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# Designing a Web-Based Knowledge Repository in A Virtual Team and Exploring Its Usefulness

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## 1. Introduction

By using a computer network, geographically distributed people with common goals can communicate and collaborate their work efforts across time and space barriers. These groups has been called "virtual teams" (Geber, 1995). The virtual teams are used to support various kinds of collaborative efforts ranging from routine, mundane works to complex, creative works (Geber, 1995; Snizek, 1995). Because the virtual teams can bring together the right mix of people who have the appropriate set of knowledge, skills, information, and authority to solve difficult problems quickly and easily, they are receiving considerable attention from knowledge workers (Boldyreff et al., 1996; McGuire, 1996). These knowledge workers are characterized as highly qualified individuals who need to make decisions under non-routine, unstructured, and uncertain environments (Knight et al., 1993). As the numerous benefits and advantages of the virtual teams in increasing effectiveness and efficiency of knowledge workers becomes widely recognized, organizations face a new challenge in coping with their new organizational structure (Davidow & Malone, 1993). The challenge is to turn the scattered, diverse knowledge of their knowledge workers who are working in a virtual team into a well-structured knowledge repository (Spek & Spijkervet, 1996; Wiig, 1993).

The recent popularity of the World Wide Web (WWW) has provided a tremendous opportunity to create a knowledge repository and to extend the scope of collaboration in an easy and cost-effective manner. However, there is an increasing need to ensure that the developed knowledge repositories are robust, reliable, and fit for their needs (Heijst et al., 1996). At present, many organizations design and deploy web-based knowledge repositories without evaluating them properly. The proposed research designs a web-based knowledge repository for multimedia systems design and explores its usefulness.

## 2. Designing A Web-Based Knowledge Repository For Multimedia Systems Design

Multimedia is an umbrella term generally referring to the seamless integration of text, sound (such as spoken words, music, or sound effects), visual images (such as still photographs, motion pictures, or animation), or other electronically represented information under computer software control (England & Finney, 1996; Tway, 1992). Therefore, a multimedia project generally requires a collaborative effort among many developers with a variety of backgrounds, such as personnel, context experts, instructional designers, users or clients, and so forth (Alber, 1996; England & Finney, 1996). Because each of them possesses totally different backgrounds, training, and experiences, communication among them is always problematic. Unifying a design team that is comprised of members from different disciplines, with different skills and different ways of describing multimedia, might be a major problem that project managers must solve in order to complete projects successfully. One obvious recommendation is to promote actively the acquisition, sharing, and integration of knowledge within a design team (Walz et al., 1993). In order to enhance knowledge exchange and resolution of conflicts among team members, many real-world design teams construct a shared memory (Walz et al., 1987, 1993). However, because many design teams manage the shared memory in an ad hoc manner, and just store formal knowledge, such as users' manuals and user analysis reports, they cannot manage the dynamic evolution of knowledge that occurs throughout a design process (Walz et al., 1993). In order to manage and speed the evolution of knowledge, it is necessary to develop a new knowledge repository that encourages design participants to bring their knowledge and skills to bear on the design. Also this should be accomplished without forcing on them mediation through explicit description. This paper designs a knowledge repository that can facilitate expression, transmission, and evaluation of ideas from design participants.

The knowledge repository consists of three agents: user agent, annotation agent, and design

knowledge agent. Each agent consists of a knowledge base and a set of production rules that manage its knowledge base and generate adequate interfaces for designers. In order to perform their tasks, the agents communicate with other agents. The knowledge bases are implemented using Microsoft Access. The rules are implemented using JavaScript. For the interface between JavaScript and Microsoft Access, the CFML (Cold Fusion Markup Language) is used.

### 3. Exploring Usefulness of A Web-Based Knowledge Repository

While the web allows unlimited number of users to create and disseminate knowledge across time and space barriers, it does not support dynamic knowledge exchanges within virtual teams (Rasmus, 1996). Knowledge Management (KM) is suggested as a methodology for creating, maintaining, and exploiting a

well-structured knowledge repository (Wiig, 1993). KM is defined as the collection of processes that support the creation, dissemination, and utilization of knowledge between appropriate individuals, groups within an organization, and independent organizations (Spek & Spijkervet, 1996; Wiig, 1993). Whatever information technology is used for implementing a knowledge repository, it should support the processes of knowledge creation, dissemination, and renewal, as well as the structures of retention facility of a knowledge repository (Hosseini, 1995). Spek and Spijkervet (1996) identify four basic KM activities: knowledge creating, knowledge securing, knowledge distributing, and knowledge retrieving activities. By investigating how well a web-based knowledge repository supports the processes, its usefulness can be evaluated. Table 1 summarizes performance criteria for investigating impacts of the knowledge repository on the KM activities.

<TABLE 1: Performance Criteria>

KM Activities	Related Theories	Propositions	Design Features	Performance Criteria
Knowledge Creating	Gestalt Theory (Mayer, 1992)	Problem representation rests at the heart of knowledge creating activity; the tools should be invented for helping people to represent problems in useful way.	Storyboard-Based Knowledge Creating	<ul style="list-style-type: none"> <li>• Simplicity of Knowledge Creating</li> <li>• Richness of Knowledge Creating</li> <li>• Flexibility of Knowledge Creating</li> </ul>
Knowledge Securing	IPS Model (Newell & Simon, 1972)	Memory consists of three major components: declarative memory, productive memory, and working memory	Content-Based Indexing	<ul style="list-style-type: none"> <li>• Ease of Consistency Checking</li> <li>• Ease of Knowledge Change Management</li> </ul>
Knowledge Distributing	Information Theory (Shannon, 1948)	Mutual awareness is an important issue for supporting communication; As people gain more knowledge about their social systems, their communications becomes effective.	Feedback	<ul style="list-style-type: none"> <li>• Awareness</li> <li>• Timeliness</li> <li>• Fairness</li> </ul>
Knowledge Retrieving	Cognitive Flexibility Theory (Spiro et al., 1988)	If users can access various perspectives for solving a problem, they might get a deeper, clearer understanding about the problem; Because of the limited capability of human memory, too much knowledge makes users experience cognitive overload problems	Hypermedia-Based Knowledge Presentation	<ul style="list-style-type: none"> <li>• Ease of Knowledge Navigation</li> <li>• Ease of Knowledge Searching</li> </ul>

In order to evaluate the usefulness of the knowledge repository, two experimental teams are formed. Table 2 compares the two design teams. The

teams use the knowledge repository for communicating and sharing their design knowledge.

<TABLE 2: Comparative Summary of Two Design Teams>

	Distributed Team	Local Team
Size	4 Designers	3 Designers
Recruit Method	USENET News Group	Local Multimedia Company
Prior Meeting	No	Yes
Usage	Initial Design Stage	Later Design Stage
Task	Designing a multimedia system for a computer literacy course	Designing a multimedia system for teaching disaster preparedness and response

There are many conflicting and competing user needs for constructing a knowledge repository. Individual users (designers) have totally different preferences for these needs. Therefore, in order to explore the usability of the knowledge repository, we need to consider all attributes that are valuable to designers. We choose the multi-attribute approach, the Analytic Hierarchy Process (AHP) model, as an appropriate method for evaluating usefulness of the knowledge repository. The approach enables us to identify the relative usefulness of the knowledge repository under more than one criterion or attribute. Keim et al. (1997), Liebowitz (1985), Maiden et al. (1997), and Sinha and May (1996) show the usefulness of the multi-attribute approach as a strategy for evaluating software or proposed features of new software products.

#### 4. CONCLUSION

Two evaluation studies show that the knowledge repository creates a promising environment for multimedia systems design. More specifically, they indicated that the knowledge repository supports knowledge creating, knowledge securing, and knowledge retrieving activities for multimedia systems design, but it does not support knowledge distributing activity as much as it does for other activities. Additionally, the research finds that the social interactions between the group members play an important role in the success of the collaborative multimedia systems design and that the knowledge repository does not support the socialization of design teams. Its inability in supporting the socialization directly links to its low performance level in supporting the knowledge distributing activity.

Since designers in the distributed team do not know each other, they had a hard time to coordinate their design efforts. Although the knowledge repository reduces the gap between the continually changing knowledge and the awareness of the existence of such knowledge by distributing knowledge actively, it does not help them to integrate effectively their knowledge with others'. Without knowing each other personally, the designers resist sharing critiques among themselves within a virtual working space. In the case of the local

team, the inability of KMS in providing timely information does not enable the designers to maintain their socialization processes that they can experience at the face-to-face meetings. To make KMS more effective in distributing knowledge within a virtual working space, designers need to be motivated for the regular use of the knowledge repository. Within both experimental groups, proper management strategies can enhance the usefulness of the knowledge repository in supporting the knowledge distributing activity.

#### 5. REFERENCES

References available upon request to Seung Baek at Saint Joseph's University