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Prospects of Collaborative Knowledge Management (CKM) In A Knowledge Based Economy: A Focus On Construction Firm

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----------ABSTRACT----------

Over the last decades, construction firms in Nigeria and globally have been forced to re-think its operations and reconsider its human capital, as thedrive towards project delivery is greatly dependent on the cohesive power of the human capital as well as the smart application of Information and communication systems. This research seeks to assess the prospects of Collaborative Knowledge Management (CKM) of construction firmin a knowledge-based economy, with the view to encouraging its application. The research is an investigative study, in which a quantitative research method was used. A purposive sampling techniquethat considered large building construction firms and captured in its management structure, the responsibilities of the key knowledge professionals at unit and departmental levels was used. These knowledge professionals were identified as Architects, Quantity Surveyors, Land Surveyors, Builders and Engineers, who are unit/departmental heads. Twenty eight (28) firms involving the five (5) knowledge professionals in each firm participated in the research, giving 140 respondents. The Cronbach's coefficient alpha was used to check the internal consistency of the data, hence ascertaining the reliability of the instrument (above 0.8), while the content validity was conducted to ascertain the relevance of the research questions as well as the tools. The Kruskal-Wallis test, which is the nonparametric equivalent of a one-way ANOVA, was used for testing whether samples originate from the same distribution. The research identified twelve (12) prospective benefits in the application of CKM as: Information Integrity, Ease of access, Information Availability, Information Organization and Structure, Information Confidentiality and Hierarchy, Information Security and Contingency Planning, Process Knowledge Integration, Organizational Knowledge Transfer, Response Time, Organizational Experience Consolidation and Management, Organizational Experience Consolidation and Management, New Knowledge Generation and Innovation.Theresearch concludes that the prospects for collaborative knowledge management cannot be over emphasized, as the drive towards project delivery is not a one man's responsibility. The twelve Prospective benefit of the application of CKM to which the different professional groups had high significant level of agreement. However, the most significant Prospects was identified as Information Confidentiality and Hierarchy, this also spelling out the fact that the security and authenticity of the information is necessary for CKM. To encourage the adoption and use of CKM, it is important for the construction firms to consider these Prospects, with emphasis on the security and authenticity of the information, this might require the establishment of relevant passcode, transparency and possibly the use of block chain technology as a full proof system in considering its implementation and management.

Keywords*: Collaboration, Knowledge Management (KM), Construction, Web-Based Tool, Firms*

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I. INTRODUCTION

The driving forces of industrial revolutions have been based on skills, data, information, Knowledge and other factors. Knowledge has been viewed as the internalization of information or the collection of a group of information in a specific area. The information age as we knew it has given birth to a knowledge age.In a knowledge-based economy, construction firms has realised that the biggest asset it possess is knowledge and experience associated with its human capital (Kamara, Augenbroe, Anumba, Carrillo, 2002). The increasing pressure of cost and time reduction, delivering better projects and fighting ever-increasing environmental challenges has made the effective use of intellectual capital even more important. Construction firms embark on projects that are interdisciplinary and multi-agent in behavioural processes, which continue to access, create

knowledge, and apply it to practical work to realize the value of knowledge. Most construction projects are unique and fast moving, so work organizations are rather dynamic, as they must be restructured repeatedly with different professionals, management, materials, equipment, and crews (Sauer, Liu and Johnston, 2001). Traditional pattern of construction projects lead to the fragmentation, which made communication an obstacle among all the professionals (Xin and Jiming, 2010). In the recent times, construction projects have turned into a more complicated, dynamic and interactive scenario. Construction firms are constantly required to speed-up reflective decision-makings on time. With this growing complexity comes an increasing need to understand how disciplines relate to each other especially with the increased intricacy of projects there is a growing need for collaboration (Bhatla & Leite, 2012; Dvir et al., 2003; Eastman et al., 2011). Knowledge therefore is noted to be one of the most important resources contributing towards managerial decision-making and enhancing the competitive advantage of construction firms in carrying out such projects (Carrillo, 2004 and Nonoka, & Takeuchi, 1995, Almahmoud and Doloi, 2013).

Collaboration on the other hand represents a strategic alternative to the monolithic approach to business development and competition. It involves a different approach to business – focused on managing business relationships between people, within or without groups, and within and between organizations. In the present global economy, strongly influenced by IT (information technology) and information systems evolution, the modern organizations try to face the challenges by adjusting their strategies and restructuring their activities, for aligning them to the new economy requirements. It is certain, that the enterprise's performance will depend on the capacity to sustain collaborative work. It is obvious that, all collaborative environments (workgroups, practice communities, collaborative enterprises) are based on knowledge, and between collaboration and knowledge management (KM) there is a strong interdependence.

Collaboration may be seen as the combination of communication, coordination and cooperation at the total life cycle of construction project (Xin and Jiming, 2010). Communication is related to the exchange of messages and information among people, coordination is related to the management of people their activities and resources, and cooperation is related to the production-taking place on a shared space. Collaboration technology typically focuses on collaboration and group processes (cooperation, communication, coordination and coproduction). Knowledge Management (KM) technology typically focuses on content (creation, storage, sharing and use of data, information and knowledge). Yet, to achieve their common goals, teams and organizations need both KM and collaboration technology to make that more effective and efficient. Therefore collaborative knowledge management (CKM) is considered as a process of collective resolution of problems where it is useful to memorize the process of making collective decision and to structure the group interactions to facilitate problem solving and sharing of ideas (Lewkowicz, 2000). Understanding that collaborative knowledge management deals with the management of both organisational and personal knowledge, there is the need to harness this potential. Wasko and Faraj (2000) suggest that knowledge is a private property that is exchanged in the expectation of a commensurable return. Hall (2003) also argues that knowledge is a private commodity and it is up to the owner to decide whether to share it or not. To entice people to share their knowledge as part of a social exchange transaction, they need to be persuaded it is worth doing so.

Over the last century, the view on the design and implementation of collaborative solutions has shifted from a more technology driven perspective in general to a more sociotechnical perspective used at the turn of the last century (Dix, 2017). This shift moves the focus from the technology to the people and the organizational context in which the technology is implemented in and as such moves towards a more holistic perspective. The sociotechnical system approach focuses on describing and documenting the possible as well as the actual impact of the introduction of a specific tool/system/technology in an organization (Johannesson & Perjons, 2014; Sackey et al., 2014). This kind of documentation also helps analysing the difficulties that are faced when implementing the tool/system/technology. As communication and collaboration are inherently social activities common in construction and as such become part of a sociotechnical system (Sackey et al., 2014), this becomes important in the development of tool/system/technology supporting these actions. Chien et al. (2014) identified a number of challenges in construction when implementing new tool/system/technology, ranging from financial, management related and personnel related to technical risk factors (Chien et al., 2014). These factors can manifest themselves in expectations from the personnel to challenges in compatibility of the tool/system/technology concerning current ways of working (Davies & Harty, 2013). The success of implementations of tool/system/technology in construction has mainly been research from a tool/system/technology push view (Hartmann et al., 2012; Xue et al., 2012). tool/system/technology push is defined as the development of new tool/system/technology that offers a business process change from a tool/system/technology perspective in contrast to a demand pull where demand drives the development (Chidamber & Kon, 1994; Hartmann et al., 2012) The sociotechnical system view helps consider not just the implementation of the technology tool/system/technology, but the environment that creates the context for the implementation as well, which is the management of construction firms (Arayici et al., 2011).

II. LITERATURE REVIEW

Classification of Construction Firms in Nigeria

Several criteria exist in the classification of firms such as labour size, annual turnover, net worth, working capital, project size etc. However, according to Onugu (2005) and Global (2010), firms in Nigeria are majorly classified into four major categories based on the combination of the afore mentioned parameters as seen below:

Micro firms: A firm, whose total cost including working capital but excluding cost of land is not more than ten million Naira (N10,000,000) and/or with a labour size of not more than thirty (30) full-time workers and/or a turnover of less than two million Naira (N2,000,000) only.

Small firms: An enterprise whose total cost including working capital but excluding cost of land is between ten million Naira (N10,000,000) and one hundred million Naira (N100,000,000) and/or a workforce between eleven (11) and seventy (70) full-time staff and/or with a turnover of not more than ten million Naira (N10,000,000) in a year.

Medium firms: A company with total cost including working capital but excluding cost of land of more than one hundred million Naira (N100, 000,000) but less than three hundred million Naira (N300, 000,000) and/or a staff strength of between seventy-one (71) and two hundred (200) full-time workers and/or with an annual turnover of not more than twenty million Naira (N20, 000,000) only.

Large firms: According to AbdulAzeez (2012), any enterprise whose total cost including working capital but excluding cost of land is above three hundred million Naira (N300,000,000) and/or a labour force of over two hundred (200) workers and/or an annual turnover of more than twenty million Naira (N20, 000,000) only.

Knowledge Management in Construction

There are two categories requiring KM in the construction industry: at inter-organisational level, within projects, across temporary, multi-discipline project organisations; and at intraorganisational level, within individual firms (Kamara et al. 2002). Even within organisations, the project-based, short-term and task-oriented nature of construction work inhibits learning on a continuous basis (Egbu and Botterill, 2002). It is recognised that construction organisations have been managing knowledge informally for years, but that the challenges facing the industry "mean that most organisations now need a more structured, coherent approach to KM (Hari et al. 2004)." In a study of Carillion, a leading UK construction company, Jewell and Walker (2005) found the main business driver for KM to be the "very nature of the modern construction industry – being highly competitive, high risk, with low margins. To succeed in this environment, a business has to be sharper, more efficient, and consistently using its knowledge assets to 'get it right first time' and avoid repeating mistakes." Kamara et al. (2002) identified processes for managing knowledge in construction as; reliance on accumulation of individual knowledge; long-standing agreements with suppliers; post project reviews to capture lessons learned; transfer of people in different activities; formal and informal feedback; informal networks and collaboration; reliance on departmental\divisional heads to disseminate knowledge and the use of ICT tools to support information sharing and communication In a survey of large UK construction organisations, it was found that a requirement to share tacit knowledge and disseminate best practice were key drivers of KM and a lack of time and standard work processes within organisations as the main barriers to KM (Carrillo et al., 2004). Other identified barriers to KM include lack of management support, employee resistance to sharing knowledge, poor ICT infrastructure, lack of dedicated resources, poor organisational culture, poorly articulated strategy, and difficulty in evaluating benefits (Robinson et al., 2005; Dainty et al., 2005). In considering KM within organisations, Nonaka and Takeuchi (1995) discuss four ontological levels of knowledge creation, individual, group, organisational and inter-organisational. In a similar vein, Jashapara (2004) discusses how learning occurs at individual, team and organisational levels, the human dimension being central to these.

Individual Knowledge

Knowledge workers should be self-starters, continually striving for creative solutions and building on their educational qualifications and experience repertoire and must be sufficiently motivated to seek out opportunities and design their own work, often with little direction (Storey, 2005). Motivating individuals to learn and share knowledge can be particularly difficult in pressurised environments such as construction where time for reflection is limited (Jashapara, 2004). Storey (2005) discusses knowledge workers in the context of training, empowering, and rewarding them, and more specifically the role of HR in facilitating the use of available knowledge and encouraging people to learn. Training and development is considered an important aspect of KM by Olomolaiye and Egbu (2004) who cite the need to equip employees with the skills to manage their own learning and development and the development of an effective CPD plan. They also propose that awareness of KM can be improved by using training as a vehicle to focus on achieving quality, creativity, leadership and problem solving. Participation in continuing education, conferences and similar CPD activities can allow employees the opportunity to "reflect upon their work, trade stories and ideas with co-workers, or catch up on professional theory and practice (Grisham and Walker, 2005: 554)."

Project Knowledge

Every day on construction projects, new problems are encountered and solutions arrived at which are rarely documented, the lessons learned residing only with those individuals directly involved in the problem-solving process (Kazi et al., 2005). By capturing and sharing project knowledge, the amount of reinventing the wheel and waste can be reduced, whilst improving project performance. Traditional methods for capturing lessons learned include discussion and informal meetings followed by their documentation (Mohamed and Anumba, 2005). In a case study of a Finnish construction organisation, Kazi et al. (2005) identified a number of social processes for sharing project knowledge such as site visits, audits, and meetings.

Organisational Knowledge

In attempting to manage knowledge within construction organisations, there are three key types requiring consideration; product (technical knowledge), process (procedural and regulatory knowledge) and people (identifying people with specific skills and experiences) (Egbu and Robinson, 2005, Kamara et al., 2002). Practices for the sharing of such knowledge are identified in Table 1, many of which dovetail with HRM activities (Dainty et al, 2005).

Web-Based Tool in Collaborative Knowledge Management in Construction

Ghani, (2009) identified that a new group of web-based information management tools has emerged based on freeform social software that enhances individual knowledge work, group communication, and collaboration. Information management tools for knowledge work and communication are not new. The new tools open up one-to-one and group communication to be viewed by many users if not the public. They differ fundamentally from the old suite of tools in that they are based on user participation and are mostly characterised by participatory services, where users create content. They usually allow users to manage and modify their own data within a given system²information that is usually made public for others benefit. Thus the services get better the more people use them. Organisation or knowledge is drawn out of user actions like tagging or visiting sites. But by far the most dominant characteristic is that of participation. Participation is built into the actual architecture of the tool or service offering (Vizcaino, 2007).

Web 2.0

Web 2.0 is also (perhaps most) often described as a group of people-driven tools that allow collaboration. These include blogs, tags, mash-ups and, wikis (Ghani, 2009).

Blog

According to Ghani, (2009), Blogs are most commonly used as an online version of a personal journal. Essentially, a blog is simply a web page that contains periodic, chronological ordered posts, additionally grouped by categories. Users visiting the blog can often add comments to posts. Administering a blog (updating it by adding new posts, creating links to other web pages, adding pictures, categorising posts, etc.) is extremely simple.

Setting up a blog can be more complicated but keeping it updated and posting end-user comments to it is very easy. User settings are typically highly configurable. Because of the emphasis on reverse chronological posting, blogs are often characterised as promoting form over content. Blogs are most commonly used as an online daily journal or personal KM tool. For example, teenagers may post photos, poetry, game scores and other content to share with their friends. Others have used it as a log file, to record chronological data like system updates.

Tags

Tagging is essentially a form of social book marking. It allows users to tag or categorise web pages with words they create. When tagging a particular page, one can see words others have used to categorise the page, thereby synchronising our own categories with others to create an overall order. We can also see how many others have tagged the same page, any notes they wrote about that page, what other pages they have tagged, add them to a network of contacts and contact them. Tagging is also present in services like Flickr, YouTube and Yahoos MyWeb. Tagging is a way to let structure emerge (Ghani, 2009).

Wiki

A wiki is fundamentally a web of interlinked pages where each page typically contains a concept (a name) and a description of that concept (an article). Users are allowed to edit any part of the article, modify the description, add new names, add external links and add links to names (and their corresponding articles) that do not exist yet (so that another user can fill in the description of the new concept) (Ghani, 2009).

WhatsApp

According to Mohd and Mohd (2018), due from the pressure of globalisation, it is necessary to construction industry adopted virtual communication into project team's practices in order to overcome the challenges of contemporary business environment. Even though virtual communication have been identified bring more opportunity in business environment. Supported by advance in electronic information and communication technology such as WhatsApp tool becoming mainstream application into global businesses and also making people lives close virtually and remote physically at the same time. Nowadays, WhatsApp tool also change the way project teams communicate, rather than face to face interaction. Previous study mention that WhatsApp as valuable for project management (Priyono, 2016). As well as the growing interest by practitioners in potential benefit of WhatsApp in the workplace remains controversial. For instance, the application are able to share an images, video, audio, text massage, and variety of documentation file belong to project team members (WhatsApp, 2017). The concept of WhatsApp is founded on the idea of open communication, which breaks the boundaries of traditional communication. Furthermore, it also shifts people relationship among individuals and groups in business process and human life management. The application gains the reputation too enhance productivity and increasing disturbance. Further, yet despite the potential advantages of WhatsApp for projects, these applications are rarely used.

Table 1: IT Tools commonly associated with collaborative knowledge management

Technology	Description/examples
AI technology	Expert systems, learning systems.
Communication and collaboration systems group	E-mail, teleconference, video conference, chat, IM, forum, Listserv, groupware calendar, log, shared information spaces workflow management system, group decision support system.
Documents management system	Management of electronic documents, a system to search, edit, distribute, retrieve, archive and otherwise mange the complete lifecycle of documents
Content management system	Management of electronic content including multimedia files.
Intranet	A network contained within the enterprise. It is used to share information and computing resources among employee as well as to facilitate group working.
Search engine	Tool that searches the contents of a web.
Learning system	Distance learning, e-learning and computer-based training.
Knowledge mapping tools	Any resource that locates people by their knowledge; human resources skill set inventory system.

Source: Ghani (2009)

Prospects of Collaborative Knowledge Management

Although technology has an important role to play, experts have argued that knowledge management cannot be implemented using technology alone, Anumba et.al. (2003), Davenport and Lawrence (1998), and Ruikar et.al. (2007) very effectively pointed out that IT alone cannot take form of knowledge management on its own, it is the way IT has been implemented to support knowledge management that is important. It has also been argued that non IT knowledge management solutions can also be quite effective within organizations. Al Ghassani (2002) criticizes knowledge management technologies for using expensive IT infrastructure which is difficult to implement and has an increased emphasis on explicit knowledge. In fact, research has shown that information management tools, such as emails, intranet, extranet and document management systems may have negative impact on organisation's knowledge management capabilities. This is due to the fact that such tools cause information overload due to unorganised and ad-hoc information exchange.

McAfee (2006) divides information technologies used by knowledge workers for communication in two categories; channels, and platforms. Emails, direct messaging, document management system, etc where information is created by anyone and degree of commonality is low, are called channels, whereas intranet, extranet and information portals are called platforms. In platforms, a selected group of individuals, which is approved and then made widely available, generates the content. Here the production is controlled and centralised and the degree of commonality is high. Davenport (2005) has argued that knowledge workers are not happy with channels or platforms currently available to them, some even feeling that their productivity actually diminishes due to the ineffectiveness of the solutions available. The type of tools most usable for collaborative work are knowledge repositories and collaboration aids, however their use remains voluntary.

Even though researchers have discussed the limitations of ICT widely, one must not take an entirely negative view of what ICT has to offer within the context of knowledge management. Majority of the problems associated with ICT seems to be around how it is implemented and managed rather than what the technology has to offer, however According to Dave and Koskela (2009) collaborative knowledge management a better management of these technologies by their utilization.

The following shows the Prospects of Collaborative Knowledge Management among professionals based on a certain framework(Dave & Koskela 2009 and Castellón & Gutiérrez 2013).

Table 2: Prospects of the Collaborative Knowledge Management Framework

Prospects	Characteristics
Information Integrity	Defined as the property, which seeks to maintain data free of unauthorized modifications.
Ease of access	This is a key characteristic since the main objective is to be able to obtain the relevant information, for the situation at hand, in the easiest possible way.
Information Availability	The system must be operating continuously with up-to-date information, which will be reachable when it is needed.
Information Organization and Structure	The system deals with information, gained from experience, which in many cases is unstructured. For that information to be useful it is essential that it is organized and structured otherwise there is a clear risk of missing on relevant information at the time of consultation.
Information Confidentiality and Hierarchy	Confidentiality as the property that prevents access from unauthorized users or systems and hierarchy so that access rights can be organized according to the level required by authenticated users.
Information Security and Contingency Planning	Security policies, which determine authorized use of the information and contingency planning to assure service continuity, including backups and hot/warm alternate sites, in case of temporal or permanent loss of information.
Process Knowledge Integration	This characteristic is directly linked to the system´s objective, which is to generate knowledge, in that way support decision-making, and support the creation of new ideas to help maintain the competitiveness of the organization. Therefore, the system must allow processes to have access to the information produced and reported by other processes thus learning from the experience gained while carrying out other, relevant activities, in the organization.
Organizational Knowledge Transfer	This characteristic aims to make the knowledge acquired easily assimilated by the organization´s users. For the users to accept, use, assimilate and be satisfied with the information it must be accessible in a user-friendly way but that is not enough. It is key that the same ease will be there for users to contribute to the system with information from the experience gained while participating in their own organizational processes.
Information Access Response Time	This characteristic seeks to reduce the knowledge base search time in order to make this resource an attractive source of decision-making knowledge.
Organizational Experience Consolidation and Management	Many information systems are capable of structuring and cataloguing information but often fail at consolidating ALL the information. For example: the tacit knowledge, gained from the experiences in the dayto-day operations and processes or projects completed by the organization. This results on teams repeating time after time the same steps without the benefit of experience due to the lack of consolidation of the knowledge acquired and thus resulting on a lack of awareness of relevant knowledge for a particular process and the inability to reconstruct that knowledge from fragmented data.
New Knowledge Generation and Innovation	The capability to produce new ideas and to put them into practice in order to strengthen the organization by generating new products and services and by optimizing the use of information resources with the ultimate goal of maintaining a competitive advantage

Source: Adapted from Dave & Koskela (2009) and Castellón & Gutiérrez (2013)

III. RESEARCH METHODOLOGY

According to Creswell (2003), Fellow and Lui (2015) research methods can be classified into two broad classifications (qualitative and quantitative). Hanson (2008), however, argues that these sociological approaches have converged. Certainly, one can be integrated within the other (e.g. Haynes et al., 2007) in order to strengthen research design (Patton, 1990). In qualitative research, an exploration of the subject is undertaken, sometimes without prior formulations – the object may be to gain understanding and collect information and data such that theories will emerge and so, tends to be exploratory. On the other hand the quantitative method approaches adopt 'scientific method' in which initial study of theory and literature yields precise aims and objectives with proposition (s) and hypotheses to be tested – conjecture and refutation may be adopted.

Data Collection Techniques

The primary data was obtained through field survey, using a structured questionnaire. According to Joshi Kale, Chandel& Pal (2015), the need to quantify the thing, which cannot be measured through conventional measurement techniques, has necessitated the transformation of an individual's subjectivity into an objective reality. Attitude, perceptions and opinions are such qualitative attributes amenable for quantitative transformation due to above mention reason. Qualitative research techniques do try to compensate, by depicting the complexity of human thoughts, feelings and outlooks through several social science techniques, still the quantification of these traits remains a requirement and that's how psychometric techniques come into picture. The Likert which gives definition to the psychometric techniques, is referred to as an "Evaluative continua" scales as proposed by Fowler, (2002), which are numerical or adjectival scales, where, multiple choice questions should ideally offer five to seven (5-7) response options, ranging from strongly disagree to strongly agree as the case might be. There are two (2) major constructional diversities of a Likert scale as the analytical treatment and interpretation with Likert scale largely depends upon these diversities.-Symmetric versus asymmetric Likert

scale- If the position of neutrality (neutral/don't know) lies exactly in between two extremes of strongly disagree (SD) to strongly agree (SA), it provides independence to a participant to choose any response in a balanced and symmetric way in either directions (Joshi and Pal, 2015). This construction is captured in the five (5) point likert scale as a symmetric scale, against the seven (7) and ten (10) point likert scale, which are considered asymmetric.

Population Size

The Population for the study are registered construction firms within the Federal Capital Territory (FCT), this is due to the large concentration of construction firms within the region. The presence of a large volume of construction activities, have driven most construction firms in the country to establish a branch within the FCT. The respondents are the knowledge workers/ in the construction industry such as Engineers, Quantity Surveyors, Architects, Land Surveyors and Builders in those companies, especially those who head a unit where firm policies and decisions are made, as they are expected to know how to respond to the questions being asked and identify most of the facts that lead to reliable conclusions. The population of construction firms were obtained from Corporate Affairs Commission (CAC) as 3,126 registered Construction companies in the FCT of Nigeria, and a further classification was conducted on the basis of the firm's size, specialization and most importantly the availability of unit/departments that captures the knowledge professionals.

Sample Size and Sampling Technique

The sampling is concerned with the selection of a subset of individual, from within a statistical population to estimate characteristic of the whole population. The objective of sampling is to provide a practical means of enabling the data collection and processing components of research to be carried out whilst ensuring that the sample provides a good representation of the population, Fellow and Lui (2015).

According to Priscilla (2005), determination of sample size depends on five factors:

1. Desired degree of precision
2. Statistical power required
3. Ability of the researcher to gain access to the study subjects
4. Degree to which the population can be stratified
5. Selection of the relevant units of analysis

The following are the classification of sampling techniques as identified by Charles and Fen (2007) as: Probability Sampling, Purposive Sampling, Convenience Sampling, Mixed Methods Sampling. The research

The research focused on the purposive sampling technique. The purposive sampling technique, also called judgment sampling, is the deliberate choice of a participant due to the qualities the participant possesses (Tongco, 2007).

The following are the classifications of purposive sampling techniques: Sampling to Achieve Representativeness or Comparability, Sampling Special or Unique Cases, Sequential Sampling, and Sampling Using Combinations of Purposive Techniques as identified by Charles and Fen (2007): Kuzel (1992), LeCompte and Preissle (1993), Miles and Huberman (1994), and Patton (2002). The research used the Multiple Purposive sampling Techniques, considering the following:

i. **Homogeneous Sampling**: The choice of a homogeneous population consisting of companies with departments/ units for the knowledge professionals such as Builders, quantity surveyors, Architects, Land surveyors and Engineers.

ii. **Reputational Case Sampling**: The firms involved are large construction firms with reputation

iii. **Revelatory Case Sampling**: the nature of the research is to reveal the true state of construction firms with respect to their readiness for the adoption of collaborative knowledge management as well as the need for a framework.

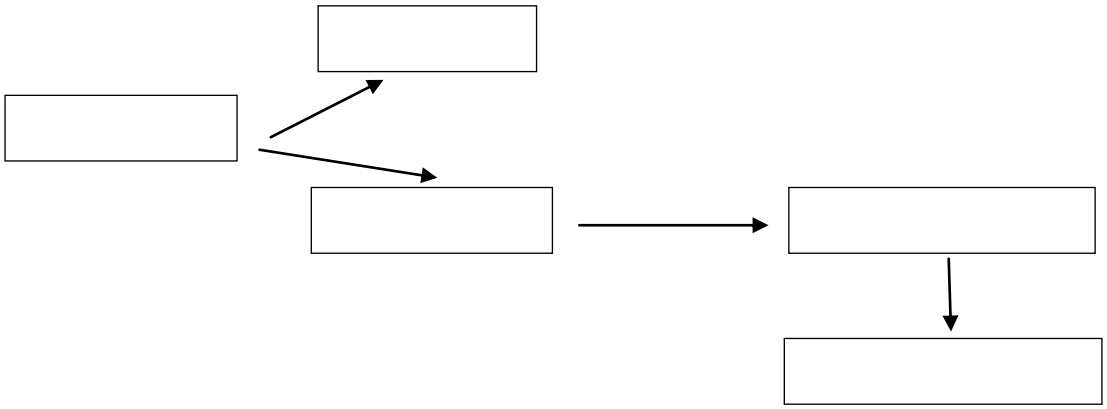
iv. **Confirming and Disconfirming Cases**: The nature of the research is also tied to Confirming and Disconfirming the state of the construction firms

Therefore, considering the population distribution of these construction firms (Large building construction firms) within the study area (Abuja) and the availability of structured units/departments that captures the knowledge professionals in these firms, the research identified a population of thirty two (32) building construction firm. However, the research could only effectively access twenty eight (28) construction firms.

Questionnaire Design

Good questionnaire design is crucial (Bulmer, 2004; Creswell, 2003; de Vaus, 2002; McGuirk and O'Neill, 2005; Oppenheim, 1992; Parfitt, 2005; Patton, 1990; Sarantakos, 2005) in order to generate data conducive to the goals of the research. Questionnaire format, sequence and wording, the inclusion of classification, behavioural, knowledge and perception questions, and questionnaire length and output, was considered to ensure reliability, validity and sustained engagement of the participant. The principal requirement

of questionnaire format is that questions are sequenced in a logical order, allowing a smooth transition from one topic to the next (Sarantakos, 2005). This will ensure that participants understand the purpose of the research and they will carefully answer questions to the end of the survey (McGuirk and O'Neill, 2005).
The nature of the questionnaire as shown in figure 3.1 showed that the questionnaires were both open ended and close ended. Every section had provision for both closed and open ended questions. The close ended questions were multiple choiced questions, reflected in the five point likert scale from section two, the multiple choiced questions in the likert scale provides determined choices from previous literatures.
Figure 1: Questionnaire Design



The questionnaire is designed in such a way that the knowledge workers can properly articulate and respond accordingly for their firms. The questions are coined, and adapted from existing literatures that are of relevance to this research. The research implored an "Evaluative continua" scales as proposed by Fowler, (2002), which are numerical or adjectival scales, where, multiple-choice questions should ideally offer five to seven (5-7) response options, ranging from strongly disagree to strongly agree as the case might be.

Reliability test

The most fundamental requirement of a research instrument is that it be reliable in the sense that it would yield consistent results if used repeatedly under the same conditions to test the same participants and is therefore relatively unaffected by errors of measurement. Most researchers have focused on internal consistency, as measured by Cronbach's coefficient alpha (Cronbach, 1951). By conventional psychometric criteria, any values of coefficient alpha below .6 are regarded as poor, even for relatively heterogeneous constructs (e.g., Robinson et al., 1991). Indeed, for measures of individual differences in cognitive processing, more stringent standards of internal consistency are expected (Childers et al., 1985; McKelvie, 1994). Administering these questionnaires on a single occasion is obviously much less arduous than locating the same individuals for testing on two separate occasions. It is therefore not surprising that fewer researchers have directly evaluated the test–retest reliability of these instruments.

Therefore, the research implored the use of the internal consistency method using the Cronbach's coefficient alpha (Clarke, 1986; Entwistle and Ramsden, 1983; Watkins and Hattie, 1980). The internal consistency of the constituent scales of the questionnaire appears to as 0.853 indicating that the data is internally consistent thereby reliable for the study as seen in Table 3

Cronbach Alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Table 3: Cronbach's coefficient alpha

Source: Cronbach, (1951)

Validity test

The other fundamental requirement of a research instrument is that it be valid in the sense that it measures the trait or traits that it purports to measure (Biggs *et al*., 2001, Richardson, 2004). Validity is arguably the most important criteria for the quality of a test. The research focused on the content validity, where the

questions were subjected to professionals in both the academia and practice to validate the appropriateness of the questions as well as the tools for the research.

Data Analysis Procedure and Presentation

The analyses of data and discussion of results were based on the categories of data. Analysis of the drivers and barriers was done using descriptive statistics such as Means Score (MS) and Standard Deviation, a non-parametric Kruskal-Wallis test.

The choice of the Kruskal-Wallis test (Kruskal and Wallis 1952, 1953) which is the nonparametric equivalent of a one-way ANOVA is because of its use for testing whether samples originate from the same distribution. The Kruskal-Wallis test does not make assumptions about normality. However, it assumes that the observations in each group come from populations with the same shape of distribution and that the samples are random and independent. This test is a more flexible, convenient, easy to use and powerful technique similar to a parametric one-way ANOVA. For ease, Statistical Package for Social Sciences (SPSS) computer package was used in conducting the analysis.

Nonparametric methods require less stringent assumptions than do their parametric counterparts; on the other hand, they also use less information from the data. When the assumptions of the parametric tests are not met, the nonparametric tests are the ones to be used.

The Kruskal-Wallis test is useful as a general nonparametric test for comparing more than two independent samples. It can be used to test whether such samples come from the same distribution. This test is powerful alternative to the one-way analysis of variance. Nonparametric ANOVA has no assumption of normality of random error but the independence of random error is required. If the Kruskal-Wallis statistic is significant, the nonparametric multiple comparison tests are useful methods for further analysis.

IV. DATA PRESENTATION, ANALYSIS, AND DISCUSSIONS

Preliminary Research Data

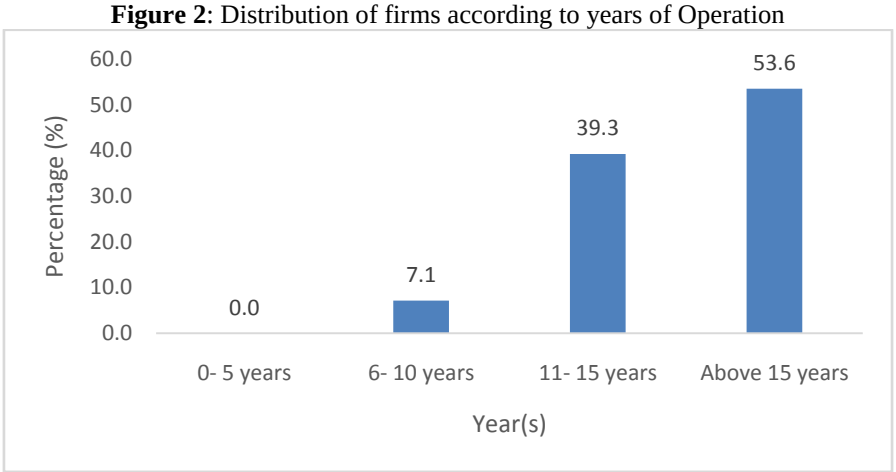
As earlier mentioned in the chapter three (3), a total of twenty eight (28) construction firms were selected for the study with the knowledge professionals as a critical criteria for their selection as identified by Egbu, and Robinson, (2005) and Oke *et al*. (2013). The results of the findings are presented in the subsections below.

The data were collected from Abuja, focusing on the various construction firms within the region and the following construction knowledge professionals as the respondents: Engineers, Quantity Surveyors, Land surveyors, Architects and Builders.

Distribution of firms according to years of operation

From the figure 2, it can be seen that firms operating in the periods above 15 years formed the largest groups of the respondents; having 53.6 %, followed by firms with periods 11-15 years having 39.3 %. Firms with 6-10 years have a 7.1%, while 0-5 years were not represented in the population. This imply that a large proportion of the firms have gathered relevant experience over the duration of operation. From the responses obtained, the distribution of the various firms' years of operation can be seen below

Figure 2: Distribution of firms according to years of Operation



Source: Field survey (2019)

Prospects of Collaborative Knowledge Management in the Firm

It is also important that the knowledge professionals are aware of these prospects in project delivery. These prospectswere classified into twelve (12) as identified by Castellón & Gutiérrez (2013) and they are: Information Integrity, Ease of access, Information Availability, Information Organization and Structure, Information Confidentiality and Hierarchy, Information Security and Contingency Planning, Process Knowledge Integration, Organizational Knowledge Transfer, Response Time, Organizational Experience Consolidation and Management, Organizational Experience Consolidation and Management, New Knowledge Generation and Innovation.

Table 4: Kruskal-Wallis test ofProspects of Collaborative KM

	Professionals	N	Mean Rank		
Prospects	Builder	28	70.23	Kruskal-Wallis H	.163
	Engineer	28	69.05	Df	4
	Land Surveyor	28	69.14	Asymp. Sig.	.997
	Architect	28	71.70		
	Quantity Surveyor	28	72.38		
	Total	140			

Source: Field survey (2019)

The Kruskal Wallis result for the test of significant difference within and between the groups of professionals in the firms on the existence of Prospects of Collaborative KM is presented in Table 4

The mean rank ranged between 72.38and 70.23 and the Chi-square value (Kruskal-Wallis H) was obtained to be 0.163 which is less than the critical value (0.207) and the p-value (0.997) is greater than 0.05. The overall results indicated no significant difference within and between all groups of knowledge professionals in the construction firms in terms of agreement with the existence of Prospects of Collaborative KM in its adoption in the construction firms. However, this is not to say that they are all at the same level of agreement, some variations still exist, but they are not statistically significant.

Table 5: Descriptive Statistics ofProspects of Collaborative KM

	N Statistic	Range Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Error	Std. Deviation Statistic	Variance Statistic
Information Integrity	140	4	1	5	4.24	.065	.764	.584
Ease of access	140	3	2	5	4.31	.057	.669	.447
Information Availability	140	4	1	5	4.36	.059	.700	.490
Information Organization and Structure	140	4	1	5	4.26	.071	.836	.699
Information Confidentiality and Hierarchy	140	2	3	5	4.39	.050	.595	.354
Information Security and Contingency Planning	140	4	1	5	4.19	.078	.921	.847
Process Knowledge Integration	140	4	1	5	4.26	.062	.733	.538
Organizational Knowledge Transfer	140	3	2	5	4.34	.055	.654	.428
Response Time	140	4	1	5	4.33	.061	.724	.524
Organizational Experience Consolidation and Management	140	4	1	5	4.25	.070	.832	.692
Organizational Experience Consolidation and Management	140	2	3	5	4.36	.050	.590	.348
New Knowledge Generation and Innovation	140	4	1	5	4.13	.074	.872	.760
Valid N (listwise)	140							

Source: Field survey (2019).

Considering Prospects of Collaborative KM, from the table of descriptive statistics results (shown in Table 5) revealed 'Information Confidentiality and Hierarchy', 'Information Availability' and 'Organizational Experience Consolidation and Management' are the most important Prospects of Collaborative KM in its adoption in the Nigerian construction industry with mean scores of 4.39, 4.36 and 4.36 respectively. 'Organizational Knowledge Transfer', 'Response Time', 'Ease of access', 'Information Organization and Structure' and 'Process Knowledge Integration', also stand out as important Prospects of Collaborative KM with mean score of 4.34. 4.33, 4.31, 4.26 and 4.26 respectively. 'New Knowledge Generation and Innovation' is least with mean scores of 4.13, but is also considered an important Prospects of Collaborative KM.

It is important to identify the general agreement of the professionals on the subject matter, as each professional might tend to have a perspective based on the uniqueness of professional specialization, which agrees with Abubakar (2012), Idris (2017). In looking at the Prospects of collaborative KM in construction firms, the research identified twelve relevant items, of which Information Confidentiality and Hierarchy was the

most significant. According to Tuomi (2000), Davenport & Prusak (1998) and Mohammed & Alexander (2017), the confidentiality of information must be primary for proper collaboration to take place. This information must be orderly for proper internalization.

V. CONCLUSION AND RECOMMENDATION

In conclusion, the Prospects for collaborative knowledge management cannot be over emphasized, as the drive towards project delivery is not a one man's responsibility.The research carefully identified twelve Prospective benefit of the application of CKM to which the different professional groups had significant level of agreement. However, the most significant Prospects was identified as Information Confidentiality and Hierarchy, this also spelling out the fact that the security and authenticity of the information is necessary for CKM.To encourage the adoption and use of CKM, it is important for the construction firms to consider theseProspects, with emphasis on the security and authenticity of the information, this might require the establishment of relevant passcode, transparency and possibly the use of block chain technology as a full proof system in considering its implementation and management.

Conflict of Interest

As the corresponding author, I wish to states that there is no conflict of interest.

REFERENCES

[1]. AbdulAzeez, A. D. (2012).Development of a Prototype Electronic Document and Record Management System (EDRMS) for Small and Medium Building Firms (Published doctoral thesis), Department of Building, Ahmadu Bello University, Zaria.

[2]. Abubakar, M. (2012). An Assessment of Readiness of the Nigerian Building Design Firms to Adopt Building Information Modelling (Bim) Technologies.A Thesis Submitted to the Postgraduate School, Ahmadu Bello University, Zaria-Nigeria in Partial Fulfilment for the Award of Master of Science (Construction Management) Department of Building Faculty of Environmental Design.

[3]. Almahmoud, E. & Doloi, H. (2013), Analysis of Stakeholders' Influence on Construction Processes using Social Network Analysis. Being a paper presented at the Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors held in New Delhi, India in association with the University of Ulster and IIT Delhi, 10th12th September.

[4]. and Information Technology, Nelson Mandela Metropolitan University, School of the Built

[5]. Anumba, C., Bouchlaghem, N., Whyte, J., Duke, A. (2003) Perspectives on an Integrated Construction Project Model. Int. J. Cooperative Inf. Syst. 9, 283-313. Doi:10.1142/S0218843000000107

[6]. Arayici, Y., Coates, P., Koskela, L., Kagioglou, M., Usher, C., & O'reilly, K. (2011). Technology adoption in the BIM implementation for lean architectural practice. Automation in Construction, 20(2), 189–195.

[7]. Bhatla, A., & Leite, F. (2012). Integration framework of bim with the last planner systemtm. In IGLC 2012 - 20th Conference of the International Group for Lean Construction. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84874473993&partnerID=40&md5=f1d0a3125bc8391cba925390e71e2d1f

[8]. Biggs, J., Kember, D., and Leung, D. Y. P. (2001). The revised two-factor Study Process Ques-tionnaire: R-SPQ-2F. Br. J. Educ. Psychol. 71: 133–149.

[9]. Bulmer, M. (2004): Questionnaires, 1st edition, Sage Benchmarks in Social Science Research Methods, edited by: Bulmer, M., Sage Publications, London, 354.

[10]. Carrillo, P. (2004) Managing knowledge: lessons from the oil and gas sector, Construction Management and Economics, 22(6), 631-642.

[11]. Charles T. & Fen Y. (2007) A Typology with Examples. Journal of Mixed Methods Research. 1(1). 77-100.

[12]. Chien, K. F., Wu, Z. H., & Huang, S. C. (2014). Identifying and assessing critical risk factors for BIM projects: Empirical study. Automation in Construction, 45, 1–15. https://doi.org/10.1016/j.autcon.2014.04.012

[13]. Childers, T. L., Houston, M. J., and Heckler, S. E. (1985). Measurement of individual differences in visual versus verbal information processing. J. Consum. Res. 12: 125–134.

[14]. Chilipunde, R. L. (2010). Constraints and Challenges Faced by Small, Medium and Micro Enterprise

[15]. Clarke, R. M. (1986). Students' approaches to learning in an innovative medical school: A cross-sectional study. *Br. J. Educ. Psychol.* 56: 309–321.

[16]. Contractors In Malawi, A thesis submitted to the Faculty of Engineering, the Built Environment

[17]. Creswell J.W. (2003) Research design quantitative and mixed methods approaches

[18]. Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika 16: 297–334.

[19]. Dave, B., and Koskela, L. (2009). "Collaborative knowledge management—A construction case study." Automation in Construction, 18(7), 894–902

[20]. Davenport, T. H., and Lawrence P., (1998) Working Knowledge: How Organizations Manage What They Know. Cambridge, MA: Harvard Business School Press.

[21]. Davies, R., & Harty, C. (2013). Measurement and exploration of individual beliefs about the Consequences of building information modelling use. Construction Management and Economics, 31(11), 1110–1127. https://doi.org/10.1080/01446193.2013.848994

[22]. De Vaus, D. A. (2002): Surveys in Social Research, 5th edition, Allen & Unwin, Crows Nest, Australia, 379.

[23]. Dix, A. (2017). Human–computer interaction, foundations and new paradigms. Journal of Visual Languages and Computing, 42, 122–134. https://doi.org/10.1016/j.jvlc.2016.04.001

[24]. Dvir, D., Raz, T., & Shenhar, A. J. (2003). An empirical analysis of the relationship between project planning and project success. International Journal of Project Management, 21(2), 89–95.

[25]. Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2011). "BIM handbook: a guide to Building Information Modeling for owners, managers, designers, engineers and contractors". Wiley & Sons, Inc., 2011.

[26]. Egbu C O and Robinson H S (2005). Construction as a Knowledge-Based Industry, in Anumba C J, Egbu C O and Carrillo P M, Knowledge Management in Construction, Blackwell Publishing, Oxford.

[27]. Entwistle, N. J., and Ramsden, P. (1983). Understanding Student Learning, Croom Helm, London.

[28]. Environment.

[29]. Fellows, R. & Liu, A. (2015). "Research Methods for Construction" 4th Edition. London: Blackwell Science Ltd.

[30]. Fowler, F. J. (2002): Survey Research Methods, Applied Social Research Methods Series, Sage Publications, Thousand Oaks, 178.
[31]. Ghani S. R. (2009), Knowledge Management: Tools and Techniques. DESIDOC Journal of Library & Information Technology, 29(6), 33-38.
[32]. Global construction 2010. Oxford Economics, 3 March 2011, London
[33]. Hall, H. (2003) "Borrowed theory: Applying exchange theories in information science research". Library and Information Science Research, 25, 287-306.
[34]. Hanson, B. (2008): Wither Qualitative/Quantitative: Grounds for Methodological Convergence, Qual. Quant., 42, 97–111.
[35]. Hartmann, T., Van Meerveld, H., Vossebeld, N., & Adriaanse, A. (2012). Aligning building information model tools and construction management methods. Automation in Construction, 22, 605–613. https://doi.org/10.1016/j.autcon.2011.12.011
[36]. Haynes, K., Barclay, J., and Pidgeon, N. (2007): Volcanic hazard communication using maps: an evaluation of their effectiveness, B. Volcanol., 70, 123–138.
[37]. Idris, H. (2017) Professionals Perception on the Factors Affecting the Capture and Reuse of Project Knowledge in the Nigerian Construction Industry. An unpublished MSc. Construction Management Thesis from Ahmadu Bello University Zaria.
[38]. Johannesson, P., & Perjons, E. (2014). An introduction to design science. Springer.
[39]. Joshi, A. Kale, S. Chandel, S. & Pal, D. K. (2015). Likert Scale: Explored and Explained. British Journal of Applied Science & Technology, 7(4), 396-403.
[40]. Kamara, J. M., Chimay, A. J., Carillo, P. M. (2002) A Clever approach to selecting a knowledge management strategy, International Journal of Project Management, 20(3), 205-211.
[41]. Kim, D. J. and Yan, T. A. (2010) "A New Approach for Collaborative Knowledge Management: A Unified Conceptual Model for Collaborative Knowledge Management", in Proc. 6th Americas Conference on Information Systems, Lima, Peru, August 12-15.
[42]. Kruskal, W.H. (1952): W.A. Wallis, Use of Ranks in One-Criterion Variance Analysis, in: Journal of the American Statistical Association. 47 (260), 583-621.
[43]. Kuzel, A. J. (1992). Sampling in qualitative inquiry. In B. F. Crabtree & W. L. Miller (Eds.), Doing qualitative research (pp. 31-44). Newbury Park, CA: Sage.
[44]. LeCompte, M. D., & Preissle, J. (1993). Ethnography and qualitative design in educational research (2nd ed.). New York: Academic Press
[45]. Lewkowicz, M. (2000), "Design of groupware for cooperative knowledge management", Ph.D. dissertation, Paris VI univ., 2000.
[46]. McGuirk, P. M. and O'Neill, P. (2005): Using Questionnaires in Qualitative Human Geography, in: Qualitative Research Methods in Human Geography, edited by: Hay, I., Oxford University Press, Australia, 147–162.
[47]. McKelvie, S. J. (1994). Guidelines for judging psychometric properties of imagery question-naires as research instruments: A proposal. *Perc. Mot. Skills* 79: 1219–1231.
[48]. Miles, M., & Huberman, M. (1994). Qualitative data analysis: An expanded sourcebook (2nd ed.). Thousand Oaks, CA: Sage.
[49]. Mohammed, A. and Alexander A. (2017), Information Security in an Organization. International Journal of Computer (IJC). 24(1), 100-116
[50]. Mohd A. A. P. and Mohd N. M. N. (2018). Effective of communication using WhatsApp: Industrialised building system (IBS) construction. AIP Conference Proceedings 2016, 020018 (2018); doi: 10.1063/1.5055420
[51]. Nonaka, I. O. and Takeuchi, H. (1995). The knowledge-creating company: how Japanese companies create the dynamics of innovation. Oxford, Oxford University Press
[52]. Oke A. E., Ogunsemi D. R., Adeeko O. C., (2013) Assessment of Knowledge Management Practices among Construction Professionals in Nigeria, *International Journal of Construction Engineering and Management*, 2(3), 85-92. doi: 10.5923/j.ijcem.20130203.06.
[53]. Onugu, B.A.N. (2005), Small and Medium Enterprises (SMEs) in Nigeria: Problems and Prospects, PhD thesis, St. Clements University, Australia.
[54]. Oppenheim, A. N. (1992): Questionnaire Design, Interviewing and Attitude Measurement, Continuum, London, 303.
[55]. Parfitt, J. (2005): Questionnaire design and sampling, in: Methods in Human Geography, edited by: Flowerdew, R. and Martin, D., Pearson Education Limited, England, 78–109.
[56]. Patton, M. Q. (1990): Qualitative Evaluation and Research Methods, 2nd edition, Sage Publications, Newbury Park, 532.
[57]. Priscilla A. Glasow (2005): Fundamentals of Survey Research Methodology. MITRE, Washington C3 Center McLean, Virginia. 1-28.
[58]. Priyono, A. (2016) "The Use of ICT Platforms to Promote Knowledge Exchange in Project-Based Organisations," Int. J. Entrep. Knowl., 4(2), 5–21.
[59]. Robinson, J. P., Shaver, P. R., and Wrightsman, L. S. (1991). Criteria for scale selection and evaluation. In Robinson, J. P., Shaver, P. R., and Wrightsman, L. S. (eds.), *Measures of Personality and Social Psychological Attitudes*, Academic Press, San Diego, CA, pp. 1–16.
[60]. Ruikar K, Anumba, C.J., Egbu,- C., (2006) Integrated use of technologies and techniques for construction knowledge management. Knowledge Management Research & Practice. 5, 297–311
[61]. Sackey, E., Tuuli, M., & Dainty, A. (2014). Sociotechnical systems approach to BIM implementation in a multidisciplinary construction context. Journal of Management in Engineering, 31(1), A4014005.
[62]. Sarantakos, S. (2005): Social Research, 2nd edition, Palgrave Macmillan Hampshire, 464.
[63]. Sauer, C., L. Liu and K. Johnston, Where project managers are kings. Project Management Journal, 2001. 32(4): p. 39-49.
[64]. Tongco, M. D. (2007). Purposive Sampling as a Tool for Informant Selection. A Journal of Plant, People and Applied Research Ethnobotany Research and Applications, 1-12.
[65]. Wasko, M, and Faraj. S. (2000), "'It is what one does: why people participate and help others in electronic communities of practice", Journal of Strategic Information Systems, 9, 155-173.
[66]. Watkins, D., and Hattie, J. (1980). An investigation of the internal structure of the Biggs Study Process Questionnaire. Educ. Psychol. Meas. 40: 1125–1130.
[67]. WhatsApp Inc., (2017) "WhatsApp Encryption Overview,". 1–10.
[68]. Xin Dong and Jiming Cao (2010) Research on Construction Projects Integration Knowledge Management Model Based on Collaboration Theory and Non-linear Polya Processes. The Conference on Web Based Business Management. 978-1-935068-18-1 © 2010 SciRes. 1162-1165.
[69]. Xue, X., Shen, Q., Fan, H., Li, H., & Fan, S. (2012). IT supported collaborative work in A/E/C projects: A ten-year review. Automation in Construction, 21, 1–9.