Developing a Framework for Knowledge Management System: The case of Flintstone Engineering SC.

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Abstract

Knowledge is a principal source of wealth in the present day business. Construction is a knowledge-based activity which uses knowledge as a critical resource in daily organizational activities. Eliciting the current organizational knowledge and proposing Knowledge Management System (KMS) framework is the main purpose of this paper. The proposed framework is used as a guide to implement KMS in the construction industry. Flintstone Engineering SC. (FE), which is one of the industries, was selected as a case study for this work. The work was conducted to elicit FE organizational knowledge areas and to develop a KMS framework for FE. Process oriented approach was used to elicit organizational knowledge from domain experts. Interview was used as knowledge acquisition method. Elicited knowledge was analysed using open coding method to develop knowledge taxonomy and KMS framework. Using open source content management system, Drupal, a prototype KMS is developed.

Keywords: Construction Industry KMS; Construction Industry KMS Framework; Construction Industry KM

1. Introduction

Knowledge is a principal source of prosperity in the present-day economic era called “knowledge age” or “knowledge economy” [1, 2]. Collective employees’ knowledge in producing state-of-the-art competitive products and services assisted by technological improvements and innovations is tapering competition gap between organizations [2]. Organizations consider knowledge as a key and the most treasured resource for their business success [3]. Knowledge Management (KM) has become an issue to organizations since the early 1990s [2]. Traditional production factors such as labour, capital, and land are no longer adequate for the competitiveness of organizations [4]. Through effective KM, an organization gains competitive advantage by sharing and reusing knowledge [5]. KM, using collaborative technology, can be used to avoid information overload, utilize technology improvement, upsurge professional specialization, provide an advantage for competition, reduce effects of workforce mobility and turnover, and capitalization of organizational knowledge [5].

Alavi and Leidner [6] tried to show the use of information technology deployment to facilitate, support and enrich organizational processes of knowledge conception or establishment, effective documentation and retrieval, dissemination, and solicitation. Furthermore, according to Gupta *et al*. [7], KMS is group of information systems intended to administer organizational knowledge, which in turn can be considered as organizational tool to discover, choose, establish, distribute and transfer knowledge and know-how essentials for activities such as problem solving, active learning, strategic planning, and decision making.

Currently there is no systematic knowledge management practice in Ethiopian construction companies. The reason for this may be lack of appreciation for KM practices, lack of experience and skill in KM and the limited role of information communication technology (ICT) deployment. We consider this gap and propose a framework for KMS to manage intangible organizational resources so that organizations recognize the benefit of formal KM practices.

2. Related Work

The construction industry, which is mainly project-based, has the challenge of losing organizational knowledge. Identifying the knowledge gap in KMS in Ethiopian construction companies is critical to appreciate and use KMS as a tool in market competition. This KMS framework will help to develop KMS to formalize knowledge capturing and reuse process, which will help construction companies be locally and internationally competent, witness business success and increases its contribution to national economy. Construction knowledge can be methodological, procedural, technical, practical, skill, and experience [8]. Furthermore, construction knowledge embraces planning, engineering, procurement, and operations [9].

Knowledge areas in the Ethiopian construction companies are not clearly known. As a result, knowledge areas are different for different companies. This makes difficult to strategically plan KM in construction companies and in the construction industry as a whole. Internationally, construction body of knowledge researches are structured by Construction Industry Institute (CII) and made available on their website. These knowledge research areas are: business and project processes, commissioning and start-up, construction execution, construction technology, design planning, and optimization, information, human resource management, and information technology [10]. This is a good starting point to look into researches, but it is difficult to adopt for Ethiopian construction companies KM. Another reference in construction knowledge is from project management institute certification PMBOOK [11]. The body of knowledge here is integration, scope, schedule, cost, quality, resource, communications, risk procurement, and stakeholder management. Here the limitation is that it is only for the project, which is temporary in nature, and KM needs to be implemented at a company level. Our work aims to fill the research gap in identifying knowledge areas which are relevant to the Ethiopian construction industry, taking FE as a case study. Having these knowledge areas, a KMS framework is proposed and a prototype KMS is developed to evaluate its acceptance.

ICT has a significant role in KM. Its application for organizational KM can be seen as selecting, verifying, documenting, and availing best practices, assisting organization leaders in strategic corporate knowledge planning and creation, and maintaining knowledge networks [6]. KMS framework is important for identifying and selecting appropriate ICT for KM. This will provide comprehensive understanding and association of ICT for KM.

Research on KM framework for integrating KM and ICT capabilities in Malaysia's construction consulting companies was conducted using a Delphi technique [12]. The research aims to fill the research gap between existing literature and industry strategies and finding strategies that enhance construction consultancy companies to employ KM. The research proposed a four-quadrant matrix KM versus ICT capabilities. Based on the proposed framework, the research concluded that Malaysian construction consultancy companies select exclusive ICT capability to complement explorative KM.

A framework by Spek and Spijkervent identifies stages in KM [13]. The stages are conceptualize, reflect, act, and retrospect. Conceptualization is acquisition of information about knowledge resources through researching, classification and modelling of existing knowledge. Evaluation of conceptualized knowledge via principles and criteria are in reflection stage. Acting stage incorporates engagements to take place to improve the knowledge. Retrospect is about comparing the old and new knowledge situations [14].

Nonaka and Takeuchi developed Socialization Externalization Combination Internalization (SECI) model for the Japanese manufacturing sector [15]. It identifies four types of knowledge conversions: socialization, externalization, internalization and combination. The authors derive knowledge conversion based on dichotomy between explicit and tacit knowledge. Socialization is tacit knowledge conversion from one entity to the other. Externalization is conversion of tacit to explicit knowledge. Combination is conversion of explicit knowledge to other form of explicit knowledge. It

creates more advanced knowledge by comprehending knowledge from different sources. This is more facilitated by using different IT. Internalization is conversion of explicit to tacit knowledge. This is a characteristics of both individual and organizational knowledge.

Ethiopia is one of the most ancient countries in the world and has its own alphabet for written documentation. Traditional KM in religious and social institutions is practiced for centuries. Among these practices, religious Poetry Schools, traditional medicines and Islamic devotional chants are good examples of knowledge creation and sharing. KM practices in Ethiopian academic institutions and businesses are not yet developed satisfactorily. Furthermore, scholarly papers on KM are not easily available.

Temtim Assefa developed a theoretical knowledge sharing framework for the Commercial Bank of Ethiopia which can serve as a guide to workplace knowledge sharing [16]. The work used case study research method to solicit knowledge enabling factors. Organizational, individual, social, task and technological factors are identified which have a significant influence on knowledge sharing activities at Commercial Bank of Ethiopia. Furthermore, organizational, individual and low association of ICT are factors that are highly involved in an employee's attitude toward knowledge sharing practices. The research proposed KMS architecture that serves as a guideline to implement KMS in the Commercial Bank Ethiopia. The study also developed KMS processes, knowledge repository and KMS technical architecture. The developed KMS architecture has three layers which are presentation, process and data storage layers. The first layer is for end users to interact with the KMS. The second layer contains collection of software like search engines, data mining and communication tools for processing user's requests submitted in the first layer. The third layer stores data or knowledge contents in different databases. The study recommends adopting these findings to other sectors which plan KM in their organization.

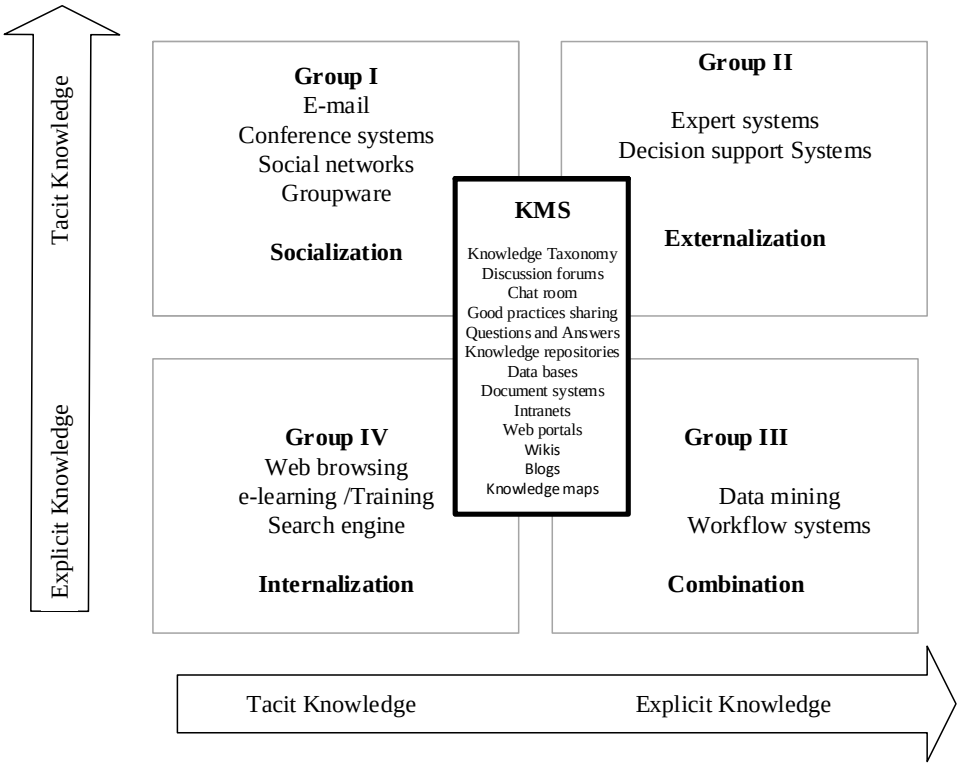
Minwiyelet Fiseha conducted a research on Ethiopian Revenue and Customs Authority [15]. The research proposed a knowledge model to implement KMS for import customs clearance to overcome knowledge loss due to high employee turnover. Knowledge contents and knowledge requirements for import customs clearance processes are systematically collected and analysed using decision making knowledge model method. Business process oriented modelling technique is used to describe knowledge relationships and it is also used for developing conceptual framework for modelling knowledge on business processes. The research used design science research method to build knowledge model and the corresponding prototype.

3. The Proposed Solution

As a base to implement KM and KMS in an organization, a blueprint called KMS framework needs to be formulated. In this paper, SECI model is selected to develop the KMS framework. The reasons of selecting SECI model are:

1. SECI is a well known model and is comprehensive and well addressed knowledge conversion from tacit to explicit.
2. It allows deep understanding of processes at all levels, which makes it convenient for IT.
3. Its essences are convenient for selecting IT for KMS. That is to say socialization is for knowledge sharing, externalization is for knowledge codification, combination is for knowledge storage and processing of data, and internalization is for knowledge learning.

We adopted the SECI model by Nonaka and Takeuchi [15] as KMS framework and modified it as shown in Figure 1.



Figurer 1: The Proposed KMS Framework

KM is mainly management of people and ICT. This framework is focused in selecting appropriate system of software for effective and efficient KM in an organization. Software collections are selected and placed at the intersection of the four quadrants grouped as KMS. Companies, based on their requirement, can select either of the four quadrants together with this KMS to implement KM.

- Group I: Companies which depend solely on their tacit knowledge can select this quadrant.
- Group II: This group is appropriate for companies where tacit knowledge dominates the business processes.
- Group III: Companies making their business mainly on organizational explicit knowledge can take this quadrant.
- Group IV: This quadrant addresses KM implementation for companies which need to internalize explicit knowledge for their business.

FE, which has mainly tacit knowledge, falls under Group II of this framework. This KMS can be implemented by a content management system.

3.1 Select KM Technology

As a solution, we propose to organize company's knowledge in knowledge repository and making it accessible using web-based technology with knowledge search capability. This can be implemented using content management system.

Today's IT industry has plenty of tools to be used in organizations' day-to-day operations. Some of these tools support collaboration and communication. KM tools target in supporting knowledge discovery, capturing, processing, and sharing.

A wide variety of KM tools are available. We selected content management system technology for the following reasons.

1. The construction industry uses many technologies and keeping these records in any format and avail them when needed is more facilitated in content management systems.
2. Content management system uses intranet or the Internet as communication platforms, which are available in most construction companies.
3. The content management system can be used as a document management system by digitizing documents electronically.

4. Searching for content can be facilitated by implementing different search engines.

3.2 The Proposed System Architecture

To implement the proposed KMS, a four tier system architecture is selected. The tiers are: client tier, web tier, business logic tier, and database tier as shown in Figure 2. Tiers are the physical locations of presentation, data service, business logic, and data access layers across separate computers and systems.

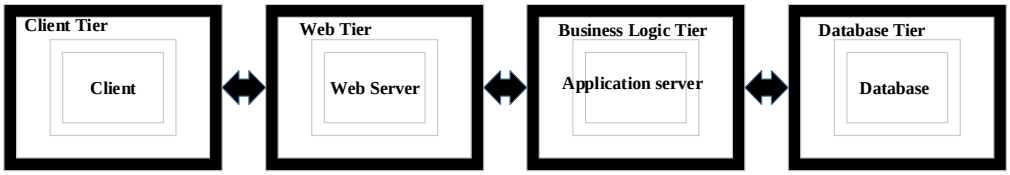


Figure 2: The Proposed System Architecture

Software components to construct the application or service are grouped logically to form layers. This makes the design to re-use some components. These layers include presentation layer, data service layer, business logic layer, and data access layer.

Presentation layer: is for the user to interact with the system. Its purpose is to allow the user to input data, interpret users data and send request to data service layer and display the result to the user.

Data service layer: is for the purpose of securing business logic layer. It optimizes system replies for proper display on client machines.

Business logic layer: is to facilitate data exchange. It is responsible for development of business rules, processes and needs with relation to the system.

Data access layer: is to access the database and make operations on the data.

Figure 3 presents the prototype developed to evaluate the proposed knowledge management framework.

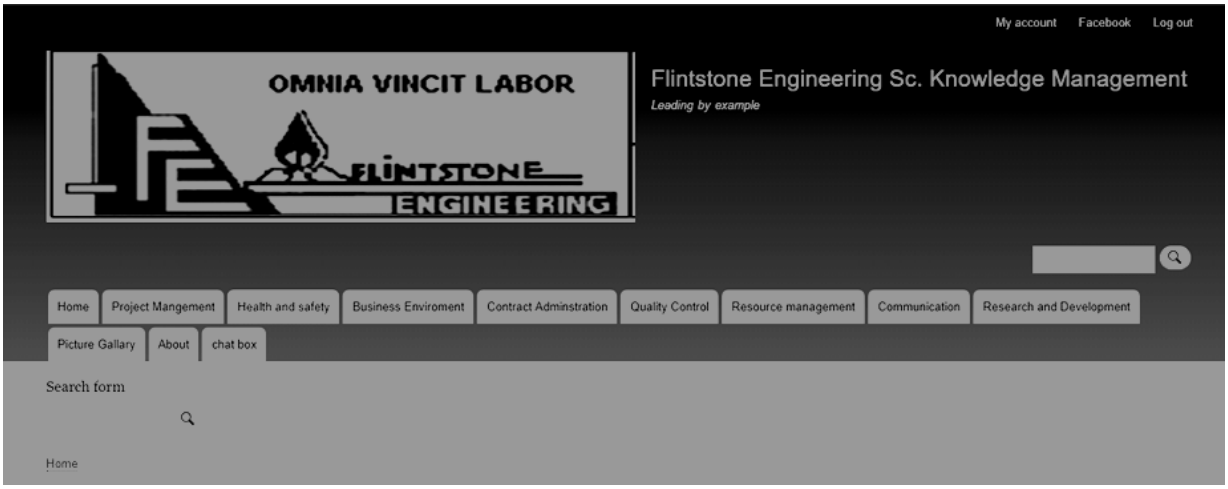


Figure 3: Prototype Website

4. Discussion

4.1 Technological Evaluation

The selected web-based technology suits enough to the current organizations IT capability and users' needs for KMS. Putting this KMS on the Internet for employees and management staff with different access rights will make the organization's knowledge more accessible. Since the organization has many projects geographically scattered, availing this KMS helps a lot for both knowledge retrieval and building knowledge on the day-to-day experience. All relevant data formats are available as knowledge on the repository. FE management can request further

technological capabilities like report formulation and integration with other third-party software to share construction knowledge industry wide. This paper proposed a KM framework which can be adapted to any construction company. Integrating every company's knowledgebase at the national level would also be possible.

4.2 User Accessibility

The first level knowledge taxonomy derived from knowledge elicitation can embrace the organization's knowledge and is accepted by domain experts. On second level knowledge area taxonomies, some domain experts have different opinions. This was also observed during the knowledge elicitation process. We availed keyword search to alleviate this problem and users are convinced to use it. The website design is easy to use since everybody is using web technology one way or another. We considered the national bandwidth limitation issue and put only links on the main page so that contents will be downloaded based on the user's selection.

5. Conclusions and Future Works

This work was conducted to develop a KMS framework for FE. Process oriented approach was used to elicit organizational knowledge from domain experts. Elicited knowledge was analysed using open coding method to develop knowledge taxonomy and KMS framework. Using the open source content management system Drupal, a KMS prototype is developed.

The prototype is used to evaluate the relevance of KMS to solve organizational problems such as document access and sharing. This KMS framework and the prototype KMS can be easily adapted to any other construction company in the country and amalgamating all KMS leads to the national construction knowledgebase.

Further research is needed for developing national level construction industry knowledgebase by integrating all construction organization's knowledge and making it accessible to all stakeholders.

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