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# An Intelligent Agent-Based Framework for Knowledge Management on The Web: An Exploratory Study of A Virtual Team in Designing A Multimedia System

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# **An Intelligent Agent-Based Framework for Knowledge Management on The Web:**

## **An Exploratory Study of A Virtual Team in Designing A Multimedia System** [Seung Ik Baek](#), [Jay Liebowitz](#), and [Srinivas Y. Prasad](#) [Mary J. Granger](#)

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### 1. Introduction

The recent proliferation of personal computers and communication networks has enabled organizations to acquire and retain their distributed organizational structures (Halal et al., 1996; Tapscott, 1995). Using a computer network, geographically distributed people with common goals can communicate, coordinate, and collaborate their work efforts across time and space barriers. These groups of people have been called "virtual teams" (Davidow & Malone, 1993; Geber, 1995). Jessup et al. (1996) define virtual teams as "turbo task forces, with teams forming and disbanding as needed, with team size fluctuating as necessary, and with team members coming and going as they are needed." 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 involved in non-routine, unstructured, and uncertain problems (Jessup et al., 1996; McGuire, 1996). Today such teams can be quite large and they can be distributed around the globe. The quality of their results depends on how well individual knowledge can be communicated among members of a virtual team. The challenge that modern organizations face 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). Knowledge Management (KM) is suggested as a methodology for creating, maintaining and exploiting a knowledge repository (Stewart, 1995; 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 (Liebowitz & Wilcox, 1997).

The recent popularity of the World Wide Web (Web) has provided a tremendous opportunity to expedite the dispersment of various knowledge creation/diffusion infrastructures (Chen & Gains, 1997; Ives & Jarvenpaa, 1996). Because the Web enables organizations to create a knowledge repository and to extend the scope of collaboration in an easy and cost-effective manner, it creates the possibility of developing global collaborative KM platforms (Barua et al., 1995; Davenport, 1996). However, the

unstructured nature of the Web creates an information overload problem. While the Web allows various kinds of knowledge to be created and disseminated across time and space barriers, it does not support the processes of using and updating the knowledge in a timely manner. Rasmus (1996) and O'Leary (1996) suggest the use of intelligent agents as a promising solution for assisting and facilitating these processes. This research will focus on developing a conceptual model for KM and a framework for the roles of intelligent agents in the conceptual KM model. Furthermore, it will implement and evaluate the intelligent agent-based framework on the Web under a collaborative environment for designing a multimedia system.

## 1. An Intelligent Agent-Based Framework for KM

### 2.1 A Conceptual Model of KM in Designing A Multimedia System

Spek and Spijkervet (1996) identify three basic activities necessary to build a well-structured knowledge repository: creating knowledge, securing/combining knowledge, and distributing/retrieving knowledge.

#### 2.1.1 Creating Knowledge

When designing a multimedia system, designers, developers and users, with their own unique group and individual perspectives, create one or more design solutions consistent with the user requirements. Whenever design participants gain a new understanding about user requirements, they develop new design knowledge. The design knowledge is refined continually by other group members throughout a design process. A highly expressive, precisely defined set of attributes for design knowledge representation can facilitate the ability to create new knowledge in a knowledge repository.

#### 2.1.2 Securing/Combining Knowledge

Since multimedia systems design is multi-disciplinary, enhancing team collaboration is extremely important in the design process. It can be achieved only when all team members share the same knowledge, understand it clearly, and freely integrate their knowledge into existing knowledge. All these can happen by storing and indexing knowledge properly. Throughout a process of multimedia systems design, partially or completely specified new design knowledge should be evaluated by checking whether or not it is consistent and specifying how it should be integrated with the knowledge already stored in a knowledge repository. The dynamic indexing mechanism supports the knowledge securing activity.

#### 2.1.3 Distributing/Retrieving Knowledge

Collaborative design process is fundamentally a learning process. Design team members can come to a working understanding about a multimedia system by continually learning from each other. To support the collaborative learning for design, there needs to be open, flexible, and reactive communication channels to distribute knowledge. The gap between

the continually changing design knowledge can hinder effective collaborative learning. A knowledge retrieving activity can be executed when a designer seeks pieces of knowledge that are required to perform one's tasks. Normally, a knowledge retrieving activity is based on one or more keywords. In a rapidly changing environment, such as an environment for designing a multimedia system, keyword-based knowledge retrieving is no longer productive. The dynamic nature of such an environment requires content-based, context-based knowledge retrieving.

Heijst et al. (1996) state that by streamlining these processes an organization can implement KM successfully. Especially, in the case of designing a multimedia system which requires multi-disciplinary, ill-structured, highly creative knowledge, the continuous streamlining of the three KM processes is important.

## 2.2 KM Agents

To enhance knowledge flow in a conceptual KM model, three KM agents are designed and implemented: user agent, knowledge manager, and knowledge agent. Table 1 summarizes the major roles of these agents in supporting KM.

<Table 1: Roles of KM Agents>

KM Activities	KM Agents	Major Functions
Creating Knowledge	User Agent	Remember all KM activities of users; Dynamically organize a person's agenda.
Securing Knowledge	Knowledge Agent	Index knowledge; Detect inconsistency; Save, retrieve, and update knowledge from a knowledge repository.
Distributing Knowledge	Knowledge Manager	Monitor all changes that occurred in a knowledge repository; Provide critics to new knowledge
Retrieving Knowledge	Knowledge Manager	Reformulate queries based on an ontology; Determine the most favored alternative based on preference weighting and ranking.

## 3. A Validation Strategy

The next goal of this research is to validate the framework in a real-world setting. More specially, through an exploratory study, the research is to investigate the KM activities of designers as they use an intelligent agent-based KM system on the Web to design a multimedia system. The exploratory study will be conducted in a local multimedia company. During the study, the Web, intelligent agent-based KM system presented in this research will be implemented and used for supporting a virtual team engaged in designing a mid-sized, educational multimedia system. Table 2 summarizes performance criteria.

<Table 2: Performance Evaluation Criteria of A Web-Based, Intelligent Agent-Based Framework for KM>

KM Activities	Related Theories	Theoretical Propositions	Design Features	Performance Evaluation Criteria
Knowledge Creating	Gestalt Theory (Mayer, 1992)	In Gestalt Theory, problem representation rests at the heart of knowledge creating activity. The theory suggests that tools and techniques should be invented for helping people to represent problems in useful way.	Storyboard-Based Knowledge Creating	Ease of Use of Storyboards; Clarity/Ambiguity of Storyboards; Richness of Storyboards
Knowledge	IPS Model	The IPS model assumes that human memory	Content-Based	Easy of Storyboard Editing;

Securing	(Newell & Simon, 1972)	consists of two major components: long-term memory and short-term memory.	Indexing for Storyboards and Feedback Messages	Effectiveness of Intelligent Access Control
Knowledge Distributing	Information Theory (Shannon, 1948)	Information Theory argues that the ability of individuals to generate and transmit knowledge has the potential to promote interdependency among individuals. It states that mutual awareness is an important issue for supporting collaboration.	Feedback	Timeliness/Responsiveness of Feedback; Negotiation Productivity
Knowledge Retrieving	Cognitive Flexibility Theory (Spiro et al., 1988)	Cognitive Flexibility Theory states that, if users can access various perspectives for solving a problem, they might get a deeper, clearer understanding about the problem. Because of the limited capacity of human memory, too much knowledge makes users experience cognitive overload problems.	Hypermedia-Based Knowledge Presentation	Cognitive Overload; Intuitive/Disorientation of Interface; Flexibility

#### 4. Expected Contributions

For MIS Scholars: This research will facilitate theoretical investigations into KM and design principles of IT-based KM support capabilities.

For MIS Practitioners: This research will suggest various design strategies for intelligent KM systems.

#### References

References available upon request from first author.