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KNOWLEDGE MANAGEMENT IN CONSTRUCTION INDUSTRY OF RIVERS STATE (MONIER CONSTRUCTION COMPANY)

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Abstract: **Construction knowledge management is a wide area of study filled of a lot of information that has not been properly shared in the process of construction projects in the Construction industry and organizations in Nigeria and Rivers State in particular, which in turn affect the performance and growth of the industry in terms of quality, time and cost. This research work is aimed at investigating the mode of practicing knowledge sharing in the local construction firms in Rivers State Nigeria and Monier Construction Company (MCC) as a case study. The aim is to provide a platform that will enhance the current best practice of knowledge sharing, to face the challenges of meeting the client desire and customer satisfaction.**

A total of one hundred (100) questionnaires were distributed to Architect, Quantity Surveying, Engineers, Builders and other experts across Monier Construction Company (MCC). The method of analysis employed is descriptive, because descriptive is a transformation of raw data in a form that make them easy to understand. The software's used to support this descriptive analysis are, Statistical Package for Social Science (SPSS) version 17.0, it was used to analyze the data for mean score, frequencies and percentage test method. Microsoft excel 2007 was also used to plot bar graphs and pie charts to show the findings and averaging index techniques.

The results revealed that Monier Construction Company currently adopts the traditional method of knowledge sharing which is not an efficient and effective approach in sharing knowledge among its employees. The questionnaire revealed that face-to-face interaction, site meeting, internal training, project briefs and monitoring and coaching are confirmed as the main means of sharing knowledge, best practice and experiences of experts and engineers in the construction companies and in Monier Construction Company Rivers State, Nigeria. This suggests that the social interaction between the Project Managers, Architects, Quantity Surveyors, Engineers, experts and other professionals working in the construction companies are very important for effective knowledge sharing practices to foster project planning and scheduling. Hence This research work recommends that head of the construction organizations and industries in charge of projects should encourage engineers and experts to share knowledge and experiences to improve the quality of project delivery, working morale and innovation in the construction organizations.

Keywords: **Knowledge Management (KM), Monier Construction Company (MCC), Knowledge Sharing, Organizations, Construction, Rivers State, Nigeria.**

1. INTRODUCTION

1.0 Background of the Study

All over the world construction industry has played a significant role in contributing to the Gross Domestic Product (GDP) of both developed and underdeveloped countries. The reason for this dynamic nature of the construction industry is based solely on growing demand for quality by clients, complexity of construction projects, advancement in technology and introduction of new innovations amongst others.

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In Nigeria, the construction industry has played a dominant role in contributing to the national GDP since 1960s to 1990s, accounting for about 70% of the GDP (Planning Committee on the National Construction Policy, 1989). It is imperative that construction firms take up challenges in this new era of global competition to boost their productivity level by effectively utilizing all departments or units in the construction industry to play their own role to improve on the growth of the industry and keep on the development. [4]

As the Nigerian economy begins to progress further, the demand for housing, basic amenities, and infrastructure begins to increase. As the nation progress towards becoming a developed nation by the year 2025, the construction industry would play an important role in this development process.

Following these increasing demands, the construction industry needs to satisfy and champion the changes inherent in construction demands and development stages. The local construction industry distinguishes itself from other industries by having a slower rate of technological development and lower productivity because of its inability to meet up demand and keep pace with the momentum generated by trending development programs. Several researchers have criticized the local construction industry for its low competence level, low demand, consistent low productivity and poor performance over the years for its lack of innovation and inability to employ a more diverse workforce (Olomolaiye, 1987; Aniekwu, 1995; Okuwoga, 1998; Adeyemiet al.; 2005). This has reduced its contribution to the national economy to a mere 1% of the GDP in 2002 (AfDB/OECD, 2004). [4]

Adnan (2002) stated that the construction industry is a driving force that activates a nation's physical development by initiating projects from conceptualization to realization. The conceptualization and realization of projects can bring about benefits to the nation and its people, thereby satisfying the demands and growth of the national economy. Over the years construction industry has been defined by many researchers such as Wells (1995) who described construction as the creation of physical infrastructure, superstructure and related facilities. Abdullah (2004) described the construction industry as a sector of a nation's economy which constructs, alters, repairs, and demolishes buildings, civil engineering works and other related structures. The construction industry equally includes the assembly and installations of on-site prefabricated material components and building services.

The construction industry is a work place that is dominated by heuristics. Masqood (2006) noted that construction firms operating within the industry refer to perform their project management tasks based on their past experiences, rather than a textbook approach. The construction industry requires a lot of intellectual knowledge which can be usable by construction firms operating within the industry to add value, innovation, competitiveness and improve their future project performance. Kamara et al. (2002) stated that the cost of attracting, recruiting, and retaining talented employees is expensive. In coming years, the construction industry is expected to lose a large chunk of its skilled and knowledgeable workforce which adds further complications to the industry. At the moment there is no single strategy available to accommodate problems that arise in construction industry. One of the most efficient and effective tools for strengthening the construction industry organizational competitiveness is through best practice knowledge management and sharing.

The construction firms operating within the industry use knowledge management (KM) to create, identify, share the knowledge best practices, lesson learnt and experiences within the organization. Construction firms without defined goals and unique deliverables would probably lead to difficulty in efficiency in recording, and capturing project knowledge. The significance of knowledge management in construction industry has been accepted and has been proven to enhance the performance of project success.

1.1 Statement of the Problem

Knowledge management is responsible for selection, evaluation, and implementation of knowledge and information strategies aimed at creating an environment within a firm to supports work with both external and internal knowledge in order to improve efficiency and performance. The implementation of knowledge management strategies involves all people, product, the firm itself and technological instruments needed to improve the firm's wide level of competencies and ability to learn.

Krogh (2000) expressed that knowledge management has made the definition of knowledge sharing less wide as it involves basically a processes of acquiring a person's or firm's knowledge and expertise distributing it to wherever it may be needed to produces better results and performance for the person or firm.

Nelson, et al (1993) expressed that the study of knowledge sharing is the means by which an organization acquires internal and external knowledge, and successfully implementing knowledge sharing involves a vast learning processes rather than a basic communication process, as knowledge must be locally relevant and adapted to suit the incumbent organization (Nelson and Rosenberg 1993). In addition, sharing of knowledge involves the conversion of the types of knowledge which explicit and tacit knowledge and vice versa, while the knowledge is distributed between the organization, individuals and back Wang (1999).

Knowledge has always been a crucial factor in organizations and the success of an organization or firm is a function of how much the organization is able to create, distribute, transfer, imitate and utilized knowledge assets Nonaka and Takuchi (1995). A study has shown that when employees leave a firm, they leave with more than 70% of their knowledge and between 30% to 40% of those employed to replace them spend their time looking for new knowledge LPCUBE (2003). [15]

However, if knowledge sharing has been implemented, then related or same problems do not need to be done all over again, especially problems in construction industries. Nowadays, knowledge sharing within firms is gaining more attention and acceptability as more and more firms are becoming more aware of the importance of knowledge transfer and distribution.

Dougherty (2007) in his work argued that the construction industry is not doing enough in utilizing and formalization of knowledge in comparison to other industries such as pharmaceuticals and automobile etc, he gave reasons for this failure to that of word of mouth and personal contact which is still influential within the industry. Rooke et al. in 2005 further noted, knowledge is passed on by individuals and it might but it not properly captured, documented or recorded and when new employees acquire knowledge by observing or being given instructions by these experienced individuals.

There is a significant relationship between knowledge sharing and the efficacy of best practices in the construction industry, particularly in the construction firms of Rivers State Nigeria. Also, the modes of Knowledge Sharing are Vital to add value to this relationship.

1.2 Aim and Objectives

This study is aimed at investigating the mode of practicing knowledge sharing in the local construction firms in Rivers State Nigeria. This aim is to provide a platform that will enhance the current best practice to face the challenges of meeting the client desire and customer satisfaction. In order to accomplish the aim of this study, the following objectives are formulated:

a) To determine the current status of knowledge sharing practices in planning and scheduling processes in the local construction firms in Rivers State, Nigeria.

b) To identify the most frequent means used in knowledge sharing practices within scheduling and planning process in the local construction firms in Rivers State, Nigeria.

c) To reveal the importance of managing knowledge sharing and the roles of individuals and firms in the implementation in the local construction industry in Rivers State, Nigeria.

d) To suggest a way-forwards for improvement in the management of planning and scheduling process in the local construction industry in Rivers State, Nigerian by developing a suitable best practice approach that will utilize information technology.

1.3 Research Questions

In order to address the aim and objective of the study, the following research questions provide the basis for this study.

Main Question,

a) What is the approach for sharing knowledge practices in the four areas of project planning for the construction firms in the Rivers State Nigeria?

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Secondary Question,

b) What are the organizational structure, functions and responsibilities of the construction firms?

c) How to share knowledge practice availability and usability, distribution methods, content and layout between industry and stakeholders?

d) What are the selection criteria, and best practice suitable for utilization?

e) How to ensure the process of continuous improvement by the firm effectively?

f) What are the success factors and possible barriers for utilization of knowledge sharing practices?

1.4 Scope of the Study

This study is focused on one company which the result can be generally applicable to the to the entire local construction industry. Monier Construction Company (MCC) is a taken into consideration for this study because is a firm that act as main contractors in construction projects operating in Rivers State Nigeria. The studied areas of the firm are the building and civil engineering departments which comprises of Project managers, M-E Engineers, Architects and Quantity Surveyors, that are equally responsible for planning and scheduling of construction projects as it cuts across every management task in a project from conceptualization to finish.

All in all, the study is conducted in order gather descriptive information concerning how practices can be shared within a construction firm. From this study awareness can be created within construction firms of the importance of knowledge management and sharing across its employees based on data provided by practitioners and experts within a more knowledge intensive setting.

1.5 Research Methodology

Figure 1.1 shows the stages of implementation of this study. This research design is divided into two phases. Phase one accommodates the aims and objectives, research problems, research scope and relevant literatures. Phase two consists of accommodate the structured questionnaires distributed to the respondents in the selected firm and the analysis of the returned questionnaires to achieve the aims and objective of this study, with the way forward and conclusion reached.

1.6 Significance of the Study.

This Study is important because it attempts to link relevant knowledge sharing concept and contents with the construction industry, especially the construction firms of Rivers State Nigeria. It also affirms the need for a research survey of the Nigeria construction firms vis-a-vis project management principles.

1.7 Thesis Organization

The thesis organization is divided into the following six chapters which together constitute the research progress of this work and gives the reader a brief overview of on what the main content of each chapter is.

Chapter One- Introduction- This chapter discusses the introduction to the study, the background of the research problem and the scope of the research study. Research questions are formulated and relevant research aims and objectives are presented. A suitable methodology was selected in order to achieve the objectives of this study.

Chapter Two- Knowledge Management in Construction Industry- in this chapter Knowledge Management in construction industry is reviewed to present an explicit knowledge of the research study. It deals with the introduction to knowledge, understanding knowledge management, previous work on Knowledge management, and current concepts, tools in handling Knowledge management issues. The main topic revolves around best practices -what they are, what adopting best practices leads to, factors for a successful initiative and other issues related to the notion of best practices.

Chapter Three- Planning and Scheduling of Construction Projects- This chapter presents the planning and scheduling and its relevance in implementing knowledge management. It looks into the selected research strategy, a brief background explanation of the investigated and barriers to planning and scheduling.

Chapter Four – Research Methodology- This chapter presents the methods that will be used for raw data collection to support this research.

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Chapter Five–Data Analysis and Finding – This chapter presents the results and opinions of the respondents at MCC firm in Rivers State. A structured questionnaire is to assess the applicability of the knowledge sharing in construction planning and scheduling proposed as well as the findings inherent in the study.

Chapter Six- Conclusion and Recommendations- In this chapter a comparative analysis and possible means of looking into future work that will support the firm as well as areas of improvement and the knowledge management feedback from respondents is evaluated.

2. KNOWLEDGE MANAGEMENT IN THE CONSTRUCTION INDUSTRY

2.0 Introduction

To survive in a competitive knowledge economy, it is imperative that firms needs to do more in forecasting tomorrow than yesterday and constantly looking out on new ways to correct and prevent problems and make continuous improvement to achieve business sustainability. Knowledge management makes sense to first organize what people know as a division and then to share it, which led to a whole host of cultural issues.

Alavi and Zack (1999) in their work stated that knowledge management highlights the importance of a sharing culture in order to support and foster knowledge management focus. In fact Knowledge Management (KM) focuses on different alternatives of sharing and storing the knowledge of individuals as a way of improving the competency, speed, efficiency and profitability of an organization.

Qunitas, et al. (1997) define knowledge management as a means of managing all knowledge continuously to meet various requirements in an organization. Coleman (1999) defines knowledge management as an umbrella term for a wide variety of interdependent and interlocking functions which comprises of knowledge creation, knowledge valuation and metrics, knowledge mapping and indexing, knowledge transport, storage and distribution, and knowledge sharing. Gurteen (1998) comprehensively defined knowledge management as an emerging set of organizational design and operational principles, processes, organizational structures, applications and technologies that helps knowledge workers to dramatically leverage their creativity and ability to deliver business value.

Knowledge management implementation enables an organization to learn from its corporate memory, share knowledge, and identifies competencies in order to become a forward thinking and learning organization. Researchers such as Kamara, et al. (2002) and Love, et al. (2003) highlighted the benefits of knowledge management to the growth of organizations if successfully implemented as it is evident in producing innovation, reducing project time, improving quality and customer satisfaction. According to Siemieniuch, et al. (1999) noted that organization's intangible assets can be used properly to create value, with both internal and external knowledge being leveraged to the benefit of the organization if knowledge management is been implemented successfully.

In the construction industry, knowledge management can improve communications within teams, and provide more informed knowledge by sharing best practice documents, lessons learned, project management and system engineering methodologies, examples of review packages, and the rationale for strategic decisions. Kaklauskas, et al. (2005) distinguish such knowledge management benefits as productive information use, activity improvement, intelligence enhancement, intellectual capital storage, strategic planning, flexibility acquisition, best practice gathering, success probability enhancement and productive collaboration.

There is no precise definition of knowledge management within the construction industry. However, Egbu (2004) in his work describes knowledge as an important resource for construction organizations due to its ability to provide market leverage and contributions to organizational innovations and project success. The idea of knowledge as a competitive resource within project-oriented industries is a concept shared by various researchers such as: Nonaka and Takeuchi, Egbu and Botteril, and others.

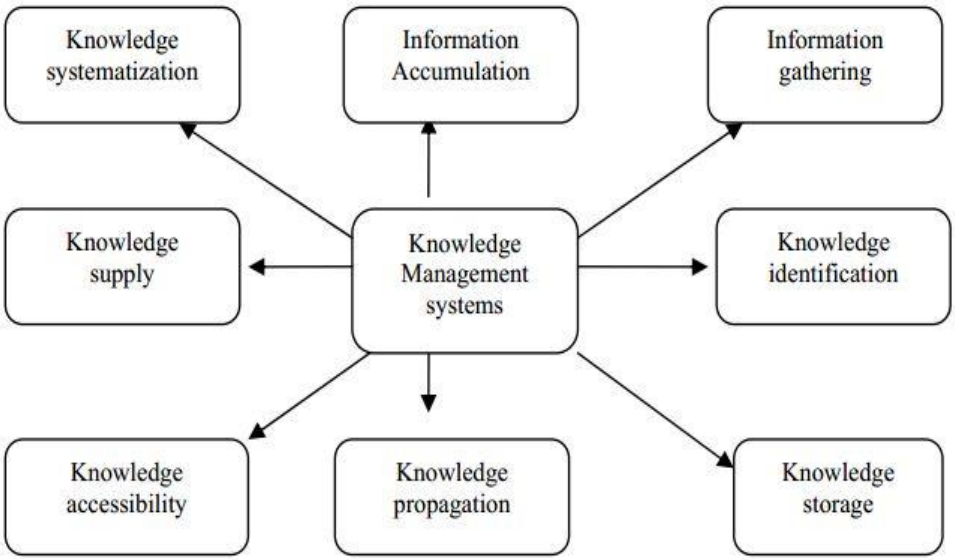
Braf (2000) split the definition of knowledge into two parts and defined them as Explicit and Tacit Knowledge. Polanyi (1950) defined tacit knowledge with an old saying that "People know more they can tell". Sanchez (2005) refined the work of Polanyi by defining tacit knowledge as rooted into actions, procedures, ideas, values and emotions and this type of knowledge only exist in the human body. Simard and Rice (2007) state that the greater the degree of tacit knowledge, the harder the knowledge is to share.

While explicit knowledge is objective, rational and can easily be documented, Little et al (2005) stated that explicit knowledge is knowledge that can easily be communicated to others in form of verbal or written language and examples of explicit knowledge are books, manuals and formulas. Both forms of knowledge are important for organizational effectiveness and growth. Mohamed and Anumba (2006) finally argue that tacit knowledge is mainly associated with the construction industry which calls for a knowledge management mechanism to be set aside.

2.1 Concept of Knowledge Management

If organizations seek to effectively implement knowledge management, Davenport and Prusak (1998) maintained that there must be a shared implication of the terminology which they presented as three levels of knowledge. Firstly, they define data as discrete and objective facts about events without placing it in any context. Secondly they defined information as contextual, categorized, calculated, corrected and condensed combinations of data embodied as a message between a sender and receiver. And finally, they combined information with experience and got the feelings of individuals which in turn create knowledge.

The concept of knowledge management is summarized using the systems approach generally adopted by many researchers, as shown in figure 2.1.below.



Source: Laura (2008). [5]

Figure 2.1 Concept of Knowledge Management

The above systems approach is further explained in Table 2.1 below.

Table 2.1: Concept of Knowledge Management. [11]

Data →	Information →	Knowledge
Raw facts and figures.	Facts and figures taken in context, which convey meaning.	An accumulation of information, building on existing ideas and experience.

To enable us distinguish between data, information and knowledge as a concept of knowledge management as summarized in the table 2.1, we look into the work of Meadow (2002) as he defines data as raw facts, strings of

elementary symbols such as letters or digits. According to Drucker (2001) stated that data can be transformed into information when it's put into some context, with respect to relevance and purpose but with or without experience.

Boisot (1998) noted that knowledge builds upon information that is extracted from data. Bouthillier and Shearer (2002) argues that knowledge is different from information because it is predictive and can be used to direct action while information merely is data in context which have the static characteristic.

2.2 Knowledge Management Processes

Alvavi, et al. (2001) stated that knowledge management concepts existing in different literature differ considerably in terms of numbers and labeling of process rather than the underlying knowledge management concepts. It is important to review the work of Grant (2005) which distinguishes between two key processes, namely the generation of new knowledge and the effective application of new and existing knowledge. Ruggles (1998) looked at it from another perspective and defines eight processes presented in Table 2.2.

Table 2.2: Knowledge management process

Researcher	Classification
Nonaka and Takeuchi, 1995 Nonaka and Teece, 2001	• Creation; • Transmission; • Utilisation
Leonard, 1995	• Acquire; • Collaborate; • Integrate; • Experiment
DeLong, 1997	• Capture; • Transfer; • Use
Ruggles, 1998	• Generate; • Access (from external sources); • Facilitate (through culture and incentive); • Present (in documents, databases and software); • Embed (in processes, products, and/or services); • Use(in decision making); • Transfer (into other parts of the organisation); • Measure (the value of knowledge assets)
Skyrme and Aidon, 1998; Spender, 1996	• Create; • Transfer; • Use
Teece, 1998	• Create; • Transfer; • Assemble; • Integrate • Exploit
Gold, Malholtra and Segars, 2001	• Acquisition; • Conversion; • Application; • Protection
Grant, 2005	• Generation; • Application

Source: Siti (2012). [15]

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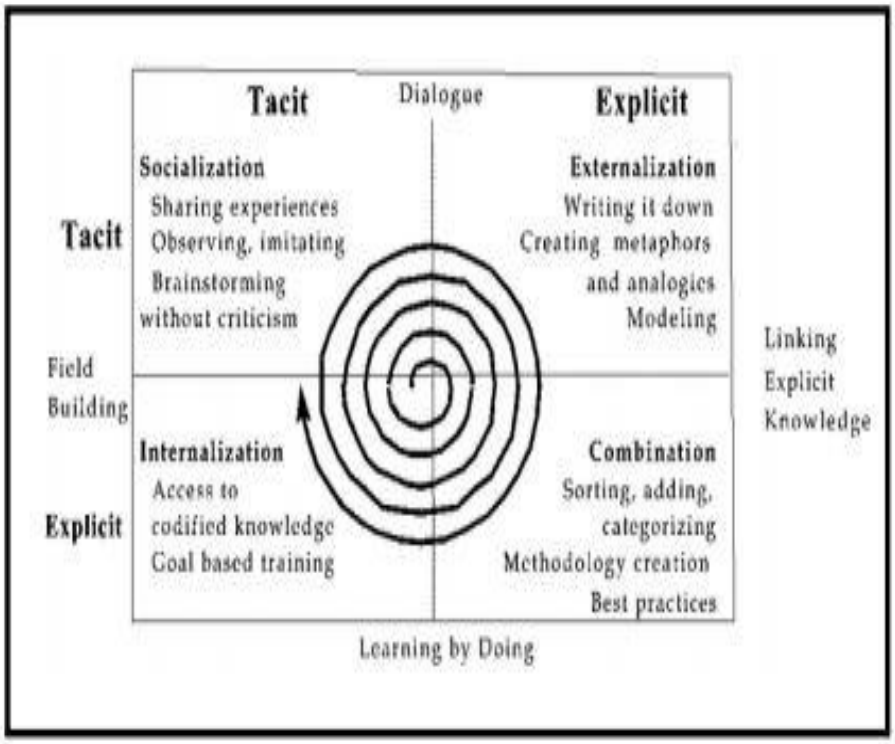
2.3 Knowledge Creation

Dave et al. (2009) stated that knowledge can be created in an organization with continuous interaction among individuals and a continuous conversion from tacit into explicit knowledge by individuals, supported by the organization. Nonaki et al (1995) presented a model of knowledge conversion named SECI as shown in figure 2.2 below and it has become the main source of reference in the area of knowledge management.



Source:Nonaka's Spiral Knowledge (Vilalba, 2006). [9]

Figure 2.2: Knowledge Creation

2.3.1 Socialization

Little et al. (2005) defined socialization as the process of converting new tacit knowledge through shared experiences. This can be achieved through sharing and experiences, observing, imitating and brainstorming without criticism. Firms often take advantage of the tacit knowledge embedded in other parties such as contractor or even other quantity surveyors by interacting with them. Shared value is created through a process of socialization, whereby a common identity and collective interpretations of reality are formed.

2.3.2 Externalization

The process of converting tacit knowledge to explicit knowledge is defined as Externalization, which can be achieved through writing, creating metaphors and modeling.

2.3.3 Combination

Combination is a conversion process which referred to forms of explicit knowledge which are conveyed through email, documents, database, meetings and briefing. This involves the collecting of relevant knowledge, distributing and editing or processing to make it more usable to user.

2.3.4 Internalization

Ray, et al. (2005) described Internalization as the process of embodying explicit knowledge into tactic. Through Internalization explicit knowledge created is shared within an organization and converted into tacit by individuals.

2.4 Knowledge Sharing

Knowledge sharing is one of the core blocks of knowledge management. Probably it is the important aspect of knowledge management. Dalkir (2005) noted that knowledge sharing is denoted as the edge to create knowledge which contributes to the increase in employees' performance and harnessing innovation. Grant (1996) stated that knowledge sharing is a key to the success of knowledge management in theory and practice. Jashapatra (2004) maintained that knowledge sharing is a set of commitments that involves the exchange of information and knowledge among the other employees in an organization.

2.4.1 Role of Individuals in Knowledge Sharing

Nonaki (995) noted that in the process of knowledge sharing, individuals in an organization serve as knowledge generator and knowledge receptor and this knowledge is generated by exchanging their ideas and experience through socialization. For instance, employee one is made to know a problem faced by a fellow employee two and employee one has the solution to the problem. Employee one may share or may not share the knowledge with employee two. It is up to employee one to share the knowledge with the employee two. The example shows that individuals serve as the driving force behind the process of knowledge sharing.

Nonaka et al. (1995) added that, knowledge sharing will not be successful within an organization without the involvement of humans. In this case it important to understand factors that influence individuals to share knowledge.

2.5 Conceptual Framework of Knowledge Sharing

This section describes the concept of knowledge sharing to further understand this research assignment.

2.5.1 Social Cognitive Theory, Constructs and Knowledge Sharing

The social Cognitive Theory is a social learning theory. Bandura (1989) introduced this theory and defined individual behavior as dynamic, reciprocal or interactive network of personal factors, behavior and the surroundings. This theory postulates that the combination of the three human behavior factors breed to a formulation of a certain outcome and expectation that lead to a decision.

These allude to the fact that individuals consider a combination of factors that are personal, social and environmental to make decisions on either to exhibit a certain behavior or not. Bandura went further to argue that the mind of an individual is an active tool which guides one's steps towards formulating expectations, abilities and outcomes.

Altruism also has a linkage with Social Cognitive Theory in that individuals look at the psychological benefits before getting involved in sharing their knowledge. Even though an altruistic person may be seen recognized as unselfish, a study conducted by Honeycutt, (1981) argues that an altruistic person gains a kind of control over the recipients.

However an altruistic individuals can act based on his own interest while social cognitive theory also argue that an individual's ability to exhibit certain behavior is based on some certain factors which may be personal goals.

2.5.2 Social Exchange Theory, Constructs and Knowledge Sharing

Blau (1964) stated that the social exchange theory is one of the models used in explaining knowledge sharing behavior and he added that Social exchange is based on the behavior of individuals, outcomes or benefits, environment and the interpersonal network between individuals. In other words the Social exchange Theory strives to use relationships or exchanges as cost benefit analyses. In this way people will strive to maximize profit and minimize cost in their own way.

The social Exchange Theory maintains that individuals may not be involved into certain activities unless they see a positive outcome. This is not in any way a commodity exchange but it can be a mental assumption of positive outcome in knowledge sharing and in a way individuals will not share their knowledge when they perceive activities as mere costs, but will intend to share it when positive returns are expected.

2.5.2.1 Trust

Fox (1974) stated that trust is the focal point of every relationship within the organization. Dyer et al. (1998) noted that with trust people tend to take risk with the intention of full participation with the other individual without causing any harm.

According to Nonaka and Tekeuchi (1995), trust among individuals in and out of an organization contributes to

improvement in knowledge sharing. Kalantzis and Cope (2003), in their work they added that interpersonal trust is directly proportional to knowledge sharing. People will be motivated to share their knowledge when they perceive that other individuals are honest, trustworthy, and reliable. Higher trust will make individuals not think of any future negative occurrence on the activities and will share their knowledge.

2.5.2.2 Altruism

Chattopadhyay (1999) saw altruism as a behavior that costs one individual and benefits another. Altruism is a costly activity that profits others (However, some individuals may share their experience and knowledge with others without thinking of the benefit he or she may gain from it. From the definitions above, it can be seen that individuals within an organization may share their knowledge unselfishly.

2.5.2.3 Mutual Reciprocity

Davenport and Prusak (2008) stated that mutual reciprocity is one of the key enablers of knowledge sharing. Blau (1964) described reciprocity as an actions that are contingent on rewarding reactions from others and that cease when these expected reactions are not forthcoming. And Kelley, et al. (1978) added that individuals involved in virtual teams would share their knowledge when they perceive a commensurate behavior from the other individuals.

It was established that knowledge sharing within organizations is enhanced through reciprocity shown by other individuals. Chiu et al. (2006) finally added that reciprocity has a positive significant relationship to knowledge sharing behavior. Mutual reciprocity is about cost and benefit. In the context of knowledge sharing, the donor of the knowledge will decide whether the recipient possesses potential of giving back a positive outcome.

2.5.2.4 Self Efficacy

Bandura (1997) described self efficacy as a people's judgments of their capabilities to organize and execute courses of action. It not based on the skills one possess but with judgments of what one can do with whatever skills one possesses. Elias et al. (2010) conducted a study on self efficacy and added that it influences individuals' adjustment behavior.

This shows that an individual's behavior of sharing his or her knowledge may be influenced by his or her self efficacy. Figure 2.3 below shows the conceptual framework of this knowledge sharing concepts as follows:

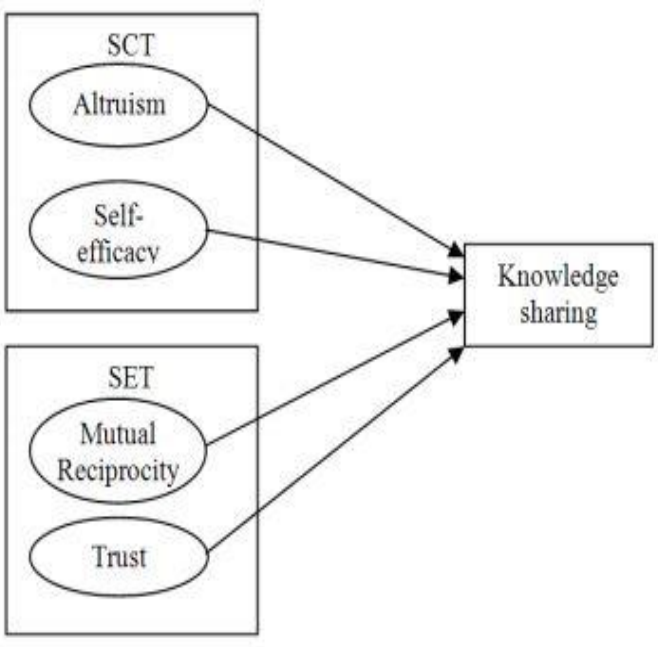


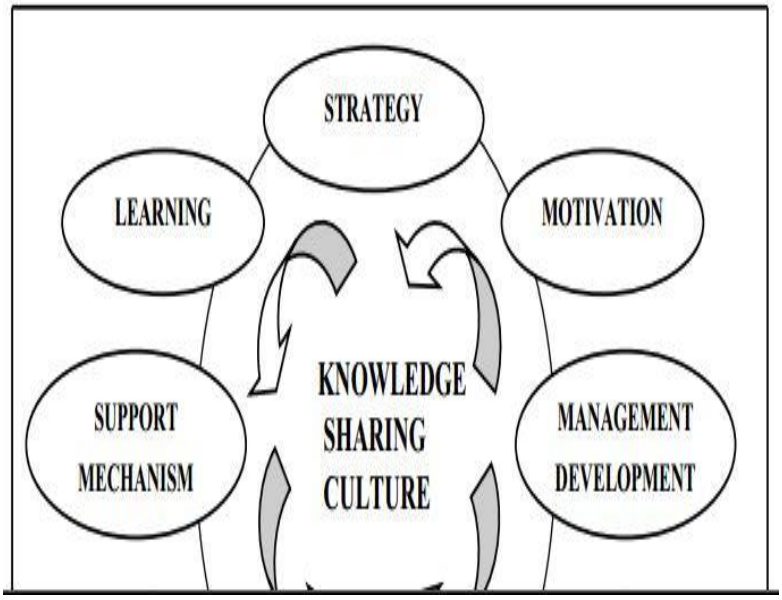
Figure 2.3: Knowledge sharing framework.

2.6 Knowledge Sharing Culture

Stoddart (2001) stated that for knowledge sharing to work, organizations first have to have a culture that open and accept sharing and he further argue that knowledge sharing can only work if the culture of the Organization promotes it. De Long

et al. (2000) conducted a study which they showed that culture influence knowledge sharing by as much as 80%. To effectively develop organization knowledge sharing culture, there must be need to change the culture of the organization strategy, structure, support mechanism, management development, communication, trust, motivation and learning.

These approaches are all based on the fundamental premise that it is the responsibility of the management to play an important part in motivating her employees toward a knowledge sharing culture.



Source: Lisa Low (2010). [14]

Figure 2.4: factors that facilitate the development of Knowledge Sharing

2.6.1 Strategy

Scarbrough (1998) remarked that the most valuable employee is one who becomes a source of knowledge and actively shares that knowledge with other people. In this context, arguably, one of the most important items for the effective sharing of knowledge is a clear and conscious knowledge strategy. In some organizations they adopt the codification strategy which is central on the computer. Knowledge is carefully codified and stored in the databases, where it can be accessed and used easily by anyone in the organization.

In other organizations, knowledge is built around an individual who developed it and is shared mainly through direct person to person contacts. Hassan et al (2001) stated that the primary reason of using the computers in organizations is to help people communicate knowledge not to store it; which is known as personalization strategy. Scarbrough (1998) and Gross (2001) show that involvement of managers in knowledge sharing is important in the sense that a leader is usually viewed as a charismatic person who is prepared to take risks and brings about long term changes in people attitudes, behaviors and culture (Adair, 1988). Leadership plays an obvious role to the managerial skills in developing organization knowledge sharing culture.

2.6.2 Structure

The knowledge infrastructure is an important part of organizational structure. Knowledge Infrastructure is the sum of those organizational structures and guidelines, as well as technical and non-technical employees, of which the organization has in their disposal. These structures, guidelines and expertise support learning process within the organization. Gareth (2004) maintained that with these infrastructures organizations goals are reached in the most efficient way.

Organization structure and processes should be designed in ways that will foster and encourages knowledge sharing among the employees through teamwork. Organization structure is way of fostering the constant growth of employees or individuals in an organization to make their knowledge, their information, their capacities and their attitude productive. It is widely acknowledge that increased employees responsibility leads to increased quality.

2.6.3 Support Mechanism

Information technology (IT) has been closely associated to knowledge management and knowledge sharing. The reason is stated by McCampbell et al. (1999) that IT provides platform not only for storage and access of information but also for communication. Therefore to actualize the concept of knowledge sharing culture, organization should put emphasize on their IT infrastructure and tools such as mail, telephone, facsimile, Internet, Intranet, e-mail with pictures reference, video conferencing, and telephone conferencing.

Smith (2001) argues that the availability of information technology tools (software) play important roles in knowledge management. It is imperative that the application of project management software, software for technical estimation and CAD software are useful for construction organization learning and sharing efforts. Egan (1998) stated that the construction industry involves several disciplines with a complex network of communications between these disciplines.

Similarly, the entire construction supply chain demands a supporting document management system to communicate, capture and record the information. The application of decision support system and standardized IT solution are therefore beneficial in distributing knowledge within the industry. Shattow (1996) concluded that information technology is obviously a supportive mechanism and an important resource for successful innovation.

2.6.4 Management Development

Fisher (1989) stated that the involvement of many organizations in a particular project provides a strong basis for conflicts during the construction process, partly due to domain of consensus, accessibility of information, interdependency of tasks, and individual performance. Mumford, et al. (1997) added that tolerance of conflict and the handling of conflicts constructively are values that support creative and innovative behavior in organizations.

The way in which an organization handled mistakes and promote safety standard will determine if their employees feel free to act creatively and innovatively in their knowledge sharing effort. Brodtrick (1997) noted that mistakes can be ignored, covered up, used to punish someone or perceived as a learning opportunity and he added that if staffs are encourage discussing their mistakes openly and seek help, it can promote a knowledge sharing and learning culture.

2.6.5 Communication

Communications can be described as a process by which information is exchanged between individuals through a common system of symbols, signs, or behavior. By developing more effective communication networks, organizations strive to create more willing and effective coordination of diverse activities.

In a study conducted by Watson Wyatt Worldwide (1998) it noted that poor communication was found to be the reason for a generally low level of trust between managers and employees in most organizations.

2.6.6 Trust

Geoffrey (1997) noted that without high trust, organizations will not fully exploit their potential assets and that no knowledge management strategy will succeed, unless organizations care about the knowledge that exists within their organizations and have their employees at heart; only then will knowledge sharing culture thieve.

2.6.7 Motivation

Robbins (1993) saw motivation as the “willingness to exert high levels of effort toward organizational goals by a way of recognizing the efforts of and satisfying her employees. The way a company rewards its employees contributes heavily to their satisfaction and retention. This is because individuals understand that in exchange for their effort and commitment, the organization will develop them and reward them for their work. And this is an important way of attracting, retaining and tapping knowledge workers as stated by Ching and Yang (2000).

2.6.8 Learning

Trevor (1992) stated that learning is being able to use information that is remembered through understanding its relevance to people experience. People are motivated to learn when they recognize that they can benefit personally from the learning.

Learning is very important to people who want to develop their skills. Senge (1990) has defined organization learning as the process through which managers seek to improve organization members’ desire and ability to understand and manage the organization and its environment so that they make decisions that will profit the organization.

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2.7 Summary

In essence Knowledge Management is in essence an organizing principle which lays the foundation for capturing the potentials of possessed knowledge within an organization. To make the most of the organizations recourses and enhance knowledge sharing, it is important to acknowledge that it is about managing both technology and people in order to provide a profitable knowledge environment. Knowledge sharing tools aim to do something useful by structuring people, information technology and knowledge content.

One challenging issue with organizations in procurement policies and procedures is the way they should expand their knowledge to enable them to deliver commendable services and promote knowledge sharing for the growth of the industry, benefits of the stakeholders, and also the community or society where the construction projects are developed and completed.

3. PLANNING AND SCHEDULING OF CONSTRUCTION PROJECTS

3.0 Introduction

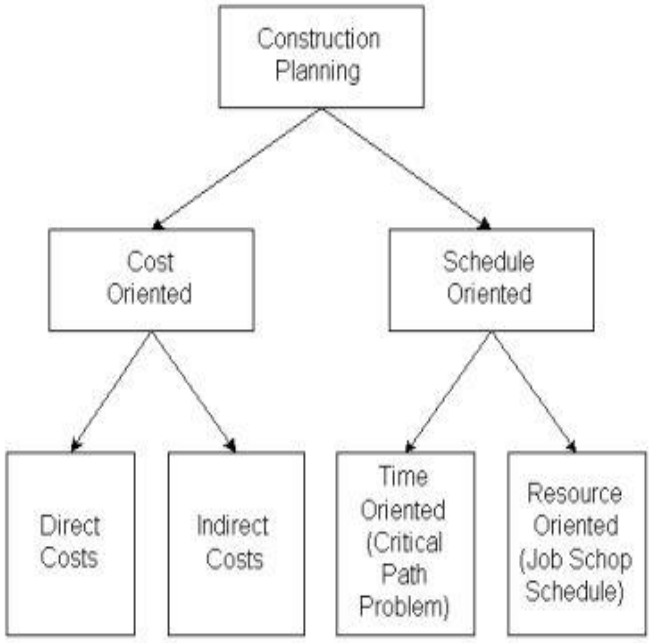
This chapter covers the introductory planning and scheduling in construction industry, the traditional methods that are being applied, the barriers affecting in the preparation of planning and scheduling of projects in the construction industry and the application of knowledge management as a new movement to improving best practice results for the industry and society as well.

3.1 Construction Planning and Scheduling

Hendrickson (1998) stated that construction planning and scheduling can follow two simultaneous paths that are described and summarized in Figure 3.1. The two paths are:

a) Cost -orientation: This involves direct and indirect cost control.

b) Scheduling-orientation: This involves time management and resource consumption definition.



Source: Hendrick (1998). [12]

Figure 3.1: Alternative emphasis in construction planning (Hendrickson 1998)

Construction scheduling is rooted in construction planning. It deals with more specific factors such as maintenance of task precedence (resulting in *critical path scheduling procedures*), or efficient use of resources over time (resulting in *job shop scheduling procedures*). However in most complex projects, cost-oriented and scheduling-oriented planning are considered.

3.2 Definitions of Construction Planning and Scheduling

For the past 30 years or so much of the construction work have been carried out based on planning which falls mainly into the category of what is called as classical planning paradigm. If we critically look into may literatures on construction industry, project management or any other industry one can find that at least one chapter is talking about planning, as it is one key area of study.

However, not one of these literatures give a precise definition of planning, independently of the particular formalism of application. One can define a pure planning task by looking from the different viewpoints according to its applicability in the related fields.

Arikan, et al.(2004) described planning as trying to anticipate what will happen and devising ways of achieving the set of objectives and targets, he added that in planning concept there are always objectives to be reached in future. It is obvious that there an extensive research has been done on planning but researcher's views often seem to differ from one other.

Looking from the work of Arikan and his colleagues above, there are few conclusions that can be drawn, in alignment with the objectives of a construction project, as follows:

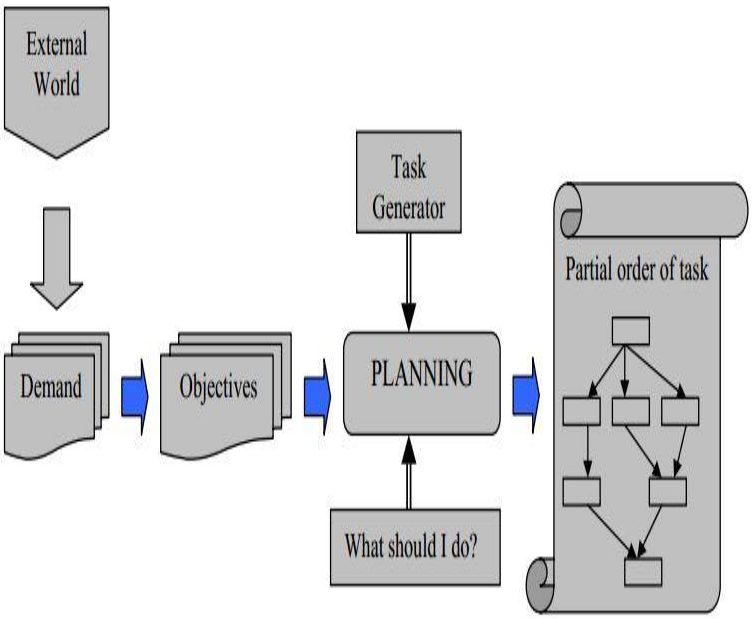
a) To complete the construction within the specified time (duration).

b) To complete it within the budget, (with a profit).

c) To complete it in compliance with technical and administrative specifications.

Mubarak (2005) states that project planning works for several functions such as: cost estimating, scheduling, project control, safety management, and others. Arikan et al. (2004) maintained that the main purpose of planning is to provide the primary duties of the manager, namely, direction and control. Secondly, they added that planning is to organize all the relationships and information systems among the many parties involved in the construction project. They finally added that the objective of planning is to enable project control and forecasting.

Smith (2002) emphasized the importance of careful and continuous project planning in the success of a realization of a project and he also added that the activities of engineers, designers, producers, suppliers, workers and contractors, and their resources must be integrated in line with the objectives of contractor. Oberlender (2000) concurred with Smith that planning coordinates all works of the construction to reach a completed quality project.



Source: Anonymous (www.google.com)

Figure 3.2: Overview of construction Planning

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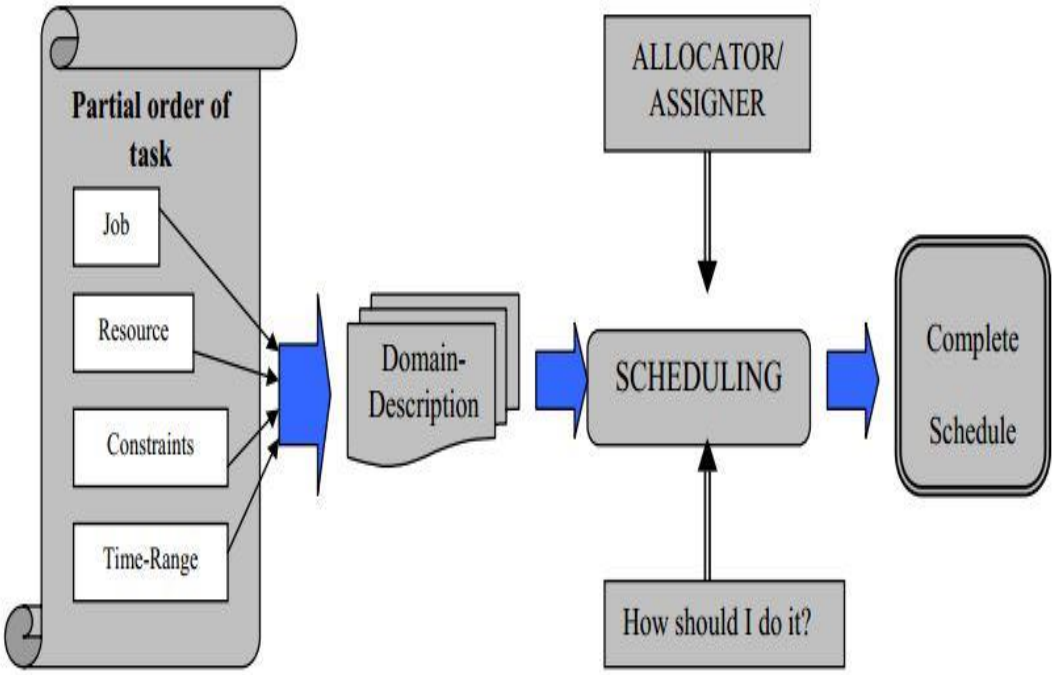
Mubarak (2005) asserted that scheduling concentrates on the timing and sequence of operations in the project planning process. The difference between Planning and Scheduling is that, project planning deals with issues such as what is going to be done, where, how and when? Project scheduling covers the issue of how it should be done. Trauner, et al. (2009) supported Mubarak's assertion and described project schedule as a written or graphical representation of the Contractor's plan for completing a construction project that emphasizes the elements of time and sequence. He further stated that the project schedule should display all the construction tasks from conception to finish of the project within the expected time and sequence in logical order.

The construction schedule is one of the most powerful management tools at the service of the construction manager. A properly planned and realistic schedule that takes into account as many variables as possible will aid in the smooth progress of a construction project, alert the construction manager when the project is about to run into unforeseen circumstances and help make needed adjustments. In order to keep the project running smoothly the plan must have some degree of ownership from everyone who will have to live by it. Else there would be risk of having employees and subcontractors who will not bring output.

Construction schedule is prepared by the scheduler or planner. On the process of preparing a schedule, the scheduler may meet with seek the intellect of experts such as estimator, manager, superintendent, sub-contractor, architect, engineer, owner, and materials' suppliers. These experts may need to study the contract, drawings, specification, and probably conduct site reconnaissance and they equally need to have ideas on manpower and productivity. Jon, et al. (2002) stated that it is imperative that a scheduling consultant in charge of construction projects strive to work develop a trusting relationship with the different participants to develop in order to work hand in hand to foster a plan and project schedule. Proper scheduling provides the best opportunity for a well coordinated and well-sequenced project to deliver on time and within budget. This is because a well-coordinated and well-sequenced project is some worth difficult to achieve and the task of scheduling is depicted in Figure 3.3 below.



Source:anonymous (www.google.com)

Figure 3.3: Overview of construction scheduling

As indicated above, it is obvious that construction project planning and scheduling are the key elements of a successful construction project management. Planning and scheduling are closely related to achieve good construction project management.

3.3 Benefits of Construction Work Schedule

The primary purpose of a construction scheduling is to outline the progress expected of a construction project in a timeline that is most efficient and cost effective as possible. This is done by various means which include:

a) The original conceptual plan can help determine the feasibility of the project and give an idea of the estimated cost of the project.

b) It serves as a reasonable, understandable document upon which contractors and subcontractors can make realistic bids on the project.

c) It makes binding agreements with subcontractors. When a subcontractor signs the agreed-upon construction schedule, they are committing to meeting its terms.

d) It gives the owner of the project a realistic timeline by which he can expect his project to be completed. It lays out the sequence of events and the process that will be followed by the construction Company and subcontractors, making it easier for him to monitor.

e) It serves as a map and scheduling tool for the project manager, who can use it to schedule work crews, time deliveries and equipment rentals and monitor the progress in case of needed changes.

f) It becomes a daily, weekly and monthly benchmark of the actual progress on the project as the construction subcontractors and crew leaders enter finished jobs and concerns.

g) It serves as a base plan for any changes that might have to be made due to unforeseen circumstances, unexpected delays (or completion ahead of schedule – it can happen!), or owner changes and additions.

h) When coupled with communication and project management software, it is an effective, efficient way to track progress, and flag trouble spots before they become critical.

i) It serves as documentation of work completed as the concerned parties sign off on agreed upon completion.

j) In the event of dispute or questions, it can serve as legal documentation of the actual history and events of the construction.

k) After project completion, it can serve as a guide in future projects through post-completion analysis.

3.4 Traditional Construction Planning and Scheduling Tool

According to Fox, et al. they noted that scheduling and planning did not receive serious attention as it is today not till 1980.The advantages to using a complete construction planning and scheduling technique include: immediate field updates such as realistic revisions, input from those actually completing the work and a stronger investment in completing the work according to schedule and on time.

The use of internet access onsite and within to the construction schedule and communication capabilities give the project leadership the tools they need to provide adequate construction supervision that is responsive and decisive. The most common traditional technique used is the Gantt or bar chart for smaller projects, but as the cost of the projects increases and becomes more demanding organizations tends to go for critical path technique or artificial intelligent based techniques.

3.4.1 Gantt Charts

Callahan, et al. (1992) defined bar charts as a collection of activities listed in a vertical column with time represented on a horizontal scale. Bar charts describe durations, start time and finish times of a particular project or activities in a chronological order.

Prior to Henry L. Gantt, planning and scheduling were undertaken without a formal procedure or method. Henry developed the Gant chart during World War I which is now commonly referred to as bar chart. This tool is more because of its simplicity, easy to prepare and has a clearly understandable format but they equally have limitations.

Wickwire, et al. (2003) gave a detailed list of disadvantages of the limitations of the tool which include:

a) Size limits a bar chart in what it can graphically present.

b) Bar charts do not show the interrelationships or interdependencies of one bar to another.

c) Bar charts do not show the available float or contingency time, nor can they show the delay impact of one bar on another.

d) Bar charts are not capable of accurately distributing or controlling manpower and project costs.

e) Adding more detail to the bar chart makes it harder to read, understand, and maintain.

Callahan, et al. (1992) finally added that bar charts cannot show the logical relationships among activities and that when there are continuous relationships between many activities, a bar chart becomes difficult to prepare schedule correctly.

3.4.2 Critical Path Method (CPM)

Between the years 1958 to 1961, the Critical Path Methods was developed by E.I. Du Pont de Nemours Company in conjunction with UNIVAC Applications Research Center of Remington Rand. This technique was first implemented in construction projects in 1961. However, in project management, the Critical Path Method (CPM) is a planning, scheduling and controlling tool which if properly implemented it will speed up the completion of projects on time.

Wickwire, et al. (2003) described CPM as a graphic representation of the planned sequence of activities that shows the relationship between elements used in a project. Before this technique was used it was introduced as planning as a planning tool which was later improved on with additional functions which appeared as proving delay claims and this function is as a result of CPM been capable of showing the picture of the project and changes.

3.4.3 Knowledge Management Method

As the construction industry continues to experience a change in paradigm to adopt new ways to improve competitiveness by adopting a proper scheduling and planning method which uses good practices, advanced construction techniques and optimize resource utilization. Egbu et al. (2002) emphasized the need of knowledge management which is about mobilizing the intangible assets of an organization, which are of greater significance in the context of organizational change than its tangible assets, such as Information Technology (IT). They further added that information technology (IT) should be understood less in its capacity to store explicit information and more in its potential to aid relationship among individuals.

The systematic capture and coordination of knowledge makes it easier to share and re-use knowledge so that it can be create cordial relationship among its employees. Egbu at al.(2005) stated that without doubt knowledge management improve competitiveness in the process of planning and scheduling if awareness is created within the organization. He identified various potential benefits of KM as follows:

3.4.4 Neural Network technique

Neural Network (NN) methods are traditionally used for forecasting, classification, pattern recognition and data mining and very small number of applicability have been found in the planning and scheduling processes. In planning and scheduling neural networks approach can be used for the purpose of optimizing the process. In normal cases it can be used for predictive scheduling as in the reactive scheduling because it quite sensitive to changing conditions. In cases when there are changes in the condition of scheduling and planning then neural network is necessary to be incorporated in the design to address the changing situation. In planning and scheduling neural network uses the following scheme for problem solving by decomposing the main problem which is:

a) Choose a variant for every job.

b) Choose a resource for every job.

c) Choose a time slot for jobs and resources.

3.4.5 Fuzzy-Logic Method

The fuzzy logic introduced Dr. Lofti Zadeh in the 1960 has been applied here to provides the possibility in order to cope with the incompleteness and dynamic behavior of scheduling and planning. Applying the different fuzzy sets, linguistic

variables and fuzzy rules (inferences engines), allows representation of the ambiguous formulated knowledge. The following types of information can be represented efficiently by using this artificial intelligent method.

a) Uncertain values for the scheduling parameters e.g. process time.

b) Vague specifications of preferences, e.g. preferences between various kinds of alternatives.

c) Uncertain definition of the due date and durations of the jobs etc

The following steps are carried out when representing imprecise information.

a) First the scheduling data is transformed into a knowledge representation for the fuzzification. The uncertain knowledge is represented by the linguistic variables such as, very low, low, high, very high etc.

b) The actual processing is done based on the fuzzy scheduling knowledge by using the rules along with the integration of fuzzy arithmetic. These are stored in the knowledge base of fuzzy controller.

c) Final step is transforming the fuzzy scheduling decisions into the crisp scheduling data for determining the concrete knowledge

3.5 Responsibility for Schedule Preparation

In order to meet the requirements of a particular construction plan there must be an agreement of the owner, construction manager, sub-contractors and designers. From the above reason it is important that the owner or construction manager to have the support of every major player in the project during the design stages of the construction schedule. During the early stages of the bidding process it pays to be open to suggestions and communication. Because better communication allows the plan to be refined based on the experience and capabilities of those who have tackled similar work in the past.

This kind of communication creates the free will for every subcontractor who makes a successful bid has a realistic stake in the project because they feel they helped define the tasks and timetable. Without proper communication updating the planning and schedule regularly becomes a time wasting effort in their minds.

3.5.1 The Clients / Owners

These people fund the construction project and own the completed facilities. The owner is assisted by consultants who, in turn, specify the scope of the construction project. In some cases the owners tend to specify the detailed layout of the facility, the type of materials to be used and all that.

The owner is assisted by some of the parties described below. And, depending on the technical expertise of his or her own staff, he or she may inspect the project work from conception to completion. The golden rule in the construction process is "He who has the gold makes the rules." As the owner controls the purse strings, he or she dictates the kind of contract that will be used and selects the other parties to the project.

3.5.2 The Construction Manager

This person is employed by the owner with result of his experience in an organization to perform predesigned planning, to help select the designer, to help select contractors, and to perform post-contract award functions which he is paid for.

When an owner contracts the services of a construction manager as his agent, the construction manager is primarily responsible for the overall planning and scheduling of the project. The construction manager may prepare an overall detailed master schedule for the project.

3.5.3 The Designers

They may be the employees of an architect or engineering organization. They design to satisfy the need of the owner utilizing all building standards and codes necessary. The designer may be retained by the owner to act as his or her representative in inspecting the project work, to review and approve materials that the contractor proposes to use in the work, to review and recommend contractor requests for progress payments, and to perform other functions on behalf of the owner.

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3.5.4 The Contractor and Sub-contractors

These are individuals or firms that are responsible for performing construction work for an owner in return for a contract fee. Contractors may fall into the category of prime contractors and subcontractors. Prime contractors have a contractual relationship with the owner while subcontractors have a contractual relationship with the prime contractor or with another subcontractor.

General contractors are prime contractors who contract to perform ail of the required work, possibly excluding some specialty items such as electrical and mechanical work that the owners desire to contract directly with the specialty contractors. The contractor or subcontractor has a certain task to perform, either personally or by use of his staff such function as home office or field functions.

3.5.5 The Design-Build Firm

The term is usually reserved for organizations that perform both design and construction functions, but such an organization may also perform planning functions.

3.6 Sources of Planning Work Schedule

There are many methods employed in project planning and scheduling. Traditionally, planning and scheduling used to take the table form which comprises from a date list, starting or completed information, which are provided by the management. Regardless of the methods adopted, the decisions made will require the collection of data on materials, machineries, equipments, manpower, finance and time which are explained briefly below.

3.6.1 Construction Materials

In the process of planning and scheduling, the measurement of quantities by the quantity surveyors from building plans and specifications can be summarized to determine the particular quantity and types of materials that is needed for a construction project. The material availability should be obtained from experience material suppliers.

3.6.2 Machineries and Equipments

For safety procedures to be adequately adhered to, the machineries and equipment which are needed in a construction project will depend on the appropriate type and the method of scheduling and planning required. The delivery time must be made available after the machinery or equipment has been selected such as cranes, cement mixers, steel bar cutter and steel bar, bending machines for structural works are required during the execution of the work scheduling. This process is necessary to prevent machineries from staying idle, which may increase cost.

3.6.3 Labor and Manpower

Labor and manpower are valuable assets in construction projects. Without labor, a project can become abandoned and the contract may be terminated by the contractor. However, labor should be taken into account during planning and scheduling in order to ensure the participation of the labor which is include skilled work force is utilized to the maximum level.

3.6.4 Finance

The allocation of finance must be properly utilized for the cost of the supply of construction materials, labor and machineries. In the case of financial difficulties it must be resolved to ensure that the construction project can be carried out smoothly.

3.6.5 Time

Time is the most important element which must be carefully monitored and taken into consideration on the process of planning and scheduling. The owners will normally check for starting dates, completed dates during the contract submissions by the contractors.

The time require for the construction materials to be delivered to site should be monitored and must be on time on a specified schedule date. This will reduce wastage, cost and fulfill workers demand. A proper understanding of the project requirements will enable a more effective and efficient materials handling at site.

3.7 Summary

With the aid of new technological advances today, it is possible to allow everything from instant communication to actual web camera supervision of the job site. The ability to update and make changes as soon as new information is available reduces delays and allows everyone to make the best use of their time. To take full advantage of the capabilities of construction schedule and project planning methods knowledge management can be adopted to foster a team attitude that encourages everyone to get fully involved to take ownership of the plan.

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