Innovative Trends in Knowledge Management: A Cloud Computing Perspective

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Abstract

The practice of Knowledge Management (KM) started more than two decades ago and its importance was realized by the leading organizations. It is now considered as an integral component of any business organization. Globalization has played a significant role in how business is conducted and thus the need of innovative KM grew. The emergence of Information and Computer Technologies (ICT) made it possible to put innovative ideas into practice in many areas including KM. This paper discusses the trends in knowledge management and how new emerging technologies have impacted the way knowledge is managed. One of the most prominent technologies within the ICT has been the emergence of Cloud Computing that has significantly impacted the way IT services are provisioned. With its key characteristics, like on-demand self-service, IT resource pooling, rapid elasticity, pay-as-you-go subscription model and reduced IT costs, it has encouraged various organizations to amend their business strategies. The small and medium scale organizations can now avail hosted services for major IT activities including KM through Cloud Computing, which was beyond their budget before the advent of Cloud Computing. The cloud environment application will be discussed in detail with respect to the knowledge management strategies and their combined adaptability to cater to future needs in this area.

Key words: Knowledge Management, Cloud Computing, Innovation.

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1. Introduction

The practice of Knowledge Management (KM) started more than two decades ago and its importance was realized by the leading organizations. It is now considered as an integral component of any business organization. KM scans all activities where there is a need to transfer knowledge whether it is informing about new developments in product/service offerings, or dissemination of information through meetings or electronic media. Nielson (2006) listed eight KM activities namely, knowledge creation, acquisition, capturing, assembling, sharing, integration, leverage and exploitation that span from obtaining new knowledge to exploitation. Wang and Ahmed (2005) described the KM process in detail, which consists of identification, acquisition, codification, storage, dissemination, refinement, application, and creation of knowledge. It is hard to define Knowledge precisely as it varies according to the domain. Knowledge is usually found either in explicit or tacit form. Tacit knowledge is hard to identify, making it a challenging job for the developers of KM, while explicit knowledge is easy to document. An example to mention about tacit knowledge is where it is present in the form of experience among the senior employees of any organization. Organizations need to capture the valuable knowledge of these senior experienced employees before they retire or move to different organizations. It is therefore necessary to convert tacit knowledge to explicit knowledge which is one of the main goals of KM (Anantatmula, 2009). According to Ellis (2003), knowledge needs data and information as input. The data are the raw facts that produce information when processed and ultimately the information itself is an input to knowledge, which can be used for problem solving. As knowledge reflects in business strategy, policy and practices at all levels of an organization, KM is therefore considered as a business activity, which can be related to both internal and external environment of an organization. Globalization brought drastic changes to business organizations forcing them to adapt new styles of conducting business. The supply chains extended to different continents seeking greater coordination within its elements such as supplier relationship management, internal process management and customer relationship management. Efficient management of these elements demanded significant changes in business strategies prompting the use of new technologies.

Researchers have given different names for KM approaches, but they mostly revolve around human influence and technology. For example, Sveiby (1997) discussed two knowledge management approaches where one focuses on people and the other on technology. Since KM is highly influenced with the developments in IT, therefore, most KM tools pertain to information systems and software (Fusaro, 1998). Hansen et al (1999) presented two distinct strategies in
knowledge management, a codification strategy, which is centered around IT resources and a personalization strategy that focuses on human resources. Gloet (2000) admitted that contemporary knowledge management approaches also include organizational learning or business information systems, and KM approaches tend to be driven predominantly within an IT or humanist framework or paradigm. Silver (2000) mentioned that KM is not only limited to technology but it is the integration of business strategy and process, organizational community and culture, expertise and technology. From the above discussion it is clear that technology plays a vital role in KM while other aspects should also be acknowledged. The core idea of KM revolves around creation, storage and dissemination of knowledge which are among the characteristics of Information and Computer Technologies (ICT) that provide a platform to unify all communication mechanisms that include among others, telecommunications, computers, PDAs, cloud computing services and RFID solutions. The emergence of ICTs made it possible to put innovative ideas into practice in many areas including KM.

Cloud Computing technology has recently emerged as a promising ICT approach to improve the way people and businesses see ICT as a service. This technology has a great influence on developing KMS. Cloud computing not only provides a central location to manage data/information and knowledge but also provides a platform to make them available on-demand, like other computing resources such as CPU, Storage, Memory and Bandwidth, etc. Among the benefits of integrating Cloud Computing with KMS are to cut costs, adopt new practices, explore new business models and provide Knowledge as a Service (KaaS).

The rest of this paper is organized as follows. In Section 2 a detailed study of innovation and its link with KM will be discussed along with the importance of ICTs and its relation with innovation and KM. In Section 3, the main features and benefits of Cloud Computing, and recent trends on how KM is adapting to cloud computing environment will be addressed in detail. Finally, conclusions will be presented in Section 4.

2. Innovation and KM

Several papers can be found that talk about innovation and those that link to KM. Most of them agree that there is a strong relationship between innovation and KM. One of the significant reasons for the survival of any organization is its competitive advantage that cannot be achieved without promoting innovation within its business processes. According to Leal-Rodriguez et al (2013) KM helps maintain the competitive advantage and create new markets. The knowledge gained from external environment will definitely lead to increased acceptance of the products or services by the customer.
Plessis (2007) stated that global economic growth has been changed by the speed of innovation, which has been made possible by rapidly evolving technology, shorter product lifecycles and a higher rate of new product development. He further added that complexity of innovation has been increased by growth in the amount of knowledge available to organizations. It is evident now that there is a strong relationship between innovation, technology and KM. There are several articles that also elaborate on components other than technology which are also crucial for innovation. Leal-Rodríguez et al (2013) inferred that there is a strong knowledge-innovation link in organizations that have low barriers to knowledge creativity, sharing and knowledge transfer and those that promote open cultures. A study by Abdi and AmatSenin (2014) showed the effect of knowledge management on innovation directly and through organizational learning. They concluded that organizational learning has a full mediation effect on KM and organizational innovation. They further added that performance of the organization can greatly benefit through commitment from senior experienced organization members in KM to learning, shared vision and open-mindedness. Krstić and Petrović (2012) included creating organizational culture based on knowledge and innovation as a role of KM. This on the other hand also implies that organizational culture that encourages knowledge sharing can have a positive impact on innovation.

In the current era of information it is challenging to handle the abundance of data available through various sources, including those that transmit real time information. Several models are available in the literature proposing the way accurate and real-time data should be extracted that can be utilized for decision making. The role of KM is vital, as it will not only use this related and significant data but will also make it available to the concerned in the most efficient way. ICTs play a major role in facilitating real time analysis and the extraction of appropriate knowledge which is considered as a major challenge.

The emergence of new technologies is a result of innovative developments and on the other hand, the same new technology can pave path for a variety of innovative applications. A simple example is the development of PDAs and smart phone technology. While the prime objective is communication, there have been countless innovative applications developed which would not have been possible to develop without the smart phone and internet technology. It is also true that ICTs have great influence on KM, and therefore any innovation in ICTs directly linked to creativity in KM. The emergence of new technologies has significantly influenced the business strategies and organizations are thriving to upgrade their current systems with these new developments, or even completely replace their old systems with new ones. Among the most
prominent ICT developments, especially those that have impacted KM are social networking, Radio Frequency Identification (RFID) technology and Cloud Computing.

RFID is considered as one of the automated technologies that has the ability to transmit information from the object it has been placed on through radio waves. A typical RFID tag can be used to identify any item with a unique serial number and mainly consists of a microchip that is connected to a radio antenna. They are mainly of two types, active and passive depending on whether it has its own power source or it depends on external power that triggers it to transmit information. With supporting technologies, it is clear that this technology offers capability to real time information. This transmitted information is captured by computers and used for a variety of applications including, retailing, transportation, vehicle tracking, tourism, hospitality, healthcare, supply chain by large, etc. It is obvious now that RFID has a role to play in the modern KMS. Chow (2007) presented a RFID-KMS that assists a manager to supervise if all tasks are handled as per standard operations procedures. This job, without such an innovative solution would be quite challenging as it involves multiple customers with varied requirements, workers with different educational backgrounds, etc. Some other KM applications that use RFID can also be found in literature like healthcare industry (Ahsan et al, 2010) and collaboration for the procurement cycle in the construction industry (El Ghazali et al, 2012).

Social networking sites are generally defined as platforms where people socialize/interact with each other and share their views and opinions, by using multimedia tools. As soon as this concept was widely accepted by people all over the globe, organizations found an opportunity to tap the information floating on these sites. They started promoting new products and capture the feedback from the discussions on these sites. While these sites store valuable information, tools have been developed to mine the related information and find patterns that were difficult to extract through traditional approaches. The users not only talk about the benefits of products offered, they also criticize them over these sites. Some users make additional efforts to share innovative ideas and may even act as disclosers of new products and services (Grützmann et al, 2013). The size of users and the amount of information floating on these sites cannot be ignored by business organizations who strive to capture and feed it to their KMS.

The popularity of cloud computing started growing after year 2000 and its characteristics of providing computing as a service had put small and medium enterprise into competition. Many of these enterprises earlier were unable to invest in the infrastructure needed to use the ICTs to its full utilization. The next section will focus on the features, its benefits and its contribution the field of KM.

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3. KMS and Cloud Computing

This section provides the details of intersection between KMS and Cloud Computing systems. We discuss in detail the main features of Cloud Computing and its benefits which can be used for improving KMS. Also, a detailed literature review is presented which illustrates the trends in evolution of KMS with Cloud Computing features.

3.1 Cloud Computing and its benefits for KM

Over the decades we have witnessed how the Information and Communications Technology (ICT) has been evolving in terms of its infrastructure requirements and the provisioning of the services and their management aspects. In recent times, Cloud Computing technology has emerged as a promising ICT approach to improve the way people and businesses see ICT as a service. According to the National Institute of Standards and Technology (NIST) definition (Mell and Grance, 2011), “Cloud Computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction”.

The computing model described above can be realized through the use of various cloud service and cloud deployments models. The three basic service models include provisioning of Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Deployment models deal with the manner in which the infrastructure of Cloud Computing system is deployed, owned and managed by the service providers & consumers. This leads to the concept of Private, Public, Community and Hybrid cloud architectures (Zhang et al (2010)). These basic concepts of Cloud Computing system are summarized in Fig. 1.

The Cloud Computing model provides various advantages as compared to the traditional IT setup. First and foremost is the saving in setup and maintenance costs. This is because the enterprises need not invest in the cost of setting up the infrastructure as IT is purchased on a pay-as-you-go basis as a service. Since the IT services are subscribed from a Cloud Service Provider which is usually at a remote site, the services can be conveniently accessed ubiquitously. The services can be accessed on-demand based on the varying workload demands at the customer site. This is the reason why the Cloud Computing system has the feature of rapid elasticity which enables the services to be scaled up and down based on customer workload demands. Finally, since the IT resources (e.g. CPU, Storage, Memory and Bandwidth) are pooled, this gives the customers a notion of unlimited resources on-demand. These features are the main source of
attraction of this technology which is growing in popularity in various areas and KMS is no exception.

Fig. 1: Illustration of Cloud Service Models, Deployment Models and Cloud Features

3.2 Trends in KM using Cloud Computing

Having seen the features and benefits of Cloud Computing to the domain of Knowledge Management, now we turn our attention to the research work which has been done in the application of Cloud Computing to the betterment of Knowledge Management Systems. To this end, we present a survey of the work of prominent researchers in this area in the last five years.

One of the early works of Delic and Riley (2009) propose the idea of combining the benefits of Cloud Computing and Enterprise Knowledge termed as Enterprise Knowledge Management (EKM) where the knowledge related to the organization/enterprise can be made available on a Cloud Computing based system. They partition the EKM system into four components, namely, the EKM Infrastructure, Applications, Content and Users. The infrastructure consists of the Enterprise data centers which host the computing, storage and network resources as the basis of the Cloud Computing setup. The type of applications will have implications for the software, operating system and programming environment. The content aspect should consider how enterprise knowledge should be represented, captured, processed and delivered. The users in the Cloud environment will have to have a different set of skills in order to gather, process and present the knowledge of the business as compared to the contemporary users.

Later, Maurer et al (2010) present an application of Knowledge Management techniques for making the Cloud Computing as self-adaptable. For this purpose, they evaluated rule-based systems, default logic, situation calculus and case-based reasoning (CBR). To demonstrate their
idea they adopt the CBR method for interpreting the measurement data from the Cloud Datacenter and trigger appropriate actions with the overall goal of preventing any Service Level Agreements (SLA) violations. It is seen that this work is reciprocal of what we have seen earlier, where Cloud Computing was improving the way KMS work.

In another work by Cruz et al (2011) provide a comprehensive survey of research in the area of Cloud Computing and Knowledge Management System by searching three prominent research databases, namely, ISI Web of Science, IEEE Xplore and EBSCO (MIS Quarterly). They conclude that Cloud Computing when applied to KMS can enable businesses to cut costs, adopt new practices and explore new business models. This is because Cloud Computing relieves the businesses to invest heavily on IT resources and simultaneously provide a platform to share and exchange information.

Abdullah et al (2011) present a model which integrates the Knowledge Management System and Cloud Computing concepts to provide Knowledge as a Service (KaaS). The KMS-based model which facilitates the KaaS has been divided into two main components, namely, KMS infrastructure and KMS functionality. The KMS infrastructure includes the Intranet, Internet and the extranet. The KMS functionality includes the Knowledge Acquisition, Knowledge Storage and Knowledge Dissemination.

Talib and Abdullah (2012) present the model of Information Technology as a Service (ITaaS) in order to ensure that both the Cloud Service Providers (CSP) and the customers who are participating in the cloud environment are satisfied and get the best maximum return on investment (for Cloud Service Providers) and desired quality of service (for the customers). They propose a three layer model to implement a Knowledge Management System based on the ITaaS. The innermost layer is termed as the Resource as a Service (RaaS) which combines the basic there services of the Cloud environment (i.e. Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS)). The middle layer is termed as the ITaaS which provides the Information Technology (i.e. IT Services, Applications) as a service which run on the Resource as a Service. The topmost layer is called the CKMS (Collaborative Knowledge Management System) with KaaS (Knowledge as a Service), where the cloud knowledge is driven based on KaaS techniques and manages, stores and facilitates based on CKMS techniques.

Sultan (2013) describes Cloud Computing to be a “disruptive” technology which has the ability to create new products and business models for the organization and businesses and help them to survive and thrive in the dynamic and competitive market environment. According to him, Knowledge Management is entering an era where ordinary people and employees can make
significant contribution to knowledge creation and management by using new ICT tools such as Computing. As presented in the paper, earlier KM technologies and approaches were expensive to implement and difficult to use and manage. With the application of Cloud Computing to implement KMS, a new era of knowledge-rich world order is in the making where even the organizations with limited means and resources can play a significant role.

Lin and Yang (2013) propose architecture and its application for a Customer Knowledge Management Information System (CKMIS). Since Cloud-based Software-as-a-Service (SaaS) has proved its popularity for its rich set of features, their practical applications on business can be expected. Thus, the authors envision a trend for CKMIS to employ SaaS as its service provision model to enhance further its effectiveness on customer relationships. They demonstrate the application of their proposed architecture in providing a SaaS CKMIS for book publishing scenario, where the customers (teachers and university professors) can easily achieve the tasks of writing, organizing and reviewing a new book and provide the information to the publishers in an efficient manner.

In the most recent work, Bimol et al (2014) discuss the financial constraints and the world economy that are affecting higher education institutions so as to provide the necessary information technology support for knowledge management activities in their respective domains of influence. They argue that Cloud computing offers a cost-effective and viable solution to such a scenario through its characteristic features of on-demand service provisioning and pay-as-you-go payment model. In their paper they discuss that Cloud model applications can obtain the advantage of working ability and communication in educational environment without taking into account the constraints of time and space. Hence, Cloud Computing provides a new solution to Knowledge management IT infrastructure problem by integrating in higher education by establishing a unified, open, simple and flexible architecture.

The above survey concludes that significant contributions have been made to the application of Cloud Computing to the domain of Knowledge Management Systems. However, some of the applications presented in the paper have been only theoretical claims and this is where this research aims to fill the gap. This is not to undermine the potential of integrating cloud computing within the knowledge management but just to affirm that these latest trends are the current developments and the businesses are already benefiting from this practice.

The application of Cloud Computing to Knowledge Management area in future is promising, as the current knowledge base is expanding at a rapid pace and researchers have already defined this explosive growth as “Big Data”. The result of this phenomenon will surely translate into what
we term as “Big Knowledge”, where the refinement of data into knowledge takes place. And this “Big Knowledge” needs to be consolidated and managed efficiently for which we envision that the Cloud Computing infrastructure will have a vital role to play.

4. Conclusions

In this research, innovative aspects of KM were discussed and several innovative trends were identified. A comprehensive discussion of the innovative application of Cloud Computing to the domain of Knowledge Management Systems was discussed in detail. It showed how the transformation of the current KMS to the Cloud environment has resulted in various benefits, namely, cost savings, improved business processes, customer satisfaction and better knowledge representation and management. The various application areas were also discussed which included Collaborative KMS, Knowledge as a Service (KaaS), Customer Knowledge Management Information Systems (CKMIS) and Enterprise Knowledge Management (EKM). Based on the critical evaluation of current issues and existing solutions, a proposal for “Big Knowledge” was envisioned and further research in this area is planned.

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