A Knowledge Management Model to Improve Performance in Tertiary Educational Institutions

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***Abstract*—**Knowledge management (KM) and learning technologies are an application of information technologies in business and in tertiary education. To successfully develop performance enhancement systems, tertiary educational institutions must link learning and operational processes with KM technologies to achieve enhanced performance. Using as a foundation concepts based upon a) process reengineering in tertiary education, b) collective learning, c) task-technology fit (TTF) theory, and d) an incorporative learning and performance architecture, this study proposes a model for incorporating KM technologies into tertiary educational processes, providing enhanced knowledge transfer and sustained competitive advantage.

***Keywords*—**Learning technology, Knowledge Management (KM), tertiary educational institutions, learning enhancement.

I. Introduction

INNOVATIVE technological solutions enabling new educational experiences inevitably lead to discussion regarding whether the use of the technology is effective. There are a number of mitigating factors in tertiary education, including the rapid rate of change in education, increased competitive pressures, increased workloads and other socio-educational issues. These demands lead institutions to constantly reassess their processes, searching for continuous growth and development [1, 2]. Knowledge Management (KM) technologies may offer assistance in achieving these goals.

In tertiary educational strategy, the improvement of operational processes is a major challenge. The implementation of Knowledge Management poses challenges such as the organization and management of diverse data, systems, and technology architectures [3]. This results from the need to incorporate various computer programs, data sources, and technology across internal processes. There is a simultaneous need for concurrently adapting enterprise architectures to keep up with challenges in the external environment. To cope with these challenges, innovations regarding the use of existing technologies (or their substitution with newer technologies) must be undertaken.

The adequate establishment of KM technologies in tertiary education processes needs to include key organizational matters such as human factors (aka learners), organizational strategy, existing and proposed processes and feasibility assessment [4]. There is a need for a broad action plan including how learners' will be included and affected [5], and the incorporation of subject matter and context processes [6]. The introduction of new experiences or systems often requires the introduction of KM technologies that frequently lack perspectives such as strategy alignment, information and communication technology (ICT) innovation, and management and industry processes changes [7].

While Knowledge Management technologies may have great potential in enhancing tertiary education processes, an adequate theoretical method for incorporating these systems must be developed such a method should be based on the activities connecting KM technologies, tertiary education processes and operation enhancement endeavors. This research uses the concepts from processes reengineering in higher education, task technology fit theory and a cooperative learning and performance architecture to suggest a theoretical model. The objective is to enable enhanced service outcomes and sustained competitive benefits. The following sections include a review of process reengineering in higher education, task/technology fit theory, performance architecture, and collective learning.

II. Concepts of Process Reengineering

In higher education, the process reengineering is used to redesign business processes in order to enhance organizational performance [8]. To achieve their goals and to be competitive, all educational institutions in our knowledge-driven world must, of necessity, be organizations who are continuously challenging themselves to develop new information and knowledge, and to do it ever faster. They must use this information and knowledge better than their rivals. In this study, the process reengineering model of Martin [9] is used as a guide for incorporating KM technologies into the processes of tertiary education institutions. The model proposes process reengineering at three levels in organizations.

The first level is procedure redesign, where new ways are needed and developed to accomplish existing processes. Without such process redesign, there will be minimal enhancement in productivity. Procedure redesign may include enhanced dissemination of knowledge and information, or automation of activities, but it does not necessarily require altering the organizational structure.

The second level is process reinvention, and the emphasis is

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on altering processes to deliver enhanced customer service. The need of customers' drives the redesign of the processes, rather than customers merely being asked to adapt their behavior to the needs of the processes. There are primary processes such as research programs and educational programs, while secondary processes include human resources and financial management.

The third level includes a thorough redesign can hopefully lead to great benefits but may have high risk as well (such as being able to minimize barriers to rapid, adaptive decision-making). Implementing redesign strategy in institutions generally results into a comprehensive reduction in operational cost; fluid communication of knowledge and information; increased rate and effectiveness in performance; minimization of barriers to prompt and adaptable decisions; increased responsiveness to customer requirements; augmented utilization of information-based decision-making; and increased value from the institution's stake in human resources [10]. Revision of the organizational strategic vision may be needed to ensure that effective reengineering strategies are in place. The failure of the institutional transformation effort is high [10] in institutions that perceive this transformation as a technical effort instead of a strategic one.

III. Task-Technology Fit Theory

Researchers are always intrigued by trying to predict and analyze the way information technology influences institutional and human performance [11]. Davern and Kaufman [12] suggest that research about effectiveness of industry processes can help enhance design perspectives for more efficient utilization of information systems and knowledge. The task-technology fit theory (TTFT) by Goodhue and Thompson [13] focuses on the relationship between key elements of information systems: user capabilities, task requirements, and system characteristics. These can be applied to knowledge systems, namely individual characteristics, task specifications, and ICT.

Task-technology fit theory [13] has been used to evaluate individual human performance with information systems and with knowledge. The theory posits [13] that information technology is likely to impact positively on individual performance, and be utilized, if the functionality of the information technology corresponds to the tasks the users conduct.

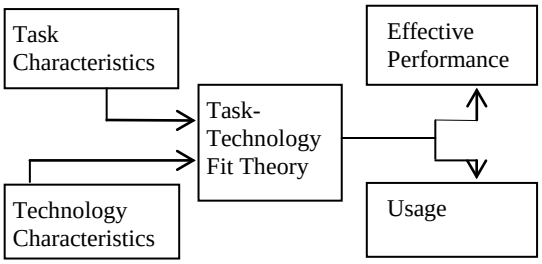

Fig. 1 Model for task-technology fit theory (Goodhue and Thompson, 1995)

A. Tasks

Are actions (processes) carried out by users to transform input to output. Task characteristics can include diverse aspects of information technology. Users depend upon the capacity of the information system to process queries using the organizational databases [13]**.** Technology may help users perform their required tasks, but characteristics of the individual, such as computer competence, training, and motivation, will in part determine whether the adoption is successful. Gerlach and Kuo [14] described user interactions with computer-based systems as a categorization of tasks.

B. Technology characteristics

Are measured using a variety of dimensions. There could be a twofold emphasis for underlying characteristics of technology: the first where the technology is viewed as a tool, and there second where it is viewed as a representation. Technology viewed as a tool has the provision for a physical interface for utilizing the technology while technology viewed as a representation suggests a model of the real task. Differentiating between technologies viewed as tool and viewed as representation is helpful in organizing different behaviors with information technology [15]. When dealing with human-computer interaction [16], technology is viewed as a tool.

C. Performance impacts and utilization

Newell [17] tried to explain individual behavior by providing a framework in terms of goals and knowledge called the principle of rationality. This principle states that if an agent has the knowledge to achieve their goals, then the agent can act [17]. This suggests that if the goals of the user are known but the knowledge of the user is unknown, then their knowledge needs to be determined. If the knowledge and goals of individual users are known, their behaviors can then be predicted. To understand performance and behavior with information technology therefore needs an understanding of both the knowledge and the goals of individuals.

IV. Cooperative Learning

Learning and training have considerable importance in any effective tertiary education institution. Faced with the ongoing challenges of continuous change and a constant need for knowledge, these institutions see cooperative learning and technology-based Knowledge Management as a way to keep pace with change by strategically incorporating learning and performance architectures [18]. Such architectures are an integration of electronic and non-electronic methods which support informal learning, formal learning, and the enhancement of performance. The model below shows the incorporation of knowledge management as a relationship between learning, learning technology, knowledge, and abilities of individuals, which can lead to the development of "smart enterprises" [18]. The concept of learning includes the following:

A. Cooperative learning

Cooperative learning can occur at the workplace. Workers learn from material provided over the corporate intranet, from peers, from publications, and through trial and failure. Where individuals are lacking in skill, there should be optional and/or

required professional development or knowledge transmission opportunities in place to enable them to complete their tasks.

B. Learning

Learning is not perceived as training. Learning goes beyond the traditional classroom and is essential to the acquisition of efficient work skills. Training has been defined as the facilitation of learning, and learning is one of the many important activities that promote individual and organizational performance.

C. Training

Training cannot exist on its own. The necessity for new knowledge and skills to develop new sustainable competence fosters an extended set of solutions to help employees learn, and to enhance individual performance.

D. Technology

Technology may be a powerful tool with regard to increasing workforce productivity, and it can play a similar role for learning. From personal computing to the World Wide Web, through global networks, technology has influenced productivity. Technology can only support learning and performance architectures; it does not create them.

E. Effectiveness

Effectiveness in learning (what individuals learn) is essential to the enterprise. Effective learning does not, in and of itself, comprise the fundamental value proposition. The value proposition is a result of the improvement of workforce performance (what individuals really do), which adds to business success.

Knowledge Management is viewed as sharing and creating a valued information experience [18] with insight within and across communities of individuals and institutions with similar needs and goals to build and develop competitive advantage. Technologies are strategically and selectively integrated to best support business-oriented learning and performance solutions. There are a number of factors which make the implementation of a KM system into tertiary education viable. These include the capabilities of modern technology, extreme high-speed Internet connectivity, and the alignment and integration of industry systems, information systems, human factor systems, and learning and performance systems.

V. Reasons for Incorporation of KM to Tertiary Education

Tertiary educational institutions are intended to be repositories of knowledge. However, one of the main repositories for this knowledge is in the minds of faculty and researchers, and this is notoriously volatile. There are difficulties in accessing, coping, and distributing this knowledge. People with knowledge leave, retire, forget, and die and they take the knowledge with them forever. However, there are processes such as cooperative learning, socialization, externalization, combination, and internationalization [20] which allow individuals to interact with one another to spread institutional knowledge. Such examples include discussion and bulletin boards, e-mails, multimedia conferences, and collaborative hypermedia.

In the process of socialization, tacit knowledge transforms to tacit knowledge where the ICT technologies used for KM allows individual interactions with one another by allowing the institutional knowledge to disseminate across the tertiary institution. In the processes of externalization, tacit knowledge transforms into explicit knowledge. The institutional repository plays a considerable role in structuring and developing knowledge to make it available to other individuals in the institution [20]. Combination processes transform explicit knowledge into tacit knowledge using supporting tools such as workflow applications and decision supports systems. Internalization processes transform explicit knowledge into tacit knowledge, facilitated by the use of knowledge management technologies that include computer-based learning and teaching, data mining, and data warehousing The goal is to create a the repetition of experiences that the individuals or experts have achieved earlier in similar conditions. Laffey [23] suggested a dynamic performance support model to tackle problem situations which incorporated knowledge development, community collaboration, references, and tools for training.

In cooperative learning processes, there is a need to create more tacit knowledge from existing tacit knowledge. Such KM technologies favor user interaction, allowing users to connect with one another. They spread organizational knowledge across the entire institution using discussion boards and lists, e-mail, bulletin boards, multimedia, collaborative hypermedia, and conferences. With internalization processes, explicit knowledge is transformed to tacit knowledge. KM technologies permit apprentices to repeatedly practice that which specialists have done in similiar situations, using tools such as data mining and data warehousing. Finally, in combinative or hybrid processes, explicit knowledge is transformed to tacit knowledge with supporting tools for workflow applications and decision support systems.

Performance improvement and learning in tertiary education has become a strategic initiative and incorporates instructional design, training, and Knowledge Management [24]. The effectiveness of tertiary education depends on the ability of the institution to manage its business processes, allowing institutions to develop institutional. Knowledge and information can be combined using technology to provide customized performance support and opportunities for knowledge users [21]. Ratbould [22] proposed a description of electronic performance support systems that incorporate KM processes and some technology learning elements.

The literature suggests that there are critical dimensions to be addressed in the transformation of knowledge management and institutional processes through utilization of adequate ICT technologies to enhance learning. Grant [25] developed a management perspective that indicated the importance of strategic and institutional contributions and theories. These perspectives are defined by a set of processes through which knowledge is developed, acquired, shared, gathered, protected, and applied by the industry to enhance their performance [26].

Literature suggests that knowledge management is a key element in the institution‘s ability to support their employees in the tasks of tactical and strategic decision making to achieve competitive benefits [27]. Yeh et. al., [28] stated that the

effectiveness of knowledge management is essential for ICT technologies. Organizational and tertiary institutions can reduce the use of manpower, material, and time, yet at the same time achieve expected results and improve output. Smith [29] and Swan [30] indicated that institutional habits are important elements in KM sharing.

Garavelli et al. [31] and Earl [32] suggested that knowledge habits, with human resource experiences, leadership, and institutional structure, is a considerable factor in facilitating implementation of KM strategies. Ortenbald [33] proposed a KM incorporated model consisting of institutional learning, learning at-the-work place, the learning environment, and an institutional structure that is flexible and natural. Learning institutions here are defined as to institutions that acquire, create, and transfer knowledge, and also reflect new knowledge [34]. A hybrid KM framework strategy in tertiary education was proposed by Sarawanawong et al. [36] in which a human factor strategy/people to people played the leading role while people-to-document strategy played the supporting roles. Chen and Burstein [36] proposed a model for KM for tertiary education that was based on a combination of ICT technology and an effective KM framework. The model focused on the KM framework that includes information resource management and organizational issues to help adapt KM implementation processes to more effective.

VI. Proposed Model

The proposed model uses basic concepts from the literature that were used to develop a process of incorporation of KM components which represent a matrix of activities that are interconnected by several phases and knowledge management components. The model, shown in Table 2 below, contains several interconnected phases which integrate knowledge management activities and KM elements to create an essential solution to a problem. Adequate enabling KM technologies or tools were used to create adequate environments to improved learning and performances in tertiary educational institutions.

TABLE I
Proposed Model of Incorporated KM into Learning

	Learning Habits	***KM Technologies***	***KM Process***
Task	KM Function	Technologies for KM	Operation of KM
Solution	Solution to KM learning	KM Functions	Solution to KM Operation
KM Reengineering	Reengineering of KM Learning	Creation of User Interface	Reengineering of KM Learning
Implementation of Solution	Incorporation of Technologies into System	Incorporation of Technologies into System	Support Services to KM

A. KM Components

1) *Cooperative learning* can occur at the workplace. Workers learn from material provided over the corporate intranet, from peers, from publications, and through trial and failure. Where individuals are lacking in skill, there should be optional and/or required professional development or knowledge transmission opportunities in place to enable them to complete their tasks.
2) Learning habits: The learning process builds upon a set of values, actions, and experiences that establish the processes of continuous learning within the institution. The process of training is a key component in the business strategy of an institution for continuous learning. By being involved in the process of learning, humans can re-analyze their learning and their relation to it. Senge [37] discussed four different components of learning that could help build a strong learning organization. These consisted of: (i) Human ability–This creates an environment that motivates individual and institutional goals to expand in partnership; (ii) Cooperative vision–Builds a sense of cooperative engagement by developing shared ideas of the future; (iii) Group learning–Transforms communication and collective analytical skills to enable group dependent development of individual intelligence and capacity; (iv) System thinking –Develops the ability to view institutional system as one whole system with changes to reflect to all elements of the system.
3) *Technologies:* ICT technologies support and lead knowledge management in tertiary education to support knowledge platforms, databases, and integrated performance support systems [38]. The fact that ICT technologies and knowledge management are related [28] assists in the dissemination of structured knowledge within an institution. Zack [39] indicated that ICT has four different roles in knowledge management: receiving knowledge, storing, connecting knowledge-oriented digital items, and defining related contents. The success of KM depends largely upon the selection of appropriate KM technologies and tools. From conducting searches to content document management to cooperation, there are an array of applications and tools that make a KM system function. The choice of appropriate ICT technologies should facilitate the search for knowledge and information, provide a platform for the coordinated sharing, updating, and archiving of knowledge, guide the matching of experts with tasks, and provide systematic assessment of existing content.
4) *KM Processes:* Knowledge management processes are based upon the concept of retrieving data and turning it into applicable and useful knowledge. These processes include data gathering, data organization, data storage data analysis, and sharing of knowledge. Tertiary educational institutions could determine what needs to be enhanced, what can be disregarded, what needs to be increased, and what could be achieved in the future. Shukor et al. [40] defined knowledge management processes as an approach to the gathering, organization and distribution of intellectual assets to guide the institution's long term performance. Knowledge management processes turn an institution's intellectual property into value, may assist in achieving greater productivity, and allow the development of competitive advantage. To develop a comprehensive method to integrate knowledge management technologies in tertiary

education processes, an institution needs to develop a knowledge lifecycle. The authors suggest selecting and targeting key organizational knowledge management processes which can operate within a knowledge management framework. The incorporation of KM technologies in tertiary educational processes, like any changes, can involve risk and uncertainly. Unless organizational receive stakeholders' support to create a conductive environment for the sharing of knowledge, the projects have little chance of success. The introduction of KM in tertiary education represents institutional change and thus the level of participation of management will strongly govern its success or failure [41]. The commitment of upper management in KM implementation will determine, to a greater or lesser extent. the amount of resources allocated and the time permitted for learners to conduct the creation and collaboration of knowledge [43].

B. Stages of Incorporation of KM

1) *Identification of a problem:* At this initial stage, the organization attempts to analyze the current situation, their objectives, and the rationale for learning, potential ICT technologies, and knowledge management processes in order to identify challenges and changes. Rosenberg [18] emphasized the importance of this stage to define both negative and positive views of the current system with regard to how the institution creates, keeps, and distributes knowledge and information, how people cooperatively work, and how specialists are used.
2) *Determination of solutions:* This stage identifies potential solutions to learning issues, technology issues and the determination of essential knowledge management. Using documentation from problem identification, the results of this stage are used to chart the essential processes. This assists not only in mapping core procedures, but is also relevant for reengineering tertiary education processes.
3) *Reengineering of processes:* This phase determines the configuration and design of technological functionalities of learning processes, knowledge management processes, the management environment. These could include tools for search engines, development of content management, regulation of proprietary knowledge and information. In this phase, learning and knowledge management processes are reengineered, with ICT technologies functioning as facilitation tools.
4) *Implementation and Assessment:* The final stage includes the development of a prototype of the reengineered processes, focusing on stakeholders' and users' concerns and issues. The tracking of changes and the implementation schedule are monitored to ensure efficient operation. The role of organizational leadership is to ensure that training precedes implementation to mitigate user resistance to change since knowledge management may represent a new way of supporting performance and learning in tertiary education, special attention is provided to the continuous management of change in the institution.

VII. Significance of Model for Practice

This research aims to identify relationships between enabling KM technologies, institutional learning, and knowledge management processes to help achieve performance enhancement in tertiary education. Knowledge can be perceived as a set of processes in learning that can be navigated, and if correctly implemented can lead to competitive advantage [42]. Knowledge management focuses on institutions addressing their knowledge in a systematic life cycle in which the role of ICT technologies is to facilitate KM efforts and development [44]. KM processes and strategies should be aligned with tertiary education processes [45].

In tertiary education, technology allows the connecting of students, faculty, and is seen as a tool for creating and sustaining learning. Technology enhances the quality of learning by providing a single gateway to a wide range of instructional resources, while maintaining institutional control [18].

The proposed model can be used as a complex framework to provide a holistic design of institutional processes to help overcome obstacles such as decreased attention to human perceptions, non-systematic study of alternatives and preliminary evaluation of performance impact. In particular, the model can serve as a tool for tertiary education leaders, stakeholders, and policy makers to increase the effectiveness and efficiency of education. This can be achieved through creating an inter-disciplinary and multi-oriented strategy to provide enhanced performance and change, assessing institutional context and human factors, and the adoption of new models for institutional change.

The rapid development of new technologies has challenged tertiary education institutions to service employees and users alike with continuously changing institutional rules. Recent trends towards knowledge, worldwide competition, internationalization, and mass customization of education have led to the development of virtual teams and network structures. This creates mutual dependencies between ICT technologies, institutional learning, KM leadership and processes. This takes into consideration skills, performances, competitiveness, and institutional knowledge to create a mutual connection that bridges individual and institutional learning. Enterprise learning seems to be closely aligned with learning tasks which are related to specific job and institutional processes, objectives, and workflows. Desired outcomes include enhanced productivity, an improved use of content, learning technologies, and resources, a significant emphasis on learning context, and improved performance and satisfaction.

VIII. Conclusion and Further Research

The objective of this study is to propose a model for incorporating KM technologies in tertiary education processes to achieve improved institutional performance. The model uses basic concepts from process reengineering coupled with task-technology-fit theory to connect institutional learning, KM technologies, KM processes, and leadership. The incorporation of KM technologies can change education frameworks, assisting in the creation of an effective and comprehensive design. The study supports cooperative learning and KM architecture, and Rosenberg [18] argued that

if tertiary learning is conceptualized as development of knowledge through encouragement and participation in practice, then developing and maintaining two separate systems, one for learning management and another for KM would not have much meaning.

The research presents suggestions for further research such as defining the extent to which institutions engage in knowledge management, assessing the adequacy of KM technologies, and their use in establishing and developing learning outcomes and requirements. The use of technologies, such as extranets, intranets or groupware, cannot by themselves deliver enhanced performance in tertiary education, and further research is required to define how these technologies can be appropriated by the users. This study focused on utilization and incorporation of KM technologies in learning, teaching, and research to emphasize the flexibility, interactions, and innovations [46] which are possible. This can only be accomplished through linking humans, tasks/goals, and pedagogy, consolidating links between KM technologies and learning processes, and improving internal development activities needed for KM technologies to be able to enhance tertiary education processes.

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