Examining the Effectiveness of Knowledge Management Systems (KMS) in Co-Creation: An Empirical Investigation

Dr. Ammar Rashid(PhD- Information Systems, New Zealand)
Assistant Professor
Department of Information and Operations Management, UCP Business School
University of Central Punjab
Lahore, Pakistan

&

Dr. Yasir Rashid(PhD- Marketing, New Zealand)
Assistant Professor
Department of Marketing, School of Business and Economics
University of Management and Technology
Lahore, Pakistan

&

Dr. Quik Wee Hock(PhD- Information Systems, New Zealand)
Senior Lean Leader
Pentair Flow and Filtration Solution
Auckland, New Zealand

Abstract
This paper discusses the effectiveness of Knowledge Management Systems (KMS) through the analysis of empirical material. Knowledge Management Systems (KMS) literature has gained prominence as a strategic initiative to facilitate better and faster decision making. Much of the previous empirical research on KMS is based on surveys of KMS users and contributors. There are limited studies that employ data directly from KMS to provide explanation on the effectiveness of KMS initiatives. This study adopts a different approach and takes advantage of direct access to actual KMS data in order to examine the influence of KMS utilization and KMS effectiveness. Drawing on Theory of Knowledge Reuse, this study examines KM generation, use and reuse on previously suggested metrics and provide preliminary framework to measure KMS success. This study is expected to both substantiate existing theories of knowledge management and provide some extensions to Theory of Knowledge Reuse.

Keywords: Knowledge Management System, Knowledge Reuse, Positivist Case study,
A higher degree of prominence of knowledge in today’s organizations demand companies to properly acquire, store and manage this asset. Towards this end, many companies develop specific information systems to facilitate the sharing and integration of knowledge [14]. These systems are referred to as Knowledge Management Systems

Knowledge Management System (KMS) is defined as a system that is designed and developed to offer decision makers and users with the knowledge they need to make better decisions and perform their tasks well [15]. This knowledge can be explicit or tacit knowledge [9]. Explicit knowledge is clearly developed and has all of its elements apparent. Such knowledge is codified and documented. This type of knowledge is generally structured, has no concealed meaning, and can be readily transmitted to others. In contrast, tacit knowledge is specified or implied, but not always expressed. It is based on personal knowledge from different personal experiences, and is largely unstructured. It is the type of knowledge that is difficult to transfer to another person by means of writing, or through verbalizing. The existing body of literature on KMS consists primarily of conceptual and general principles of KMS. Much of existing research have focused on technologies being used to build KMS, the champions of KMS initiative, desired benefits and cost of KMS, barriers to KMS implementation, majors concerns regarding KMS, and the knowledge domain being incorporated into KMS. A considerable large number of empirical studies have focused on technical related issues of KMS from individual perspective. Little research and insight exist to guide the KM researchers and practitioners in the successful KMS utilization from individual as well as organization perspective. Hence, the objective of this paper is to examine the effectiveness of KM Systems based on actual KMS data in a multinational Software Development Firm and interview data to draw useful insight.

The paper is organized as follows. First section presents a review of existing literature on KMS. This section provides a comprehensive summary of alternate views to examine KMS effectiveness and their implications on Knowledge Management (KM). Second section reviews the literature on KM formation and utilization. Third section explains the research framework in detail followed by discussion on the case. This is followed by analysis of the case. Research contributions and implications of the research are explained in the end.

Knowledge Management System

In order to understand KMS, it is necessary to first define knowledge and knowledge management. Nonaka[16] defines knowledge as a “justified personal belief that increases an individual’s capacity to take effective action”. An action in this context requires individual competencies, skills, intellectual/cognitive activity (e.g. analytical skills). This definition of knowledge further makes a distinction among data, information and knowledge. For example, Vance [17] defines data as raw facts and figures whereas information as data that is interpreted into meaningful framework. Knowledge on the other hand, is defined as “information made actionable”[18].

While the conceptualization of data, information and knowledge provides understanding of each term, they fall short of providing an explanation on when information become knowledge [7]. There have been different viewpoints emerged that provided some further clarification. For example, Nonaka[16] suggest that knowledge is information possessed in the mind of an individual (tacit knowledge), and it is personalize, subjective and related to judgments, ideas, concepts. The knowledge (explicit knowledge) then again becomes information when an individual communicated to others in the forms of text, written or through other means[19].

Most of the extant literature focused on addressing the challenges associated with creation and management of knowledge. Some researchers suggest that within the organizational context, the real challenge is less of its creation but more of its apprehension and integration [20, 21]. In reality, knowledge has limited or no organization value if it not shared. An organizational ability to capture, integrate, and share specialized knowledge among organizational members is fundamental to a firm’s
ability to create and sustain competitive advantage [21]. Traditionally, different means like face to face interactions and staff development are used to create and transfer knowledge among organizational members. These means prove to be less effective and slow as organizations become more global, and operate in virtual forms. Furthermore, others suggest[22] that knowledge would not necessarily circulate effectively within firm just because the technology to support such circulation currently exist in the marketplace.

In recent years, varieties of technologies are introduced to support knowledge capturing, integration and sharing. Generally, these computer systems facilitate communication and information sharing that can likely to have positive effect on better knowledge utilization and reuse. With such an increasing importance of knowledge in organization in today’s market place, companies have begun to implement information systems designed to facilitate codification, collection, integration and sharing of organizational knowledge. Such systems are referred to as Knowledge Management System (KMS).

Early development in creating KM technologies includes online yellow pages and document management systems. These developments are then followed by the introduction of collaborative technologies like Lotus Notes to increase information sharing and enhance communication. Subsequent KM efforts leverage technologies that support search and retrieval and introduction of e-learning tools for communities of practice. Jatinder & Sharma[23] suggest that KMS can be categorized into expert systems, groupware, document management systems, decision support systems, database management systems, and simulation systems. More recently, social computing tools (e.g. blogs, wikis, and bookmarks) have also been identified as potentially another type of KMS that can represent explicit knowledge transfer[24].

While technological capabilities are important, having a complex KMS does not necessarily guarantee success in KM initiatives[25]. One of the reason for this is because social issues appear to be significant in confirming successful knowledge sharing[26]. Repeated calls have been made by researchers to simultaneously address both technical as well as social issues to fully reap the benefits of KM initiative[5].

**Knowledge Management System Effectiveness**

Authorities in the filed have advocated two views [7] in explaining what KMS effectiveness means and how it should be measured: the system-resource view and goal-centered view. System-resource view suggests that KMS effectiveness is determined by realization of a normative state (e.g., the usage of standards for good practices used in the company). In this view, effectiveness is envisaged in terms of resource sustainability rather than in terms of specific task objectives. For example, KMS effectiveness in terms of technological resources is specified by the quality of KMS and service level. This model also recognize that systems have the capability to fulfill other functions and may have consequences beside accomplishment of organization objectives, and that these need to be considered in the overall assessment of KMS effectiveness. In addition to this, KMS effectiveness in terms of human resource might be specified by the nature of conflict and communication between the system and user personnel, participation, job satisfaction and system development.

Goal-centered view suggest that the proper way to evaluate KMS effectiveness is first to define the job objectives of the system, or the unit that is employing the system, and then develop a criteria to measure and evaluate how well job objectives are achieved. In other words, effectiveness is determined by comparing the job performance to job objectives. An example of this is comparing actual cost and benefits of KMS to the budgeted costs and benefits.

Empirical evidence shows that both view needs to be considered in assessing KMS effectiveness. In practice these two views at some point would likely to congregate. Researchers in IS filed suggest that system resources also need to be examined to explain the success, or lack of success, in meeting the
The difference between goal-centered and system-resource view is similar to the dissimilarity drawn between summative and formative evaluation approach [28].

Summative evaluation regulates whether the KMS has accomplished objectives, whereas formative evaluation assesses the quality of the system and the related support offered. The peculiarity between summative and formative evaluation approaches is comparable to the evaluation of ends versus means, or KMS outcomes versus the process. Formative assessment approach provides information during the course of the implementation process to help improve the means to achieve objectives, and help in interpreting of the assessment results. In contrast, summative assessment approach provides information on the KMS outcomes, or ends, to support decisions to further continue, or dismiss the system. Both of the evaluation approaches are typically used in providing evaluative information on KMS effectiveness.

Organizational Success
Current strategic management thinking recognizes that successful implementation and usage of Knowledge Management (KM) ensures the acquisition and growth of intellectual capital [29]. A growth in intellectual capital, a difference in the value between market value and tangible assets [30], is a key driver in achieving innovation and sustained competitive advantage in knowledge economy. In the context of this paper, organizational success is concerned with the successful implementation and usage of KM to ensure the growth of intellectual capital.

Researchers argue that creation of knowledge needs to be associated with the epistemological viewpoints. Epistemology is a science and study of knowledge. Empirical evidence shows that episteme differ between individual and corporate. For example, Von Krogh et al. [31] present the concept of corporate epistemology as the theory of why and how organizations know, and how they believe knowledge is created. Following the concept of corporate epistemology, we conceptualize the KMS is effective when there is alignment between corporate and individual understanding of knowledge.

Individual Understanding of Knowledge
The theoretical understanding of organizational knowledge has advanced over the last many years. A predominant view is a positivistic science which suggest that knowledge is seen an abstract and oriented towards problem solving [31]. Under this epistemological view, world is seen as pre-given and representationsof actual reality can be stored and re-created. In other words, managers and users of the system are able to create representations of truth through processing of the information available to them.

In contrast to this, autopoietic class of epistemology view knowledge as socially constructed. In this view, objective observation is impossible because realities are not pre-given and are not representable [9, 32]. This view also suggests that reality and knowledge in this case is historical dependent and context sensitive. Furthermore, cognition in this case is an imaginative act, and knowledge is developed through an interpretation process. This view conforms to the Japanese intellectual tradition where knowledge comprises values and emotions, and not only viewed as data or information that can be stored and managed.

Knowledge Management System Utilization
Many scholars in the organizational behavior literature suggest that people gain confidence in terms of what they can do in their work when expertise are shared among the workers [29]. KMS utilization in this paper is referred to as knowledge self-efficacy, that is the perception of a person about what he/she can do with the skill he possess about a particular system [33]. Empirical evidence shows effectiveness of the system directly depend whether users are self-efficient [34-36]. This view further suggests that people can be useful to an organization when they are self-motivated, and can contribute their
knowledge. This is typically manifested in the form where people believe that they have knowledge that can be used to solve job-related problems, improve work routines, or make a difference to their organization.

In contrast, if people feel that they lack knowledge that is useful to the organization, they will distance themselves from contributing knowledge. This is because they would likely to believe that their contribution may not result in having a positive impact in the organization. For the purpose of this study, we propose that increased level of KMS utilization will likely effect KM systems effectiveness.

Proposition 1:
Knowledge Management System Utilization influence Knowledge Management System Effectiveness
Knowledge Management Formation
It has been proposed that KM isa group of clearly defined processes and methods that can be used to search important knowledge among different knowledge management operations[37]. In the past, KM is used to confirm new product development strategies and further strengthen human resource management in accomplishing the enterprise’s goals. Nonaka and Takeuchi (1995) proposed that knowledge formation is generated with the interaction of tacit knowledge and explicit knowledge. They used multiple knowledge transformation models to further explain the development of organizational knowledge as the consequence of interaction between tacit knowledge and explicit knowledge.

The four transformation models include unification: converting tacit to tacit knowledge; externalization: converting tacit into explicit knowledge; recombination: converting explicit into explicit knowledge; and internalization: converting explicit to tacit knowledge [9]. It is suggested that when the experience is obtained by the above transformation, it becomes a valuable knowledge asset for an organization. Furthermore, since the main objective of knowledge management is to increase knowledge through spiral course of socialization, it can have positive effects overall competitiveness of the organization [38].

Several scholars including Machuca and Costa [39] and Taminiau et al. [40] suggest that successful KMS of an enterprise depends on how different activities like knowledge obtaining, refining, storing and sharing. These activities increase the value of the knowledge asset in the organization [41]. It has been suggested that knowledge has currently become the main resource and prerequisite in the successful production of any product or services[6].

Proposition 2
Knowledge Management Formation is likely to influence the overall Knowledge Management System Effectiveness
Research Framework

![Research Framework Diagram]
The Case Study

A positivist single case study research was adopted for this project. This approach is widely used and accepted in many social science fields including but not limited to Information Systems and Management [42-44]. This study followed the guidelines specified by Yin [43], Benbasat, Goldstein, and Mead [45] regarding unit of analysis, single case study and site selection.

XYZTec (pseudonym) was the selected case in this study. XYZTec was founded in 1994, is an IT solution provider, based in California, USA. They have multiple sales offices in North America, South America, Europe and Asia. XYZTec specializes in providing full range of business automation, information security; customize solutions development and independent system evaluation services. There are total of 5000 highly qualified full time employees in the company. XYZTec has a central development center in South East Asia where a team of 500 personnel are employed. The company is listed on American and Dubai stock exchange, and has achieved many quality certifications including ISO 9001 and CMMI levels.

This study followed the guidelines of Myers [46] to select an interesting case for the research. The selection of XYZTec was based on three reasons. First, Chief Executive Officer (CEO) of the company informs the researcher about the huge investment made to acquire a customized Knowledge Management System (KMS) to capture, store and use tangible and intangible information. Second, Human resource manager explained that number of employee queries on different issues has reduced significantly after the deployment of KMS. This trend has been also reported by other managers in their individual functional units. Third, System development manager indicates a trend in the development staff to use new KMS as their one stop shop to find any technical related issue.

A single case study was conducted to explore if KMS utilization and KM formation influence KMS effectiveness. It is important to note that this research was not intended to build a theory or make generalization on the basis of the study, but rather empirically examine if KMS utilization and KM formation influence the KMS effectiveness. Many scholars including Yin [43] suggests that a single case design is justified when the case study is for a revelatory or exploratory purpose. This study only selected a single case, however this can be further expanded to conduct multi case study for cross analysis. A series of twenty in-depth personal interviews were conducted, providing the primary source of empirical evidence for this study. We used actual KMS data as the secondary source. Table 1 show the number of interviews conducted by the position type and Table 2 shows the demographic information of the participants involved in the interviews.

<table>
<thead>
<tr>
<th>Position</th>
<th>Interviews</th>
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<tbody>
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<td>Chief Executive Officer</td>
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<tr>
<td>Chief Financial Officer</td>
<td>1</td>
</tr>
<tr>
<td>Human Resource Manager</td>
<td>1</td>
</tr>
<tr>
<td>Vice President Marketing</td>
<td>1</td>
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<tr>
<td>Director Development (South East Asia &amp; North America)</td>
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<tr>
<td>Project Managers</td>
<td>4</td>
</tr>
<tr>
<td>Software Engineers</td>
<td>7</td>
</tr>
<tr>
<td>Customer Support</td>
<td>3</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
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</table>

*Table 1. XYZTec Interviews.*

All the interviews were conducted face to face between December 2011 and February 2012. Initially interviews were scheduled for twenty five minutes, but in some instances it lasted up to forty-five minutes. All the interviews were semi-structured, meaning that the participants not only provide insights to pre-defined themes, but also suggest other sources of evidence[43]. All participants were notified about confidentiality and anonymity before conducting the interviews. Interviews were
recorded, transcribed and then sent back to the participants for validation. Due to strict company’s confidentiality policy, interviews tapes were first screened before handing over to the researcher. No changes were made to the original recording tapes. Once the researcher received the tapes, no follow up interviews were conducted for elaboration or clarification purpose.

<table>
<thead>
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<th>Age</th>
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<td>25-30</td>
<td>5</td>
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<tr>
<td>31-35</td>
<td>6</td>
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<td>36-40</td>
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<tr>
<td>Greater than 40</td>
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<tr>
<td>Graduate (i.e. M.A, M.S, PhD)</td>
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<tr>
<td>Female</td>
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<tr>
<td>5 – 10 years</td>
<td>11</td>
</tr>
<tr>
<td>Greater than 10 years</td>
<td>8</td>
</tr>
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Table 2. Demographic Information
In addition to semi-structure interviews, secondary data sources including KMS pages, sales reports, and customer complaints reports were also analyzed. This type of empirical data not only helped in gaining better understanding of the case, but also strength the validity and reliability of the study. This study used the suggested guidelines provided by Creswell [47] and Yin [43] to address the issues of reliability and validity in five stages. In the first stage, interview protocol and questions against other similar studies in the literature were validated. Second stage involved gaining multiple sources of empirical evidence followed by documenting and maintaining the evidence. Third stage involved asking interviews to verify the transcripts. Fourth stage involved asking peers and other experts in Knowledge Management to interpret findings. Last stage involved carefully clarifying any bias that might be conveyed in the study.

Analysis of the Case
This study followed the guidelines of Creswell [47] for the data analysis purpose. Six sequential steps were taken to interpret and translate the data. The first step involved the preparation and organization of the data for analysis. This step included first recording the interview and then transcribes it. This was followed by assigning a unique identifier to the interview and then storing in the case database. The second step also involved reading through all the data organized in step 1. This was conducted both during and after the data collection phase. The main objectives of these activities were to develop an overall understanding from the information, note down reflections on its general meaning, and identify apparent themes emerging from the data. The third step involved the start of a coding process for detailed analysis. This process takes an empirical data, segment it into categories, and assign a label (code) to each category.

All of the empirical data was grouped into pre-defined categories as per research framework. Initial codes were assigned to each category and preliminary analysis was performed for each interview transcript. The fourth step involved the refinement to the initial coding scheme. In the fifth step, findings from the previous steps were communicated to the audience. The final step in the analysis was to make an interpretation of the empirical findings. This was followed by evaluation of findings.
through peers and other experts to gain a fresh perspective. This was then debated and compared the differences of the interpretation until final consensus was reached.

First proposition of this research was to examine if KM systems utilization influence KM system effectiveness. There were many evidences gathered through the interviews with the participants as well reviewing the reports that KM system utilization influence overall effectiveness of the KM systems. Quote 1 and 2 provide evidence toward this end.

**Quote 1**
We consider our KMS as a one stop shop for all queries. As our unit starts to use it more often, it turns out that not only we get benefit from it but other unit sometimes appreciates our efforts of sharing knowledge with them.

**Quote 2**
There has been significant reduction in total search time. We used to email different units to inquire about any issue. In some cases, we used to get reply after weeks. Since we have implemented a companywide policy to heavily use KMS and share knowledge, it has improved our productivity as well as increase the individual understanding of knowledge.

Second proposition of this research was to examine if KM formation is likely to influence the overall KM system effectiveness. As mentioned earlier, we used actual KMS data to observe the pattern if formation really do effect the overall KMS effectiveness. There were set criteria were used like individual posting frequency, total numbers of visitors, popularity of post, responses in each post, usage per week, and most commented post as a measure to evaluate the effectiveness of the KMS. Many empirical studies have suggested that KM formation plays an important role in building up core competencies of an organization [48, 49]. This study finding were aligned with previous studies and enriches Theory of Knowledge Reuse [1] by indicating that role of KMS and knowledge repositories would likely to influence the KSM effectiveness.

**Research Contribution**
This paper has made important theoretical and practical contribution. From the theoretical stand point, most of the empirical research in knowledge management involves around using survey to gather information. This study adopts a different method and employ positivist case study to gathers data from interview as well as analyzes the actual data generated within a company. Since data generated through KMS systems have limited biases, the finding further extends existing knowledge management literature. In addition, this study also enriches the existing literature knowledge management utilization and formation [50]a by explaining the role of both for achieving high level of effectiveness.

This study can be useful to industry practitioners because the findings reinforce the likely impact of KMS utilization and KM formation on KMS effectiveness. This study further extends our understanding of KMS effectiveness. Data from single case study shows that increase level of KMS utilization and properly managing the knowledge in an organization is helpful to increase the individual understanding of knowledge and can help organization to perform better. This finding of this study can further provide empirical evidence to senior management personnel to pay close attention to Knowledge management initiatives and make plans to invest much more in these kinds of initiative.

**Conclusion**
In this paper, we have explored if knowledge management system utilization and knowledge management formation would likely to contribute in the knowledge management system effectiveness. Several general conclusions may be drawn from our work. First, it was found that hierarchy of system
objectives need to be considered in the evaluation of KMS effectiveness. In the context of this research, the evaluation relate to system use and the user satisfaction in using a KMS. Second, although formal evaluation approaches are required to measure the KMS effectiveness, informal approaches to gaining the perceptions of the system need be considered too. We have done this by extracting the data from the actual KM and analyze it to further gain insights. Lastly, subjective measures need to be employed so that better understanding of KMS effectiveness can be assessed.

References


