Damascus University

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Dep of .Engineering Management And Construction

Developing a Structure For Knowledge Management Implementation In Construction In Syria

A Thesis Submitted To Department Of Engineering Management And Construction Of Faculty Of Civil Engineering

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CHAPTER ONE

INTRODUCTION

1.1 Introduction:

Knowledge is seen as one of the most important resources in any organization. It is the only source that is not subject to the law of diminishing returns or scarcity. “It is the only plentiful, accumulative and durable source ,The success or even the survival of any organization depends on how effectively it manages the knowledge present internally and externally” (Switzer 2008). Reuse of existing organizational knowledge gained via past experience can greatly reduce the time spent on problem solving and increase the quality of work.

Knowledge is being recognized as a vital resource and a source of competitive advantage in today’s dynamic and changing business environment (Burton-Jones, 1999). The role of effective management of knowledge is producing innovation, reducing project time, improving quality, and customer satisfaction (Kamara et al, 2002- Love et al, 2003).

Liao (2002) stated that the knowledge derived from projects is the intangible resource for solving problems, creating core competitiveness, and initiating new situations for both individuals and organizations now and in the future.

The greatest asset for any organization is its intellectual capital (the new millennium known as knowledge age) as it costs a lot of time and money to cite the staff ,so the construction organizations like others have a fundamental need to manage knowledge before people walk out the door and their knowledge and expertise go with them. And when the organization can have its own knowledge it can survive regardless who leaves or who joins.

Taking this fact into consideration , organizations headed to organize , conduct and employ the experiences ,skills and the clear and hidden information of both the employees and the organization to make the utmost use of it, in achieving its strategic goals , supporting and adopting the strategy of making decisions (Al Ali et al , 2006).

Bender & Fish (2000) believe that today and increasingly in the future, in a knowledge age where national boundaries are of less importance to business, the transfer of knowledge and expertise, and the creation of "learning" organization have become a critical factor to any company success and competitiveness.

The overall aim of this study is to suggest a framework for a better implementation of knowledge management in construction companies in Syria. The thesis includes six chapters. Chapter 2 aims at providing required background of knowledge and knowledge management to help in conducting and understanding the KM process and main requirements needed to achieve knowledge management process . Chapter 3 provides details about methodologies to analyze results of interviews and questionnaires conducted in the research in order to help improving the KM framework. Chapter 4 describes the details of results for the two case studies, where SPSS application (version 20.0) was used to calculate frequencies and chi square test. Chapter 5 provides the concluded results for both case studies, description of main gaps founded in implementing KM and finally suggested framework for better implementation knowledge management in construction companies in Syria .Chapter 6 summarizes the final conclusion and recommendations of the conducted research.

1.2 Problem Statement :

The greatest asset for any organization is its intellectual capital as it costs a lot of time and money to cite the staff ,so construction organizations like others have a fundamental need to manage knowledge before people walk out the door and their knowledge and expertise go with them. In the light of this fact ,this study will suggest a framework for better implementation of knowledge management in construction companies in Syria

1.3 Aims of the Research:

Construction projects are of unique and dynamic nature where each step in the project lifecycle presents a number of potential opportunities to capture knowledge. If this knowledge can somehow be captured and reused, it will reduce the waste caused by "Reinventing the wheel" and therefore improving innovation, business performance and client satisfaction in this sector.

From this point of view ,this study aims to:

- Investigate and analyze the current status of knowledge management in construction companies in Syria considering its processes, practices and requirements necessary to have successful KM system through two case studies worked in construction field one in public sector and the other one in private.
- Suggesting a framework for implementing knowledge management in construction companies in Syria, which helps in increasing their competitive ability and reducing waste from resolving repeated problems.

A knowledge management framework shall enable construction companies to better implement their expertise ,skills and knowledge by sharing, documenting and storing this knowledge, and hence, preventing it from walking out of the door when experts retire or leave the company.

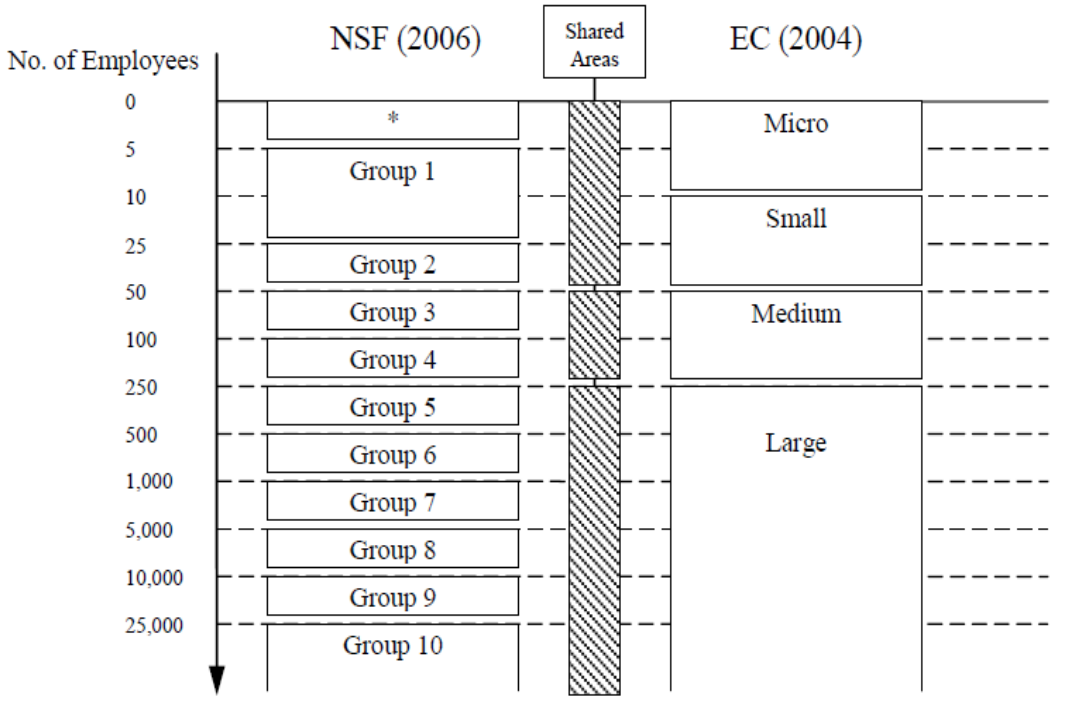
A review for KM models have been carried out and a list of requirements have been detected to evaluate the current status of KM in the case studies and therefore the status of KM in construction companies in Syria. This KM measurement helped to suggest a framework by filling the gaps which have been found in company's practices.

A comprehensive literature review is conducted to search knowledge definitions, types of knowledge, importance of KM, knowledge management in construction and knowledge management models and requirements.

1.4 Research Scope

The study was done in two engineering consultancies companies. The two case studies have similar characteristics in terms of scale, the engineering field, and being in Syria. The first company belongs to public sector, while the other one belongs to private sector.

The two case studies are classified as large scale companies according to number of employees, which exceeds more than 250 .Figure (1.4) shows the classification of companies according to European Commission (EC,2004) and National Science Foundation (NSF, 2006).



* The method excludes companies with fewer than five employees to limit burden on small business enterprises in compliance with the Office of Management and Budget's (OMB) guidelines for Federal government data collection activities.

Figure (1.4) Classification of Companies According To European Commission (EC, 2004) and National Science Foundation (NSF, 2006)

1.5 Summary

This chapter introduces the rationale behind this study as well as the problem of the research. The aims, and limitations have been highlighted briefly. In the next chapter a literature review will be conducted to find out about the concepts of knowledge ,knowledge types ,knowledge management , knowledge management in construction and its models to identify the main KM levels and the requirements needed to achieve KM process successfully .

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter aims to provide a review about knowledge and knowledge management .It commences with knowledge definition clarifying its components , a description and differentiation between the two types of knowledge (tacit and explicit) is listed ,it talks as well about the importance of knowledge and why there is a need to manage it .The second section of this chapter speaks about knowledge management concept by listing several definitions about it , the privacy of KM in construction .A description of some existing knowledge management models is provided which is used to determine the main KM process which will be adopted in this study . Finally a list of six requirements were identified as main needs that should be filled to have a successful KM process

2.2 About Knowledge:

2.2.1 Definition of Knowledge

Knowledge has always been an interesting subject for researches; so numerous definitions exist for knowledge. To know what knowledge is, we should first know about its components (data and information).

Data is raw facts without any processing, organizing or analysis, so it has little meaning and few benefits to managers and decision-makers. Data doesn't have much meaning unless it is sorted, grouped, analyzed, and summarized so it becomes information.

Information has meaning and value to the receiver. KLICON (1999) argues that information results from the interpretation of data in a given context. So, a single content of data may produce different information contents if the context is different.

Knowledge consists of information that has been organized and processed to give understanding, experience, and expertise in a specific context.

The concept of knowledge can be explained by viewing it as occupying a superior place in a hierarchy in relation to data and information. By definition data is meaningless, but when processed into information it becomes more useful. A knowledge creation process begins when individuals receive the knowledge from other sources (other individuals, books,..) in the form of data, the recipient of the data adds meaning to it so it transfers from data into information, then enriches the received information with his or her personal application. In this sense, people can transfer data or information, but the knowledge itself has to be created in the head of the individual.

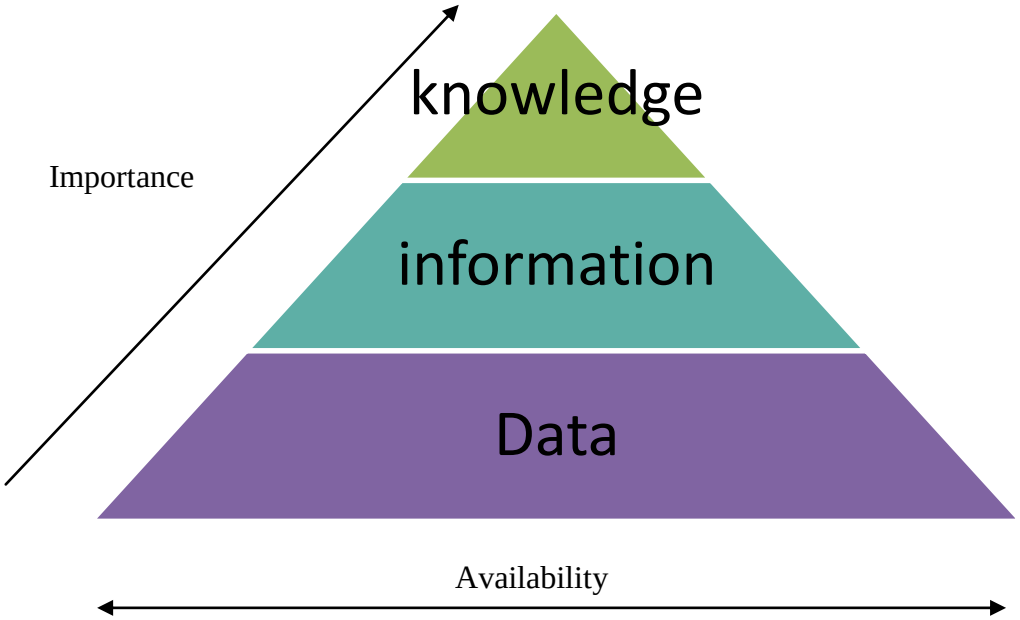


Figure 2.2.1 Knowledge Hierarchy

Bender & Fish (2000) argue that "Knowledge originates in the head of an individual and builds on information transformed and enriched by personal experience, beliefs and values, with decision and action-relevant meaning. It is information interpreted by the individual and applied to the purpose for which it is needed"

Davenport et al. (1998) defines knowledge as "information combined with experience, context, interpretation, and reflection. It is a high-value form of information that is ready to apply to decisions and actions".

According to McInerney (2002) "Knowledge is the awareness of what one knows through study, reasoning, experience or association, or through various other types of learning".

Patel et al. (2000) provide more comprehensive view of knowledge" knowledge is a body of information, coupled with the understanding and reasoning about why it is correct. Knowledge is the cognitive ability to generate insight based on information and data and it is typically gained through experience or study in some combination."

2.2.2 Types of Knowledge:

Classifying knowledge helps to identify the different types of knowledge with different nature that may need different procedures, tools and activities to process and manage important and available knowledge resources successfully (Tserng & Lin, 2004 - Lin et al, 2006).

According to Mckenna (2006) knowledge can be viewed as consisting of two types; one *tacit* and the other *explicit*.

As Herrgard (2000) and Empson (2001) contended, organizations knowledge resources can be described as an iceberg. The structured, explicit knowledge is the visible top of the iceberg, which is easy to find and recognize and therefore also easier to share.

Beneath the surface, invisible and hard to express, is the momentous part of the iceberg. This hidden part applies to tacit knowledge resources in organizations.

Polanyi sees tacit knowledge as a personal form of knowledge, which individuals can only obtain from direct experience in a given domain. Further, he encapsulates the essence of tacit knowledge in the well-known phrase ‘‘we know more than we can tell’’, so this knowledge is held in a non-verbal form, and therefore, the holder cannot provide a useful verbal explanation to another individual.

Tacit knowledge is composed of an accumulation of experience in the form of insight and wisdom, which the person may have difficulty in communicating to others but can easily utilize in the performance of a particular task.

Patel et al. (2000) define tacit knowledge as “The personal knowledge embedded in individual experience and involves intangible factors such as personal belief, perspectives, and values”.

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 heads and memories (Nonaka ,2007- Lin et al, 2006).Tacit knowledge is considered a very complex type of knowledge so the challenge of KM is to make it explicit.

In project contexts, tacit knowledge may include work processes, problems faced, problems solved, expert suggestions, know-how, innovations and experiences (Lin et al, 2006 - Ahmed 2010).

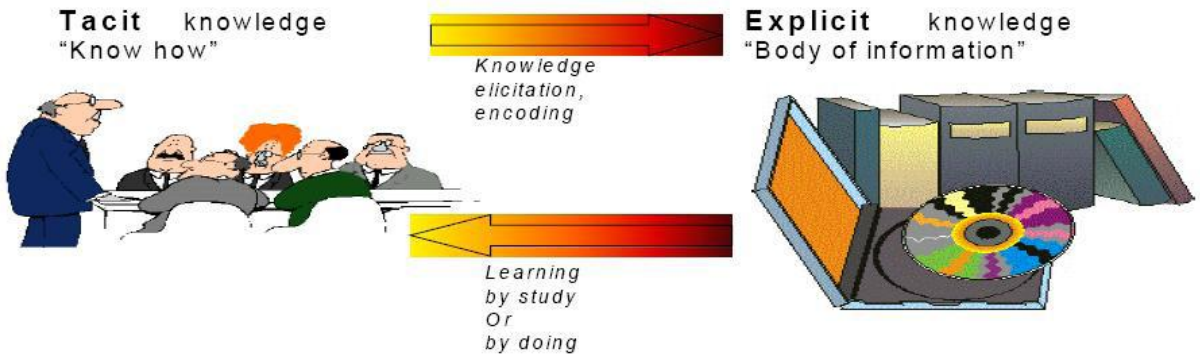


Figure 2.2.2 Types of Knowledge (Patel et al ,2000)

By contrast *explicit knowledge* easy to be captured, retrieved, shared and used because it can be expressed in words and numbers that can be managed more easily.

KLICON (1999) described explicit knowledge as being "readily available", recorded, codified and/or structured in a way that makes it easily transmissible and available to be retrieved and used, which can be found in a range of diverse sources, such as human resources data, meeting minutes and the Internet.

According to (Rice and Rice 2005) "The explicit knowledge created, should be a strong reflection of best practice within the alliance group, should exhibit shared ownership, and should be able to be easily understood outside its linguistic, organizational and cultural context"

In project contexts, explicit knowledge may include project-related contents such as specifications, contracts, reports, drawings, changing orders and data (Lin et al, 2006, Ahmed 2010).

Explicit knowledge consists of knowledge that has already been articulated or codified in the form of text, tables, diagrams, drawings, photos, audios, videos, etc., so they can be directly

and completely captured, used or shared, such as documented articles, books, reports, best practices, manuals, specifications and standards (Nickols, 2003 - Newman & Conrad, 1999).

2.2.3 Why To Manage Knowledge:

Knowledge is seen as one of the most important resources in any organization. It is the only source that is not subject to the law of diminishing returns or scarcity. It is the only plentiful, accumulative and durable source. The success or even the survival of any organization depends on how effectively it manages the knowledge present internally and externally (Switzer 2008). Reuse of existing organizational knowledge gained via past experience can greatly reduce the time spent on problem solving and increase the quality of work.

Knowledge is being recognized as a vital resource and a source of competitive advantage in today's dynamic and changing business environment (Burton-Jones, 1999). The role of effective management of knowledge is producing innovation, reducing project time, improving quality, and customer satisfaction (Kamara et al, 2002 - Love et al , 2003).

Liao (2002) stated that the knowledge derived from projects is the intangible resource for solving problems, creating core competitiveness, and initiating new situations for both individuals and organizations now and in the future.

From this point of view, managing knowledge has become a fundamental need before people walk out of the door and their knowledge and expertise go with them.

2.3 Knowledge Management (KM)

2.3.1 Knowledge Management Definition:

Chong (2006) argues that despite the importance of KM to organizational success, and despite a great deal of interest on the subject there is not yet a common consensus on the concept of KM.

- "Knowledge management is equivalent to the strategies and processes for knowledge identification, documentation and influence with the aim of making companies competitive. " (American Productivity and Quality Center,1996).
- According to Qunitas et al(1997), KM means to manage all knowledge continuously to meet various requirements in an organization.
- “KM is a strategy that turns an organization's intellectual assets - both recorded information and the talents of its member- into greater productivity, new value and increased competitiveness; it teaches corporation from managers to employees, how to produce and optimize skills as a collective entity” (Murray, 1997).
- "Knowledge management represents a systematic and organized approach of using knowledge for storing and extending knowledge in order to increase companies output and performance"(KM Research report ,1998).
- Gurteen (1998) comprehensively defined KM as an emerging set of organizational design and operational principles, processes, organizational structures, applications and technologies that helps knowledge workers dramatically leverage their creativity and ability to deliver business value.
- Knowledge management can be defined as the identification, optimization and active management of intellectual assets to create value, increase productivity, and gain and sustain competitive advantage (Webb, 1998).

- "KM is the mechanism for building the institutional memory of the firm to better apply, share, and manage knowledge across various components in the organization" (Choo,1998).
- "KM is the explicit and systematic management of vital knowledge and its associated process of creating, gathering, organizing, diffusion, use and exploitation. It requires turning personal knowledge into corporate knowledge that can be widely shared and appropriately applied" (Skyrme, 1999b).
- Alavi and Leidner (1999) define knowledge management 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".

The term of KM used in this study is defined as a set of distinct processes ,procedures and techniques, that motivate effective creation ,capturing ,sorting ,sharing and then reusing of both useful tacit and explicit knowledge ,to enable individuals of the organization to be more effective and productive in their work .

2.3.2 Knowledge Management In Construction

There are numerous challenges facing today's construction industry. These include economic swings, new markets emerging in the global economy, increasing competition, the impact of technology, new and increasing demands from clients, customers and society, and the requirement to maintain a highly skilled workforce at all levels (Egbu and Robinson ,2005-Ahmed 2010).

The complexity of industry, diversity of work players, adversarial relationships encouraged by the strategy of contracting and the project nature with pressure to complete and non-repetitive

nature of work, are all causes for much “knowledge wastage” and difficulties in accessing important knowledge (KLICON, 1999).

Construction is a project based industry where each project is unique and brings a number of stakeholders who collaborate with each other at various stages during the project lifecycle, beside that construction projects are characterized by their complexity, diversity and the non-standard nature of the production (Shen and others 2003).

The project-based, fragmented and unstable nature of the industry has led to significant knowledge loss compared with other industries. “Each construction project can be considered a multidiscipline organization which may or may not continue to work together once the project is completed” (Kamara 2002).

Knowledge Management (KM) has been promoted as a means of harnessing and utilizing intellectual resources to address these challenges, as well as improving innovation, business performance and client satisfaction. Carrillo et al. (2000) believe that knowledge management, as a concept is relatively new to the construction industry, which has “the fundamental need to manage its knowledge in a formal and structured way from project to project” .

Construction projects are of unique and dynamic nature where each step in the project lifecycle presents a number of potential opportunities to capture knowledge. If this knowledge can somehow be captured and reused it will reduce the waste caused by "Reinventing the wheel" and improve the process efficiency in general (Woo, Clyton, and Johnson 2004).

Whatever successful and unsuccessful projects have been executed, a valuable record of each one should be kept to identify best and worst company practices. In construction practice, one of effective means in improving construction management is to share experiences among engineers, which helps to prevent mistakes that have already been encountered in past projects. Problems that have already been solved do not need to be solved again. Furthermore, engineers and experts normally take domain knowledge with them and leave little or nothing that will

benefit subsequent projects or the company when they complete projects or leave the company. If experience and knowledge are shared, then the same problems in construction projects do not need to be repeatedly solved, therefore the cost of problem solving is reduced and the probability of repeat problems is decreased.

From the perspective of knowledge management, the experiences of engineers , experts, and each one contributes in the project are very valuable because their accumulation depends not only on manpower but also on the spending of much money and time. How to apply and reuse the past finished projects for future similar projects is the main issue of knowledge management in the construction phase of projects otherwise the failure in managing projects knowledge lead to reinventing the wheel, which will amount to wasted activity and impaired project performance (Anumba et al , 2005).

2.3.3 Knowledge Management Models

2.3.3.1 Boisot's Knowledge Category Model

In 1987, Boisot developed a model that considers knowledge as either codified or uncodified and as diffused or undiffused, within an organization. First, the term "codified" in this case refers to knowledge that can be readily prepared for transmission purposes such as financial data. In this model, codified undiffused knowledge is referred to propriety knowledge and is deliberately transmitted to a small group of people, on a "need to know" basis.

Second, "uncodified" refers to knowledge that cannot be easily prepared for transmission purposes such as experiences. The model suggests that uncodified and undiffused knowledge is referred to personal knowledge (e.g. experiences, perceptions, views, ideas). Third, the left quadrant of the model covers public knowledge and common sense knowledge. Public knowledge is codified and diffused (e.g. library, journals, books, newspapers, etc.). Finally,

common sense knowledge which is relatively diffused and uncodified can gradually develop through the process of socialization and externalization (Boisot, 1987). Indeed, this model suggests that there is a spread or diffusion of knowledge across organization as reflected in the horizontal dimension of the model. However, the codified and uncodified categories in the model are discrete categories of knowledge. In the vertical dimension it is noticed that there is a process to store knowledge but there isn't clear process to retrieve it .

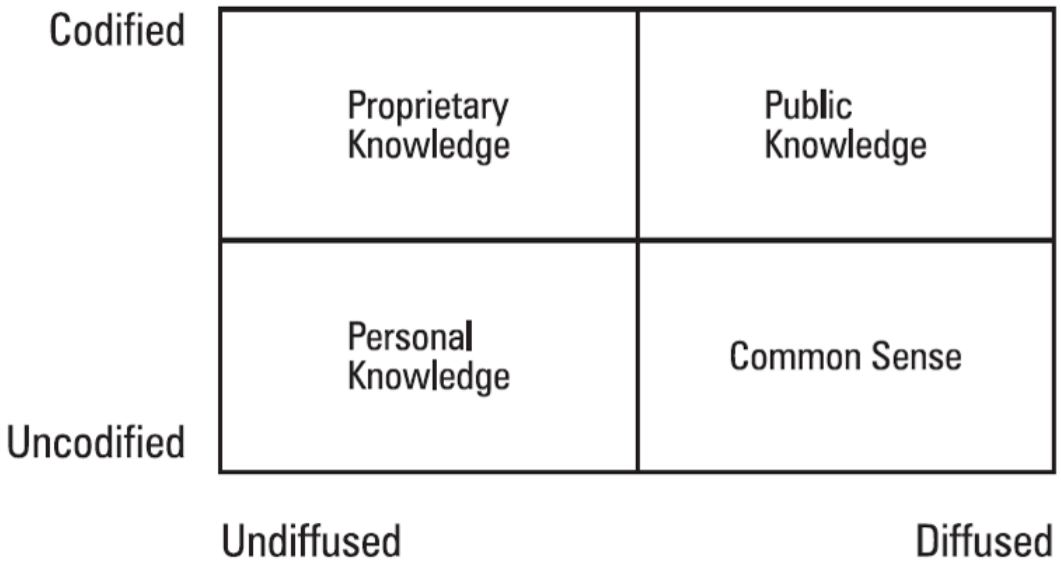


Figure 2.3.3.1 Boisot's Knowledge Category Model

2.3.3.2 Nonaka's Knowledge Management Model

Nonaka's knowledge management model (Nonaka & Takeuchi, 1995) presumes that knowledge consists of tacit and explicit elements.

This model believes tacit knowledge can be transferred into tacit knowledge by socialization and tacit knowledge can be transferred into explicit knowledge by

formalizing a body of knowledge or through externalization process. The model also believes that explicit knowledge can be transferred into tacit knowledge in others by translating theory into practice also known as a process of internalization and explicit knowledge can be transferred to explicit knowledge in others by combining various existing theories – known as combination process.

Socialization is to share or acquire others experiences or tacit knowledge through meetings, direct conversations, observation, practicing, training,… etc. Through socialization, an engineer can learn from an expert or senior engineer the tacit secrets of solving a problem in the construction projects (tacit to tacit).

Externalization is to transform tacit knowledge to explicit knowledge to enable its communication. Through externalization, a senior engineer can translate his tacit knowledge such as experiences, ideas, know-how and perceptions into explicit in the format of reports specifications, articles, procedures, descriptions,…. etc that is easy to be understood, captured, shared and reapplied (tacit to explicit).

Combination of various related elements of explicit knowledge to form new explicit knowledge is the third form of knowledge creation. Through combination, a report can combine explicit knowledge with other related knowledge to provide more analysis and understanding of valuable explicit knowledge available for employees (explicit to explicit).

Finally, Internalization indicates the process of developing new experiences by learning from, reusing and reapplying the existing explicit knowledge to produce new tacit knowledge .Through internalization, the available explicit knowledge can be reapplied by employees to learn and produce new experiences and tacit knowledge (explicit to tacit).

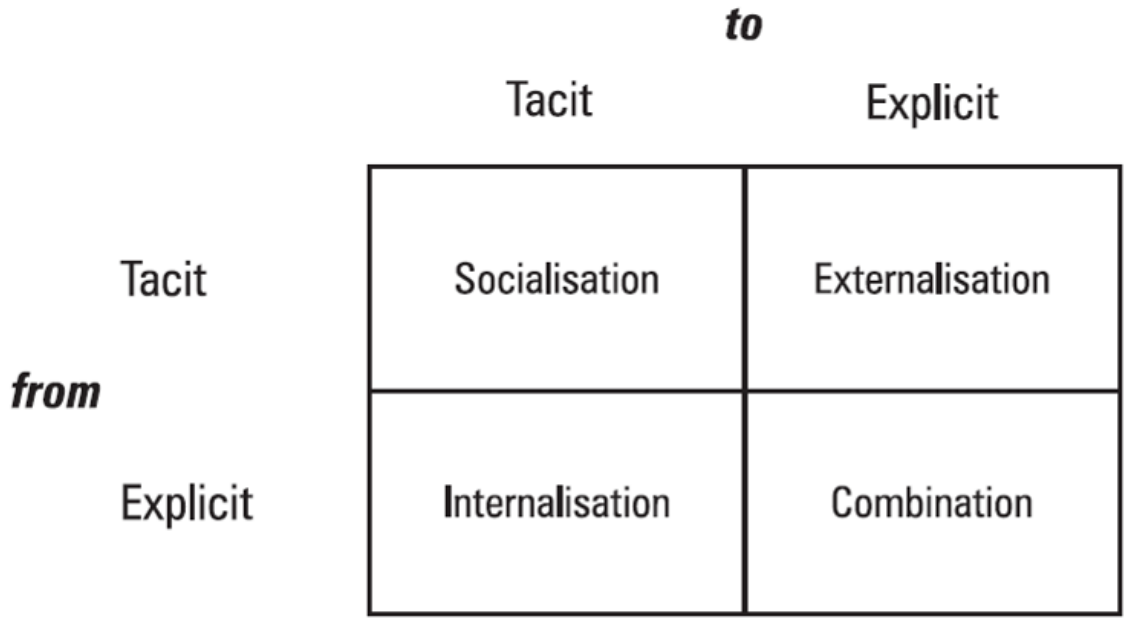


Figure 2.3.3.2 Nonaka's Knowledge Management Model

2.3.3.3Bender & Fish Model (Knowledge Hierarchy)

Bender & Fish (2000) argue that individual build his or her own knowledge by transforming and enriching information, and they define knowledge as what the individual transform information into by incorporating personal experience. They suggested knowledge hierarchy -a knowledge creation process- where individuals receive the knowledge from other sources (other individuals, books,..) in the form of data, and by that time the process begins as the recipient of the data adds meaning to transfer the data into information, then enriches the received information with his or her personal application. Patel et al. (2000) argue that the route of data-information-knowledge is bi-directional, knowledge can be externalized into information, which can be broken down into data, and vice versa.

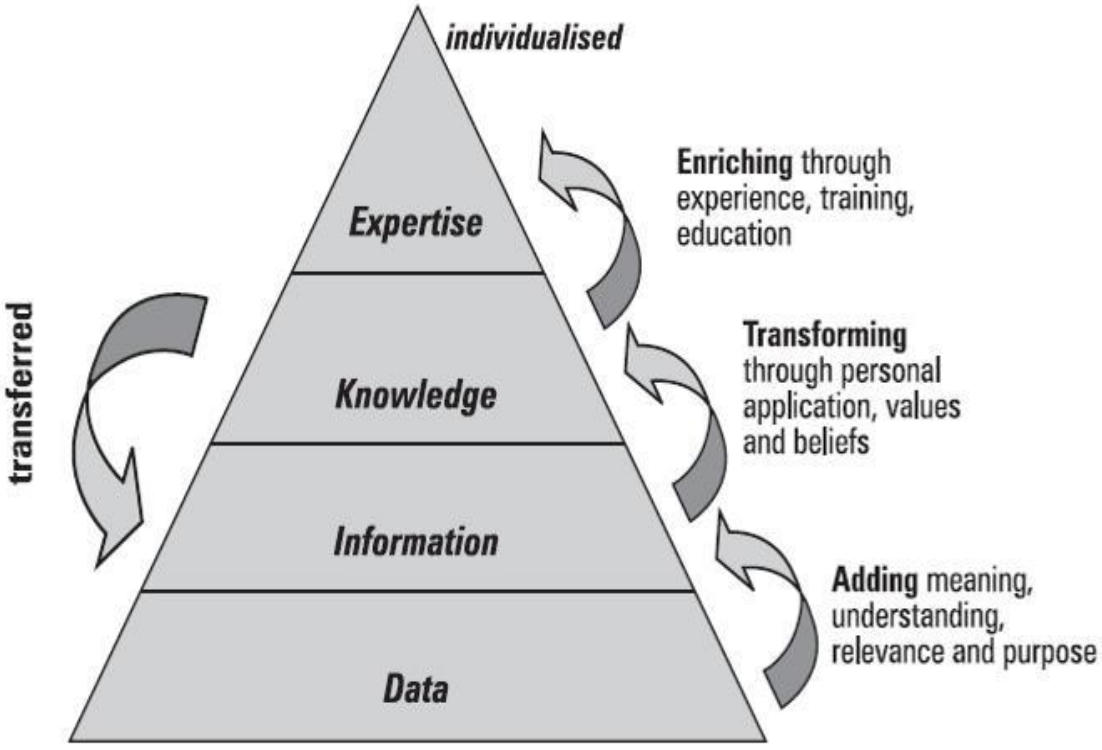


Figure 2.3.3.3 Bender & Fish Model

2.3.3.4 Knowledge Spiral Model

This model has been adapted by Gray and Denston (2005).It has been developed depending on Nonaka's model. According to this model the knowledge value will be enhanced through exchange between individuals and groups within the organization .

The spiral starts when individuals share their feelings ,experiences and even perceptual views, then the tacit knowledge is transferred and documented to explicit form ,and by using information technology facilitates ,the existing explicit knowledge will recombinant to form new one which will be converted into tacit knowledge.

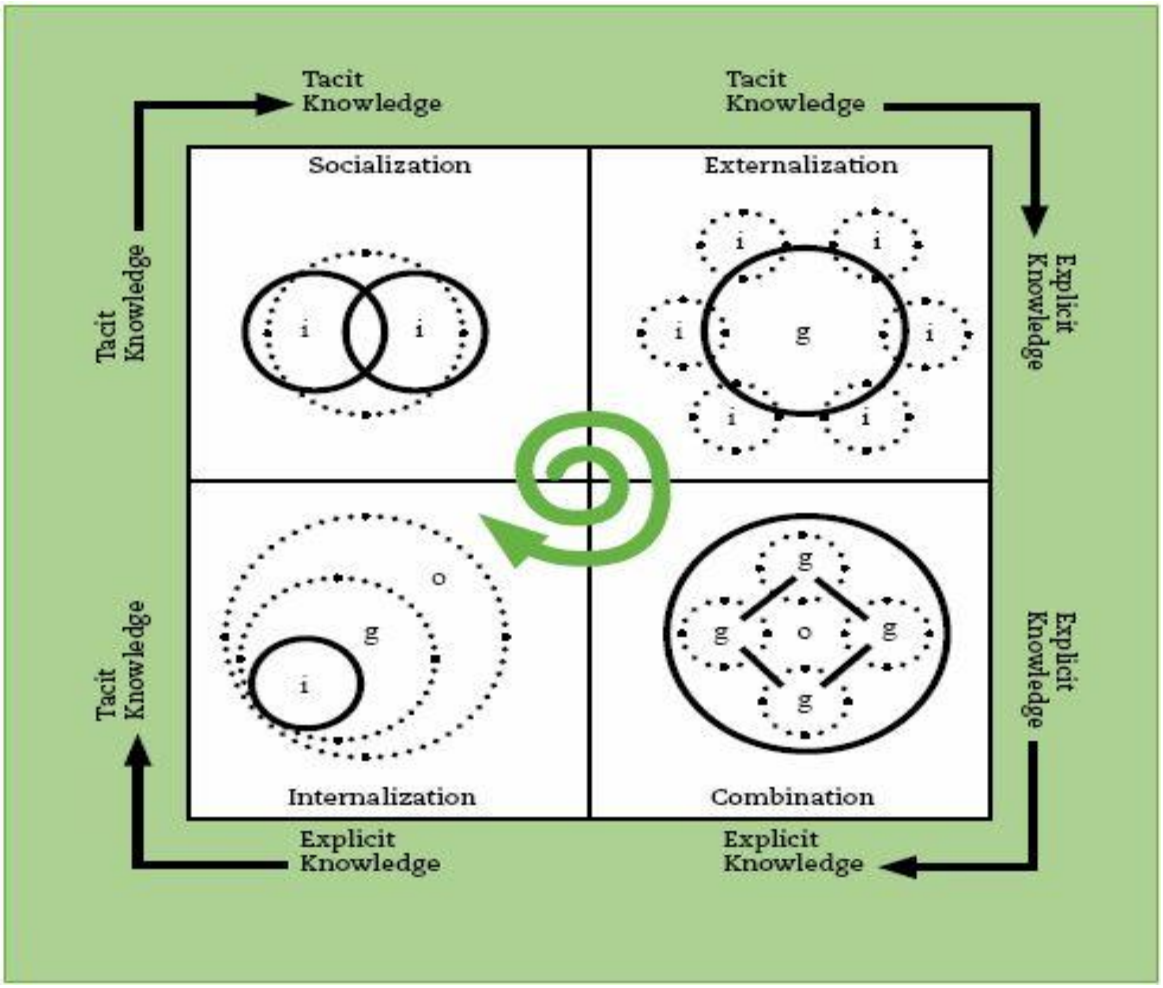


Figure 2.3.3.4 Knowledge Spiral Model (Gray & Denston , 2005)

Alom (2007) argues that Knowledge Retention is a very important step in KM process, "There is no point in having knowledge and storing it ,if it will not be retrievable ".The researcher developed a model comprises of four levels :

I. Socialization (Tacit to Tacit): where individuals knowledge is shared .
II. Codification :where the tacit knowledge is converted into explicit .
III. Combination: in this level the knowledge is captured into Organizational Memory
IV. Knowledge retrieval (Explicit to Tacit) : where the present practices should be based on previous procedures that have been shared and stored .

These levels will be adopted in this study to evaluate the KM process and how much it is applied in the case studied .

2.3.4 Knowledge Management Process Requirements

KM researchers suggest many requirements that any firm has to have , to help it reach successful KM process.”KM is not a simple IT system that can be applied ,it is more than that ,It is a full process” Alom (2007).

In defining knowledge ,Tacit knowledge shown as an essential part of the whole organization knowledge needed to be managed ,this kind of knowledge embedded in individuals mind (their understanding, skills, capabilities and acquired experiences).Walsh & Ungson(1991)consider individuals as an excellent starting point for examining information acquisition, retention and retrieved processes. Moreover, Nonaka (1994) believes that "The prime movers in the process of organizational knowledge creation are the individual member of an organization. “KM in construction projects is impossible without human interaction”(Tupenaite et al 2008).

Many individuals regard their knowledge as a personal property and source of strength and most of typical existing construction organizations find difficulty to encourage the culture of sharing knowledge (Carrillo et al ,2000). ”Knowledge is sticky and embedded in individuals mind”(Kogut & Zandar 1993) so the challenge confronted by firms is to capture this ”stickiness knowledge” .

From this point of view researches focus on individuals as an important part of KM process. Nonaka(1994) argues that face to face communication considered to be the base of the knowledge sharing “Dialogue in the form of face to face communication between participants is a process in which one builds concepts in cooperation with others”.

Face to face communication allows the distribution of captured knowledge throughout the organization to individuals or groups that may require this relevant information (Mcmanus et al 2003,Bender &fish 2000).

Case studies conducted by Carrillo and Chinowsky (2006) in six engineering design and construction organizations showed that employees resistance to knowledge sharing is one of the top barriers for KM within these organizations. Reasons, such as the lack of trust among employees, lack of time, lack of KM awareness, lack of openness to new ideas and shortage in IT support , can negatively affect knowledge sharing process, ”The IT support a key element in KM systems ,must be present to deliver the knowledge required” (Carrillo , Anumba& Kamara, 2000).

The research by Davenport and Prusak (1998) indicated that some individual behaviors can negatively affect the KM process. They suggested a set of solutions to reduce the influence of these factors and encourage knowledge creation and sharing in the organizations by applying some procedures and approaches such as providing incentives, accepting and rewarding creative errors, providing times and places for learning, meeting and sharing knowledge, and encouraging relationships and trust among employees”. Face to face meetings are great opportunity to build relationships and trust among employees and therefore to enhance team working”(Davenport & Prusak 1998) .

Building trust among members is the first step to construct self- organizing team concept (Nonaka 1994), which allows a good environment for people to share each other thinking processes as well their experiences.

(Alom, 2007- Arif, Egbu and Toma, 2010) suggests self organizing team as one of the requirements that any successful KM process has to have ,”With self organizing teams individuals collaborate to create new concepts and share experiences”(Alom 2007) .

Arif, Egbu and Toma (2010) considered lessons learnt at the end of project phases, conducting periodical training seminars and having award system are main requirements should be filled in the four levels of knowledge management process .

Meetings either formal nor informal for the project staff or even on a higher levels between different participants, create a great opportunity to both develop and share knowledge ,it is a good solution to overcome cultural barriers which usually confronted by organization when adopting a knowledge management initiative .Bender &Fish (2000) identified these barriers , First, people do not like to share their best ideas, Second, people do not like to use other people's ideas, and Third, people like to consider themselves experts and prefer not to collaborate with others.

These barriers lead researches to suggest some procedures and approaches such as providing incentives, establishing a reward system to enhance willingness to share knowledge, develop individual knowledge by training ,mentoring, conducting technical seminars and performance appraisals (Graham & Thomas ,Cheng &Kuo 2006).

Yu-Cheng and Lee-Kuo (2006) argue in their study ,that the reuse of information and knowledge of past projects; reduces the time and cost of solving problems, and improves the quality of solutions . Whatever successful and unsuccessful projects have been executed, a valuable record of each one should be kept to identify best and worst company practices. If experience and knowledge are shared, then the same problems in construction projects do not need to be repeatedly solved. Reduced problem-solving means, the cost of problem solving is reduced and the probability of repeat problems is decreased. “Establishing an effective reward strategy and developing a mechanism for KM implementation ,means commitment – from top management- to improve knowledge sharing within the team ,receiving adequate knowledge and experience from top to bottom and vice versa “(Cheng & Kuo 2006).

The top management is considered the main concern of having successful knowledge management process ,this won't be achieved without motivating all the project participants to share their knowledge and even to innovate new ideas which guarantee work high performance and save time and money.

The main requirements suggested by researchers and considered as a trigger to any successful knowledge management process concluded in Table (2.3.4).

Table (2.3.4) Main Requirements For Knowledge Management Process According To Researches

Requirement / Reference	Face to Face Communication	Lessons Learnt	Problem Solving	Self Organized Teams	Training Systems	Competition and Award System
Bender &Fish	√			√		
Nonanka	√			√		
Cheng -Kuo		√	√			√
Arif ,Egbu and Toma	√	√	√	√	√	√
Davenport & Prusak	√			√		

This study adopted all the requirements listed in the table ,and will be checked in each case study for the four KM levels to evaluate the KM status in it , which is one of the study aims. The data will be collected using questionnaires and interviews as it shown in the next chapter.

2.4 Summary:

In this chapter, literature about knowledge management was reviewed. Knowledge is viewed by all the researchers as a valuable asset for organization and there is a great emphasis for managing knowledge well and protecting it from being lost. There are two types of knowledge tacit and explicit, the difficult task in knowledge management will be capturing the tacit knowledge without losing parts of it. However, both types are to be considered while managing knowledge.

A description of some existing knowledge management models is provided which is used to determine the main KM process .A process of four levels will be adopted in this study (Socialization , Codification ,Combination and Knowledge Retrieval) . Several previous studies have been reviewed , a list of KM process requirements have been highlighted and adopted in this study .

These requirements will be checked in both case studies for the four KM levels to evaluate the KM status in it , which is one of the study aims. The data will be collected using questionnaires and interviews as it is shown in the next chapter.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

In the previous chapter a literature review was conducted , Four levels were detected for KM process and a list of knowledge management requirements were identified .In this chapter research methodology will be explained which are questionnaires and interviews .The study was performed in two engineering consultancies firms. The two case studies have similar characteristics in terms of scale, the engineering field, and being in Syria. The data gathered will be analyzed in the next chapter.

3.2 Research Methodology

The main methodology adopted in this research is the descriptive analytical one by using its tools: Questionnaires and Interviews , beside the reviewing of previous studies which helped in reaching KM process and requirements .

Owing to the fact that the subject of KM is a relatively new area, a questionnaire would allow the exploration of a significant number of issues (Chong,C.S, 2006).

Survey methodology is important and popular because of its ability to define and detail various characteristics of key issues that can be important and interesting for organizations (Chauvel & Despres, 2002). A questionnaire survey also has the ability to provide results that can be quantified and so can be easily treated and analyzed statistically.

The interview is probably the most common research method , because it provides an easy flexible method that can be used to capture important ideas and detailed opinions to enrich the research (Bryman & Bell, 2003).

3.2.1Survey/ Questionnaires

The surveys will be conducted by completing the questionnaire (See Appendix-A).Some questions have two choices (Yes) or (No) , others have four choices where the respondent can select one choice or more than one in some questions.

The surveys were distributed among 100 employees in two companies (50 employees in each one) including different specialists (engineers "civil and architectural " - engineers assistances) . A total of 78 responses were obtained, 33 responses from the first case study and a 45 from the second one. All the surveys were distributed with neither supervision nor time limitation. The questionnaire consists of 15 questions, two of them have sub questions:

1- Does your company encourage face-to-face communication with the work team?

This question is designed to measure companies' support sharing knowledge at individual level and to check whether employees are involved in knowledge sharing process. The answer to this question will be ,"Yes" or ,"No". The results of this question will be used to fill the first requirement in the table of requirements (Table 3.2.1) for each organization.

Table 3.2.1 Table of Knowledge Management Requirements

Requirements	Level 1 (Tacit to Tacit)	Level 2 (Tacit to Explicit)	Level 3 (Organization Memory)	Level 4 (Explicit to Tacit)
Face to face communication meetings	Does your company encourage face to face meetings?	Are they minuted?	Is there any accessible body of knowledge in the company?	Is it easy for employees to reach the documented knowledge?
Lessons Learnt at the end of the project	At the end of the project is the project problems discussed?	Are LL at the end of project documented?	Is there any accessible body of knowledge in the company?	Is it easy for employees to reach the documented knowledge?
Problems solving	Are you involved in solving problems?	Are the problems, the solutions ,documented?	Is there any accessible body of knowledge in the company?	Is it easy for employees to reach the documented knowledge?
Self organized teams	Does the company support teamwork?	Is the created knowledge and ideas documented?	Is there any accessible body of knowledge in the company?	Is it easy for employees to reach the documented knowledge?
Training and coaching system	Do you attend any training courses?	Are you obligated to document what you have learnt?	Is there any accessible body of knowledge in the company?	Are there any training manuals accessible for all employees?
Competition and award system	Is there any type of awards?	Is there any type of awards?	NA	Is there any motivation to use the documented knowledge?

2- How often do you attend meetings?

The aim of this question is to obtain data about the frequency of the meetings. The answer should be selected from already given multiple choices (more than once a week, once a week, once a month or rarely/occasionally). The frequency of the meetings will indicate the support of the face-to-face communication by the company.

3- What are the types of those meetings?

Knowing the types of the meetings can be useful in terms of determining the causality of the relationship in the company. In addition to that , the variety of the answers will indicate whether the company has certain system for KM or not.

4- Are they minuted?

This question indicates to whether the shared knowledge between individuals through all types of meeting is documented or not.

5- In case of problems facing the company in running any project, are you involved in solving them?

This question is to measure individuals' involvement in solving problems. The answer will be one of four choices (e.g. Always means individuals are completely involved in solving problems).

6- How are the problems solved?

The method used in problems solving is an indicator for the degree of achieving the first level of KM process (e.g. more brainstorming sessions means more people are involved in transferring tacit to tacit knowledge).

7- Are the problems, the solutions, and the procedures documented?

The purpose of this question is to know whether the company has any sort of documentation system for problems and their solutions.

8- Does the company support or encourage teamwork?

This question indicates the companies support and awareness of teamwork importance. This question will be used to get data about the existence of self organizing team.

9- Is the created knowledge and ideas from teamwork documented?

The answer of this question is one of four choices to indicate the frequency of documenting knowledge (e.g. always means "tacit to explicit" level is completely met for self organized team requirement).

10- Is there any accessible body of knowledge in the company?

This question is to check the availability of the documented knowledge in the company. the more no answers mean level 3 in KM process isn't achieved .

A) **Is it easy for employees to reach documented knowledge?**

   This question is to measure whether the existed system is available to all employees or not.

B) **Is there any motivation to use the documented knowledge?**

   This question is to check whether there is a motivation system to encourage employees to benefit from past projects or not.

11- What system is used for documenting and sharing information?

This question is to check how the knowledge is being stored, and where it can be found (server, database, intranet, and hardcopies).

12-At the end of the project, are the project problems discussed?

The answer of this question is one of four choices to measure weather the company has a policy to benefit from lessons learnt at the end of projects or not , in term of means more always answers means (tacit to tacit) level is completely met . The results of this question will be used to fill the second requirement(level I) in the table of requirements (Table 3.1.1) for each organization.

13-Are lessons learnt at the end of the project documented?

This question indicates to weather the companies have a clear policy to archive lessons learnt from projects recently constructed or not .

14-Do you attend any training courses or seminars related to your work?

The answer of this question refers to , weather the company has any system for training employees or not .The data which is collected from this question is used to measure level I for "training and coaching system" requirement

A)Are you obligated to document what you have learnt?

If the company obligates employees to document what they have learnt ,it means that converting knowledge from tacit to explicit is done perfectly .

B)Are there any training manuals accessible for all employees?

This question is to check the availability of the documented knowledge to employees. More negative answers , indicates that employees are not getting benefit from what their colleagues have learnt.

15-Is there any type of awards for documenting and sharing what you have learnt (new knowledge)?

The aim of this question is to check whether the company has any kind of awards or encouragement for knowledge sharing and documenting.

3.2.2 Interviews

The interviews follow semi-structured approach (See Appendix B). Fellows & Liu (2003) argues that semi-structured interviews fill the spectrum between the structured and the unstructured extremes. According to (Kendall & Kendall, 2002) this method may help to encourage the interviewees to provide more important, valuable and detailed responses to the interview questions.

The purpose of doing the interview is to get a wider picture and more detailed information about the knowledge sharing process and practices and how much the company administration and its employees realize the concept of KM , to what degree they apply its process and what are the obstacles of adapting full KM system. This will give supportive data to the surveys which all help in developing KM framework. .Two interviews were done, one with a manager in each company and one with a normal employee. Each interview has the following questions:

1. **Could you please give me a brief about your organization?**

The aim of this question is to get a description about the company and its work fields

2. **What is the number of employees?**

This question is designed to get an idea about the organization size.(asked only to administration level).

3. **Would you mind if I mention the name of the organization in my study? Or you would prefer to keep it private?**

This question was just to obtain permission for doing the case studies in each organization and for mentioning the names.

4. **Does your company encourage face-to-face communication with other employees? How?**

The information from this question will be matched with the similar one in the survey.

5. **How do you deal with the problem of loosing knowledge of people who leave the company (retirement, resignation)?**

This question was designed to collect data about the company (administration and employees) perception of KM concept ,and if there are any practices done in this domain.

6. **Are the previous learnt lessons documented? How are they stored?**

The aim of this question to have an idea about how much is the interest of the company about the lessons learnt from previous projects , and if there is any kind of documenting solutions for problems and projects that had been faced.

7. **Does your company offer any incentives for documenting lessons learnt from previous projects or from trainings? If yes what are they? If no, why not?**

This question is designed to measure whether the company has any kind of supportiveness to people involved in applying KM process or not ,and what are the obstacles hindering that.

8. **In case of problems the staff working in the project may face, do the staff refer to solutions that have been used in previous projects?**

The answer of this question gives an idea about the documentation and retrieval for one of the important areas of knowledge which is the past experience (Lessons Learnt).

9. **How are problems in any project solved (individually – collectively)?**

The answer of this question gives an idea about company awareness of teamwork importance and to what degree there is decentralization in taking decisions.

10. **Are there any trainings held regularly?**

This question is to check whether the employees get regular trainings and whether they have access to the information from the trainings which they have or have not participated in.

3.3 Data Analysis Methodology

The data collected from the surveys will be analyzed, by calculating frequencies and chi square value in each question , in order to know in which category the answers fall and therefore fill the table of requirements for each case study ,and determine the status of knowledge management in each company. The P value will be calculated and the chi square test will be done at 95% confidence, which means if the P value is less than 0.05 there will be a significant

difference between the expected and the observed values ,otherwise there is no significant difference.

Table (3.2.2) shows an illustration about applying the findings into the table of requirements ,black colour means that the requirement in the certain level is totally met while the white means the requirement isn’t met at all.

Table 3.2.2 Illustration About Applying The Finding Into The Table of KM Requirements

Requirements	Level 1(Tacit to Tacit)	Level 2 (Tacit to Explicit)	Level 3 (Organization Memory)	Level 4 (Explicit to Tacit)
Face to face communication meetings				
Lessons learnt at the end of the project				
Problems solving				
Self organized teams				
Training and coaching system				
Competition and award system				

The requirement is completely met

The requirement is met to a high degree

The requirement is partially met

The requirement is not at all met

NA Not Applicable

3.4 Summary

In this chapter research methodologies which are surveys and interviews were described and explained in terms of how they will be used to fill the table of knowledge management requirements .

In the next chapter the data collected will be analyzed. The analysis will be first based on the survey results ,by calculating frequencies and chi square value in each question. Secondly ,the interviews will be used as supportive data to the survey results.

CHAPTER FOUR

DATA ANALYSIS

4.1 Introduction:

In the previous chapter , the data collection methodologies were described ,a table of list of requirements for measuring the status of knowledge management has been identified . In this chapter, the data collected from the surveys will be analyzed, by calculating frequencies and chi square value in each question. Two case studies were done for two engineering consultancies companies .The results of the survey will be used to fill the table of requirements ,to evaluate the status of knowledge management in each company which will help to reach a framework for applying knowledge management and this is one of this study objectives.

4.2 Study Sample Description:

The study determines the properties of the sample according to :*Profession , Job title, years of experience and years of experience in the company.*

- **Profession:** The counts and the percentages for profession property are clarified in Table (4.2.1) and Figures (4.2.1.a and 4.2.1.b), from 40 to 45% civil engineer, while the rest are distributed between architects ,mechanical eng. and engineer assistants:

Table 4.2.1 Sample Distribution According To Profession

Profession	Case study 1		Case study 2	
	Count	%	Count	%
Civil engineer	13	40%	20	44%
Architect	7	21%	18	40%
Mechanical eng.	2	6%	0	0
Engineer assistant	11	33%	7	16%
The total	33	100%	45	100%

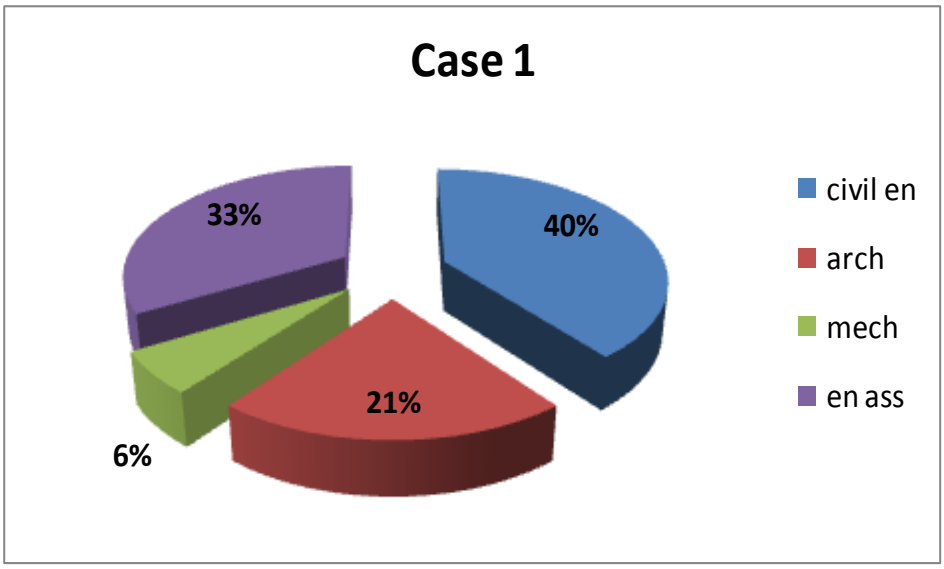


Figure 4.2.1.a Sample Distribution According To Profession for Case 1

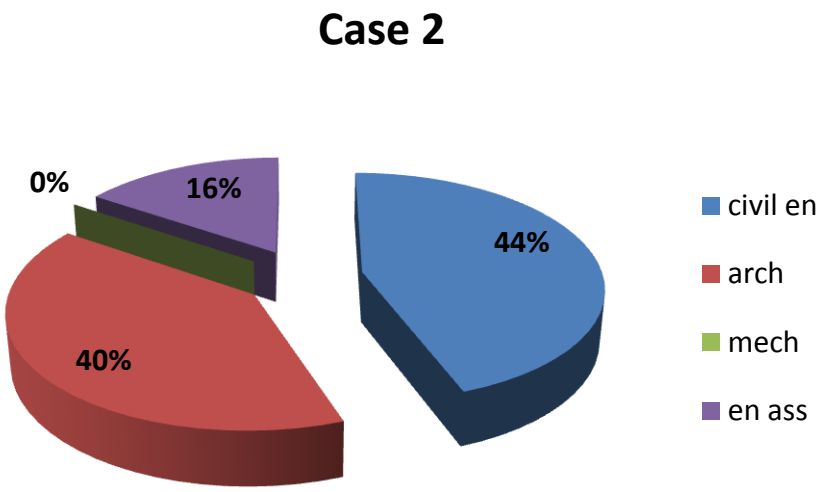


Figure 4.2.1.b Sample Distribution According To Profession for Case 2

- **Job Title :**It is clear from Table (4.2.2) that in both case studies the majority of participants in the study were normal employees about 89%, while the minority were decision makers (executive managers and project managers) about 11% :

Table 4.2.2 Sample Distribution According To Job Title

Job Title	Case study 1		Case study 2	
	Count	%	Count	%
Decision Maker	4	12%	5	11%
Normal employee	29	88%	40	89%
The total	33	100%	45	100%

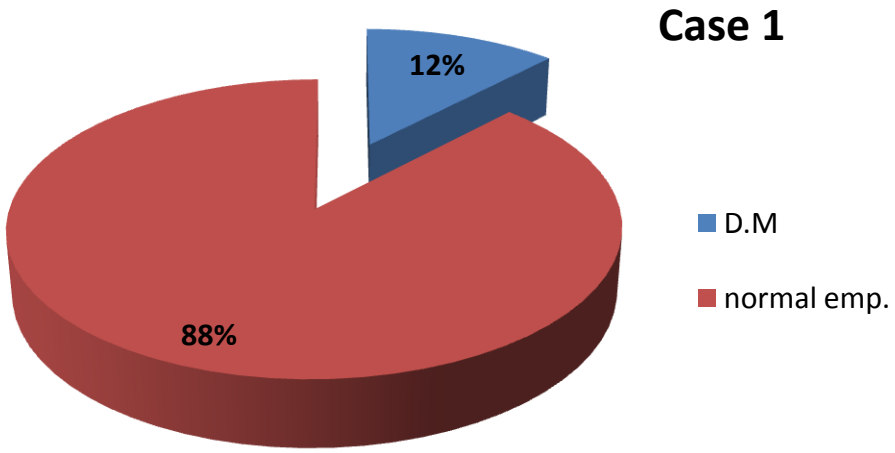


Figure 4.2.2.a Sample Distribution According To Job Title for Case 1

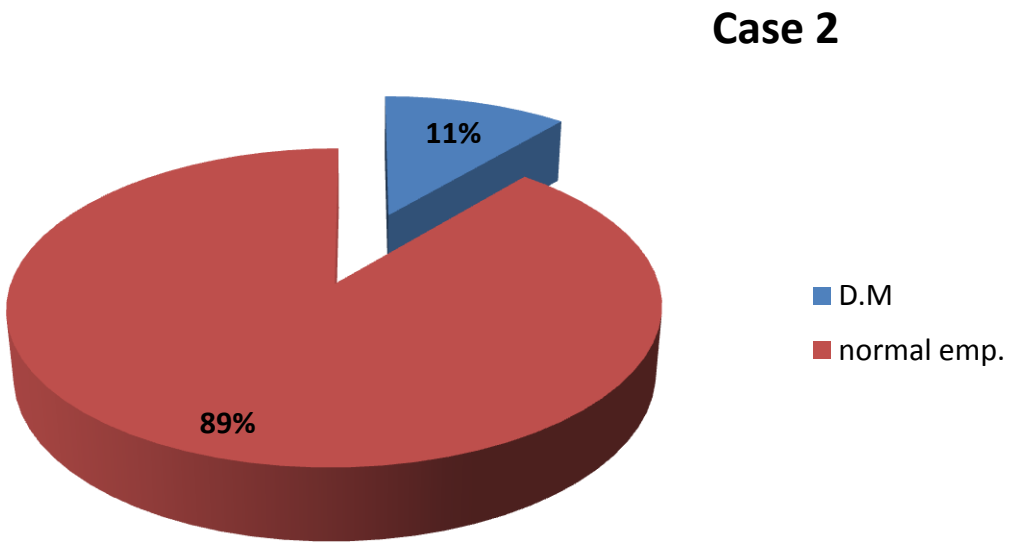


Figure 4.2.2.b Sample Distribution According to Job Title for Case 2

- **Years of Experience :** For this property we notice from Table (4.2.3) that the majority in case 1 have more than 20 years experience (58%) while the majority in case 2 were people who have less than 10 years experience(47%):

Table 4.2.3 Sample Distribution According To Years of Experience

Years of experience	Case study 1		Case study 2	
	Count	%	Count	%
Less than 10 years	6	18%	21	47%
Between 10 and 20 years	8	24%	13	29%
More than 20 years	19	58%	11	24%
The total	33	100%	45	100%

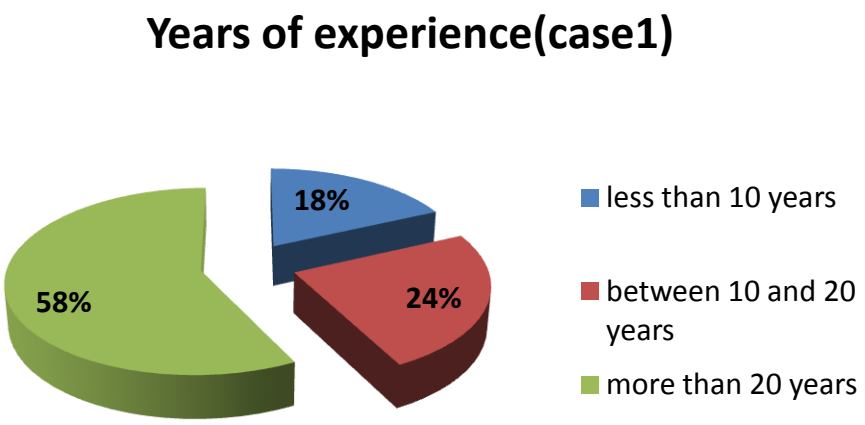


Figure 4.2.3.a Sample Distribution According to Years of Experience for Case 1

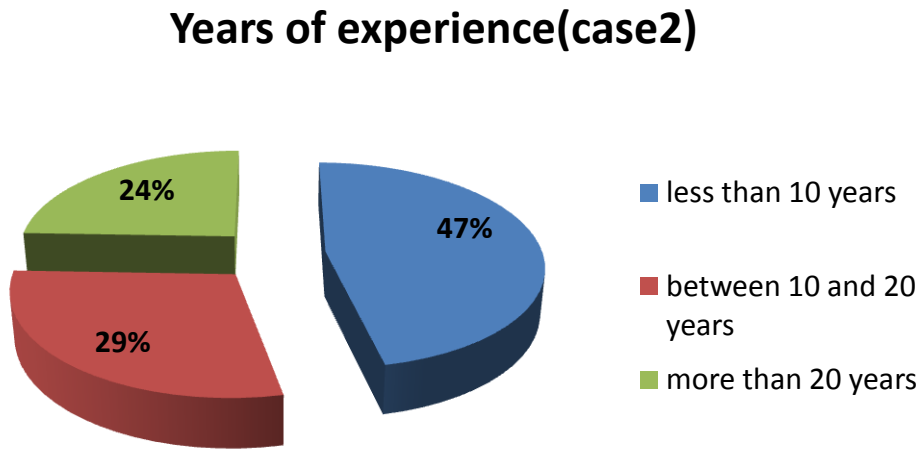


Figure 4.2.3.b Sample Distribution According to Years of Experience for Case 2

- **Years in the organization :** Table (4.2.4) shows ,the majority in the first case study (public sector) have more than 20 years experience in the company with a percentage around(49%) while in contrast the majority in the second one (private sector) have less than 10 years experience (78%).It is clear that the young category is the majority in case 2 which reflect more care from it in KM issues.

Table 4.2.4 Sample Distribution According To Years In Organization

Years in organization	Case study 1		Case study 2	
	Count	%	Count	%
Less than 10 years	7	21%	35	78%
Between 10 and 20 years	10	30%	5	11%
More than 20 years	16	49%	5	11%
The total	33	100%	45	100%

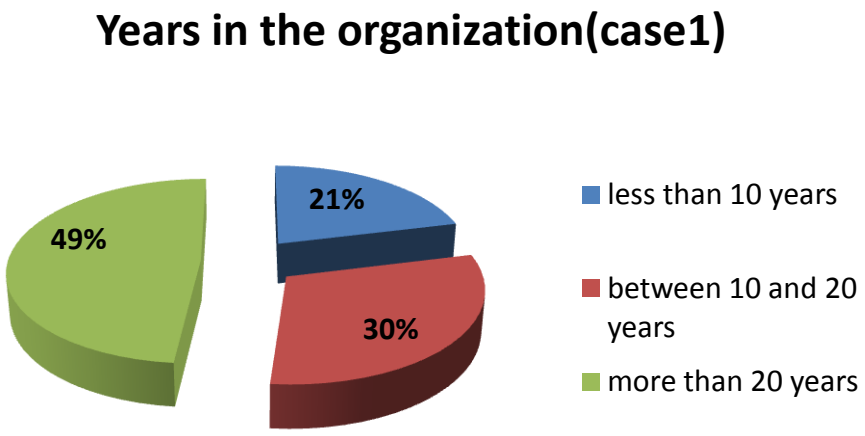


Figure 4.2.4.a Sample Distribution According To Years In Organization for Case 1

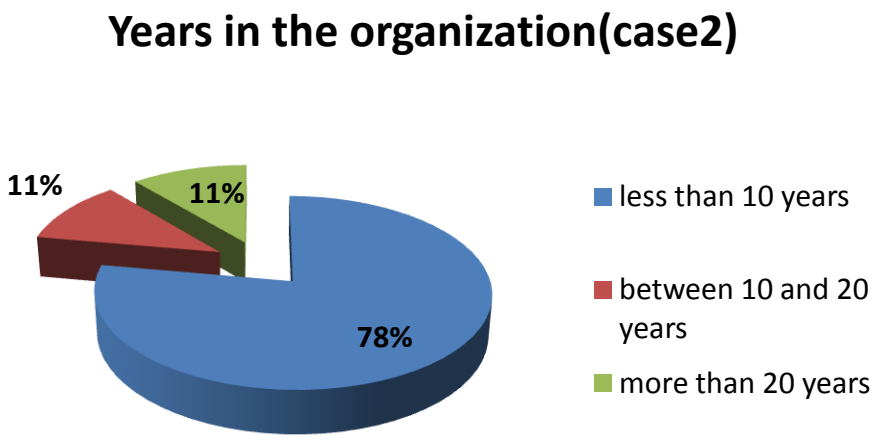


Figure 4.2.4.b Sample Distribution According To Years In Organization for Case 2

4.3 Surveys Data Analysis :

The surveys described in chapter 3 (See Appendix A) were distributed among 100 employees in two case studies . A total of 78 responses were obtained, 33 responses from the first case study and a 45 from the second one.

The data analyzed using SPSS (version 20.0) to calculate frequencies and chi square value in each question to determine whether there is a significant difference or not between expected values and observed ones (if the P value is less than 0.05 there will be a significant difference between the expected and the observed values ,otherwise there is no significant difference), and therefore to know in which category the responses fall. a chi square test performed at 95% confidence.

- **Question 1 :Does your company encourage face-to-face communication with the work team?**

This question was to check whether the company encourages face-to-face communication or not. Table (4.3.1) shows a summary of the collected data. The P value was 0.024 in Case 1 (See Appendix C) and 0.000 in Case2 (less than 0.05) which means that there is significant difference. The responses in both case studies were about 70% and 82% for "yes" in GCEC (General Company for Engineering Studies and Consulting) and Case 2, which means that both companies encourage face to face communication. Probably this is done very well in Case 2.

Table 4.3.1 Data Summary of Question1

Q1	GCEC		Case 2	
	Count	%	Count	%
Yes	23	69.7	37	82.2
No	10	30.3	8	17.8
Total	33	100	45	100

- **Question 2 : How often do you attend meetings?**

Q2 was about the frequencies of attending meetings .Table (4.3.2) summarizes the data of responses. Although the chi square test has given no significance difference for question 2 as p value is 0.023 for GCEC and 0.022 for Case 2 (See Appendix C) , we can still notice differences in the findings. In GCEC a total of 75% were given to the answers "once a month "and "rarely" while in Case 2 , 69% was given to answers " more than once a week" and "once a week". However in GCEC 34% of the employees are rarely attending meetings and 42% of them attend

meetings once a month while in Case 2 (37%) attend meetings more than once a week and 31% for attending once a week. This indicates that the frequency of attending meetings in Case 2 is more than in GCEC.

Table 4.3.2 Data Summary of Question 2

Q2	GCEC		Case 2	
	Count	%	Count	%
More than once a week	3	9.1	17	37.8
Once a week	5	15.2	14	31.1
Once a month	14	42.4	11	24.4
Rarely	11	33.3	3	6.7
Total	33	100%	45	100%

- **Question 3 : What are the types of those meetings?**

  Q3 is used to get an idea about the most common type of meetings in each company , the total of all the answers does not give 100% because the answer can be more than one selection .In the two case studies a mixture of all the choices were selected and there was no specific indicator to the most common type of meeting used in each company. We can clearly notice that the scheduled type is the least one used in GCEC while in Case 2 the unscheduled is the least .

Table 4.3.3 Data Summary of Question 3

Q3	GCEC		Case 2	
	Count	%	Count	%
Formal	17	51.5	27	60.0
Informal	16	48.5	18	40.1
Scheduled	6	18.2	16	35.5
Unscheduled	15	45.4	4	8.9

- **Question 4: Are they minuted?**

  Q4 indicates whether the shared knowledge between individuals through all types of meetings is documented or not. Around 49% of the responds in GCEC and 56% in Case 2 were for documenting only formal meetings ,this indicates that most formal meetings are being minuted and documented .This result is supported by chi square values 0.0001 for GCEC and 0.005 which indicates that the answers are concentrated in one category (only formal ones).

Table 4.3.4 Data Summary of Question 4

Q4	GCEC		Case 2	
	Count	%	Count	%
Always	3	9.1	9	20.0
Often	13	39.4	11	24.4.1
Only formal ones	16	48.5	25	55.6
Not at all	1	3.0	0	0
Total	33	100%	45	100%

- **Question 5: In case of problems facing the company in running any project, are you involved in solving them?**

  Q5 is to measure individuals involvement in solving problems. The results shows 49% in GCEC and around 45% in Case 2 are involved in solving problems ,and 24% in GCEC and 22% in Case 2 respond that they share in solving problems just when they have been asked .This indicates that employees in both case studies share in solving problems partially . Moreover both chi square test values (0.007 for GCEC and 0.020 for Case 2) were less than 0.05 which enhance that the responses were in a certain type of responds (often).

Table 4.3.5 Data Summary of Question 5

Q5	GCEC		Case 2	
	Count	%	Count	%
Always	7	21.2	9	20.0
Often	16	48.5	20	44.4
Only if I asked	8	24.2	10	22.2
Not at all	2	6.1	6	13.3
Total	33	100%	45	100%

- **Question 6: How are the problems solved?**

  The purpose of this question is to identify the most common used methods for solving problems. The results have shown that the highest percentage in GCEC (40%) was given to individual way in solving problems , whereas the highest percentages in Case 2 (76%) were given to management decisions. The results indicate that even people are involved in solving problems according to previous question but this was done individually or for executing management decisions .

Table 4.3.6 Data Summary of Question 6

Q6	GCEC		Case 2	
	Count	%	Count	%
Brain storming	4	12.1	3	6.7
Referring to previous problems	7	21.2	6	13.3
Management Decisions	9	27.3	34	75.6
Individually	13	39.4	2	4.4
Total	33	100%	45	100%

- **Question 7: Are the problems, the solutions, and the procedures documented?**

  Table 4.3.7 summarizes the data obtained from question 7 to know whether the problems and their solutions are documented or not. The P value which is calculated ,shows no significance difference as the values were 0.000 in both cases .The high percentage is "rarely" in GCEC with around 58% ,but in Case 2 answer "often" gets the highest responses with around 51%. This means that GCEC doesn't have a policy to document problems and solutions in other words, we can make an assumption that there is a low awareness about the need of documenting knowledge in GCEC while in Case 2 this awareness got higher.

Table 4.3.7 Data Summary of Question 7

Q7	GCEC		Case 2	
	Count	%	Count	%
Always	4	12.1	15	33.3
Often	8	24.2	23	51.1
Rarely	19	57.6	5	11.1
Not at all	2	6.1	2	4.4
Total	33	100%	45	100%

- **Question 8 : Does the company support or encourage teamwork?**

  Q8 indicates the companies support and awareness of teamwork importance. The chi square test for this questions shows no significance difference in Case 2 as p value is 0.245 more than 0.05 while in GCEC p value is 0.002 less than 0.05 which means there is a significance difference .The responses in GCEC concentrate on answer "often" while the responses in Case 2 distributed mainly between "always" and "often" answers. We can conclude that both case studies are supporting teamwork and knowledge sharing.

Table 4.3.8 Data Summary of Question 8

Q8	GCEC		Case 2	
	Count	%	Count	%
Always	11	33.3	16	35.6
Often	16	48.5	13	28.9
Only in low levels	4	12.1	8	17.8
Not at all	2	6.1	8	17.8
Total	33	100%	45	100%

- **Question 9: Are the created knowledge and ideas from teamwork documented?**

  Table 4.3.9 summarizes the data obtained from question 9 to know whether the knowledge obtained from team work is documented or not. Both chi square test values (0.0001 for GCEC and 0.008 for Case 2) were less than 0.05 which means that the responses were in a certain type of answers , about 58% in GCEC and 40% in Case 2 from responds were for (only formal ones). Based on this data we can conclude that even the two companies support team work but there is no enough awareness for documenting the resulted knowledge from this work .However this is done in Case2 better than in Case 1.

Table 4.3.9 Data Summary of Question9

Q9	GCEC		Case 2	
	Count	%	Count	%
Always	1	3.0	9	20.0
Often	7	21.2	15	33.3
Only formal ones	19	57.6	18	40.0
Not at all	6	18.2	3	6.7
Total	33	100%	45	100%

- **Question 10 : Are there any accessible body of knowledge in the company?**

  Table 4.3.10 summarizes the data obtained from question 10.The results show positive answers from the majority in both companies 73% in GCEC and 76% in Case 2 .this means that in both companies there is a kind of organization memory which will be detected in question 11 .

Table 4.3.10 Data Summary of Question 10

Q10	GCEC		Case 2	
	Count	%	Count	%
Yes	24	72.7	34	75.6
No	9	27.3	11	24.4
Total	33	100%	45	100%

- **Question 11 : What is the system for documenting and sharing information?**

Q11 was to check what the available system(s) in each company are, the total of all answers does not give 100% because the answer can be more than one selection. The data shows that in the two companies hardcopies, softcopies & intranet are used. This means that there is no one system applied all over the company which indicates that the knowledge is probably fragmented.

Table 4.3.11 Data Summary of Question 11

Q11	GCEC		Case 2	
	Count	%	Count	%
Hard Copies	15	45.5	36	79.0
Soft Copies	28	84.8	21	46.6
Intranet	5	15.2	10	22.2
No system	18	3.0	4	8.9

- **Question 10a : Is it easy for employees to reach to documented knowledge?**

  The question measured whether the existed knowledge is available to all employees or not .The answers were distributed between "yes" and "no" with about 79 % for "No" in GCEC and 21% for "yes". This result can be explained that even if there is an available archive in the company for LL ,problem solving and other knowledge ,GCEC employees don't get benefit from it .In Case 2 it is clear that , part of employees benefit from the documented knowledge.

Table 4.3.10a Data Summary of Question 10a

Q10a	GCEC		Case 2	
	Count	%	Count	%
Yes	7	21.2	26	57.8
No	26	78.8	19	42.2
Total	33	100%	45	100%

- **Question 10b: Is there any motivation to use the documented knowledge?**

  This question is to check whether there is a motivation system that encourages employees to benefit from past projects or not. The majority of responses were negative 76% in GCEC and about 73% in Case 2, which indicate that there is no clear motivation policy to encourage employees to use documented knowledge.

Table 4.3.10b Data Summary of Question 10b

Q10b	GCEC		Case 2	
	Count	%	Count	%
Yes	8	24.2	12	26.7
No	25	75.8	33	73.3
Total	33	100%	45	100%

- **Question 12: At the end of the project, are the project problems discussed?**

  This question is to measure weather the company has a policy to benefit from previous projects or not. The P value was calculated and gave a result of 0.049 in GCEC and 0.000 in Case 2 less than 0.05 ,which means that there is a significant difference. In GCEC the majority gave negative answers 66% for “not at all” and “rarely” while in Case 2 the majority were positive answers 58% for “often”. Negative answers indicate that lessons learnt at the end of the project haven’t been discussed, while in Case 2 this matter is done to a high degree.

Table 4.3.12 Data Summary of Question12

Q12	GCEC		Case 2	
	Count	%	Count	%
Always	2	6.1	11	24.4
Often	9	27.3	26	57.8
Rarely	10	30.3	6	13.3
Not at all	12	36.4	2	4.4
Total	33	100%	45	100%

- **Question 13 : Are lessons learnt at the end of the project documented?**

was to check whether the companies have a clear policy to archive lessons learnt from projects recently constructed or not .The p value was calculated and gave results (0.038 in GCEC and 0.004 in Case 2) less than 0.05 which means ,there is a significant difference. In GCEC the majority response 52% were for "not at all" while the majority in Case 2 around 60% were for "often" and "always" .This indicates a difference between the two companies manner ,clearly Case 2 seems to have a policy to archive LL from past projects.

Table 4.3.13 Data Summary of Question13

Q13	GCEC		Case 2	
	Count	%	Count	%
Always	0	0	7	15.6
Often	5	15.2	21	46.7
Rarely	11	33.3	12	26.7
Not at all	17	51.5	5	11.1
Total	33	100%	45	100%

- **Question 14: Do you attend any training courses or seminars related to your work?**

This question is to measure how much the company is concerned about developing human resources. The frequencies show high percentages for answer "often" in both companies ,However in Case 2 the percentage was upper around (80%) for answers "often" and "always", while in GCEC was (67%) for the same answers. This means that both companies give developing HR an importance but in different degrees.

Table 4.3.14 Data Summary of Question14

Q14	GCEC		Case 2	
	Count	%	Count	%
Always	4	12.1	11	24.4
Often	18	54.5	25	55.6
Rarely	9	27.3	8	17.8
Not at all	2	6.1	1	2.2
Total	33	100%	45	100%

- **Question 14a : Are you obligated to document what you have learnt?**

  The answers of this question are similar in both companies ,42% for answer "Yes" and around 58% for" No". This result is enhanced by chi square test (0.384 for GCEC and 0.297 for Case 2) both values are greater than 0.05.This means that documenting the knowledge which has been learnt by employees is done partially.

Table 4.3.14a Data Summary of Question 14a

Q14a	GCEC		Case 2	
	Count	%	Count	%
Yes	14	42.4	19	42.2
No	19	57.6	26	57.8
Total	33	100%	45	100%

- **Question 14b: Are there any training manuals accessible for all employees?**

This question is to check the availability of the documented knowledge to employees. The majority of responses were negative around 78% in both case studies which indicate that employees are not getting benefit from what their colleagues have learnt.

Table 4.3.14b Data Summary of Question 14b

Q14b	GCEC		Case 2	
	Count	%	Count	%
Yes	7	21.2	10	22.2
No	26	78.8	35	77.8
Total	33	100%	45	100%

- **Question 15 : Is there any type of awards for documenting and sharing what you have learnt (new knowledge)?**

  The aim of this question is to check whether the company has any kind of awards or encouragement for knowledge sharing and documenting. The p value was calculated and gave results (0.000 in GCEC and 0.001 in Case 2) less than 0.05 which means ,there is a significant difference. The majority responses were for "rarely" and "not at all" with 80% in GCEC and 77% in Case 2 .These results indicates that both cases have no award system for knowledge sharing and documenting.

Table 4.3.15 Data Summary of Question 15

Q15	GCEC		Case 2	
	Count	%	Count	%
Always	2	6.1	0	0
Often	4	12.1	10	22.2
Rarely	20	60.6	27	60.0
Not at all	7	21.2	8	17.8
Total	33	100%	45	100%

4.2 Summary :

This chapter presents the results of the data analysis for each case study, SPSS used to calculate frequencies and chi square value (Appendix C) .

In next chapter and in the light of these results ,the table of KM requirements will be filled to evaluate the status of KM in each case study ,and therefore defining the gaps in applying knowledge management process which will help in suggesting a KM framework .

CHAPTER FIVE

The SUGGESTED FRAMEWORK FOR IMPLEMENTING KNOWLEDGE MANAGEMENT

5.1 Introduction:

This study has been done in two case studies one is related to public sector and the other one to the private sector . The data which has been collected through questionnaires ,was analyzed and summarized in chapter 4 .These results in addition to the views gleaned from interviews , will be used to identify the strength and weakness aspects in KM process in each case study, and therefore fill the table of KM requirements. Finally a required framework will be suggested for employing knowledge management in construction companies in Syria

5.2 Case Studies :

5.2.1 Case Study 1 (General Company for Engineering Studies and Consulting – GCEC):

Organization profile: GCEC was founded in 1980. It is specialized in the provision of professional regional and urban planning, engineering design, site supervision, and management services for infrastructure development all over Syria. With more than (2,490) employees operating in locations all over Syria with headquarters in Damascus and 3 main branches in Homs, Aleppo and Lattakia . It offers a wide spectrum of services such as: Architectural Engineering Structural Engineering ,Regional and Rural Planning ,Geotechnical Engineering ,Electrical Engineering ,Mechanical Engineering ,Building Control Oil & Gas Engineering ,Water & Wastewater Engineering ,Bridges, Roads, Passageways & Transportation Engineering ,Site Supervision Topography & Surveying.

A study has been conducted in order to fill in the knowledge management requirements table and evaluate the KM status in it (Table 5.2.1) .

Table 5.2.1 Table of Knowledge Management Requirements for GCEC

Requirements	Level 1(Tacit to Tacit)	Level 2 (Tacit to Explicit)	Level 3 (Organization Memory)	Level 4 (Explicit to Tacit)
Face to face communication meetings				
Lessons learnt at the end of the project				
Problems solving				
Self organized teams				
Training and coaching system				
Competition and award system			N A	

The black color indicates that the organization meets the requirement listed in this cell , grey color indicates that the organization does not fully meet the requirement, whereas the blank cell indicates that this requirement has not been met at all. N/A indicates that the requirement is already not applicable at this level.

Based on the data analyzed in chapter 4 ,interviews during the visit to the organization , it has been noticed that GCEC does encourage the communication through all types of meetings, but mainly for formal and informal ones. The survey has given a high percentage for respondents said that their organization support the face-to-face communication.

However, only formal meetings are minuted. This result was enhanced by interviews answers as the interviewees ensured that there is an obligation to document formal meetings while other kinds of meetings could be documented according to the boss proposal .

The survey has given about 70% of the respondents said that they involve in solving problems, but this seems to be not in collectively way as the highest percentages were for management decisions and individually with about 67% .In some cases, especially in repeated problems , employees refer to previous solutions.

It has been realized that GCEC doesn't have a clear policy to document problems even the memory is existed -as it is clear in KM requirement table- , the survey has given only 36% of respondents said that there is a documentation of the problem solving procedures .

Although the survey has given a result of more than 80% for encouraging the teamwork in the organization, there is still a confidence crisis which prevent employees from sharing their whole knowledge, even there are regular formal meetings and some casual ones from time to time .

GCEC seems to be interested in developing its human resources ,and this is a priority for it according to interviewees .This result is enhanced by survey as more than 66% of respondents

answer “always” and “often” for attending training courses, but this percentage doesn’t tend to be high to document what they have learnt .

There isn’t any kind of awards (morally or physically) in GCEC for sharing, documenting and retrieving knowledge with more than 81% of responses were for “ rarely “and “not at all” .

5.2.2 Case Study 2

Organization profile: This organization is a multidisciplinary urban regional planning, architectural and engineering consulting company. It employs around 4,000 professionals and technicians, in 24 countries including Syria .The company provides its consulting services in Architecture, Urban & Regional Planning, Structural, Electrical Utilities, Mechanical, Transportation, Environmental, Telecommunication, Industrial and Process Engineering; Geographic Information Systems (GIS) and Information Technology (IT).

A study was done to find the answers to the questions of knowledge requirements in order to fill in the knowledge management requirements table and detect the strength and weakness KM process in it (Table 5.2.2) . The name of this organization has been hidden upon their request.

Table 5.2.2 Table of Knowledge Management Requirements for Case 2

Requirements	Level 1(Tacit to Tacit)	Level 2 (Tacit to Explicit)	Level 3 (Organization Memory)	Level 4 (Explicit to Tacit)
Face to face communication meetings				
Lessons learnt at the end of the project				
Problems solving				
Self organized teams				
Training and coaching system				
Competition and award system			N A	

Based on the results found in chapter 4 and interviews ,it has been realized that Case 2 does strongly encourage the communication through all types of meetings , however unscheduled meetings has the less percentage of conducting . The survey has given 82% of respondents said that their organization encourage the face-to-face communication.

For documenting knowledge the survey shows high percentage for ”only formal ones “ answer with about 60% .According to the interviews , a weekly meeting is being held and often minuted for each project .

The organization appears to depend mainly on the management and senior staff for solving problems. The result of the survey has shown that 64% of the respondents were involved in solving problems . The survey has shown the highest percentage for problems being solved by management decision and low percentage for problems being solved through brainstorming sessions and individually. In addition, a result of 86% was obtained for documentation of the problem solving procedures. However this documentation isn’t done perfectly .

Building trust among employees and between employees and their managers is a very important factor in allowing and encouraging teamwork and knowledge sharing .The survey has given 65% result for encouraging teamwork in the organization .However the organization seems to be aware of teamwork importance as this requirement is well done except in retrieving level.

The employees “always” or “often” attend courses or seminars related to their work ,this is according to the survey results ,about 80% of respondents agree that their organization gives a high importance to even conducting or delegating them to in or outdoor courses ,however there is no strict obligation to document what they have learnt .According to interviews ,sometimes the employees who have been delegated to outdoor courses are obligated to supply

the library of the organization with a manual or to hold a seminar to share their knowledge with others .

There is no certain award strategy for sharing or documenting knowledge ,more than 77% of answers were for “rarely” and “not at all”.

5.3 Description Of Knowledge Management Status In Both Case Studies

According to the results analysis ,the following points summarize the weakness and strength sides in applying KM in both case studies :

- There is a high degree of support face to face communication ,which means the tacit-tacit knowledge is transferred very well for this requirement .
- There is a waste in knowledge due to not documenting all the knowledge from different types of meetings .
- There is no clear policy to benefit from LL at the end of the projects ,however in private sector there is more awareness about LL importance as this requirement is achieved well but still needs developing methods for retrieving knowledge .
- Although the individuals are involved in solving problems, the majority of decisions were still being made by senior staff with no clear vision to document these solutions which affects negatively on retrieving them even if there is a hard ware (memory) for this purpose .
- There is a high degree of awareness for team work ,but still need to solve confidence crisis which prevents employees from sharing their whole knowledge.

- There is a policy for developing human resources ,by conducting seminars or delegating employees to outdoor training courses . The main problem is in documenting this new knowledge , and therefore the accessibility to related manuals.
- There are no systems of awards for encouraging knowledge sharing and documenting.
- There is a clear problem in retrieving knowledge, and therefore there is a problem in reusing it .
- The existence of organization memory doesn't mean that it is totally utilized .
- There is no clear understanding for knowledge management concept especially in puplic sector (GCEC as an example).

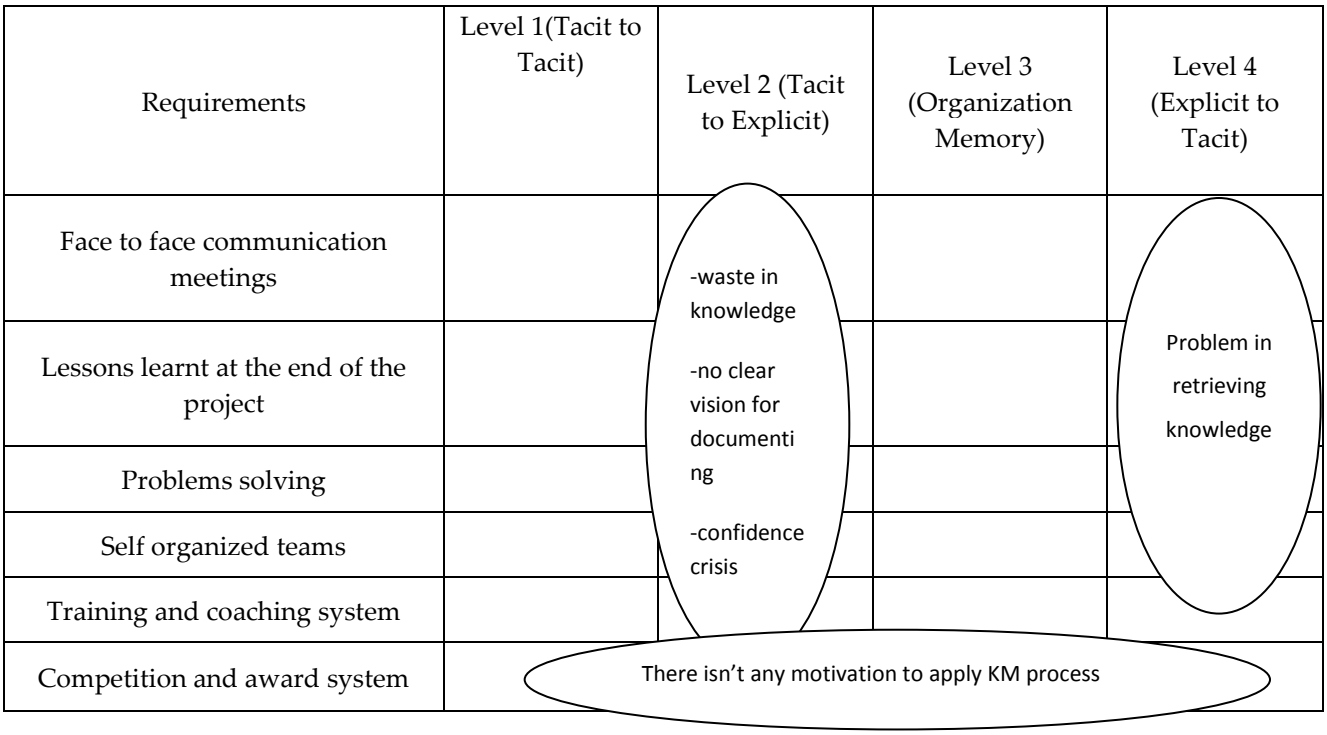


Figure 5.3 The Main Gaps In Applying KM In The Two Case Studies

5.4 The Suggested Framework For Implementing Knowledge Management In Construction Companies In Syria:

The suggested framework (Figure 5.4) consists of :

- Inputs which will form The Knowledge Base
- Operations :which are the procedures and activities that should be taken to sort ,share and exchange knowledge .
- Outputs where the knowledge will be utilized in future projects.

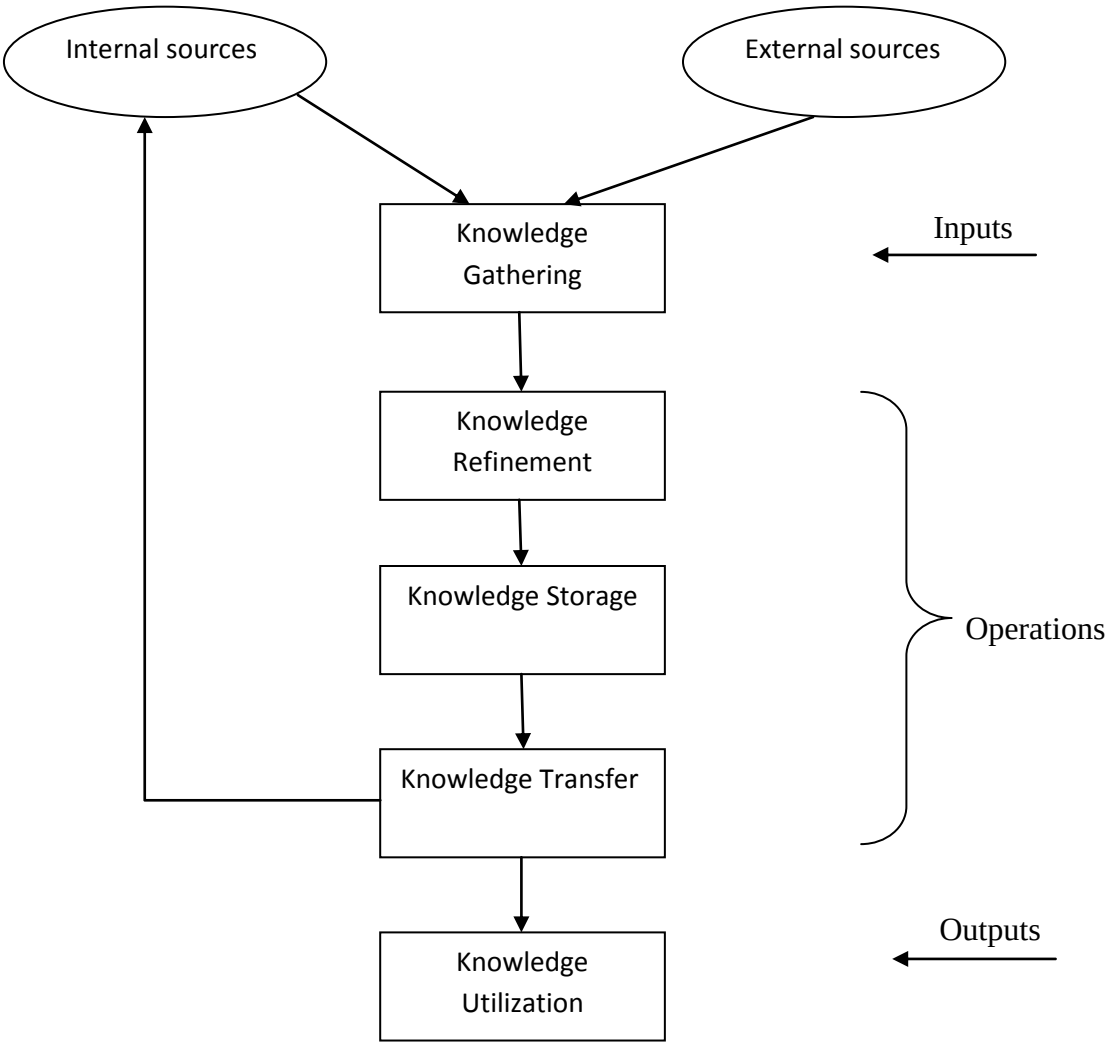


Figure 5.4 The Suggested Framework For Implementing Knowledge management In Construction Companies In Syria

5.4.1 Inputs (knowledge base) :

The first stage is to establish knowledge base which will be the foundation of the knowledge management process where the knowledge should be gathered and built through internal and external knowledge. For achieving this purpose it is suggested :

- ✓ Focusing on *individuals* as every individual in the organization is considered to hold valuable knowledge , and most of this knowledge has not been yet captured and can be lost from the company if it is not managed, shared and stored successfully. For this purpose *Informal meetings* are considered as a good opportunity to establish and share knowledge and those meetings should be documented at least in the form of few notes ,headlines or briefs .(This will be a good point to solve the problem of wasting knowledge which has been found in results analysis)
- ✓ Be sure to collect available information : It should be noticed, that the information and knowledge must be gathered from the all different bodies and organizations participating in the project e.g. clients, designers consultants, contractors, and inspectors. Project information and knowledge gathering as well as knowledge acquisition stages are strongly connected with all construction project life cycle activities, including: conceptual planning, design, procurement, construction, operation and maintenance.
- ✓ Capture the knowledge in different forms :We do accept that not every piece of tacit knowledge can be converted into explicit form, and we might not be able to do much about it. But what we can do, is to maximize the conversion as much as we can. One thing we can do to enhance the efficiency of knowledge capture is to capture it in multiple formats. Some knowledge might be more effectively captured if it is stored in the form of video or voice of the owner of the knowledge, and maybe converting it into a text file will result in loss of some of the context of the knowledge. So the conversion

from tacit to explicit form should not be just in the form of a text file but should have multiple types of files that can potentially add context to the knowledge.

- ✓ Construct library (could be e- library) This includes e-books and e-reports of many areas of technical and procedural issues , in addition to the international standards. Hardcopies should be available such as books and training booklets. E- learning could be considered in building knowledge base ,this will help in getting new knowledge (the company could offer paying half fees of the study).

5.4.2 Operations :

The second stage is the procedures and activities needed to sort ,share and exchange knowledge for this purpose it is recommended the following :

- ✓ Building trust between individuals means better knowledge sharing process can be achieved. *Informal sessions* can be arranged and encouraged by the organizations where knowledge can be shared and discussed. A *monthly workshop* outside the workplace might also help in building relationship between employees and thus build kind of trust. *Lunch breaks* give a good opportunity for sharing knowledge and discussing different issues related to work ,and help in reducing aggressive manner in relations .
- ✓ Provide financial support for establishing KM system
    - Construct memory :Build an active organization memory which may take a form of IT system such as servers ,databases, and intranet. The main purpose of using such systems is to store knowledge and to make it available for people to retrieve and use. It should be an information respiratory where all the related knowledge should be housed (saved)and its second role is to be a transmission tool so employees can reach what they need. In order for such system to serve its

purpose it should be accessible to employees, searchable, fast, safe (regular backup systems), user friendly and well organized. It is preferred for such systems to be empowered by search engine which helps in searching for the area of interest and should have restricted access ,since it could contain private information which will be available just for senior management .Beside all that filtering the gathered information is a necessity to avoid the overload and to allow for easier finding the desired knowledge .

- Awards system: Create individuals willingness to work with others and share knowledge by allocating a part of organization budget for implementing incentive /rewards systems to encourage people to participate affectively in KM process .

✓ In-house training programs is a good way to share knowledge between employees ,for this purpose training manuals should be loaded on organization memory (an IT system) or as a form of printed material , to give a chance for employees to benefit from them, whether they have attended the trainings or not.

✓ Mentoring is well recognized as an effective method of transferring knowledge and experience, as junior and senior staff can meet and senior staff can give the help and support to juniors in certain fields.

✓ Outdoor courses :support individuals to extend their knowledge by delegating them to outdoor courses to acquire new knowledge

✓ Job rotation can be useful in terms of enhancing individuals' knowledge by working in different places and communicating with different people. It is useful as well for the company to benefit from the people's knowledge and skills in different departments and branches. Moreover, many people are multi-skilled and by rotating them they are

getting the chance to improve their different skills, benefiting the company by the skills they have and sharing their knowledge and ability with bigger number of people.

5.4.3 Outputs:

Achieving the previous stages successfully will help in the third one where knowledge will be transferred even in information ,procedures ,solutions to be used in the future projects , or as a feed back to the knowledge base so the explicit knowledge transfers to tacit one again .

5.5 Summary :

Successful knowledge management means that four steps must be implemented and several requirements should be fulfilled . Any problem in achieving the requirement of each step will result in preventing the knowledge management from functioning. The goal of this study was to investigate and analyze the current status of knowledge management in construction companies in Syria during its processes and practices and list of requirements necessary to have successful KM system through two case studies worked in construction field one in public sector and the other one in private . Several gaps and barriers have been found in applying KM process, lack of awareness ,unwilling to share knowledge ,confidence crisis, lack of seriousness in having policy lead in preserving knowledge obtained . In light of this results a framework has been suggested for a better implementing knowledge management in construction companies in Syria. Based on what has been mentioned in this chapter ,some recommendations will be suggested in the next chapter .

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction :

Based on the fact that knowledge become nowadays an essential source like any other tangible resources ,which needs to be managed ,this research investigates and analyzes the current status of knowledge management in construction companies in Syria and suggests a frame work for implementing knowledge management in these companies to increase their competitive ability and reduce waste from resolving repeated problems . In order to achieve these objectives ,this study started with a review of the relevant literature focusing on fundamental theoretical concepts that are related to the topic , different KM models were provided ,and a list of requirements were identified which enabled in investigating the status of KM in the case studied .It was found that none of the studied organizations meets all the requirements ,and therefore according to the gaps which were found a frame work suggested for better implementation to KM process. In this chapter a list of recommendations will be listed which will help in applying the suggested framework successfully .

6.2 Conclusions & Recommendations :

Based on the results found in this study about the status of knowledge management in construction companies in Syria ,the research recommends that knowledgeable environment should be created in the organization by applying the following :

- ✓ Top management support is essential in making successful knowledge management.
- ✓ Knowledge management department should be developed to be responsible and execute all knowledge management activities .

- ✓ To have open door policy in flowing knowledge by reducing bureaucracy and centralization in making decisions
- ✓ Create an awareness for KM importance and the concept of it by conducting seminars about this topic . Order of Engineering is a perfect place for this purpose
- ✓ Create a culture of post project review which allows the subsequent dissemination of lessons learnt by adapting it as a policy .
- ✓ Having reward system to encourage employees to contribute affectively in all knowledge management process stages .

6.3 Recommendations For Future Research :

This study investigated the status of knowledge management in construction companies in Syria ,and suggested a framework for implementing knowledge management in construction companies in Syria .

More efforts can be conducted by future researches to develop this framework to an IT system helps in implementing knowledge management in construction sector by concentrating on a practical way for filtering, storing, and retrieving knowledge as it is a main problem in having perfect knowledge management system .

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Appendices
Appendix A

Survey Questions

This survey is intended for academic purposes, the results will be used in Master research titled "**Developing a Structure for Knowledge Management Implementation in Construction in Syria**"

Profession: _____ Job Title: _____
Years of Experience: _____ Years in the organization: ____

1- Does your company encourage face-to-face communication with the work team?

□ Yes □ No

2- How often do you attend meetings?

□ More Than once a week □ Once a week □ Once a month □ Rarely/Occasionally

3- What are the types of those meetings? (Note: you can select more than one choice, as applicable)

□ Formal □ Informal □ Scheduled □ Unscheduled

4- Are they minuted?

□ Always □ Often □ Only formal ones □ Not at all

5- In case of problems facing the company in running any project, are you involved in solving them?

□ Always □ Often □ Only when asked □ Not at all

6- How are the problems solved?

□	□	□	□
Brain storming sessions	Referring to previous problems	Management decisions	Individually

7- Are the problems, the solutions, and the procedures documented?

□	□	□	□
Always	Often	Rarely	Not at all

8- Does the company support or encourage teamwork?

□	□	□	□
Always	Often	Only in low levels	Not at all

9- Are the created knowledge and ideas from teamwork documented?

□	□	□	□
Always	Often	Only formal ones	Not at all

10- Are there any accessible body of knowledge in the company?

□	□
Yes	No

If yes, please answer the followings:

a) Is it easy for employees to reach to documented knowledge?

□	□
Yes	No

b)Is there any motivation to use the documented knowledge?

□	□
Yes	No

11- What is the system for documenting and sharing information?

□	□	□	□
Hard copies in the archive	Softcopies in the server	Intranet	There is no system

12-At the end of the project, are the project problems discussed?

□	□	□	□
Always	Often	Rarely	Not at all

13-Are lessons learnt at the end of the project documented?

□ Always □ Often □ Rarely □ Not at all

14-Do you attend any training courses or seminars related to your work?

□ Always □ Often □ Rarely □ Not at all

14-a)Are you obligated to document what you have learnt?

□ Yes □ No

14-b)Are there any training manuals accessible for all employees?

□ Yes □ No

15-Is there any type of awards for documenting and sharing what you have learnt (new knowledge)?

□ Always □ Often □ Rarely □ Not at all

Appendix B

Interview Questions

1. Could you please give me a brief about your organization?
2. What is the number of employees?
3. Would you mind if I mention the name of the organization in my study? Or you prefer to keep it private?
4. Does your company encourage face-to-face communication with other employees? How?
5. How do you deal with the problem of loosing knowledge of people who leave the company (retirement, resignation)?
6. Are the previous learnt lessons documented? How are they stored?
7. Does your company offer any incentives for documenting lessons learnt from previous projects or from trainings? If yes what are they? If No, why not?
8. In case of problems the staff working in the project face, do staff refer to solutions that have been used in previous projects?
9. How are problems in any project solved (individually – collectively)?
10. Are there any training held regularly?

Appendix C

Results For Chi Square Test and P values

- Does your company encourage face-to-face communication?

Q1	GCEC	Case2
Chi-Square	5.121[a]	18.689[a]
df	1	1
P Value	.024	.000

- How often do you attend meetings?

Q2	GCEC	Case2
Chi-Square	9.545[a]	9.667[a]
df	3	3
P Value	.023	.022

- Are the meetings minuted ?

Q4	GCEC	Case2
Chi-Square	19.727[a]	10.133[a]
df	3	2
P Value	.000	.005

- In case of problems facing the company in running any project, are you involved in solving them?

Q5	GCEC	Case2
Chi-Square	12.212[a]	9.844[a]
df	3	3
P Value	.007	.020

- Are the problems, the solutions, and the procedures documented?

Q7	GCEC	Case2
Chi-Square	20.939[a]	24.600[a]
df	3	3
P Value	.000	.000

- Does the company support or encourage teamwork?

Q8	GCEC	Case2
Chi-Square	15.121[a]	4.156[a]
df	3	3
P Value	.002	.245

- Are the created knowledge and ideas from teamwork documented?

Q9	GCEC	Case2
Chi-Square	21.182[a]	11.800[a]
df	3	3
P Value	.000	.008

- At the end of the project, are the project problems discussed?

Q12	GCEC	Case2
Chi-Square	7.848[a]	29.400[a]
df	3	3
P Value	.049	.000

- Are lessons learnt at the end of the project documented?

Q13	GCEC	Case2
Chi-Square	6.545[a]	13.578[a]
df	2	3
P Value	.038	.004

- Do you attend any training courses or seminars related to your work?

Q14	GCEC	Case2
Chi-Square	13.667[a]	27.089[a]
df	3	3
P Value	.003	.000

- Are you obligated to document what you have learnt?

Q14a	GCEC	Case2
Chi-Square	.758[a]	1.089[a]
df	1	1
P Value	.384	.297

- Is there any type of awards for documenting and sharing what you have learnt (new knowledge)?

Q15	GCEC	Case2
Chi-Square	23.848[a]	14.533[a]
df	3	2
P Value	.000	.001