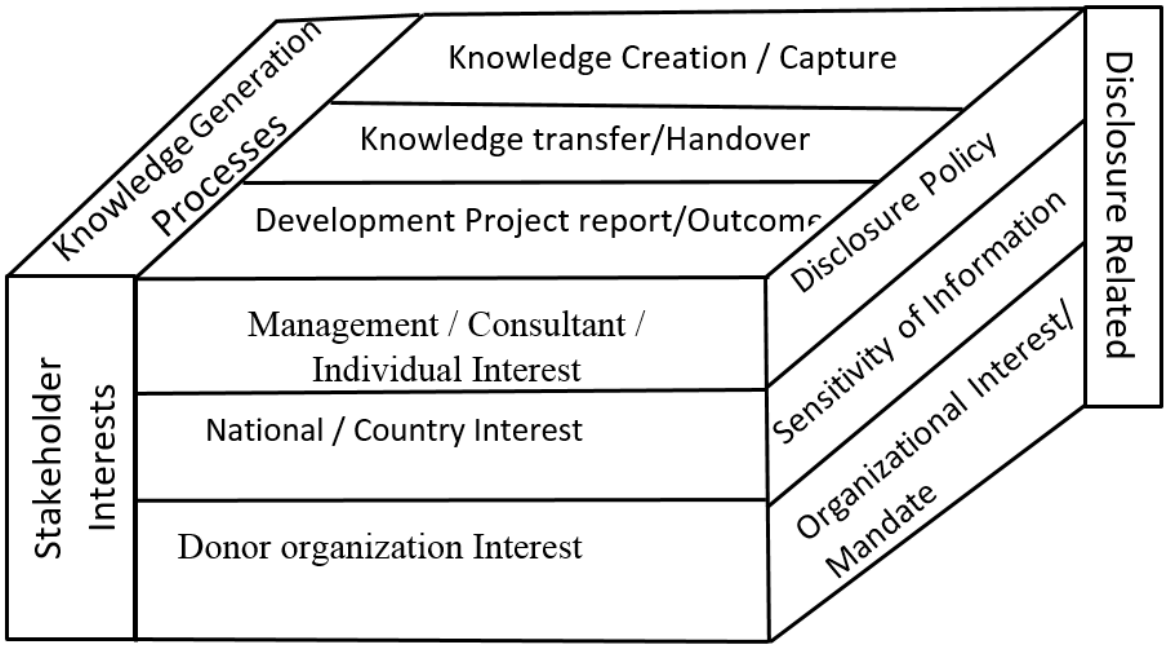


Figure 5. 2: Dimension of Knowledge Management in ENTRO

5.4.1 Knowledge Generation Processes

The knowledge generation process is the first knowledge dimension of ENTRO, which includes knowledge creation, capture and transfer. Significant volume of knowledge products are generated by the consultants, employees, interns, projects and sub-projects in ENTRO. Every

project and sub-project delivers significant volume of work on inception, pre-feasibility study, feasibility study, plans, project deliverables and final reports among other resources.

Similarly, internship program in ENTRO requires interns to deliver scientific study on specific area of interest that have the potential to benefit the member states and communities. Further, consultants in the organization and employees work and produce knowledge products that have significance to the member states, communities and of interest to donor organization.

These knowledge products are, however, mishandled due to lack of a proper knowledge management framework and system in the organization to properly manage the generated knowledge at different levels. Hence, it is critically important the organization develops a framework and implements system that can deal with the proper knowledge creation, capture and transfer in the organization.

5.4.2 Stakeholder Interests

Stakeholder interest is the second knowledge dimension of ENTRO, which includes Individual, National and Stakeholder Interest of Knowledge in ENTRO. The trans-boundary nature of the organization entertains the different interest groups who can influence the knowledge in ENTRO at different stages and levels. Individual, national and stakeholder interest is one dimension of knowledge in ENTRO that should be dealt with. The interest of different groups in the organization influences knowledge in the organization in many different ways.

To make things further complicated, individuals at some positions in the organization represent their respective countries. These individuals are expected to stand by the interest of their countries and influence the different stages and contents of some knowledge products. Furthermore, lack of proper knowledge management system in the organization creates a loophole in proper transfer of knowledge during transition of individuals and continuity of the knowledge process and lifecycle influenced by the interest of these individuals in the transition.

For instance, an individual whose interest and area is on irrigation or watershed management would not be embraced by a successor more interested on an individual whose national and individual interest is hydroelectric power generation. Similarly, an individual consultant

working on flood preparedness and early warning system, when dispatching the results of the research he is doing implicates a threat from an upstream country to a downstream one, will probably alter, hide, or mislead to reflect a national interest of his respective country. Although, the checks and balances on research contents are checked and cross-checked, there are significant numbers of times individual, national and stakeholder interests influence the knowledge management in ENTRO.

Some areas of research and knowledge generation in the organization are political and are highly influenced by the political narrative. For example, the Grand Ethiopian Renaissance Dam (GERD) technic committee is always accompanied by the political arm of each country. This is due to the fact that the outcomes of the technic committee research and study have significant political implication and each country wants the upper hand in the results to maximize their corresponding countries benefits from the developments related to the river.

Donor organizations, similarly, have significant interest and influence the knowledge process and the management of it. These organizations, without breaking the integrity of ENTRO, try to influence the research, development and outcome of projects and sub-projects which they fund in a direction that reflects their organizational interest and sometimes the interest of some member countries.

A simple scenario to explain this is, for instance, a donor organization which is interested in agricultural productivity wants the organization to focus on areas that utilize water although some member states want to focus on water saving or power generation instead. Similarly, some donor organizations are influenced by lobbying group of some member countries somewhere else to drive the recipient organization in a direction that benefits one country better than another.

In general, due to the lack of effective framework and system in the organization to handle knowledge products, leads to the alteration, misappropriation and mismanagement of significant resources and valuable knowledge and knowledge products.

5.4.3 Disclosure Related

The third knowledge dimension of ENTRO is disclosure related, which includes Mandate, Sensitivity and Disclosure Policy of Knowledge Products in ENTRO. ENTRO is mandated with the implementation of "*Shared Vision Programs"*. According to the ENSAP (2001), this includes the "*creation of an enabling environment for investments and action on the ground within a basin-wide framework. This program will promote the shared vision through a limited, but effective set of basin wide activities and projects. While local and national governments will address what needs to be done at the local and national levels, the challenge of regional cooperation is to address development opportunities with trans-boundary implications*".

While ENTRO was mandated on specific program implementation with cooperative agreement with a common understanding and the implementation of the "*Shared Vision"* programs and a set of guidelines were in place, the implementation of the subsidiary action programs have no clear cooperative framework in place. Despite the lack of such framework, the organization has the full mandate, an overlooking body – the Nile Technical Advisory Committee (Nile-TAC) and the governing body – the Eastern Nile Council of Ministers (ENCOM).

Figure 5.3 shown below the pillars of Basin-Wide Shared Vision Program that any knowledge products produced in any of its activities are governed by the cooperative understanding to *achieve sustainable socio-economic development through equitable utilization of and benefit from, the common Nile Basin water resources*.

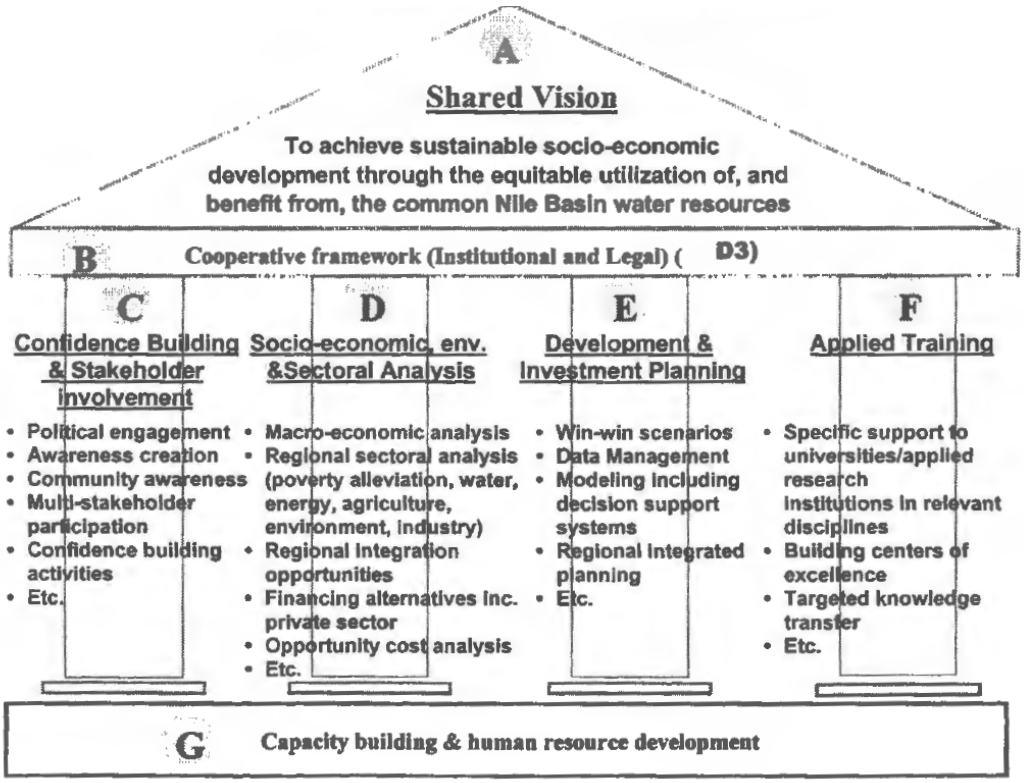


Figure 5. 3: Pillars of Basin-Wide Shared Vision Program

(Adopted from ENSAP, 2001)

Yet, the resources and knowledge product in the organization are very sensitive and have significant political and national security implication and had to be handled with profound confidentiality. As the resource (i.e. Water) is scarce and competition among nations is high, countries attempt to prioritize the implementation of development agendas in the interest areas that benefits their own people first; with ENTRO as an instrument and the cooperative framework as a tool.

Therefore, controlling the implementation of activities and programs in ENTRO plays a crucial role. There comes also the critical role of individual representatives of countries in exploiting sensitive knowledge products to their corresponding member states. Disclosure of such sensitive and broadly confidential knowledge products requires a structured policy guideline and accountability, which is missing in the case of ENTRO. Hence, the author recommends a special unit in the organization that deals with Knowledge Management to address all the issues discussed above. Furthermore, it is critically important to have a working Knowledge

Management System in place, in order to have *equitable utilization of and benefit from* the knowledge resources in the organization. This system should implement the recommended Knowledge Management Framework specific to ENTRO.

5.5 ENTRO specific Knowledge Management Framework

Government and non-government agencies; large, medium and small private enterprises in many domains such as engineering, education and manufacturing, are drowning in an ever-increasing deluge of data. This is because their employees create, capture and share massive amounts of data and knowledge in their daily business activities. Thus, having an ability to analyze data in a timely fashion can ensure businesses and institutions to have a competitive edge to improve productivity in their decision-making.

Thus, many organizations recognize Knowledge Management as a valuable method and have begun to support this practice to meet business needs and objectives. KMS integrates an extensive range of tools. The goal of KMS is not to manage all the existing knowledge inside the organization, but it is to manage the rightly selected knowledge and make it readily available to help people create real-time decision making in the organization (Baharuddin et al., 2016). In this way, individual and organizational performance can be improved. Due to its imposed structure, it may in some situations limit our ability to be creative in our approaches to dealing with knowledge. Although this is true for any framework, it is believed that the order it brings will allow practitioners in all knowledge-related areas to be better informed about what to do.

KMS can be depicted as a single, server-based repository that allows centralized analysis, security, and control over knowledge, which is designed for a strategic business unit or a department that it is a lower-cost version. KMS supports reporting and query tools, store current and historical data, and consolidate data for management analysis and decision-making. Even though there are many recent studies that have been done on KMS in managing organizational assets, there is still little debate these days about KMS in supporting dynamic decision-making**.**

There are also limited studies on the role and importance of incorporating data from different sources for better decision-making. There is no universally accepted method or approach in analyzing different sources of data for in-time decision-making. Knowledge Management has

emerged as a methodology for capturing and managing the intellectual assets of an organization as a key to sustaining competitive advantage. Alavi and Leidner (2001) define knowledge management systems (KMS) as "a class of information systems applied to managing organizational knowledge. That is, they are IT-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer and application".

A KMS can be used as knowledge repositories, knowledge networks, directories of subject matter expertise, intranets including corporate portals, groupware and collaboration tools, desktop computer conferencing and other similar services.

The researcher conducted semi-structured interviews with sample populations to collect relevant information for his research and each of the respondents provided their view of the knowledge management practices in ENTRO. The findings of this research indicates that there have been large volume of knowledge products generated from each specific project activities. Majority of respondents in this research revealed that they store the knowledge products under their supervision on random, local storage locations such as PCs, drives, on the shelves of staff and organization's library and shared folders. The research found out that the knowledge acquired in the organization are scattered in different forms across the organization and consultants.

Similarly, the knowledge products captured in variety software including hydrologic modeling software, hydraulic/hydrodynamic modeling software and tools like ArcGIS, Global mapper, quick terrain modeler, Audio/video, Microsoft office tools which are generating diverse data and information posing difficulty in data harmonization. Which make, as all respondents unanimously agree that, locating a knowledge product or information in the organization is very difficult

Some of the knowledge products developed under supervision of these respondents are stored on shared drives without control of who accesses them. Each units of the organization are storing the data and information or knowledge products either in hard copies, or in soft versions within each unit. These knowledge products are not regularly updated and contain outdated information. Furthermore, some respondents iterate that duplication of contents and lack of

knowledge sharing policy contributes to the challenges managing the knowledge in the organization.

As indicated by some respondents, this is because there is no proper knowledge management system/ framework in the organization that facilitates standardized knowledge management practice, sensitivity and policy, which are the biggest challenge in knowledge sharing and dissemination.

According to the respondents of this research, the organization has to create a mechanism to harmonize and standardize ENTRO's knowledge management processes with high sensitivity care for its knowledge products and policy in-place to overcome the challenges in knowledge management processes, knowledge sharing and knowledge products retrieval. Hence, the finding of this research proposed a knowledge management framework to manage the organizations valuable water resources knowledge products and facilitates knowledge management practices or/and knowledge sharing within ENTRO and other stakeholders of the organization as well as promote collaboration with the other two NBI centers to harmonize, standardize ENTRO's information, knowledge products and knowledge management systems.

Figure 5.4 illustrates the proposed Knowledge Management Framework for ENTRO, which is built on integrating three key categories of dimensions pertaining to: (a) the knowledge generation process (i.e. creation, capture, transfer); (b) stakeholder interests (i.e. national interest, consultant interest, donor interest) and (c) disclosure related (sensitivity, mandate, and disclosure policy). In section 5.4, we discussed the knowledge generation processes, stakeholder interests and disclosure related components of knowledge dimension. These dimensions used as inputs for the development of the proposed KMS framework.

Hence, the proposed KMS framework has to integrate the knowledge dimensions mentioned above with Individual/National Interest, Knowledge Base, Donor Organization Interest and used Technology as enabler to achieve the research objectives and address the research problems stated (in chapter one) and contribute to achieve the Shared Vision objectives of ENTRO.

As the figure (Figure 5.4) depicts KM is a technically complex process requiring a robust institutional setup that clarifies required policies mandates, hierarchies and responsibilities at each of the knowledge generation, capture/storage and dissemination stages.

Knowledge Management also requires a sound and reliable technological support, along with commensurate expertise.

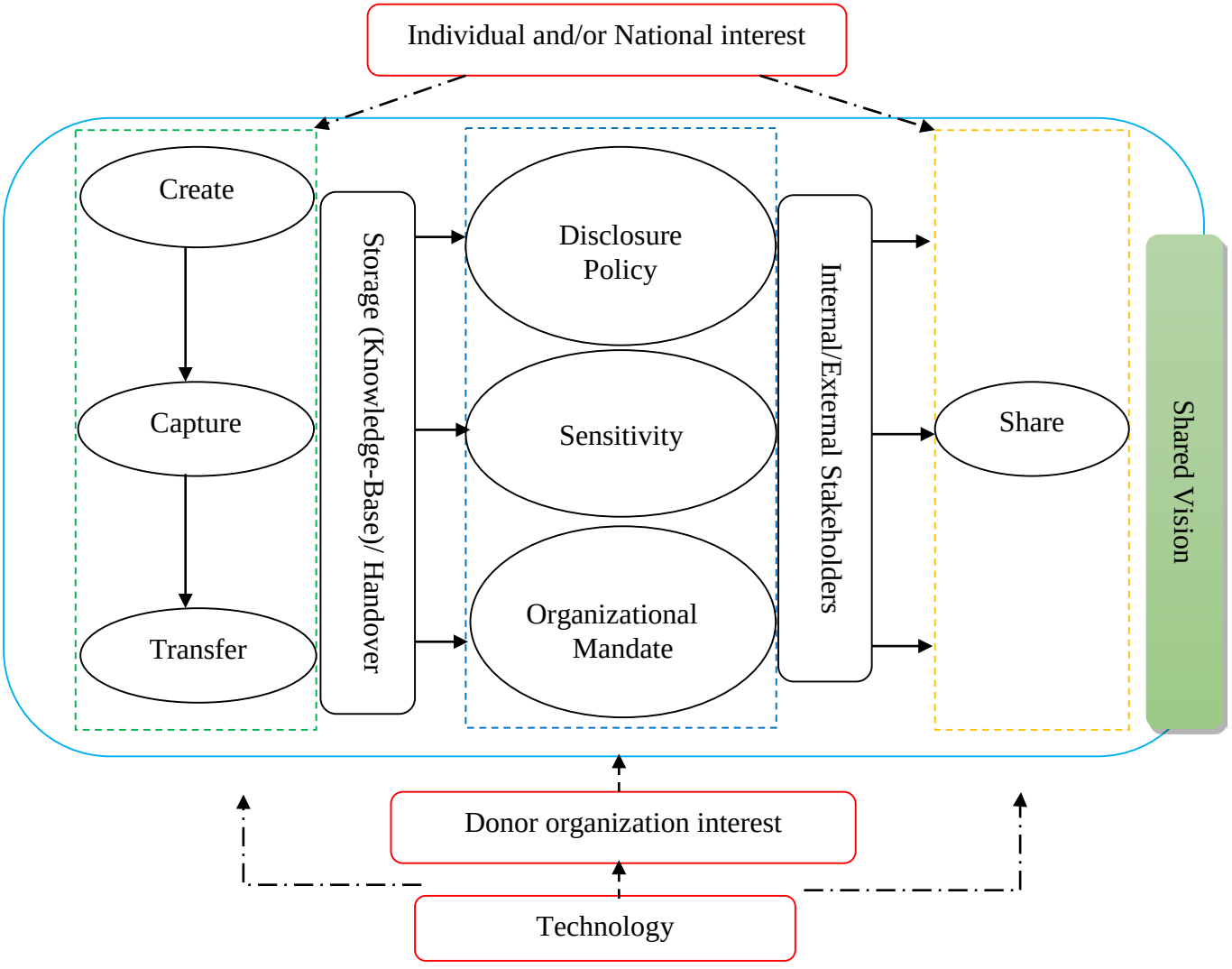


Figure 5. 4: Proposed KMS Framework for ENTRO

This suggested framework is expected to address the problems ENTRO is grappling with as identified at the outset of this research in section 1.2 page 4 (Statement of the Problem) and achieve the research objectives stated in chapter one.

The shared vision is a framework of cooperation in activities of ENTRO in order to realize *equitable utilization of and benefit from* the knowledge resources in the organization. The components of the proposed KMS framework discussed as follows:

The Individual/National Interest, Knowledge Base, Donor Organization Interest and uses of Technology components of the proposed KMS framework in water resources management and planning discussed as follows:

5.5.1 Individual and /or National Interest

Individuals or groups of individuals play a critical role in the processes of knowledge creation, capture and transfer. These knowledge products should be handed-over to ENTRO in order to achieve the common benefit stated in the Shared Vision objectives of the organization.

Individuals mostly come up with new ideas, new concepts, innovative product or process through projects research and observation to build organizational knowledge products (that should be properly handled through ENTRO's knowledge management system).

5.5.2 Handover (Knowledge-Base)

The system should be able to place a check-and-balance on the interest of individuals and nations. Employees, consultants and country representatives create, capture, transfer and handover ENTRO's knowledge products in the activities of the organization under the shared vision. The knowledge products, which created and captured by these individual are properties of the organization and has to be dealt with under ENTRO's knowledge bases and handled with the proper disclosure policy and organizational mandate and sensitivity care.

ENTRO then should handle these sensitive products with the proper knowledge management processes, disclosure policy and mandate. Interested stakeholders should only receive knowledge products through the proper organizational channel. Eventually, individuals and member states have interest that might influence the outcome of activities in violation or beyond the *Shared Vision* of *equitable utilization of and benefit from* the knowledge resources in the organization.

5.5.3 Donor organization Interest

Donor organizations funding the whole organization or some activities show interest in choosing focus area and attempt to influence the outcome of activities in favor of specific agenda which have the potential to violate the *Shared Vision* of *equitable utilization of and benefit from* the common Nile Basin Water resources (and the knowledge resources in the organization) to achieve sustainable socio-economic development. Hence, ENTRO as an organization has to follow its organization mandate and should be able to place a check-and-balance the interest of individuals or/and nations, Employees, consultants and country representatives to create, capture, transfer, handover/store and retrieve its knowledge products.

5.5.4 Technology

Technology is an enabler for every activities of knowledge management including that of ENTRO. ENTRO applies technology in all the activities of the knowledge management system from creation to handling to sharing knowledge products. Technology plays critical role in all the daily routines of employees and it is the backbone of the proper utilization of KMS in ENTRO. Information technology is widely used as a medium for the flow of knowledge.

Knowledge based technologies has to be used to support and improve the management of knowledge creation, storage/retrieval, transfer, and application for knowledge management practice in ENTRO. Hence, choosing the right technology is critically important for ENTRO and the member states in order to realize the *Shared Vision.*

Technology need to be applied in ENTRO activities mainly in three major ways (as shown on figure 5.4):

- Technology for knowledge codification and storage that includes different types of knowledge repositories and knowledge creation systems. Knowledge codification refers to the ability to learn or develop new knowledge products or services; and knowledge storage requires a structured storage capability and results in the ability of universal accessing and quick searching of information and the effective use of knowledge. Software tools and searchable databases which allow search for knowledge products across many repositories on behalf of the user; and data mining tools that help to identify

new patterns in large volumes of data also belong to this kind of technology. ENTRO implements a large storage space accessible for every user and serves as a repository for shared working documents for internal use during project activities. Such resources are stored on storage server the enables employees to access latest works in progress in the organizations.

- Communication technology that supports knowledge transfer and experiences through the development of team spirit irrespective of its format, user operating system, or communication protocols and standards. Communication technology being utilized in ENTRO include Office and productivity; internet and e-mail exchange; graphics tools and knowledge maps; database systems which are pointers to knowledge providers inside or outside ENTRO and similar other communication and productivity tools.
- Collaborative technology that enhances person-to-person collaboration which can happen at the same or different time and in the same or different place. Collaborative knowledge management tools that allow people to share documents, make comments and engage in discussion are valuable aids that support organizational learning and development of knowledge products in ENTRO.

Knowledge management technologies should provide persistence and relevant strategies so that people can find information that was created in the past and regenerate it to create new knowledge through the concrete application of existing knowledge. Knowledge technology can help ENTRO to initiate collaboration and innovation, facilitate knowledge sharing practices, also bring knowledge management the ability to carry out knowledge management processes, quickly, efficiently and cost-effectively, making it an enabling solution.

Technology is mostly assumed to have positive impact in the management of knowledge in an organization. Nevertheless, it is also possible that technology can downplay this assumption when it is used as a tool to fulfill the interest of individuals and states outside the scope of the organizational mandate and the *Shared Vision.* This research finds out that organizations' implementation of technology to enhance and assist the knowledge management process can be exploited to fulfil individual interest and destruction of valuable knowledge products that are generated with the aim to benefit countries and people. Hence, it is critically important to

include the technology perspective in the knowledge management framework and thoroughly think about the implementation to strategically benefit the member states and citizens.

Chapter Six

6. EVALUATION OF THE KNOWLEDGE MANANGEMENT FRAMEWORK

After developing the knowledge management framework, evaluation is a critical task. Evaluation achieved through reviewing the knowledge management framework with domain experts to confirm that the framework is true representation of the organizational knowledge.

The researcher used human expert evaluation methods to evaluate the effectiveness of the knowledge management framework. The evaluation data collected through interviews with senior staffs who were participated in the semi-structured interviews during data collection processes (in chapter four). This human expert evaluation method was important to validate that the knowledge management framework can achieve its intended objectives.

Three senior staffs interviewed to evaluate the proposed framework. The interview had four open ended questions divided in to two groups: general importance of the knowledge management framework and knowledge dimension of the knowledge framework. The first category used to review the ability of the framework to facilitate the knowledge management activities and the second category used to review completeness of the knowledge dimension of the proposed knowledge management framework to address knowledge management practices within ENTRO.

The researcher explained some of the key concepts about knowledge management including knowledge, type of knowledge, knowledge management system, knowledge management processes and knowledge management framework in order to facilitate better understanding and conducting of the interview. After key concepts explanation, the researcher presented the knowledge management framework and explained its information and expertise components as well as how it will help if the framework is implemented for respondents. The finding with list of responses for the interview questions by the respondents are organized based on the previously mentioned groups and discussed as follow.

Category 1: The knowledge management framework capabilities to facilitate the knowledge management processes

In general, the respondents recognized that the knowledge framework is very significant and helps ENTRO staffs to reduce knowledge acquiring tasks for new officers, reduce knowledge product loss due to employees or consultants' turnover and increase knowledge sharing among ENTRO staffs and other stakeholders in knowledge management processes. The monitoring and evaluation officer said the following:

> *I found this knowledge framework helpful for its standard means of managing the water resources knowledge product, ease of access and managing the knowledge products in the organization. The components, which are mentioned on the framework, are very critical and stated their role very well. The knowledge management processes that is involved for a project activity has cited as coherently and explicitly as possible. It vitally helps to understand the knowledge management process in a clear and precise ways.*
>
> *He also added, "The framework is also facilitate to improvement, and identify any rooms and measures for better performance" for the project activities and managing the knowledge products in the organization.*

ENTRO's senior social and communication officer confirmed the proposed knowledge management framework facilitates knowledge management processes and reduce the knowledge products loss due to employee and consultant turnover.

> *I am very impressed the way the framework designed and how the components are interacted. This knowledge management framework could help to manage the vast volume of knowledge products, which are generated from ENTRO's projects activities and programs, as well as enhance collaboration among employees and other stakeholders of the organization.*

The knowledge management framework can highly facilitate the knowledge products capturing process and offers better management of the knowledge products in ENTRO.

As the senior social and communication officer explained:

> *The knowledge framework looked like it would very useful means of knowledge capturing and it reduces many of the previous difficulties with knowledge retention processes. He further said that the framework could highly improve the organization communication channels and engagements for water resources management and supports ENTRO to manage its valuable knowledge resources as well as promote knowledge sharing among stakeholders of the organization. The framework can also contribute to bring Riparian States/countries together to reach common understanding, achieve information symmetry to build trust and catalyze cooperation.*

ENTRO's ICT/ System administration officer is another participant in the knowledge management framework evaluation processes and he described the knowledge management framework as:

> *I understand that the proposed knowledge management framework could contribute to "Shared Vision objectives" of the organization - achieve sustainable socio-economic development through equitable utilization of, and benefit from, the common Nile Basin Water resources" by managing the storage, accessibility and maintenance of knowledge products generated under every unit in the organization. The knowledge management framework can be a critical asset for an organization and the knowledge products it generates through time to properly handle its knowledge products.*

The respondents also have positive response about the capability of knowledge management framework to facilitate knowledge capturing and sharing among employees with appropriate disclosure policy and sensitivity care. The ICT/ System administration also further explained his understanding about the knowledge sharing process capability of the knowledge framework as:

> *I think the knowledge framework is very helpful to share the knowledge products in simplest way among stakeholders. The knowledge management*

dimension in the framework is clear and flexible as well as improve the knowledge capture and storage for future retrieval process.

Category2: Completeness of the knowledge content of the knowledge management framework

Knowledge dimension is the major concern of this research knowledge framework that helps to successful implementation of knowledge management system for ENTRO's knowledge management processes. It provides value for the knowledge capturing, transferring and handover processes. The success of the knowledge framework is determined by knowledge dimension of the knowledge process. Currently, knowledge dimension of ENTRO's knowledge management framework is found unique and has its own dimension stated in chapter five (Figure 5.3) since organization has trans-boundary nature.

The majority of the respondents felt that the knowledge management framework contains most of the knowledge dimensions needed to perform the knowledge generation processes.

The monitoring and evaluation officer mentioned the following about the knowledge dimension:

In addition to its standard means of managing the knowledge products and ease of access the water resources information, the knowledge framework is rich in its knowledge management dimension contents. The framework contains all stakeholders and their interests in project activities and can serve as a monitoring and evaluation tool to assess and track progress and preparing periodic reports (quarterly, mid-year and annual); preparing status report for funding Missions; to closely follow up the impact assessment process of the projects, and prepare action plan on governance decisions and status report.

Positive comments were also received from the social and communication officer. He felt that the knowledge framework provided *useful knowledge dimension to enhance the knowledge management processes and uses of the knowledge products to promote social and economic development, enhancing food and energy security and reduction of rural poverty through sustainable management of the shared water resources of the sub basin*.

He also added:

> *The proposed knowledge management framework can strengthen the knowledge base of ENTRO for its water resources planning and management, improve regional collaborations and contribute on building consensus among the countries public and stakeholders for cooperative basin development and management of the shared Eastern Nile water and related resources. Moreover, the sensitivity nature of the knowledge products (which is one of the components of the knowledge management framework in figure 5.5) needs special attentions with proper disclosure policy while sharing / disseminating such knowledge in order to inform the public, technical and political discourse in a factual manner.*

The ICT/System administration officer explained the completeness of the knowledge management framework and its contribution to the overall achievement of the Shared Vision Objective of the organization:

> *In my opinion, this framework is more helpful when it incorporates the knowledge management strategy and collaborates with the other two NBI centers to harmonize, standardize ENTRO's information, data and knowledge management systems. The proposed knowledge management framework can also contribute on establishing easily accessible, centralized EN basin-wide information and knowledge base; improving access to information and knowledge sharing; facilitating WR Planning and decision making countries; and increasing visibility of ENTRO.*

The knowledge management framework evaluation demonstrated that the framework is helpful and can be productive for knowledge management practice in water resources management processes. The proposed KMS framework can have significantly role to achieve the Shared Vision objectives of the organization and reduce knowledge loss due to high employee or consultant turnover and facilitates knowledge management processes in water resources management.

Chapter Seven

7. Conclusion and Recommendations for Future Works

7.1 Conclusion

The establishment of ENTRO is in order to facilitate the implementation of the Shared Vision program with the aim of *equitable utilization of and benefit from* the common Nile Basin Water resources. Hence, the member states established ENTRO in order "*to achieve sustainable socio-economic development through the equitable utilization of, and benefit from, the common Nile Basin Water resources"*.

Eventually, the member states selected and triggered the implementation of specific programs and projects in the basins of the Nile River. These programs and projects selected for implementation to realize the *Shared Vision* are the main sources of knowledge products in the organization. Water Resources Management Unit of Eastern Nile Technical Regional Office (ENTRO) is a significantly important section that generates large amount of knowledge products under selected activities of projects and programs in the organization to achieve the Shared Vision of the member states.

The researcher conducted semi-structured interviews with the sample population and used his personal observations to collect relevant data for his research and presented in a way to address the statement of problems and research questions as well as to achieve the research objectives stated in chapter one. The respondents provided their view of the knowledge management practices in ENTRO. The findings of this research indicates that there have been large volume of knowledge products generated from each specific project activities.

Despite the growing knowledge and knowledge products in the organization – ENTRO, there were no practicable Knowledge Management System and Framework in place to properly handle the valuable products generated. As a result, the organization and the member states could not benefit from the generated knowledge products to the fullest. Further, challenges from individuals and states with special interest in the basin-wide development and resources posed systematic and widespread influence throughout the knowledge acquirement, disclosure and

sharing processes. Meanwhile, lack of proper knowledge management system and framework was a challenge due to the nature of the knowledge products and mandate of the organization.

Hence, this research was conducted to identifying the knowledge management resources and their processes of ENTRO; assess and capture the knowledge resources needed as a fundamental aspect of Knowledge management in water resources management research and to develop a knowledge management system framework for water resources management that supports ENTRO to manage its valuable knowledge resources and promote knowledge sharing.

In due process, the researcher identified the dimensions of knowledge management in the organization specific to water resources management in the context of shared vision development interest, where individual and states play critical role in the process. This framework emphasized the interest of individuals and member states in the whole knowledge process; the effectiveness of disclosure policy and mandate; following of proper channels from knowledge acquiring to sharing; and other factors like technology and how it affects the knowledge management and system in ENTRO.

As a result, the researcher proposed a new knowledge management framework, which deals with the dimensions identified. Accordingly, the organization – ENTRO, should implement a knowledge management system that should incorporate all the components pointed out in this framework to handle the knowledge products produced in the organization and realize the *Shared Vision*. The proper implementation of the proposed framework into a practical Knowledge Management System (KMS) is expected to eventually lead to a maximized benefit from the knowledge products created, captured in the organization and member states.

Finally, the proposed knowledge management framework evaluated by domain experts, from the sample population who were participated in semi-structured interviews, to determine the effectiveness of the knowledge management framework.

7.2 Recommendations for Future Works

The objective of this research was to answer the problems stated in chapter one. Research on Knowledge Management Systems and Framework requires a wide and deep study. When it comes to specialized institutions like ENTRO that has trans-boundary nature, off-the-shelf Knowledge Management systems do not fit to business processes easily. Hence, it is critically important to thoroughly investigate and analyze the special needs of the organizational behavior. Dimensions such as interest (individual and national), sensitivity, and mandate have to be dealt with properly.

Further research on building knowledge modeling for water resources management should be given emphasis in the future studies related to watershed management knowledge modeling, flood forecast and preparedness knowledge modeling, irrigation and drainage development knowledge modeling, hydropower development and trade knowledge modeling, sustainable management of lakes and linked wetland systems knowledge modeling, pollution control and water quality management knowledge modeling, and water use efficiency improvement knowledge modeling to enhance the knowledge management practice of ENTRO.

These knowledge models needs to be integrated with the proposed Knowledge management framework to properly capture, store, update, share and retrieve the vast volume of knowledge products generated by various project activities and programs of ENTRO.

Moreover, ENTRO as trans-boundary organization, which has intergovernmental nature, it has to consider also developing a knowledge management strategy to make the proposed KMS framework more efficient and effective; as well as considering on developing a knowledge portal to make easily accessible its knowledge products by its stakeholders.

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7.3 Limitation of the Study

The main limitations of this study were data collection; due to the sensitivity of information in the organization and national interest of individuals working for ENTRO. Obtaining much knowledge resources on knowledge management from employees based on the schedules of the researcher was a challenge due to the time constraint of employees. Furthermore, due to lack of proper knowledge management practice in ENTRO, the information provided was with little significance and richness. The other constraint that the researcher came across was the difficulty to find literatures those are directly related to organizations in the context of Knowledge management for water resources management in organizations of trans-boundary nature. Yet, the researcher has exerted significant effort to review other industries research works on KM framework development.

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Appendix 1: Interview Outline

1. Respondent Line Position
   - ☐ Executive Director
   - ☐ Senior Water Resources Expert/Modeler
   - ☐ Senior Project Coordinator
   - ☐ Regional Dam Safety Coordinator
   - ☐ Social Development and Communication Head
   - ☐ IT Officer
   - ☐ Finance and Human Resources Head
   - ☐ M&E Officer
   - ☐ Baro-Akobo Multipurpose Water Resources Development Study Project
   - ☐ ENTRO current Study Consultants (BAS, IT, etc.)

2. **What type of data, information/Knowledge Product is typical of your Unit?** (e.g. hydrologic, rainfall, river flow, sediment, water quality, finance, socio-economic-demography, cropping pattern, dam parameter, etc.)

3. **Do you commission local, regional and international consultants to undertake new or supplementary studies**? Why do you commission such studies (e.g. to fill missing hydrologic i.e. rainfall, river flow, water balance, data? To establish Dam operation parameters? To determine Irrigation water use etc.?)

4. **What are the major challenges you encounter in commissioning for such studies** (e.g. inventorying existing data/information/knowledge on your specific field? Identifying data gaps?)

5. **Once you get the results from studies how do you capture, store, disseminate, and retrieve the data, information and knowledge products?** What challenges do you face when it comes to knowledge sharing?

6. **How difficult or easy is it for you to locate data/information/knowledge product whenever you need it in the event you face challenges?** What do you think is the cause for your difficulty/challenge?

7. **Are you responsible for keeping, maintaining, updating data and knowledge product produced under your supervision**? When you are not there, who else will take this responsibility?

8. **Is there a centralized** data and knowledge product center? Is there any technology, knowledge management system in place to facilitate knowledge creation, capturing and transfer as related to your work?

9. In general, what are the major constraints to make your data, information and knowledge product **accessible to stakeholders within ENTRO and outside** ? Is there any workable disclosure policy in the organization? Policy that defines the mandate and sensitivity of knowledge products in the organization?

10. Does your work entail use or application of diversity of software and applications to generate hydrologic, water resources, etc. data? Do you face challenges in terms of **data harmonization and standardization**? (e.g. formats, units, etc.)

11. **Does ENTRO have standardized policy and procedure you have to follow to manage data, information and knowledge produced under your supervision?** Or, you have to create your own individual system to manage the data you generate? If yes, what challenges does this pose to you and your colleagues and in general for ENTRO?

12. Finally, do you think ENTRO needs to standardize the management of its knowledge products?

Thank you for your time.

Appendix 2: Interview Checklist for Knowledge Management Framework Evaluation

1. Do you think that the knowledge management framework contains all the required knowledge management processes in ENTRO?
2. Do you think that the knowledge management framework simplify the knowledge capturing and application process?
3. Do you think that the knowledge management framework facilitate knowledge sharing in ENTRO and other stakeholders?
4. Do you think that the knowledge management framework contributes the *Shared Vision* of *equitable utilization of and benefit from* the knowledge resources in the organization?