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Expanding Group Support System Capabilities from the Knowledge Management Perspective

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ABSTRACT

A group support system (GSS) is a computer-based system that enables people in different places to discuss and make decisions on connected computers. Expanding GSS capabilities from the knowledge management perspective is believed to significantly improve the performance and satisfaction of group meetings. This study develops the organizational knowledge management process, proposed by Alavi and Leidner (2001), to expand the capabilities of a GSS. Additionally, a prototype system has been implemented. Finally, an experiment is conducted to evaluate the system and demonstrate its applicability and usability.

Experimental results indicate that users perceive a web-based GSS with knowledge management capabilities to be more helpful and more satisfying than a conventional GSS. They also perceived that using a web-based GSS with knowledge management capabilities can improve the decision quality.

INTRODUCTION

Accompanied by organizational expansion and globalization, organizational decisions making are become more multi-faceted considerations for conforming to stakeholder, legislation, environment and macro economic situation. Organizational decisions are much more complex and interconnected now than in the past (Courtney, 2001). Organizations now encounter with more complicated and chaotic environments than before, and thus require unequivocal decisions for rapidly to responding to critical situations.

Banker and Kauffman (2004) concluded that decision makers need to discriminate between imperfect and perfect information. Decisions might be made not only by single person, but also by groups of specialists in the related spheres. Communication technology can be employed to collect experts and veterans experiences in the group meeting, and meet the requirements of ameliorate group decision efficiency of IT researchers. Liou and Nunamaker (1999) conclude that Group Support Systems (GSS) environment can electronically facilitates the seizure of knowledge.

Nevertheless, until now, there are only a few GSS studies have contributed significantly to make true design-science research. Consequently, this investigation, proposes a prototype of web-based GSS with group memory and knowledge context in order to enhance the efficiency of access to knowledge in GSS. A critical component of the GSS-based concept-generation process is group memory, which is a granary of ideas formed by users of GSS (Satzinger, *et al*., 1999).

Group meetings play a significant role in the daily operation of most businesses. Neustadt and May (1986) observed

that "the future has no place to come from but the past." Decision makers must understand how the past affects their present decisions. In troublesome circumstance, it is controversially that any good decision could be made in a single meeting with few persons (Huber, 1990). Hence, the GSS combined with collective memory is likely to provide additional information processing support (Paul *et al*., 2004).

Williams, *et al.* (1988) asserted that GSS provides academics with an extraordinary opportunity to tell comprehensive details of group member interactions. Satzinger, *et al.,* (1999) stated that group memory provides stimuli, in the form of ideas, to the individuals using the software. Liou and Nunamaker (1990) concluded that a group meeting supported by GSS can facilitate the electronic acquisition of knowledge, and distill individual experts' knowledge in a parallel fashion.

Paul, *et al.* (2004) argued that information and knowledge are not easily accessible in large organizations and that the use of group memory is expected to provide information processing support. Therefore, a shared repository that preserves prior experience of group members for group meetings needs to be developed.

Orlikowski (1992) noted that group members' mental models and organization skeletons and conventions eventually affect how GSS is implemented and applied in organization. Boose, *et al*. (1992) also observed that combining GSS and knowledge acquisition techniques will encourage the collaborative support environment. Thus, leveraging knowledge management realizes the strategic value and enforces the competitive advantage of an organization. Holsapple and Whinston (1996) found that GSS might enable group meeting participants to possess their own knowledge stores and hold them in its knowledge system. Information technology can escort to a greater radius and profound of knowledge creation, storage, transfer and application in organization (Alavi &Leinder, 2001).

The process of the meeting is accelerated, if we can promote the share willing among group members, and it will also facilitate the communication among group members and enhance the connections among them. The knowledge context information recorded in GSS is improved and connected in this case. The concept of organizational knowledge management process proposed by Alavi and Leidner (2001) is utilized. This study integrates some helpful knowledge management concepts to expand the capabilities of GSS, including group memory, knowledge context, and knowledge sharing.

This study develops a Chung Cheng University Knowledge-based GSS (CCUKGSS) and evaluates the effectiveness of the CCUKGSS. In order to understand the group members' response about the CCUKGSS, a laboratory experiment was conducted to measure the perceived usefulness, perceived ease of use, perceived decision quality, and perceived satisfaction with the meeting. The experimental results support our arguments.

The remainder of this article is organized as follows Section 2 gives a comprehensive review of previous GSS and knowledge management studies. Section 3 describes a framework for expanding GSS capabilities from the knowledge management perspective. Section 4 presents the methodology of system evaluation and results of system evaluation. Finally, Section 5 discusses and concludes the findings.

LITERATURE REVIEW

DeSanctis (1993) first elucidated why GSS is a significant research field. The study of GSS can help our understanding of organizations and the role of technology in organizational change. GSS technologies are designed to support groups working in different places and times, trying to joint their experience and knowledge for fulfill group tasks, beyond the constraint of space and time.

Group Support System

Huber, *et al.* (1993) defined GSS as the collective computer technologies for serving groups to identify and address problems, opportunities, and issues. Efficient and effective IT artifacts will help solve new challenges before us. Artifact based on technology, organization-based and people-based are necessary to address the problems faced and the opportunities afforded by interaction among people (Hevner *et al*., 2004).

GSS is an information technology system for supporting group tasks to elevate group performance. It is composed of communication technology, computer artifacts, and decision election. Briggs, *et al*., (1998) described GSS as a suite of network-based software to support coordinated and consensus team efforts toward achieving a goal.

Nunamaker, *et al*., (1993) observed that the use of GSS technology can often significantly improve group processes and outcomes in many cases. DeSanctis and Gallupe (1987) categorized GSS into three levels. The level 3 GSSs are characterized by machine-induced group communication patterns and can comprise expert advice in selecting and forming rules to be adopted during a meeting.

A GSS gives participants their own knowledge stores in its knowledge system (Holsapple & Whinston, 1996). A GSS is a computer-based software system that allows people in different places to discuss and make decisions on connected computers. Many researchers believe that expanding GSS capabilities from the perspective of knowledge can significantly enhance the performance and satisfaction of group meetings. DeSanctis and Gallupe (1987) defined a GSS as follow "A GSS combines communication, computing, and decision support technology to facilitate formulation and solution of unstructured problems by a group of people." Thereupon, GSS can bring positive change to organizations. GSS can be as an organizational change mechanism depending upon our assumptions about the role of computing technology in management and organizational success (DeSanctis, 1993).

Table 1: Related Studies in GSS.

Year	Author	Primary Finding
1987	DeSanctis and Gallupe	Categorize GSS into three levels
1987	DeSanctis and Gallupe	GSS facilitate the solution of unstructured problem
1993	DeSanctis	GSS can be an organizational change mechanism
1993	Huber, *et al*.	GSS is a collective computer technologies for serving people to conquer problems
1993	Nunamaker, *et al*.	GSS can improve group processes and outcome
1993	Zigurs	GSS make us realize group member interaction
1996	Holsapple and Whinston	Participants' own knowledge can be stored in GSS's knowledge system
1998	Briggs, *et al*.	GSS is a suite of network-based software
1998 2002	Dennis, *et al*. Liang	Information exchange was affected by parallel communication, group memory and anonymity
2004	Hevner, *et al*.	Technology, organization and people-based artifacts can address the problems we faced and the opportunities afforded by the interaction of people

Additionally, GSS provides an extraordinary chance to learn the details of group member interactions (Zigurs, 1993). Table 1 summarizes the related studies in GSS. In GSS, information exchange and use is affected by three components namely parallel communication, group memory and anonymity (Dennis, *et al*., 1998; Liang, 2002).

Group Memory

Memory can be broadly defined as the inherent ability of human beings to accumulate, preserve, and accordingly refresh their own experience. Those stored up practices can be held in personal repositories, which are likely to be explicitly transmitted or open for sharing. (Huber, 1984) Memory is "the faculty of retaining and recalling things from past" (American Heritage Dictionary, 1969; Paul, *et al*., 2004). Neustadt and May (1986) stated, "The future has no place to come from but the past." Decision makers have to understand how the past shapes their current decisions. Paul, *et al*. (2004) observed that the organizational memory has two roles, action guidance and interpretation. They can affect the actions of individual or groups and can be adopted to filter and categorize information or knowledge.

Simon (1960) revealed that the group memories of organization members are vast thesauruses of realistic knowledge, customary skills and operating practices. Conklin (1996) claimed that the Holy Grail of teamwork is shared understanding. GSS facilitates associates to form opinions anonymously if stipulated. Nagasundaram *et al*. (1995) argued that a group memory allows members to queue and filter information and may reduce information overload. Dennis, *et al*., (1998) found that information shapes the group's decision results, with or without GSS.

Group memory is commonly employed to deliberate upon the past and reflect the interest of the present (Schwartz, 1997). A group has a capacity to remember, collective memory is not a given but rather a socially constructed concept, and group memory is the reconstruction of the past (Halbwachs, 1941). Within the knowledge base of GSS, electronic knowledge repositories of GSS can keep a group memory drawn from electronic minutes of group meetings and also offers it to the group meeting participants, who need to access historical information or knowledge for recommendations. According to Weiser and Morrison (1998), a project memory can seizes, saves, and appendixes project information for later use by others. An important function of a group and organizational memory is to enable new group members to obtain information rapidly from prior group session (Hoffer & Valacich, 1993). Table 2 summarizes the related studies in group memory.

Table 2: Related Studies in Group Memory.

Year	Author	Primary Finding
1941	Halbwachs	Collective memory is a socially constructed view, and group memory is the reconstruction of the past
1960	Simon	Group memory of organization members are vast treasures of realistic knowledge, customary skills and operating practices
1969	American Heritage Dictionary Shapiro and Varian	Memory is the faculty of retaining and recalling things past
1984	Huber	Store in personal repository, Practices can be explicitly transmitted or opened to be shared
1986	Neustadt and May	The future has no place to come from but the past
1993	Hoffer and Valacich	Organizational memory can accelerate new group members reap information from prior group session
1995	Nagasundaram, *et al*.	Group memory can enables members to queue and filter information and may reduce information overload
1996	Conklin	The Holy Grail of teamwork is shared understanding
1997	Schwartz	Group memory is the way of common people deliberate upon the past and then reflects the interest of the present

1998	Dennis, *et al*.	Information will shape the group's decision results, with or without GSS
1998	Weiser and Morrison	Project memory can seizes, saves, and appendixes project information for external persons to use it later
2004	Paul, *et al*.	Organizational memory has two roles- action guidance and interpretation role

Knowledge Management

Knowledge management (KM) is form from "the strategies and processes of identifying, capturing and leveraging knowledge" (Manasco, 1996). The knowledge consolidation process involves individuals' social interactions, by using internal communication channels for knowledge delivery to achieve at a common purpose for problem solving (Mitchell, 2006).

Ives, *et al*. (1998) argued that knowledge management may particularly be regarded as the effort to make knowledge of an organization available to raise human and organizational accomplishment. Alavi and Leinder (2001) noted that knowledge has occupied the minds of philosophers since the classical Greek era, and has led to many epistemological debates. Sveiby (1997) defined knowledge as "the capacity to act." Knowledge is usually not discernible from information or data (Alavi & Leidner, 1999). Knowledge also has the potential to be applied across the time and space domains to generate increasing returns (Fortune, 1991; Shapiro & Varian, 1999; Garud & Kumaraswamy, 2005).

Knowledge management has abstracted the minds of IT researchers for many years, and has led to many theories. Knowledge can be created, shared, amplified, enlarged, and justified in organizational settings (Nonaka, 1994). Knowledge management can be treated as turning raw data into carefully selected information, and converting it to valuable knowledge (Kanter, 1999). In addition, McManus and Snyder (2003) proposed that KM had became a key business strategy and knowledge can be delivered by an Electronic Performance Support System (EPSS).

Data and information are originate in group members' communications, historical legends, narratives, and can be causally converted into knowledge. Knowledge is a fluid mixture of framed practice, values, contextual information and expert intuition that provides a skeleton for measuring and assimilating novel experiences and information (Davenport & Prusak, 1998). Additionally, knowledge frequently becomes embedded in documents, repositories, routines, processes, practices and norms. In an organization, knowledge management refers to identifying and leveraging the collective knowledge to improve the organization's competitive advantages (Von Krogh, 1998). Furthermore, IT can construct external meeting places and create a forum in which tacit knowledge can be transformed into explicit knowledge (Johannessen, *et al*., 2001). The ultimate aim of KM is to give the right information to the right person in the right place at the right time (Von Krogh, *et al*., 2000). Table 3 summarizes the related studies in knowledge management.

Table 3: Related Studies in KM.

Year	Author	Primary Finding
1991 1999	Fortune Shapiro and Varian	Knowledge can be applied across time and space domain to create increasing returns
1994	Nonaka	Through group or individual's mental process, knowledge can be created, shared, amplified and justified in organizational settings

1996	Manasco	KM is the strategies and processes of identifying, capturing and leveraging knowledge
1997	Svelby	Knowledge is the capacity to act
1998	Davenport and Prusak	Knowledge provide a skeleton for evaluating and assimilating new experience and information
1998	Ives, *et al*.	KM can increasing human and organizational accomplishment
1998	Von Krogh	KM refer to identifying and leverageing the collective knowledge to improve the organization competitive advantages
1999	Alavi and Leidner	Knowledge is usually not discernible from information or data
1999	Kanter	KM is turning raw data into well selective information and convert to valuable knowledge
2000	Von Krogh	The ultimate goal of KM is to lead the right information to the right person at right place in the right time
2001	Johannessen, *et al*.	Tacit knowledge can be transformed into explicit knowledge through the place construct by IT
2001	Alavi and Leidner	Information exchange was affected by parallel communication, group memory and anonymity
2003	McManus and Snyder	Knowledge can be deliver by an EPSS and KM had became a business strategy
2006	Mitchell	Deliver by internal communication channel, knowledge can achieve the common purpose of problem solving

Integrating KM concepts into GSS Design

KM concepts should be integrated into GSS design for several reasons. For instance, a human resources department recruiting new members for organization, always needs to retrieve information from inside personnel databases or from the extraneous human resources providers and job-hunters. Meetings then need to be held to enroll new workers. The process always involves several rounds of interviews with new people, and consumes precious time of the CEO, CIO or other chief supervisors in company.

If personal expertise records from inside or beyond the organization can be kept and integrated into the GSS knowledge base in order to mine out the useful information about manpower with dedicated knowledge management, then the annual recruitment process can be accelerated. DeSanctis and Gallupe (1987) defined a decision-making group as two or more people working together to find the solution to problems, and group decisions need to follow the collaborative experience of the group meeting.

Kwok, *et al*. (2002) adopted the concepts map in semantic network to locate the knowledge structure resident in students, and they found that GSS can promotes knowledge procurement providing a productive collaborative learning context where people can interact, constitute and estimate knowledge acquired and shared by groups. Parent, *et al*., (2000) specified that knowledge is created among groups through the interaction of ideas formed by group members.

Since man is mortal, group members gradually die, and their collective memory dies with them. If the group

memory is not recorded in time, then it fades and eventually disappears. Therefore, keeping the collective memory of group members became a major issue in this study. Cultivate knowledge among groups and organizations, is an important issue. Information technology can contribute to the dynamic processes of knowledge creation, preservation, propagation and absorption in an organization.

Organizational decisions are now much more severed, involved and interconnected than they were in the past (Courtney, 2001). By enhancing the functional ability of GSS, those ideas invented in the group meeting can be preserved so that they can be easily accessed at the following meeting. Group memory can grow best if stored in the knowledge base in the GSS's electronic repository. The depth offered by a group memory information system raise the confidence of decision makers (Stein & Zwass, 1995).

Parent *et al*. (2000) stated GSS can elevate knowledge creation in focus groups by capturing and enhancing more ideas, and thus increase knowledge creation in terms of the collection of relevant ideas. Kwok and Khalifa (1998) found that a GSS-supported meeting assists the acquisition of knowledge related to the task at hand, and helps participants to know more about the task, thus in turn, further improving the group process. Hence, this study proposes a reputation rating mechanism to enhance participants' self-esteem and stimulate GSS participants' sentiment toward knowledge-sharing.

Ma and Agarwal (2007) found out reputation system that rate participator on their contributions quality can provide a readily available collection of "experts" to knowledge seeker. Wasko and Faraj (2005) noted that reputation in a website forum is an important motivation for contributing knowledge. Knowledge thus acquired can be accessed electronically in a GSS, and supported by knowledge extraction from individual experts, and by providing a group interaction milieu to uplift the realm of expertise (Liou & Nunamaker, 1990). Table 4 summarizes the related studies in GSS and KM. To demonstrate the advantage of the proposed web-based GSS product, Table 5 shows the comparison results of different GSS products, namely CCUKGSS and four other well-known products of GSS products: GroupSystems (University of Arizona), SAMM (University of Minnesota), Facilitator, and OptionFinder.

Table 4: Related Studies in GSS and KM.

Year	Author	Primary Finding
1987	DeSanctis and Gallupe	The decision-making group is two or more people who are work together for finding the solution of problem
1990	Liou and Nunamaker	Knowledge can be accessed electronically inside GSS, and support knowledge extraction form individual experts in a parallel way
1995	Stein and Zwass	The depth offered by a group memory information system will positive effect on the decision makers' confidence
1998	Kwok and Khalifa	GSS supported meeting will facilitates the acquisition of knowledge related to the task at hand
2000	Parent, *et al*.	Knowledge is created among groups by the interaction of ideas generated by group members
2002	Kwok, *et al*.	GSS can promotes knowledge procurement through its functions that can provide a productive collaborative learning context
2005	Wasko and Faraj	Reputation in forum of website is an important motivation for a person to contribute his knowledge
2007	Ma and Agarwal	Reputation system that rate participator on their contributions quality provide a readily available collection of "experts" to knowledge seeker

Table 5: A Comparison of Functionality of Various GSSs.

GSS / Function	CCUKGSS	SAMM	GroupSystmes	Facilitator	OptionFinder
Use	For Academic Research	For Academic Research	Merchandise Product	Merchandise Product	Merchandise Product
Reputation Mechanism to Motivate Knowledge Share	Yes	No	No	No	No
Meeting Minute Report	Keep Meeting Minute in .txt Format	Keep Meeting Minute in Records	Keep Meeting ideas, review, voting results in DOC or RTF format	Keep Meeting ideas, review, voting results in several Formats	Use diagram to indicate the aggregate results of opinions

Note: * Facilitate's Facilitator was cited from "http://www.facilitate.com/"
** OptionFinder was quoted from "http://www.facilitate.com/"

CCUKGSS: A WEB-BASED GROUP SUPPORT SYSTEM INTEGRATING KNOWLEDGE MANAGEMENT CAPABILITIES

GSS is computer-based software that allows people in different places to discuss and make decisions on inter-connected computers. Venkatraman (2004) found Web-Services can help organization to seamlessly bridge communication gaps among different systems. Opera and Marchewa (2006) manifested that the Internet had provided an exceptional opportunities for both organization and individual to connect each others. In addition, expanding GSS capabilities from the perspective of knowledge management can significantly improve the performance and satisfaction of group meeting participants. This study deployed a knowledge base GSS within Taiwan's Chung Cheng University (CCUKGSS) to design a useful GSS product. The architecture follows conventional design of GSS, based on the computer-based facilities of CCUKGSS, and a U-shaped decision room (Figure 1).

Figure 1: A Snapshot of the CCUKGSS Laboratory.

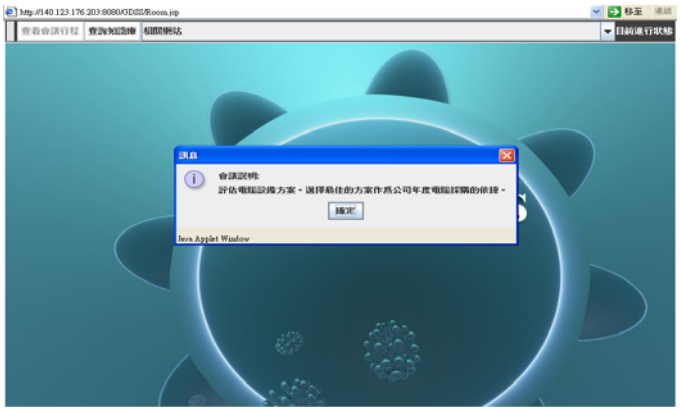

Figure 2: A Sample Screen (Logon Meeting of the CCUKGSS).

By adopting the concept of organizational knowledge management process proposed by Alavi and Leidner (2001), this study constructed a novel framework of web-based GSS from the perspective of knowledge management, and integrated it into the primary developed GSS. The architecture of CCUKGSS is a client-server framework designed for constructing a conceptual model to create, capture, absorb and extend ideas produced in group meeting processes. The CCUKGSS mainly supports the pooled decisions, and needs a meeting facilitator to arbitrate the meeting process. Figure 2 is a sample screen in logging on meeting of the CCUKGSS.

Design of knowledge capturing model of CCUKGSS

Knowledge moves slowly or rapidly through organizations and it is exchanged, bought, bartered, found, generated, and applied to work (Davenport & Prusak,1998). Since knowledge can be traded, a knowledge market must exist for knowledge buyer and seller to exchange their knowledge goods.

To capture and preserve the knowledge generated in group meetings, the CCUKGSS form from a group meeting system, knowledge management system and knowledge base as illustrated in Figure 3. These basic components construct the premier design of knowledge apprehend model for knowledge buyers and sellers to barter with each others in group meetings. Inside the subsystem of group meeting, this study had amended the deficiency of conventional GSS without mechanism for acquiring and preserving knowledge. User motivation differs in term of the degree to which contributed information is instrumental to a user's goal (Stein & Zwass, 1995). A reputation umpire who can participate, what type of information is requested from participants, how it is accumulated, and how it is made aboveboard obtainable to other community members (Dellarocas, 2005).

To increase the motivation for knowledge sharing, this study considered the knowledge query and reputation functions into the original group meeting subsystem. To elevate improve the sharing motivation of individual that participate in group meeting, an evaluation mechanism was added to GSS. Davenport and Prusak (1998) revealed that a person with a reputation for knowledge sharing is likely to achieve reciprocity in company. Therefore, in the group meeting, the participants can use the reputation function to measure others' ideas, and inquire solutions from knowledge database.

The knowledge management system is utilized for participants to inquire about information related to group meetings. It also allows participants to offer their evaluation and rank for what they had seized. Group members can also apply this function to recommend their own ideas or others' notion. By withdrawing experience from reputable person or knowledge database, group meeting members will acquire abundant information to make their own choice efficiently, and agree on how to achieving the task in group meeting. Accordingly, the knowledge management system can preserve those originated ideas and transfer them into knowledge base. By preserving those contents of group meeting, the knowledge base in CCUKGSS will become a knowledge repository, thus facilitating the knowledge exchange and retrieval for the next group meeting.

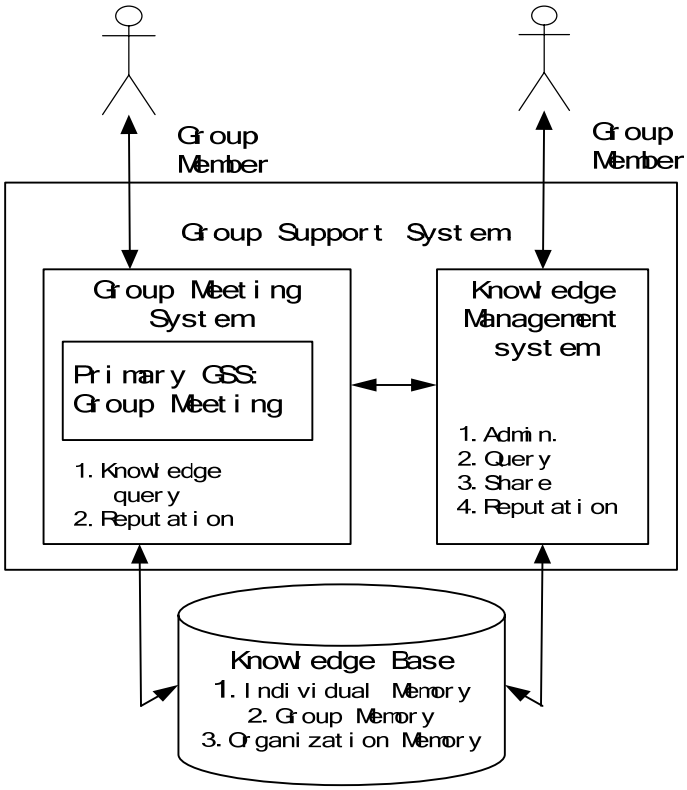

Figure 3: The Architecture of the CCUKGSS.

An IBM' xSeries-355 was used as a server to build the system, and the application was developed with a web-based design. The database was MS SQL2000, and Java and JSP (Java Server Pages) were adopted to generate HTML and other of documents for web-based design.

Rationale of CCUKGSS Design

The entity-relationship model is useful for realizing and deriving the entity set view of data (Chen, 1976). The entity-relationship model is a set of abstractions for symbolizing the semantics of data, and for trying to provide a conceptual mechanism for depicting the skeleton of rationale design of CCUKGSS.

To locate and preserve the group memory created in group meeting, the "Meeting_Session", "Group_Member", and "Knowledge_Item" were adopted to carry information about group meetings. This information was then extracted, and transformed into helpful knowledge. This study used the power designer (Sybase) version 9.5 to develop the entity-relationship diagram of CCUKGSS, as depicted in Figure 4.

In the entity of "Meeting_Session", each meeting could be related to its own tasks, contexts and participants. The "Group_Member" entity contains the profile and the reputation rating of participants for members to identify themselves and others. Finally, the entity of "Knowledge_Item" includes the reviews of group members, the meeting scheme solutions, the rules, the web resources, and the results of discussion process. One meeting session contains many knowledge items, and the group members can also contribute many knowledge items within many meetings.

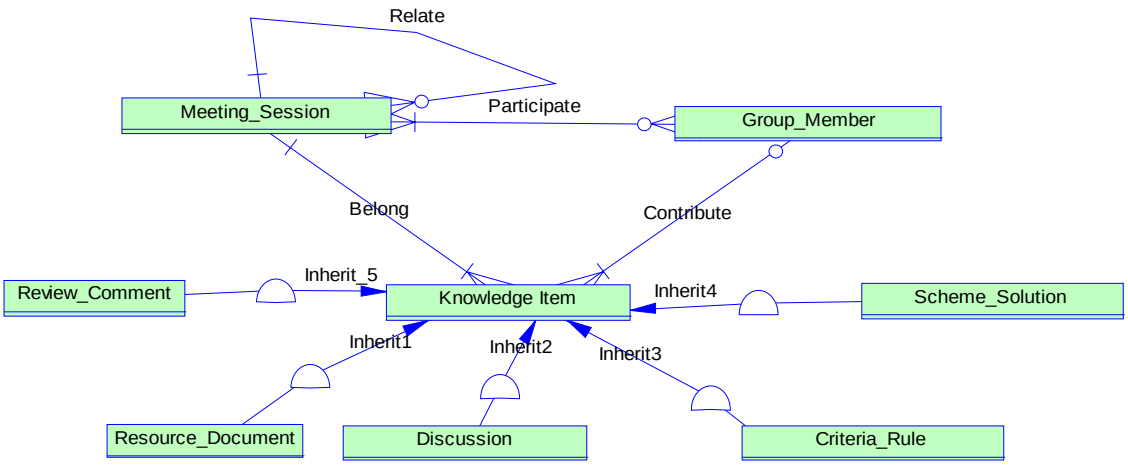

Figure 4: The E-R Model of the CCUKGSS.

Description of CCUKGSS

Knowledge is the expressively organized accumulation of information through experience, communication, or inference, and it can also be regarded as objects to be stored and manipulated. (Zack, 1999) Traditionally, researchers frequently categorized knowledge as tacit or explicit. In group meetings, the participants' interaction activities are always complicated and continuous.

Knowledge transfer in an organization is the procedure through which one unit (e.g., group, department or division) is affected by the knowledge of another (Argote & Ingram, 2000). In order to depict the group meeting flow and knowledge inquiry process, this study constructed a knowledge web to prevent those ideas from being lost. Figure 5 display the function decomposition diagram that was employed to develop the system. One major subsystem of the CCUKGSS is "Meeting Subsystem", which includes the functions of creating and controlling the group meeting process, and regulates the process of recommendation participants to other group members.

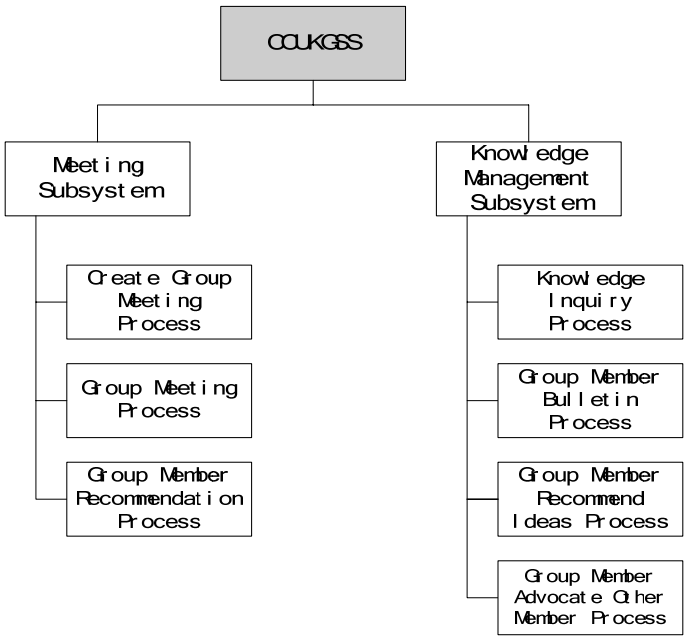

Figure 5: The Function Decomposition Diagram of the CCUKGSS.

Another main subsystem of the CCUKGSS is "Knowledge Management Subsystem", which contains the processes of knowledge inquiry, bulletins, recommend ideas, and member recommendations. The qualified participants join the session at the start of meetings. Figure 6 illustrates the four group meeting stages, namely criteria contention, schemes discussion, rating of alternative options, and voting.

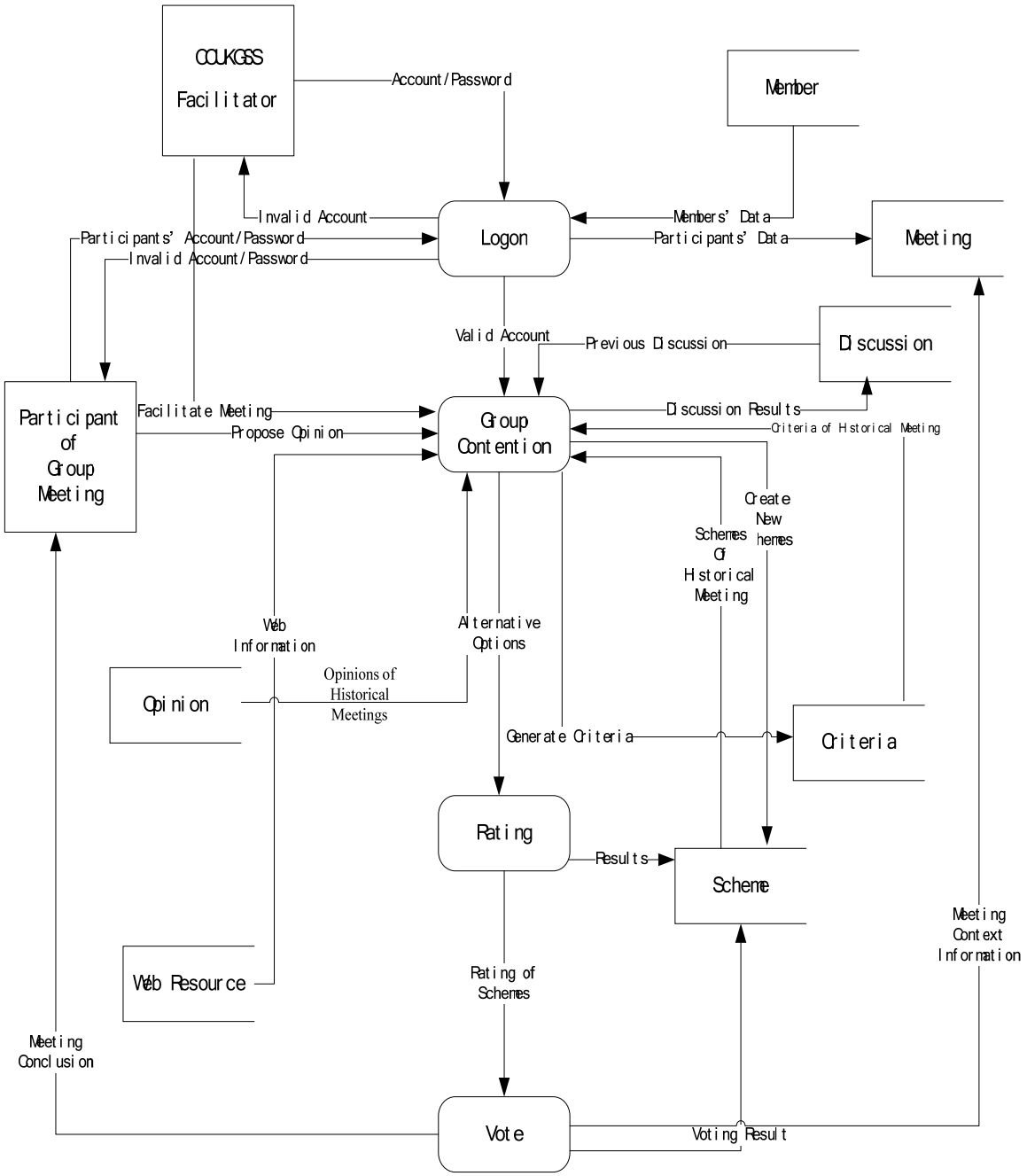

Figure 6: The Primitive Diagram of the CCUKGSS.

Participants can also accumulate these processes and digest them into their own minds. They can then absorb sufficient practices and quickly apply them to the other organizational tasks in subsequent group meeting.

The CCUKGSS facilitator governs the entire group meeting processes and system, as illustrated in Figure 7. The facilitator can also initiate the group meetings, as depicted in Figure 8. The participants in the group meeting can

utilize CCUKGSS to draw on previous experiences and information in order to enhance their creativity in group meetings.

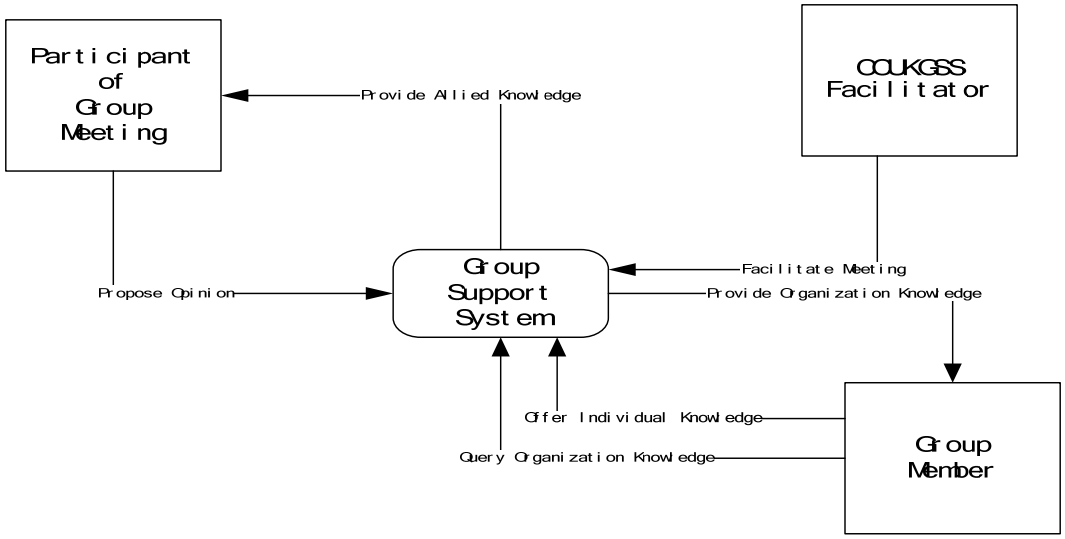

Figure 7: The Context DFD of the CCUKGSS.

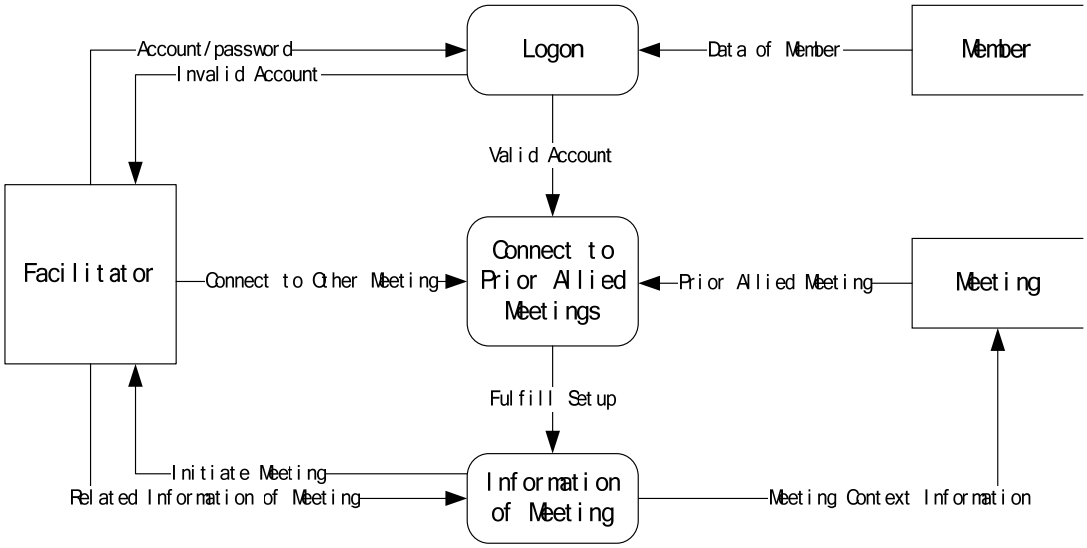

Figure 8: The Group Meeting Initiate Flow of the CCUKGSS.

SYSTEM EVALUATION

A laboratory experiment was undertaken to evaluate the effectiveness of the CCUKGSS system. The participants of CCUKGSS filled in a questionnaire to access their experience of the grouping meetings once the experiment was finished, to discover the group members' perception of CCUKGSS. The system evaluation processes had five stages: experimental design, development of instruments, lab experiments, data analysis, analysis result and description.

Experimental Design

The "Yearly Computer Selection Task" was chosen as the research task. Participants were asked to read the task information in advance, and then join the group meeting to work out the best solution to it. All experiments were processed in the laboratory of CCUKGSS.

The task involved a fictitious case study about a computer company that need to procure new personal computer (PC) apparatus to handle increasing numbers of transactions. The company also had to consider about the different practices and requirements for more powerful PCs. Therefore, the procurement manager had to prepare four alternative solutions, to be discussed by three managers from the IS, Accounting, and R&D departments in a group meeting. The participants used the CCUKGSS to communicate with each others, and obtain information from the system and internet, in order to help them choose an optimal computer.

Instrument Development

Explaining and canvass personal acceptance of new technology is one of the most mature research fields in the contemporary IS domain. In particular, Davis's (1989) technology acceptance model (TAM) posits that the strength of personal intention to use a technology can be explained by recognition of the technology's usefulness and attitude towards its use (Chau & Hu, 2001).

Regarding instrument construction, the items adopted to operationalize the constructs of each investigated variables were adopted mostly from relevant previous studies, with appropriate validation and wording changes. Specifically, items measuring perceived usefulness (PU) and perceived ease of use (PEOU) were adapted from Davis (1989), while items measuring perceived decision quality (PDQ) and perceived satisfaction with the meeting (PSM) were taken from Becerra-Fernandez and Sabherwal (2001). All items were measured with a seven-point Likert-type scale with anchors ranging from "strongly agree" to "strongly disagree". The final questionnaire was validated by two professional translators to ensure that no syntax or semantic biases arose during the translation from English to Chinese.

Experiment Procedure

The participants were asked to fulfill a questionnaire about their demographical data before joining the experiment to help discover group members' experience of CCUKGSS. The facilitator of CCUKGSS then introduced the experiment process flow and tasks so that participants understood the missions and purpose of the group meeting. The facilitator of CCUKGSS acquainted the group members with GSS before the beginning of the group meeting. Participants were asked to follow the system menu and exercise the functions of CCUKGSS, to ensure they could all operate the system correctly. The facilitator also assigned to each participant one of the three department roles of IS, Accounting, and R&D manager.

During the experiment process is proceeding, every group meeting member was required to use the GSS to discuss, rank and vote for a preferred solution for the "Yearly Computer Selection Task". Each participant also had to fill a questionnaire to evaluate their perceived experience about the CCUKGSS after they had finished the experiment.

Data Analysis

Fifteen experiments were performed to collect evaluation data. The experienced participants were recruited from CCU's BBS (Bulletin Board System), all students have to meet the term of previously used the early version of CCUKGSS on BBS. Forty-five volunteer participants joined these group meeting experiments. The participants were paid about US$3 to complete the experiment. Table 6 presents the profile of the participants.

Table 6: Profile of the Participants.

Variable	Category	Count	Percentage (%)
Gender	Male	24	53.3
	Female	21	46.7
Department	MIS	33	73.3
	Others	12	26.7
Education	Undergraduate	23	51.1
	Graduate	22	48.9
GSS Meeting Experience	One time	26	57.8
	Two times	14	31.1
	Three times	5	11.1
Teamwork Experience	Low	3	6.6
	Medium	2	4.4
	High	40	89.0
Computer Usage Frequency	Low	8	17.8
	High	37	82.2

The survey adopted a 7 points Likert Scale. The user satisfaction with the system was tested by *t*-test. A mean score (μ) of *t*-test above four was taken to indicate above-average satisfaction with the CCUKGSS. The functionalities of CCUKGSS involving the knowledge component were tested with the statistics tool-SPSS 10.0.

The mean μ was utilized as the participant satisfaction criterion. A value $\mu > 4$ would denote positive that the group support system was treated as evidence of perceived usefulness and perceived ease of use about this web-based group support system.

Before employing the collected data for *t*-test statistical assumptions, the shape of data distribution was tested for correspondence to the normal distribution (Hair, *et al*., 1998). The results of skewness and kurtosis tests demonstrate that the normal distribution assumption was satisfied.

Analytical Results

The group support system was measured by an instrument with 7 points Likert Scale, in which a score of four is a neutral (neither negative nor positive) feeling about the expansion of knowledge component in CCUKGSS. A score above four represents user confidence in this web-based system. Adapted from Davis (1989) and Becerra-Fernandez and Sabherwal's (2001) measurements, this study adopted four constructs, namely "perceived usefulness" (PU), "perceived ease of use" (PEOU), "perceived decision quality" (Quality), and "satisfaction of knowledge" (Satisfaction), and to reveal the participants' perceptions of CCUKGSS. By using a *t*-test with SPSS 10.0, four hypotheses were tested as below:

H1: Users feel that the CCUKGSS is more useful than the conventional GSS.
H2: Users feel that the CCUKGSS is easier to use than the conventional GSS.
H3: Users are more satisfied with the CCUKGSS than with conventional GSS.
H4: Users perceive higher decision quality with the CCUKGSS than with conventional GSS.

After verifying the shape of data distribution for correspondence to the normal distribution with SPSS, three outliers were identified inside the data, and then eliminated to ensure a normal distribution of data. Table 7 shows the skewness and kurtosis values after remove the outliers. Statistical results indicate that all skewness, kurtosis and Z values are in range ± 1.96 , thus satisfying the standard of normality assumption.

Table 7: Tests of the Skewness and Kurtosis (after outliers removed).

	Skewness		Kurtosis	
	Statistic	Z	Statistic	Z
PU	-0.082	-0.217	0.367	0.483
PEOU	-0.211	-0.558	0.656	0.863
PSM	-0.452	-1.196	-0.122	-0.161
PDQ	-0.438	-1.159	1.268	1.668

PU: perceived usefulness; PEOU: perceived ease of use; PSM: perceived satisfaction with the meeting; PDQ: perceived decision quality,. # of observations = 42.

According to the descriptive statistics results in Table8, PEOU was the most significant variable. Thus, although CCUKGSS involved new components of knowledge, its interface and functions were user-friendly, enabling users to use it effortlessly. The second significant factor is the perceived decision quality, which demonstrates the new system can enhance the quality of decisions made by group meeting members.

Table 8: Descriptive Statistics.

Variable	Sample	Mean	Standard Deviation	Standard Error
PU	42	5.39	0.59	0.09
PEOU	42	5.94	0.52	0.08
PSM	42	5.32	0.71	0.11
PDQ	42	5.52	0.52	0.08

PU: perceived usefulness; PEOU: perceived ease of use; PSM: perceived satisfaction with the meeting; PDQ: perceived decision quality.

Table 9 presents the *t*-test results when α=0.025, indicating that all four variables were significant. These results reveal the web-based CCUKGSS is more useful and easier to use than conventional GSS. Moreover, there results indicate that participants needing to make an optimal decision need the related specific knowledge about the topic of that group meeting. The GSS designer always seeks to provide the right information to the right members of the group meeting at the right time. This not only improves the effectiveness of group meetings, but also improves the efficiency of achieving right target of group meeting.

Introducing a knowledge component into GSS can clearly improve the function of GSS. Additionally, analytical results indicate that the users of a web-based group support system are comfortable with the new design, because they have already used browser to surf on the Internet with the other IT artifacts. Therefore, adding a knowledge component to a web-based GSS can also help users easier to search for advice from the Internet or draw them from knowledge base within the GSS.

Table 9: Results of the *t*-test.

Variable	d.f.	t-value	Significance
PU	41	15.369	.000
PEOU	41	24.351	.000
PSM	41	12.064	.000
PDQ	41	19.006	.000

PU: perceived usefulness; PEOU: perceived ease of use; PSM: perceived satisfaction with the meeting; PDQ: perceived decision quality.

CONCLUSION

Discussion

Orlikowski (1992) asserted that deploying the technology widely and using it over time, enable creative ideas and innovations to flourish. One of the most important recent innovations in GSS technology is web-based GSS, in which users can ubiquitously access groupware beyond the limitations of time and space. As noted by Grudin (2002), "Once a digital representation of an action reaches a network, it can surface anywhere on the planet at any future time."

Paul, *et al*. (2004) insisted that the combining GSS with collective memory is likely to provide additional information processing support. From the perspective of knowledge management, this study has constructed a web-based GSS framework, based on the organizational knowledge management process proposed by Alavi and Leidner (2001). The capabilities of organization memory, knowledge context, and knowledge sharing are integrated into the CCUKGSS.

The process of IT adoption and usage is important to deriving the benefits of IT. (Karahanna, *et al*., 1999) This study elaborated a reputation rating mechanism in order to elevate participants' self-esteems and stimulate GSS participants' sentiment toward knowledge-sharing. Ma and Agarwal (2007) observed that a reputation system that rate participants on the quality of their contributions provides a readily available collection of "experts" to knowledge seekers.

Although the sharing willing of users still requires further investigation (Lippert & Swiercz, 2007), Wasko and Faraj (2005) found that reputation might be an important motivation for contributing knowledge. Promoting share willing among group members speed up meetings, facilitates communication among group members and enhance the connections among them. Hence, the knowledge context information recorded in CCUKGSS is enhanced and connected. These knowledge components are eventually applied to proactively transfer proper knowledge, and to retrieve knowledge items from knowledge base within the CCUKGSS, according to user queries.

Information held in personal repository is likely to be inconsistent, and must be explicitly transmitted or opened in order to be shared (Huber, 1984). Davenport and Prusak (1998) believe that reputation is a proxy for value, to be used to evaluate the flood of information received. Most of users are used to retrieving information through Web browsers. Thus, adding a knowledge component to a web-based GSS helps users to search the information from internet, or to draw it from the knowledge base within the GSS. Additionally, group meeting members can easily operate with the new GSS, reducing their resistance to use new IT artifact. Since this new web-based GSS can provide fund of knowledge to users, the user satisfaction can be improved, thus also ameliorate the group meeting process.

Stein and Zwass (1995) indicated that preserving organizational memory is an essential concern among organizations. The real power of GSS technology lies in how it transforms the process of group work (Dennis & Gallupe, 1993). This study also reveals that the perceived decision quality is refined by increasing the efficiency of

finding right targets in group meetings.

Implications

The knowledge consolidation process involves individuals' social interactions, by using internal communication channels for knowledge delivery in order to arrive at a common purpose for problem solving (Mitchell, 2006). This study show that CCUKGSS that with reputation rating mechanism and preserved historical group memory can enhance participants' self-esteems and stimulate GSS participants' sentiments toward knowledge-sharing, thus improving the coherence of participants for upgrading performance in group meeting.

Current GSS technologies are designed to support different groups working together within a period of times, and attempt to combine their experience and knowledge for achieve group tasks, that beyond the constraints of space and time.

Human mental models and organization structures and cultures significantly influence how groupware is implemented and used (Orlikowski, 1992). CCUKGSS can improve performance in group meetings, and support the entire group meeting processes. It can also be used to search the related knowledge in a specific group meeting context, and discover associated tacit knowledge. The reputation rating mechanism improves participants' self-esteems and encourages knowledge-sharing among GSS participants, thus accumulating organization memory into the group system.

Therefore, IT can evoke a greater breadth and depth of knowledge creation, storage, transfer, and application in organization (Alavi & Leinder, 2001). Technology dissipates into the atmosphere around us, becoming emblematic of the modern era (Orlikowski & Icono, 2001). Group Support systems (GSS) are computer-based software system that allows people in different places to discuss and make decisions on connected computers. This study shows that expanding GSS capabilities with the knowledge management functions can improve the performance and satisfaction of group meeting.

Limitations and Future Research

Nunamaker, *et al*. (1991) stated that group meetings may lack a clear focus, and that group members may not participate in them, making GSS less effective than they could be. Results of the previous studies show that group meetings are not as productive as expected (Dennis, *et al*., 1988). This study did not dichotomize the experiment samples into control and treatment groups. Participants were all proficient in GSS. Therefore, this investigation could be criticized for lacking the rigorous of a traditional experiment.

To control the cost of the experiment, the participants were all recruited from campus possibly distorting the group meeting experiment result. Group meeting members participated in only one experiment for one time. Therefore, the GSS users might not have appreciated the importance of the reputation rating mechanism. These restrictions all might distort the group meeting experiment results.

Dennis *et al*. (1998) explored the effect of GSS under a majority/minority split of opinion in the group. This information would shape a group's decision, with or without GSS. In future, IT should be employed to help filter messages coming into group memory, and to determine not only where to store this new information, but also even whether to keep it.

Jessup and Valacich (1993) concluded that designing a GSS to effectively support groups operating in a wide, interrelated, and chaotic environment is still a large technical challenge. Artificial intelligence, agents, and work flow routines should be integrated into group memory technologies, so that GSS can automatically self-regulate its own knowledge.

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