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ABSTRACT

With the advancement of new communication and virtualization technologies, various tools and models have been proposed for enabling effective management of the e-collaboration processes related to the creation, sharing, and presentation of collective knowledge. In the theoretical perspective, two significant aspects of collaborative knowledge management have been considered: (a) the *internal processes* of collaborative knowledge creation and sharing, which occur not only within the individual knowledge workers but also among them (collaboration); (b) the effective design of *human-computer interfaces* facilitating the internal processes, by providing functionalities for the knowledge workers to comprehend, conceptualize, and cooperate in knowledge creation and sharing through e-collaboration processes, including the effective presentation of the generated knowledge on the website. At the present time, although there exist several studies in the related areas, there is no unique conceptual model that can be applied toward assessing both the interface layer and the internal processes of collaborative knowledge creation and sharing in distributed ICT-based work contexts. This gap has been a great motivation for us to propose a conceptual model, namely the *Unified Collaborative Knowledge Management* (UCKM) model, which can be used to design and evaluate the overall knowledge management process, including the underlying sub-processes, the presentation of knowledge, and the human-computer interfaces.

Keywords

E-Collaboration, Collaborative Knowledge Management, Unified Model for Collaborative Knowledge Management, Wikipedia

INTRODUCTION

Knowledge management (KM) is not just about technology; it is the process of creating values from intellectual capital and sharing that knowledge with others who need that capital (Kroenke, 2008). The goal of knowledge management systems (KMS) is to provide the right information, to the right person, just in time, in order to make the most appropriate decision. Theoretically, knowledge management can be described with two different processes: (1) the knowledge creation & storage process, and (2) the knowledge sharing & distribution process (Raghu & Vinze, 2007). With recent technological advancements of new communication information technologies, such as wikis, blogs, social networking, avatar-based 3-D virtual worlds, et al., there has been a huge change in the way people communicate and contribute to creating and sharing knowledge. Knowledge management with wikis[1], for example, is a new community-based collaborative approach to create and share knowledge, namely the *collaborative knowledge management (CKM)*. Wikis are often used to create collaborative websites and to power community websites. One of the best known wikis is Wikipedia[2], which is the largest online multilingual free encyclopedia built collaboratively using wiki software. The English-language Wikipedia, for example, currently (as of February-27-2010) contains more than 3,200,000 articles (almost 15 million articles worldwide in more than 270 languages), and there are over eleven millions registered user accounts[3]. In Wikipedia, through the web interface, people

[1] A wiki is a type of computer software using which users may create and share web pages. It includes a set of linked web pages created through the incremental development by a group of collaborating users. They are provided with tools and authorization to view, create and edit an existing topic. All the articles posted are under GNU Free Document License.

[2] http://en.wikipedia.org/wiki/Wiki

[3] http://en.wikipedia.org/wiki/Special:Statistics

with diverse backgrounds and perspectives are allowed to present and create collective knowledge, which improves over time and eventually converges.

Although there have been numerous studies on knowledge acquisition and sharing in the past decade, most of the studies do not focus on this new way of collaborative knowledge acquisition and sharing using online collaborative communication information technologies such as wikis. Limited number of studies (Dearstyne, 2007; Kolbitsch & Maurer, 2006; Parameswaran & Whinston, 2007; Wagner, 2004) have introduced the wiki technology; they, however, do not discuss the emerging approach of the collaborative knowledge creation and sharing processes of knowledge management via web interface. Therefore, the goal of this study is to fill this gap by proposing a conceptual model for collaborative knowledge management, namely the *Unified Collaborative Knowledge Management (UCKM)* model, and by illustrating the online collaborative knowledge creation and sharing processes using a wiki application (i.e., *Wikipedia).*

THE EVOLUTION OF KNOWLEDGE MANAGEMENT

The evolution of Knowledge Management (KM) can be chronologically divided into four periods: Development, Consolidation, Extension, and Elaboration. Table 1 summarizes the evolution of Knowledge Management in each of those four periods.

Evolution Period: Main Focus	Key Theme & focused issues	Driving Forces	Examples of KM Systems
Development: Within an organization (1960s – 1970s) Know-what	The conceptual foundations of KM - Resource based view of the firm (Penrose, 1959) - Knowledge classification (Polanyi, 1962) - Organizational learning models (Argyris, 1976)	- Increased number of large organizations - Transaction processing systems and manufacturing automation	- Expert systems & knowledge-based systems in research labs (e.g., DENDRAL-1971; MYCIN-1975; HACKER-1975)
Consolidation: Beyond a single organization (1980s – early 1990s) Know-how	Competitive strategic framework - Organizational design and strategic fit (Mintzberg, 1980) - Strategic capability of the firm (Prahalad & Cowin, 1983)	- Globalization - Shift toward service and knowledge based organizations	- Operational uses of DSS and GDSS - Computer Supported Cooperative Work (CSCW) (Kraemer & King, 1998) - Total quality management
Extension: Internet-based (mid 1990s - onwards) Know-where	Internet based applications & systems - Increased attention to knowledge and intellectual capital management - Industry practice and prescriptions for effective KM (Davenport, Long, & Beers, 1998)	- Web applications (Web 1.0) - Business process re-engineering - Emergence of information economy	- Business intelligence - Data mining & data warehouse technologies - Workflow management systems
Elaboration: Web 2.0 & collaboration (late 1990s - onwards) E-Collaboration	Collaborative knowledge management - Conversational knowledge management - Web-based group work management - Distributed collaborative design - Distributed collaborative authoring	-Web service platform - People power, social networking, collective intelligence (Web 2.0) - Mobile technologies	- Internet based KM Services (e.g., www.askme.com, 1999) - Wikis (1995), Blogs (approximately 1994) - Intelligent and mobile agent systems

Table 1. Evolution of Knowledge Management (KM)

The development phase of KM started in early 1960s (Raghu & Vinze, 2007) and went through 1970s. It was the time when KM concepts (i.e., know-what) were developed and explored. The growing number of large organizations with the need for transaction processing systems and manufacturing automation was the essential force that formulated the conceptual

foundation of KM. The key research themes related to this time period were the resource based view of the firm (Penrose, 1959), knowledge classification (Polanyi, 1962) and organizational learning models (Argyris, 1976), et al.

KM entered a period of consolidation beginning in 1980s and lasting until early 1990s. During this time period, emphasis shifted from developing conceptual foundations of KM to achieving competitive advantages using knowledge management systems in the global business environment. Issues such as organizational design and strategic fit (Mintzberg, 1980) and strategic capability of the firm beyond an organization (Prahalad & Cowin, 1983) became more important, partially because of the increasingly competitive global business environment.

The appearance of the Internet and the World Wide Web, along with the concepts of business process re-engineering and digital economy, helped to create the extension period of knowledge management (early 1990s and onwards). The concept of knowledge was extended to knowing where to find it (i.e., know-where) via the Internet. With the support of technologies such as business intelligence, data mining, data warehousing, and workflow management systems, the KM studies in this period have extensively focused on Internet-based applications and systems (Davenport et al., 1998).

The fourth period of KM evolution (i.e., elaboration) began in late 1990s and has extended through the present day with the appearance of online virtual communities and Web 2.0 applications (Kim, Yue, Perkins-Hall, & Gates, 2009). The focus of this period includes the collaborative knowledge management and conversational knowledge management (Parameswaran & Whinston, 2007). With the growth of people power in online communities, innovative ways of online collaborations, and the advancement of technologies such as Web service platform, social networking, Wikis, Blogs, ubiquitous computing, and others, the main focus and practice of KM has been moving towards a new trend (i.e., e-Collaboration).

THEORETICAL MODELS OF COLLABORATIVE KNOWLEDGE MANAGEMENT

Although a few studies (Cress & Kimmerle, 2008; Dearstyne, 2007; Kolbitsch & Maurer, 2006; Oinas-Kukkonen, 2005; Parameswaran & Whinston, 2007; Salisbury, 2008; Wagner, 2004; Yang et al., 2008) in the knowledge management and communication information technology areas discuss new ways of collaborative knowledge acquisition and sharing, to the best of our knowledge there is very limited research on the theoretical framework that can capture the collaborative knowledge management process and the human-computer interfacing of knowledge creation and sharing via website interface at the same time.

Oinas-Kukkonen (2005) presented a 7C model for the evaluation of organizational knowledge creation. The model consists of six elements grouped into three contexts: Technology context (*Concurrency* and *Connection*), Language context (*Communication* and *Comprehension*), and Organizational context (*Collaboration* and *Conceptualization*), which altogether contribute to the creation of growing *Collective Intelligence* (the 7th element). As a part of knowledge management theory, the model highlights the process of organizational knowledge creation and its applicability to organizational knowledge management inside organizations. This model is valuable in evaluating the knowledge creation and management process at the organization level, but it does not address the collaborative knowledge creation process on the web and how the process relates to the new interface design elements of Web-based knowledge management systems.

Combining Luhmann's social systems theory (Luhmann, 1986, 1995) and Piaget's cognitive theory (Piaget, 1970, 1977a, 1977b), Cress and Kimmerle (2008) proposed a theoretical model describing how learning and collaborative knowledge building take place with wikis. From the cognitive system's perspective, they described how individual learning occurs as a result of two iterative processes: *externalization* and *internalization*. People first externalize their own knowledge conveyed into a social system (e.g., wiki) by their own cognitive processes, and later inter-individual knowledge transfer and collaborative knowledge building take place when people interact with the social system. Using Piaget's model of equilibration (Piaget, 1970, 1977a, 1977b), they described two ways of how people deal with new information (i.e., *assimilation* and *accommodation*). If new information is not in line with their existing knowledge, this triggers a cognitive conflict. To solve this conflict, people can either assimilate the new information (i.e., understand new information on the basis of existing knowledge and integrate the information into their prior knowledge) or accommodate the new information (i.e., change their knowledge in order to better understand the environment and its information). Although their framework describes the collaborative knowledge building process using a wiki, it is mainly focused on the cognitive processes of individual learning without considering interface designing elements of Web-based collaborative knowledge management systems.

Yang et al. (2008) proposed a 8C reference model for Web 2.0 applications. This model presents the interface design elements as 8 Cs: *Context* (how the site is designed), *Content* (what information is presented), *Community* (how the users communicate with each other), *Customization* (the customizable capability of the website), *Communication* (how the site communicates with the user), *Connection* (how the site is related to other sites), *Commerce* (e-commerce functionalities), and

Collaboration (features that allow participants to collaboratively contribute, e.g., article posting, collaborative editing, et al.). Although the 8C model well represents the interface design elements of the new trend of Web-based applications, it does not capture the internal mechanisms of the underlying collaborative knowledge management process.

Salisbury (Salisbury, 2003, 2008) proposed a framework (namely Collaborative Cognition Model) for managing the life cycle (create, preserve, disseminate, and apply) of knowledge in organizations and described how learning can be supported at the individual, team, and organizational levels. The model addresses learning in the context of the work at the moment – creating an 'authentic context' for learning at the individual level; at the team level, the model supports learning in the context of a 'distributed environment' where cognition is distributed across individuals, their artifacts, and the history of their artifacts; the model supports creating a knowledge spiral in an organization where transferring knowledge from one organizational member to another.

Since the previous studies provide complementary theoretical contributions to the research in collaborative knowledge management, the combination of those studies would provide a unique conceptual model that can facilitate both the internal collaborative KM process and the external interface design elements of collaborative KM through web applications.

THE UNIFIED COLLABORATIVE KNOWLEDGE MANAGEMENT (UCKM) MODEL

To provide a comprehensive view of collaborative knowledge management, combining the three previous models, we propose a synthesized conceptual model, namely the *Unified Collaborative Knowledge Management (UCKM)* model (Figure 1) in distributed ICT-based e-collaboration work contexts. From the social systems' perspective, the model conceptually consists of two layers: the inner process layer and the outer interface layer.

The *inner layer*, aka the *CKM Process Layer*, represents the internal mechanisms of the knowledge creation process, which consists of cognition, comprehension, conceptualization, consensus, and collaboration. Comprehension, conceptualization, and collaboration are consistent with corresponding elements in the model proposed by Oinas-Kukkonen (2005). The first component, *Cognition*, refers to the consciousness and willingness of an individual to get involved in the knowledge creation process. *Comprehension* refers to the individual process of surveying and interacting with the external environment to identify problems, opportunities, and need; the process embodies explicit knowledge in tacit knowledge. *Conceptualization* is a reflection process articulating tacit knowledge to form explicit concepts and systemizing the concepts into collaborative knowledge management systems (e.g., wikis) through consensuses and collaborations. This process is similar to that of externalization of the model proposed by Cress and Kimmerle (2008). People can externalize their individual mental knowledge by contributing to creating collaborative knowledge in collaborative knowledge management systems, and then later other people can share the knowledge and/or edit the collaborative knowledge in the systems. The conceptualized (i.e., externalized) knowledge generated out of those processes can be used to facilitate other members' collaboration, which eventually requires to consensus.

The *Collaboration* process represents the interactions between members of a team, working together to create and/or share knowledge. *Consensus*, as an inherent part of the collaboration process, is an agreement among members and is a way to make decisions. Consensus is a fundamental component of building and revising knowledge through collaboration. Those five processes iteratively interact with each other and collaboratively contribute to the creation of *Collective Knowledge* that is a result of the processes. The collective knowledge eventually evolves in breadth and depth through the e-collaboration processes. It is worthy to know the collective knowledge creation mechanism is not a sequential process; the overall knowledge creation process is an iterative co-evolution process, consisting of looping back from one process to one of the other processes. Because of the open and iterative co-evolutional process that is much like that of the natural selection process, the concept "Darwikinism" is used to describe this socially Darwinian process (Boulos, Maramba, & Wheeler, 2006).

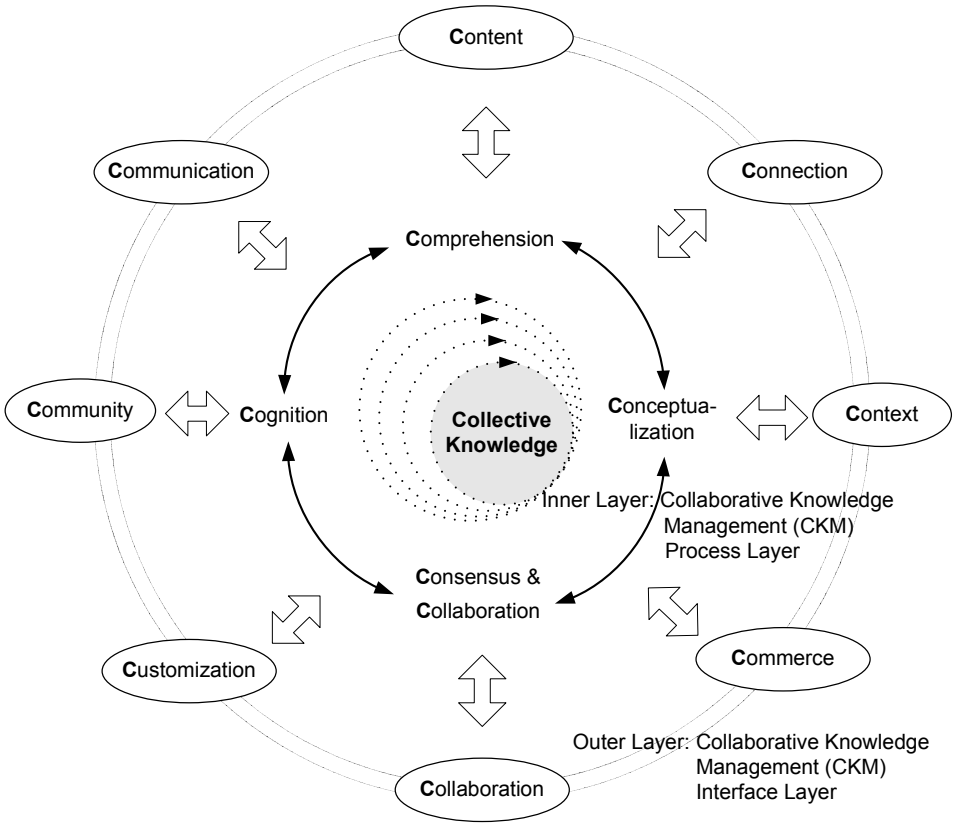

Figure 1: A Unified Collaborative Knowledge Management (UCKM) Model

Adopted from the extended 8C Interface Design elements of the previous study (Yang et al., 2008), the *outer layer*, aka the *CKM Interface Layer*, illustrates the external web interface design components of ICT-based collaborations in knowledge creation and sharing processes exhibited by some social web applications, such as wikis, social network sites, and blogs. The eight interface elements (i.e., *Context*, *Content*, *Community*, *Customization*, *Communication*, *Connection*, *Commerce*, and *Collaboration*) describe the common characteristics of human-computer interfaces in collaborative social computing web applications. *Context* refers to how the site is designed with respect to its visual and navigation components. The visual design component of the CKM interface deals with the graphical aspect of the sites, including the page layout and the use of graphics, photographs, colors, and various fonts types to improve the look and feel of the sites. The navigation design component is about the functionality of the navigation schemes of the sites. *Communication* deals with how the sites communicate with their users. The communications features include search function, broadcasting, and push or pull applications (e.g., RSS) related to communication with users for knowledge usages and disseminations (e.g., findings and sharing). *Community* refers to how users interact with each other through both synchronous and asynchronous communication methods, such as instant messaging, message boards, e-mail lists, and others). *Customization* deals with the site's ability to tailor itself based on users' preferences or to provide personalization features for users to customize their space in the system. *Commerce* refers to the site's electronic commerce functionalities such as shopping cart, advertisement, referral program, and other business models of the site. For non-commercial organizations, features related to sponsorship programs, affiliate programs, and donations are in this category. *Connection* refers to how formal linkages from outside sites are embedded, in the form of logs, advertisements, mashups, and others. *Collaboration* refers to the site's ability to provide users with interface and services to carry out high degree of collaboration, such as collaborative editing, project management, et al.

The two layers are strongly related to each other, since all the collaborative knowledge creation and sharing activities of the inner process layer are directly and concurrently supported by the outer interface features of the web applications. While the outer layer captures the interface elements of collaborative knowledge creation web sites, the inner layer represents the underlying process of collaborative knowledge creation. The primary outcome of the inner layer, namely the collective knowledge, becomes part of the content element of the outer layer. All the eight interface elements in the outer layer, on the

other hand, provide necessary interface to effectively facilitate the knowledge creation process in the inner layer. One notable feature of this conceptual model is the appearance of *collaboration* in both layers. From the outer layer (or interface layer), collaboration represents the contributive work of users and developers through the Web application interface. The other *collaboration* in the inner layer represents the conceptual process of collaborations among knowledge workers with consensus. The *collaboration* process in the inner layer is enabled by the *collaboration* interface in the outer layer, which provides various interface elements for the knowledge workers to collaborate.

APPLICATION OF THE UCKM MODEL IN EVALUATING WIKIPEDIA

As an open web technology for e-Collaboration, a wiki is a web application that allows visitors to add, remove, edit, and change web content. The ease of interaction and operation makes a wiki an effective tool for mass collaborative authoring. From a functional aspect, wikis represent a combination of the technology (the application software), the practice (business logic), and the collection of collaborative inputs of its participants (Wagner, 2004). From a knowledge management perspective, a wiki provides an ideal collaborative knowledge work environment that allows many participants to work together to create and share conversational knowledge (Wagner, 2004). The most well known example of wikis is the Wikipedia.org, an online encyclopedia where people create and edit content for sharing on a wikis platform. Wikipedia has attracted many researchers via its fast growth, in terms of the size of its contents and the number of participants in its online community. There are different motivations for people to share their knowledge through Wikipedia, which include fun (e.g., writing/editing is fun), ideology (e.g., information should be free), values (e.g., it is important to help others), understanding (e.g., gain new perspective on things), enhancement (e.g., feel needed), protective (e.g., feel not lonely), careers (e.g., make new contacts that may help business or career), and social (e.g., interaction with others) (Nov, 2007).

In Wikipedia, people of the same interest may join and make contributions by creating new articles, and editing or giving comments and feedback to existing articles. The creation and sharing process begins when an individual recognizes the need for a specific topic (i.e., *Cognition)* with his or her understanding of the key issues related to the identified topic (i.e., *Comprehension*) and is willing to be involved in the creation process (i.e., posts a new article / content) via technological means (e.g., Web interfaces). If the topic is already started by somebody else, the individual can add his or her knowledge with a *consensus*. As an important rule for e-Collaboration in Wikipedia, a consensus needs to be made before changing (edit\delete) articles. Figure 2 is illustrates how consensus is reached in Wikipedia. All the articles have to be under GNU Free Documentation License, and anyone who does not want the material to be freely available to the users should not post the material. The individuals can also learn from the existing article, the contributive works, the ideas, and experiences that come up during the contribution (i.e., *Conceptualization*). These activities finally articulate tacit knowledge and form explicit knowledge through *collaboration*.

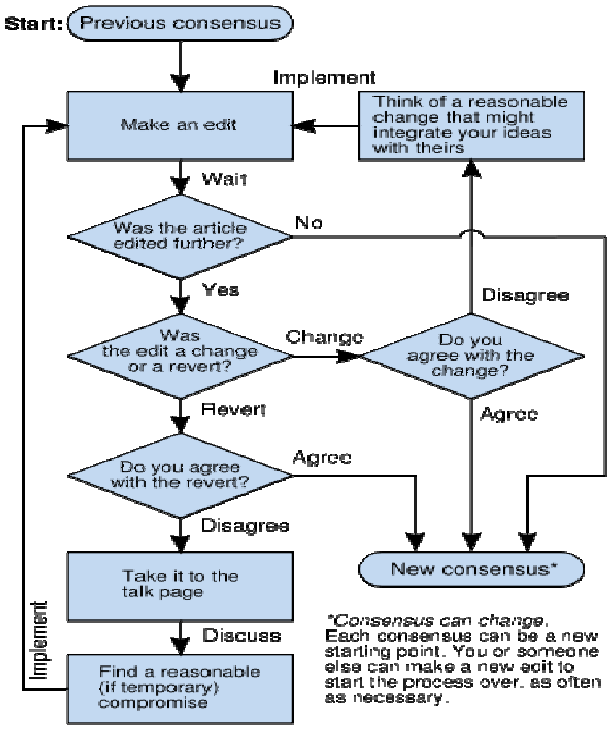

Figure 2: Consensus Flowchart for Wikipedia[4]

These five key elements keep on interacting and collaboratively contribute to the creation of *Collective Knowledge*, which is the ultimate outcome of this iterative process. Since these elements keep on interacting with each other, the knowledge repository of Wikipedia (i.e., collective knowledge) continues to be enhanced (both in size and quality) over time. The internal knowledge creation processes as illustrated by Wikipedia are summarized in Table 2.

Elements	**Description**
Cognition	As a wiki system is open to collaborative contributions and its success depends on the participants' collective effort, users are conscious and motivated to contribute to its content development.
Comprehension	The generated knowledge is available to all to access. Furthermore, the reader's comprehension of the article is enhanced by the online interactions between participants in the wiki community.
Conceptualization	By reading the existing content of the article and learning from the discussions made by other participants, a contributor may conceptualize his/her knowledge by either posting comments/corrections or a completely new version of the article. The contributor may even start a brand new article, which provides more specific knowledge related to an existing article.
Collaboration	The collaborative contribution to the article extends to a larger group of users with consensus increases the size as well as the quality of the source of information / knowledge. Interactions between participants in the wiki community (e.g., article posters, wiki editors, et al.) help to identify and correct articles with incorrect contents.
Consensus	Issues related to the validity of the contents may be raised by anyone, and the consensus-reaching mechanism adopted by the wiki community helps the contributed contents to converge, resulting in a new version of the article.

Table 2. The Internal Processes of Wikipedia

[4] Wikipedia, http://en.wikipedia.org/wiki/Image:Consensus_new_and_old.svg#fle

The web interface components of the Wikipedia play significant intermediary roles for communications among the participating knowledge contributors and users. They form the external human-computer interface layer that facilitates the underlying (internal) collaborative knowledge creation and sharing processes. Collective knowledge is the heart of the Wikipedia; it constitutes the free and open *Content* of the Wikipedia. The structure of the content and the design layout of wiki pages are related to the *Context* element. Through the support of web interface of the Wikipedia, including hyperlinks of other related sources of information (i.e., *Connection*), participants can effectively engage in activities such as posting new contents, and commenting, reviewing and editing the posted contents (i.e., *Communication*). When individuals who share the same interest participate at a particular topic, a *community* of special interest is created. *Customization* is another component that depicts the site's ability to tailor itself (tailoring) or to be customized by the user (personalization). For example, registered authors in the Wikipedia can keep a watch list to monitor changes to a certain article. Customizing the look and feel of the site or the community group is another example of customization. Since donation is the main source of funding for the Wikipedia, the Wikimedia Foundation, the parent organization of Wikipedia, provides a link in every Wikipedia page to guide prospective patrons to donate to Wikipedia. Although there is no advertisement or commercial activity (i.e., *Commerce*) found in Wikipedia, the site itself possesses great potential for e-commerce, as it has been attracting a large number of users involved in its daily activities. The final element, *Collaboration*, is the most important and unique component of Wikipedia's interface features. The wiki software features are designed to foster a system of continuous peer reviews by the contributors and even occasional readers to improve the quality of the contents. To maintain consistency of quality, consensuses need to be made as part of the collaborative editing process. The Wikipedia collaborative design principles[5] provide the needed guidelines that help consensus to be reached (Yang et al., 2008). Descriptions of Wikipedia's interface elements are included in Table 3.

Elements	**Description**
Content	Wikis are useful in the area where the content or knowledge is not centrally controlled, but resides in multiple owners. The content of wikis may be less useful to organizations that have stable and formalized set of knowledge (not changed much by experiences, e.g., a company's accounting policies may not benefit at all from being represented as a wiki (Wagner, 2004)). On the other hand, a wiki would be useful for the employees and customers to exchange their know-how regarding the company's products or services.
Communication	The wiki implements fast communication across the Internet with great speed of expansion (effect of 'Power of N') (Wagner, 2004). Site owners and coordinators may employ broadcasting or various conversational technologies (such as email, discussion forum, Internet chat, et al.) to communicate with the users and contributors.
Connection	Wiki pages include hyperlinks of related topics, which connect to other sources of information, extend, and improve the collective knowledge.
Community	Wikis have large communities of users across the Internet. These communities contribute at the rate of four hundred words per minute, twenty four hours a day. The users may communicate with each other via conversational technologies, such as email, discussion forum, Internet chat, et al.
Context	The layout of wiki pages is well organized. Most pages contain text and hyperlinks. The multi-language support feature provides users comfort and efficiency in choosing preferred language to view the contents.
Customization	There is a lack of expressive capacity of text editing components. Wiki pages usually contain text and hyperlinks. Non-text content is separated as attachments; directly incorporating media files into wiki pages is yet to be supported.
Commerce	There is no commerce activity found in the current Wikipedia.com; donation made by the users is the only form of revenues. A popular wiki site such as the Wikipedia possesses great potential for e-commerce, given the large number of users involved in its daily activities.

[5] The collaborative design principles are open, incremental, organic, mundane, universal, overt, unified, precise, tolerant, observable, and convergent (see http://c2.com/cgi/Wiki?WikiDesignPrinciples).

Collaboration	Wikipedia is open for voluntary collaborative development involving multiple distributed participants adhering to a set of collaborative design principles. In addition to the user communication functions as discussed above in the *Community* and *Communication* elements (emails, discussion forums, Internet chat, et al.), the most important collaboration feature in the Wikipedia is the mechanism of reaching consensus in the distributed and concurrent co-authoring process. The mechanism allows all individual contributors to share their knowledge and, at the same time, a tentative version of the article to be made, despite all the different viewpoints. With respect to cross-organizational collaboration, the relative instability of the architecture of Wikis restricts the incorporation of standards-based open source wiki software by different organizations and therefore limits collaboration among organizations.

Table 3: The Interface Elements of Wikipedia

DISCUSSION AND CONCLUSION

The Internet and web technology have not only changed how people collect information, conduct their businesses, and communicate with their customers, but also have changed how knowledge is created and shared. The collaborative knowledge creation process aided by computer and communication technologies is the most popular way for individual knowledge workers and work groups to create collective knowledge. There exist various social technologies typically used to facilitate collaborative knowledge creation, including emails, online discussion forums, Internet chat rooms, instant messaging, Web logs, and Wikis (Wagner, 2004). These tools allow the communication to take place between one-to-one, one-to-many, or many-to-many individuals and provide efficient channels for information and knowledge sharing through e-Collaboration. The interesting features of collaborative knowledge include the undemanding economical and technological requirements, fast and potential spreading, and suitability for environments where knowledge is distributed to owners far apart (Wagner, 2004).

Due to the ease of use, openness, and rapidity of deployment of web-based social computing technologies such as wikis, the collaborative knowledge creation and sharing process can be easily adopted by many educational and professional services. Undoubtedly, the major advantages of the CKM are the openness, accessibility, and low cost of knowledge creation through e-collaborations. Paradoxically, the major disadvantages are also related to these advantages. Since virtually anybody can easily create, edit, and alter the contents of CKM systems, there are several challenges with respect to inaccuracy and low quality of contents, violations of copyrighted and/or patented materials, knowledge meta-taxonomy, and others (Boulos et al., 2006). Therefore, further work is required to remedy these issues.

Along with the advancement of social technologies, collaborative knowledge management is acknowledged as a new approach for knowledge acquisition and sharing through e-Collaboration. Proper understanding of new ways of collaborative knowledge management in Web-based systems is important. This study proposes a conceptual framework (i.e., UCKM) of online collaborative knowledge management by intergrading previous models. The framework provides a holistic view of the knowledge creation and sharing processes through two layers (i.e., inner CKM process layer and outer CKM interface layer). The inner process layer is composed of several key elements (i.e., Cognition, Comprehension, Conceptualization, Consensus, Collaboration, and Collective Knowledge) and describes conceptually how collective knowledge is created, acquired, and shared among multiple contributors. The outer interface layer consists of eight design elements, which altogether represent the comprehensive interface components of the new generation of web applications (i.e., Web 2.0).

As an example of applying the UCKM model, this study employs the elements in the model as lenses to examine Wikipedia's collaborative knowledge creation and sharing processes, as well as its interface design elements. The project managers for other wiki applications or other collaborative knowledge management projects may benefit from a conceptual comparison, by applying the UCKM model to evaluate their applications' existing or proposed services and design components. The framework, however, has limitations. Since it is a conceptual model, it cannot provide all perspectives of collaborative knowledge management in detail. In some sense, components of the model may not be mutually exclusive. Further analysis of those components and their relationships is part of the future directions of this project.

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