경영학연구논문집 제5권 제2호 pp 87~108, 울산대학교.
Journal of Management Vol 5, No. 2, pp. 87~108, 1998
University of Ulsan

Future Developments of Group Decision Support Systems*

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<Abstract>

Group decision support systems (GDSSs) has been shown to reduce meeting time while increasing group effectiveness and satisfaction in many situations Further increases in effectiveness may be achieved via the incorporation of advanced technologies such as: 1) natural language translation for multilingual groups, 2) natural language processing in the forms of intelligent agents for retrieving information from on-line databases, and consolidating comments generated during the meeting; 3) hypermedia as a means of retrieving information from richer media sources such as text, sound, graphics, or a combination of these; 4) speech recognition for easier comment entry and communication, and 5) advanced telecommunication for faster and richer distributed communication over long distances These technologies might also give a way to overcome limitations in GDSSs Some of the advanced technologies that will be incorporated with GDSSs in the near future were developed and experimented by the author of this paper and researchers at the University of Mississippi. The results propose intelligent GDSSs The others have been studied to be combined with GDSSs. These technologies promise the future of GDSSs This paper discusses each of these technologies and the issues that they bring to the future of group decision support systems. This paper also proposes prototype GDSSs incorporated with these more advanced technologies

* 이 논문은 1998년도 울산대학교의 연구비에 의하여 연구되었음

그룹의사결정지원시스템의 미래의 개발

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<요 약>

그룹의사결정지원시스템은 여러 상황에서 그룹의 효율과 만족을 증가시키면서 회의의 시간을 줄여주는 것으로 나타나고 있다 다음과 같은 진보된 기술의 결합을 통해서 그룹의 효율은 더욱 증가할 것이다 1) 여러 언어를 사용하는 그룹을 위한 자연어 번역 기술, 2) 온라인 데이터베이스로부터 정보를 검색해내고 회의 동안 생성된 진술이나 논평을 모아서 정리하기 위한, 지능 대리인의 형태로 개발된 자연어 처리 기술, 3) 글자, 소리, 그래픽, 그리고 그것들의 조합과 같은 것들로 된 풍부한 미디어 자원으로부터 정보를 검색해내는 수단으로서의 하이퍼미디어 기술, 4) 더욱 쉬운 코멘트 입력과 대화를 위한 음성인식 기술, 그리고 5) 먼 거리에 걸친 분산된 환경의 대화시스템에서 더욱 빠르고 풍부한 대화를 위한 진보된 원거리통신 기술 이러한 기술들은 그룹 작업의 효율을 높여줄 뿐만 아니라 그룹의사결정시스템의 단점을 극복할 수 있게 한다. 이 논문의 저자를 포함하는 미시시피 대학의 연구자들이 가까운 장래에 그룹의사결정지원시스템에 결합될 몇 개의 진보된 기술들을 개발하고 실험하였다 그 결과로서 지능그룹의사결정지원시스템의 형태가 제안되었다 다른 기술들도 그룹의사결정지원시스템에 결합되기 위해 연구되었다 미래에 이러한 기술들이 그룹의사결정지원시스템에 접목될 것이다 이 연구는 이러한 각각의 기술들과 그 기술들이 미래의 그룹의사결정지원시스템에 제기할 논점들에 대하여 분석한다 이 연구는 또한 이러한 더욱 진보된 기술들이 합병된 프로토타입 그룹의사결정지원시스템을 제안한다

I. Introduction

Our post-industrial society is characterized by greater knowledge, complexity, and turbulence (Huber, 1984a). With the globalization of the economy, companies face more intense challenges and competition Many of the problems faced by these companies cannot be solved by an individual, but by groups of people These characteristics cause that decision-related meetings are becoming more frequent and important Moreover, the decisions confronting groups are more complex, made more quickly, and require greater participation than in the past (Huber and McDaniel, 1986)

The goal of group decision support systems (GDSSs) is to improve the process of

group decision making or other collaborative work by removing common communication barriers, providing techniques for structuring decision analysis, and systematically directing the pattern, timing, or content of discussion. These systems have received increasing interest since late 1970s for the support of group productivity (Keen and Morton, 1978, Huber, 1984a) although participants sometimes feel emotionally unfulfilled when they do not have affective reward (Reinig, et al., 1995/1996). GDSSs can decrease the amount of time for meetings and foster collaboration, communication, and negotiation among group participants (Nunamaker et al., 1991a; 1991b; 1995; 1996/1997), but still have several problems. These include difficulties with group communication and with access to supporting information. The advanced technologies that will be incorporated with GDSSs in the future may solve some of the difficulties.

The future of group decision support systems is promising, and we can expect the technologies for GDSSs to be markedly superior to today's relatively rudimentary forms. The purpose of this paper is to introduce some of the directions in which GDSSs research may take. These new directions include a greater emphasis on artificial intelligence for information retrieval, comment analysis, and language translation. Other directions discussed are the inclusion of technologies such as hypermedia-based information retrieval, speech recognition, and advanced telecommunications for faster and richer communication. Our goal is not to give a comprehensive review of these technologies, but rather to present the salient features with respect to their use within the area of GDSSs Each technology may have a definite role to play in the near future of group decision support systems.

II. Group Decision Support Systems

2.1 Definition of GDSS

One of the earliest definitions of a group decision support systems (GDSSs) was provided by Huber (1984b) who stated that a GDSS includes software, hardware, language components, and procedures that support a group of people engaged in a decision-related meeting Others have defined a GDSS similarly as an integrated computer-based system that facilitates solution of semi- and un-structured problems by a group of people that have a joint responsibility for making the decision (DeSanctis and Gallupe, 1987). Since early 1990s, however, researchers have defined group decision support systems more broadly as the application of information technology to support the work of groups with a focus on improving group performance and organizational effectiveness Recently, the terms group decision support systems, electronic meeting systems, groupware, and others are used almost interchangeably to refer to a computer-based system for improving group collaborative

work (Vogel and Nunamaker, 1990, Policy and Stone, 1993).

2.2 Advantages and Disadvantages of GDSSs

2.2.1 Advantages of Using a GDSSs

Traditional, oral meetings and group brainstorming sessions pose several problems. Even with an agenda, the discussion often loses focus and therefore wastes time One individual's viewpoints may dominate the proceedings, and low status participants may be reluctant to contribute ideas. It often takes too long to allow everyone to have their say and to organize the results. As a result, traditional meetings typically are viewed as a waste of time When using GDSSs, however, groups experience greater productivity and more satisfaction. The advantages of using GDSSs include

1 *Parallel Communication* A GDSS allows all participants to exchange ideas and preferences simultaneously. That is, everyone can "speak" in parallel in a GDSS session As a result, a GDSS provides an equal opportunity for participation by group members, and enables larger groups to conduct meetings, which can effectively bring more information, knowledge, and skills to bear on the task (Cass, Heintz, and Kaiser, 1992).

2 *Anonymity* Most group decision support systems also allow participants to exchange information anonymously which encourages more candid comments and greater participation Especially, a group using a Korean GDSS was much less concerned with face maintenance, and a group member felt free to criticize an idea without worrying about causing another to lose face (Aiken et al, 1995)

3 *Automated Meeting "Minutes"* During a GDSS meeting, all comments, votes and other information are automatically recorded on a disk file for use with other computer applications or for printing after the meeting This recorded information may also be used in subsequent GDSS meeting Thus, a GDSS supports the development of an organizational memory from meeting to meeting (Nunamaker et al, 1996/1997)

2.2.2 Disadvantages of using a GDSS

In spite of numerous advantages of using GDSSs, there are also a few disadvantages of using GDSSs They include.

1. *Less Media Richness* Most GDSS meetings rely primarily on written communication interspersed with some oral communication. This lack of communication media richness sometimes results in misunderstanding such as sarcasm and other nuances in written messages.

2. *Slower Communication*: Information is typically exchanged by participants in a GDSS meeting by typing on keyboards and reading message on computer screens. Since typing comments is slower than speaking, individuals may prefer speaking.

3 *GDSSs are Appropriate Only Under Certain Conditions*: GDSSs are useful generally only for group meetings which require members to exchange information through comments or votes (many-to-many communications). GDSSs are not very helpful for other type of meetings such as when a speaker is lecturing to the group (primarily one-to many communication). Also, very small groups (e. g. two or three people) may find that it is more efficient and effective to hold an oral meeting instead. Other restrictions caused by the environment, task, and group characteristics may preclude the use of GDSSs (Nunamaker et al., 1996/1997)

III. Current Uses of GDSSs

3.1 An Example Illustrating the Current Use of a GDSS

The following scenario illustrates a typical application of a GDSS for improving organizational productivity (Nunamaker et al, 1989)

A plant manager was having trouble identifying problem areas that were hindering shop floor control. His subordinates seemed unable to isolate causes of the problem and possible solutions that could result in improved productivity on the shop floor A two-hour meeting of six key plant personnel had resulted in a number of arguments and no solutions to the problem

The manager decided to use the company's Group Decision Support System (GDSS) in an attempt to resolve the problem and develop a plan of action including information system requirements to improve the shop floor control process The manager met with company's GDSS facilitator to set the agenda of the meeting and to understand how the GDSS could be used to resolve the shop floor control problem The manager and facilitator decided to use the *Electronic Brainstorming, Issue Analysis*, and *Vote* programs and to invite 10 of the plant employees in addition to the manager and two junior analysts assigned to investigate the problem.

The manager and facilitator decided that the topic of the meeting should be "What are the key issues in improving shop floor control?" During the subsequent GDSS session, the meeting participants used the Brainstorming program for 35 minutes and generated 645 lines of comments about improving shop floor control At the end of the brainstorming session, the manager saw that for the first time, he was able to get concrete, meaningful answers to questions associated with shop floor control issues The two analysts saw that they were beginning to better understand the complex

nature of the overall shop floor control process

After using *Electronic Brainstorming*, the group participants used *Issue Analysis* for 30 minutes to identify key issues related to shop floor control. Then they spent 45 minutes organizing the 645 lines of comments into these key issues forming a consolidated list of requirements for effective shop floor control improvement

Finally the *Vote* program was used Each group member ranked the list of requirements developed using *Issue Analysis* in terms of importance to improved shop floor control The accumulated results were displayed to the group After 10 minutes of discussion, the meeting was concluded with comments from the manager thanking the participants. The manager was given a printout of all of the group's comments, the consolidated list of requirements, and the results of the group vote

3.2 Current Uses of the Technology

In meetings in which GDSSs are appropriate, groups have required less meeting time while experiencing greater satisfaction and effectiveness (Nunamaker, et al, 1996/1997). The members of groups that use GDSSs participate much more evenly and fully in group interactions (Briggs, et al, 1994/1995, Reinig et al., 1997/1998) Because of these benefits, more and more universities and businesses are using the technology. For example, IBM has built over 75 GDSS facilities and more than 25,000 people have used these systems within IBM (Nunamaker et al, 1991). More than 3,000 people from 200 public and private organizations and 2,000 students have used GDSS facilities at the University of Arizona. Arizona's laboratory GDSS models have been built at over 1,500 sites around the World (Nunamaker et al, 1996/1997). Dozens of GDSSs have been developed in the past two decades SAMM, Claremont, COLAB, NICK, Capture Lab, and GroupSystems are a few current systems in operation. As the use of microcomputer networks continues to grow, the prevalence of GDSS use should grow accordingly

3.3 Experiences with GDSSs

International Business Machine (IBM) is one organization among many corporations and universities that have used GDSSs to improve their group meetings. In 1986, the first field experiment of GDSSs in IBM corporation took place at the Oswego, NY, plant. Thirty groups used GDSS systems to solve problems in production in a yearlong study Groups using GDSSs saved an average of 50 percent in labor costs over traditional meeting. The groups using GDSSs also reduced the elapsed time through their projects by an average of 91 percent. The benefits were too dramatic to suspect the results So a second study was conducted for a year at six other sites in IBM, and more than fifty groups were involved in the study. In the second study, labor costs

were saved by 55 percent and elapsed times for projects were reduced and average of 90 percent (Grohowski et al., 1990).

In Boeing Corporation, another independent case study of using GDSS was run to determine whether there was a productivity increase. Sixty four groups used GDSSs for problem definition, alternative generation, evaluation, implementation planning, and documentation of group outcomes over a year. The result of the study showed that they saved an average of 71 percent in labor costs, and reduced elapsed times for projects by an average of 91 percent. The IBM and Boeing studies also presented the improvements in the quality of meeting results and the satisfaction levels of the participants (Post, 1992).

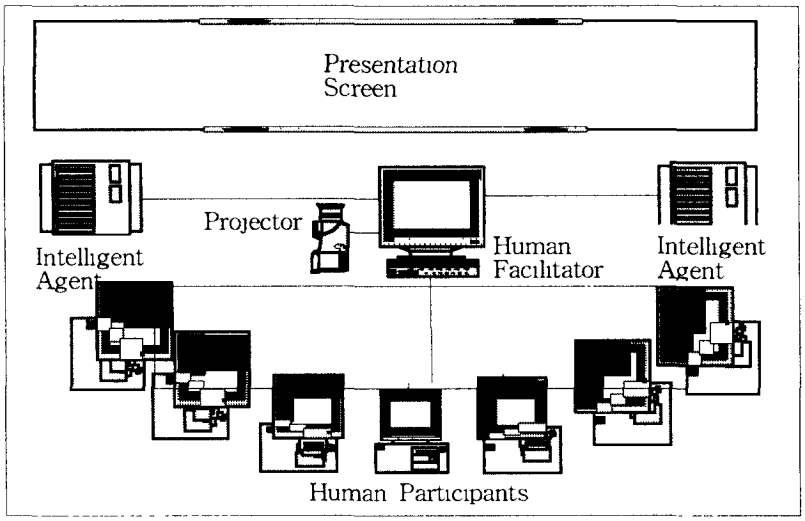
A total savings of a million dollars in eight one-week GDSS sessions to design a new personnel tracking system were reported by the U. S. Army. The U. S. Army National Guard found the savings over 70 percent in labor costs and 90 percent in project elapsed time over three information systems documentation writing projects by using GDSS sessions (Mittleman and Adkins, 1996).

IV. Future Developments of GDSSs

Advanced technologies promise to have a profound influence on the future group decision support systems Technologies that enable efficient transmission, storage, and entry and retrieval of textual, vidual, and audio information will enhance the usefulness of GDSSs. Technologies that enable efficient natural language translation and speech recognition will improve the systems' ease-of-use and ultimately, their prevalence of use (Huber, 1984b) An additional motivation for the incorporation of advanced technologies in a group meeting is provided by DeSanctis and Gallupe (1987) They have argued that GDSSs should proceed along an orderly hierarchy of increasingly technologically-advanced systems that provide a communication medium to systems that provide decision-making support before proceeding to systems that can control the pattern, timing, or content of group information exchange.

Many of the advanced technologies will incorporate some form of artificial intelligence which may be the most important technical contributor to the future of GDSSs (Aiken et al, 1991, Ellis et al., 1991, Vogel and Nunamaker, 1990) This technology can transform GDSS use from a passive process that simply presents information to an active process that enhances interactions among group participants One way of including this technology into group meetings is via the incorporation of artificially-intelligent agents or surrogates that can act for humans (Liu et al., 1990) Figure 1 shows an example of conventional setting of intelligent agent in a GDSS session.

Figure 1 Intelligent Agents in a GDSS Meeting



These agents are software modules which can be dynamically included into an on-going meeting and may even assume the role of a group participant

This paper focuses on a few advanced technologies which may be used by group decision support systems to improve their efficiency and effectiveness

4.1 Natural Language Translation

The provision of a language translation technology greatly increases the effectiveness of GDSSs in groups of people who do not share a common language For example, Figure 2 shows a sample English speaker's brainstorm screen with an edited comment

Figure 2 A Sample English Speaker's GDSS Screen Showing Editing

1 What do you think of the European common market?
2 I believe we should have one currency
3 Maybe we should have another name for this common market?
4 Trade barriers should be lowered immediately!
5 English is the language of business Therefore, everyone should learn English
6 Germany should take a leading role in the new European community
7 England will also want a leading role
8 What about France? It should not be neglected

I think that an international conference should be held to discuss this problem

F10-Save comment 14 24 55

Figure 3 shows the comments translated for a German speaker and a message from the group facilitator (Aiken et al., 1994). In this bilingual meeting, the automated language translation agent translate automatically with no human intervention. Thus, participants in bilingual or multilingual groups can see all comments in their own language, regardless of the language of origination.

Figure 3. A Sample German Speaker's GDSS Screen with Translation

1. Was halten Sie von gemeinsmen europäischen Markt?
2. Ich glaube, wir sollten eine Währung haben.
3 Sollten wir vielleicht einen anderen Namen fur diesen gemeinsamen Markt haben?
4 Handelsbeschränkungen sollten sofort gesenkt werden!
5. Englisch ist die Geschäftessprache. Deshalb sollten alle Englisch lernen.
6. Deutschland sollte eine führende Rolle in der neuen europäischen Gemeinschaft einnehmen
7 England wird ebenfalls eine führende Rolle haben wollen.
8 Und wie steht es mit Frankreich? Frankreich sollte nicht vernachlässigen

Die Sitzung wird in 5 Minuten beenden!

ESC-Verlassen 14:24:55

I and my colleagues of the Department of Business Administration at the University of Mississippi have participated to develop a multilingual GDSS which translates English, German, and Spanish comments The system is currently in use at the University of Mississippi Experimental results indicate an understanding accuracy of more than 90% and a grammatical accuracy of a little over 50%. The groups of students who participate in bilingual GDSS session express significantly greater satisfaction with the system over using the GDSS with no natural language translation in bilingual groups (Aiken et al, 1994).

The system has dictionary containing 35,000 words at present and takes approximately 6 seconds to translate a comment of three lines from English to Spanish Many translated comments are ungrammatical or awkward, such as "What be your name?" but session participants are usually able to ascertain their true meaning, especially because the comments are in the context of other surrounding comments Although the accuracy is considered to be good, occasional errors occur because of misspelling, poor grammar, slang, and idioms that are difficult to translate Future versions of the system will notify the original commentators of any bad wording to

give them chances to correct mistakes by scanning the source comments before translation Further studies on multilingual GDSSs to incorporate other languages including Korean have been doing

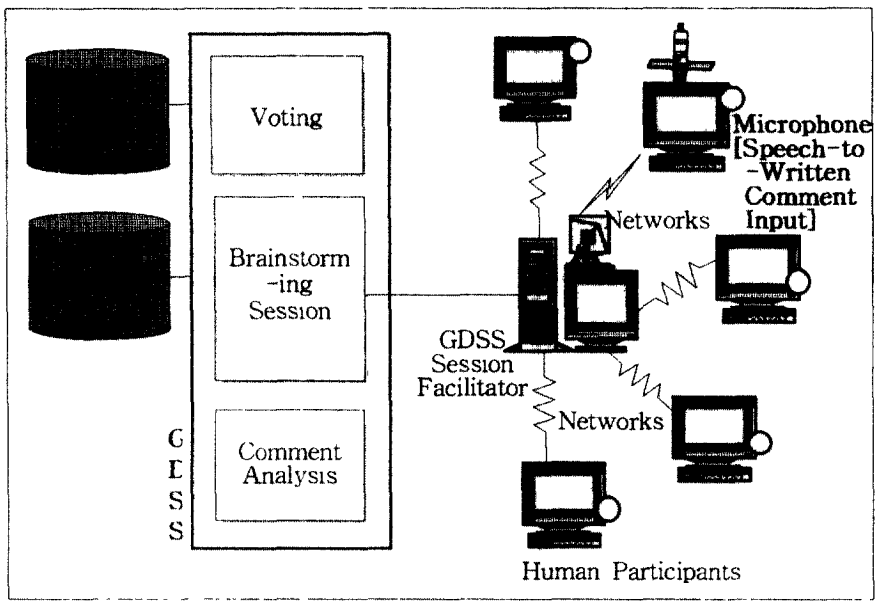
4.2 Speech Recognition

Integrating speech recognition technology within the context of a GDSS will greatly increase the efficiency of communication because most people type slower than they speak Group members would continue to read the transcribed comments on their screens, however, because people can read or scan much faster than they can listen to a conversation The communication increase may be so great that group members may become overwhelmed with information Group members' satisfaction may increase because the technology would remove the tedious entry of messages through a keyboard The benefits may be greatest among top executives who may not type well

Data entry using human speech rather than traditional keyboard input is a reality and quickly becoming a part of today's business environment although it is still costly and has rough spots Currently, many speech recognition softwares that are either speaker-dependent which need training for voice recognition and have a large vocabulary or speaker-independent which do not require training for each user but have a much smaller vocabulary are readily available to the customer (Nunoo, 1996) If a group member uses a dedicated computer terminal (in his office, for example) in a GDSS session, a speaker-dependent system that understands continuous speech may be most appropriate (Fried, 1996). In a setting in which new people use the terminals for each meeting, speaker-independent systems would be better

In addition to the problem of speech recognition, a GDSS with this technology must also overcome the problem of excess noise, if the participants are in a face-to-face environment. If all participants are simultaneously dictating messages in one room, the accuracy of the speech recognition will decline in addition to causing annoyance among the group members One method of alleviating this problem is through the use of directional microphones or microphones placed extremely close to the speaker's mouth. For distributed groups with each individual meeting in his or her own office, the problem of noise is not significant. Figure 4 shows a distributed GDSS session with speech recognition

Figure 4: Speech Recognition Comment Entry in a Distributed GDSS Session



4.3 Other Natural Language Processing

Other natural language technologies may also be used in the context of a GDSS to improve group efficiency and effectiveness. For example, with a natural language interface instead of a complex query language interface, many participants in a group meeting may be able to retrieve supporting, external information more easily and improve the quality of the group's decision. Another natural language processing application for organizing the group's comments can also improve group productivity.

4.3.1 Natural Language Processing on Information Retrieval

An information retrieval intelligent agent integrated with a GDSS has been developed and in use at the University of Mississippi to automatically retrieve information for a group (Conlon et al., 1994) I have been involved in the experiments for testing the system to develop a refined version of it. The last system has been working well and described in the next.

During an electronic brainstorming session, participants may pose queries to the system in normal English syntax but with a code of two question marks "??" at the end of the comment which causes the system to process the query. The intelligent agent receive the message, retrieves the necessary information from the applicable database or text base, composes a natural language reply to the group based upon the information, and sends it out to the group as a comment. Figure 5 shows a sample

screen illustrating the use of this intelligent agent A question about customers is asked in comment 4 in this figure The "??" code directs the intelligent agent to perform a search of text bases (past comments or ASCII disk files) or databases for the information If the agent is able to derive an answer, it is phrased in natural language and added to the discussion The braces "<" and ">" indicate the agent's reply, as in comments 6 and 9 The bottom of Figure 5 shows a new comment being formulated by a group member, another question for the information retrieval agent

Figure 5 A Sample Brainstorm Screen Showing Natural Language Processing

1 How can we increase market share at Consolidated Chemical?
2 I think our company needs to enhance its profitability rather than increase its market share
3 Where should we start?
4 First, I want to know what our market is like right now Who is our biggest customer this year??
5 I am not sure, we have to look at this year's summary report
6 <Your biggest customer is Amalgamated Paint >
7 One way to increase our market share is to lower our prices
8 What was our profitability in 1990??
9 <Your profitability in 1990 was 10 5%>

What was our market share last year??

F10-Save comment 12:30 51

In the system, the information request in English is converted by the four components of the natural language processing (NLP) system into a language that the database management system software can understand A question such as "which company ordered the largest amount of product X in 1990??" can be translated by the natural language processing system into a set of SQL commands

```
SELECT COMPANY_NAME
FROM CUSTOMER_1990
WHERE PRODUCT_NAME = 'X' AND
      AMOUNT_ORDER =
      (SELECT MAX (AMOUNT_ORDER)
            FROM CUST_1990),
```

In an experiment on the effectiveness and efficiency of the technique, the system with a data retrieval agent provided answers to participants' queries for information on average 300 to 400 times faster than the system without it. Participants of the experiment were highly satisfied with the quality of the system's answers. In the near future, the enhanced GDSS with a data retrieval agent will prevail in the market.

4.3.2 Natural Language Processing on Session Analysis

Another natural language application may be used at the end of an electronic brainstorming session to automatically organize the comments into related, coherent groups (Aiken, et al, 1991) A program called Idea Consolidator (Aiken and Carlisle, 1992), is one example of such an intelligent agent that imposes structure by grouping similar comments (as determined by their key words), thus improving the flow and readability of the session transcript. In a study conducted with this program, comments were automatically organized in approximately three percent of the time needed to manually group the comments while having higher recall and precision (the degree that relevant comments are included in the grouping and irrelevant comments are excluded) (Aiken and Carlisle, 1992) Without this function, automated comment analysis, GDSSs are somewhat tedious process because participants in GDSS sessions have to wait until all comments are organized at the end of each session The automated session analyzer may be one of the necessary part of GDSSs in the near future.

4.4 Hypermedia

Hypermedia is another technology that may increase the media richness of GDSS meetings In hypermedia systems, each unit of information is directly connected to others and users can navigate simply over the linked information space using a graphical user interface (GUI) Hypermedia allows users to explore and integrate vast libraries of text, audio, and video information (Ambron, 1988, Reisman et al, 1992) This technology is a potential means of logically organizing and retrieving data generated in GDSS meetings, and referencing richer external data Using this technology, participants could potentially browse related oral, textual and graphical information recorded in a rich, nonlinear, hypermedia database during collaborative sessions.

When participants of a GDSS meeting access information from a traditional database, the retrieved information is sometimes difficult to understand. However, if GDSS participants use a hypermedia-based database, they can obtain various kinds of information related to the topic in the form of text, tabular data, graphs, still and moving visual images, and sound which may improve the quality of the group meeting. A hypermedia-based database is one of the advanced technologies that result high

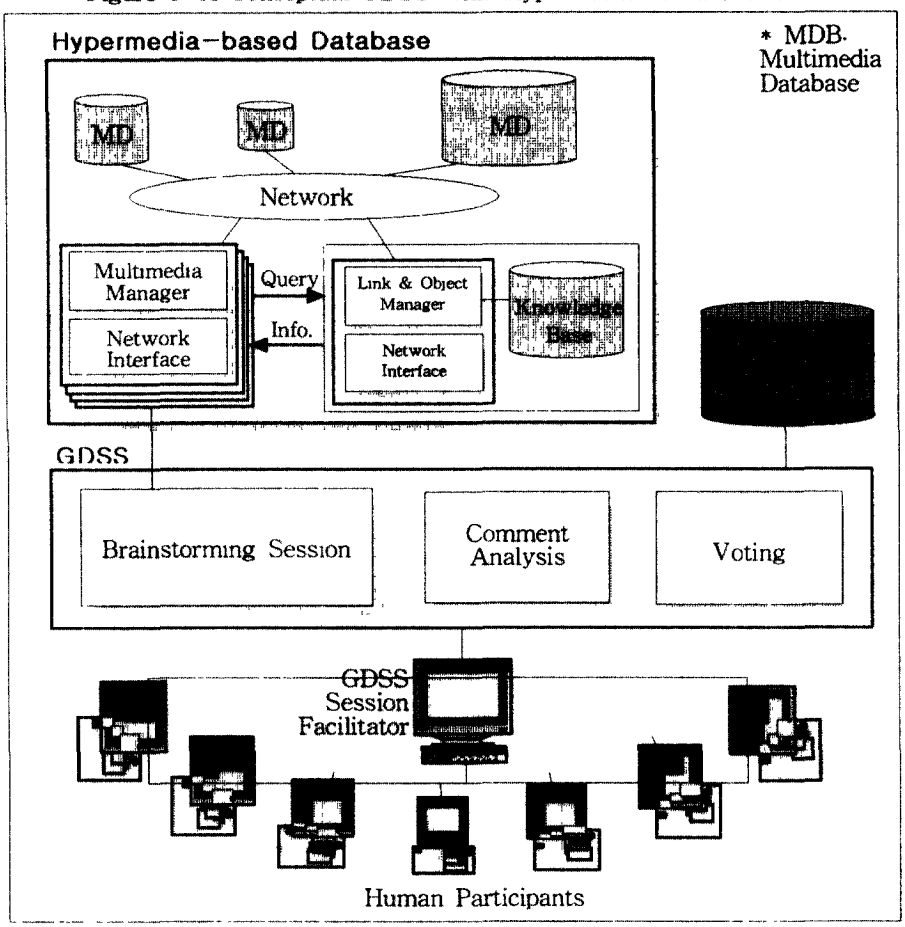
quality and intense GDSS session rather than shallow discussions without a full understanding on topics.

Recently, hypermedia-based information retrieval database management systems providing various retrieval capabilities have been developed. An example of newly developed hypermedia-based database systems that can provide simple and flexible user access capabilities is Hypermedia-based Design Image Database System (HDIDS) using a perceptional link method (Shibata et al, 1996-1997)

A hypermedia database system can include knowledge agent and knowledge base Knowledge agent performs various functions to aid intelligent information retrieval and manages databases distributed over the network. In the future, large multimedia information systems based upon knowledge base will contain multiple knowledge agents. Each knowledge agent will have its own knowledge base and area that it can cover within the database servers When knowledge agent is asked for information about a subject for which it does not have a complete knowledge base, it will ask other knowledge agents whether they have information in their knowledge base on the subject in question Thus, by cooperating with each other, knowledge agents will obtain new knowledge from distributed knowledge base and then provide new information to the participants in a GDSS session In this way, each knowledge agent utilizes several knowledge base to link users' query with multimedia database Knowledge base within a GDSS session provides information to the knowledge agent that is used to determine links to suitable objects depending upon participants' comments or requests

The conceptual design of GDSS with a hypermedia-based database is composed with multimedia database, network that connects multimedia database with knowledge agent and user interface, knowledge agent, and user interface It is depicted in Figure 6.

Figure 6: A Conceptual GDSS with Hypermedia-based Database



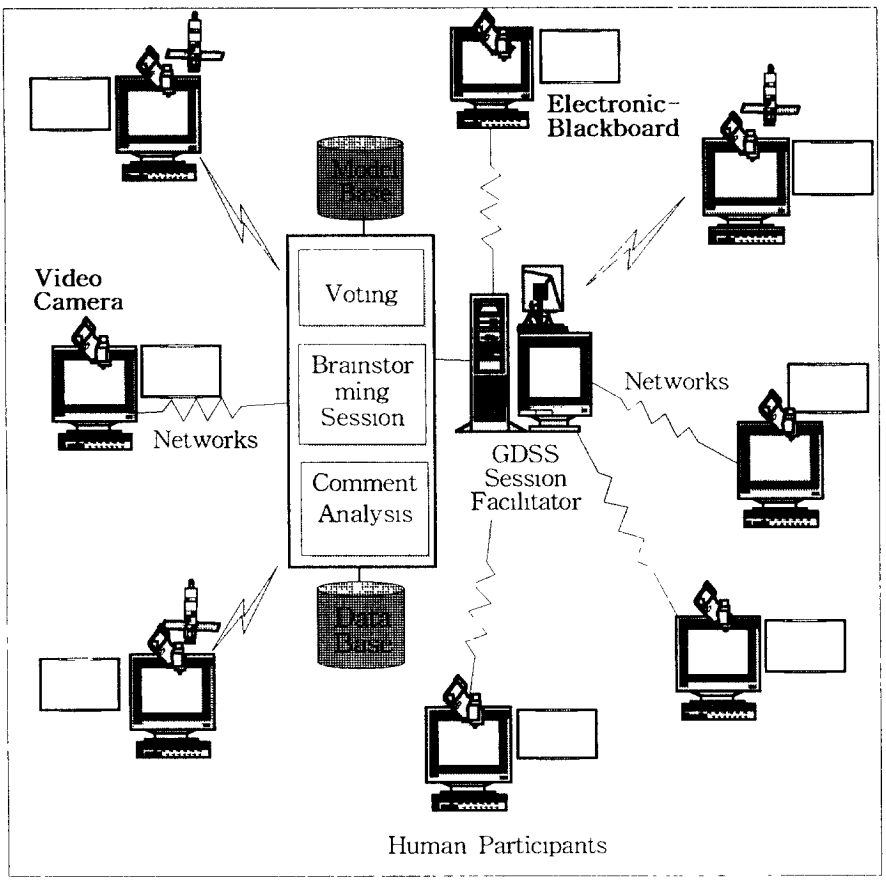
4.5 Advanced Telecommunication

Many researchers state that groups of people across the globe will one day be able to talk with and see each other, share electronic-blackboard scribblings, and watch films generated from experimental data - all via networks since early 1990s. This is the goal of a video teleconferencing, a form of GDSSs. The "video window," or "mirror project" at the University of Arizona is one project which attempts to achieve this goal (Chappell, 1992). This "window to anywhere" simulates the across-the-table feeling of being in the same room for groups that are physically distributed. The mirror project extends the concept of video conferencing by merging traditional GDSS technologies into the "window to anywhere" environment. Thus by adding full motion video and sound to a GDSS meeting, group members obtain added media richness which enhances distributed communication over long distances.

Recent technologies are converging to make this vision not only possible, but also practical. The technologies are fast microprocessors, advanced compression algorithms,

free video conferencing software, low-cost digital cameras, universal serial bus connectivity, and fast internet access (Musciano et al., 1998) One example of video teleconferencing (GDSSs) is a Multicast conferencing It allows real-time multiway audio and video communication over the internet. It also allows groups of people to participate in simultaneous video-audio conferences supporting communications with shared workspace and collaboration environments (Hardman, et al., 1998). Figure 7 shows a conceptual GDSS form with telecommunication

Figure 7. A Conceptual distributed GDSS using advanced telecommunication

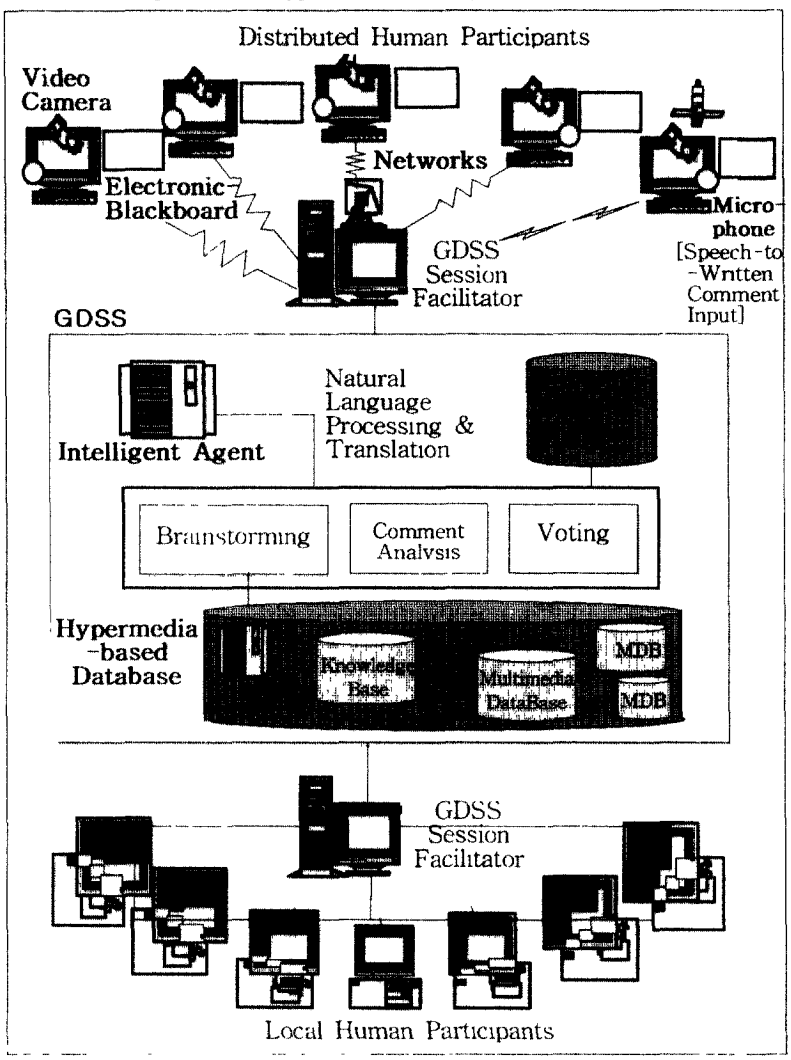


V. A Conceptual Prototype GDSS Incorporated with Advanced Technologies

In this paper, a few of information technologies that can be incorporated with

GDSSs are introduced Each technology has great potential of its own. Some of them have been already implemented and others are still on development in their field Among these, a few technologies are incorporated with GDSSs and the others are waiting for combining into technologically advanced GDSSs to give participants more flexibility and easier use. This study proposes a conceptual prototype GDSS in which all these technologies stated earlier are merged. In the prototype, intelligent agent for natural language processing and natural language translation, hypermedia-based database for flexible and easy access to rich database, and modelbase for helping participants' decision making are combined into a group decision support system. A decision room GDSS and a distributed GDSS are described altogether in a prototype The proposed prototype GDSS will give an idea for future development of GDSSs.

Figure 8: A Conceptual Prototype GDSS Incorporated with Advanced Technologies



VI. Conclusion and Limitation

Research on group decision support systems has included the study of methods to make these systems more intuitive and easier to use. One approach to increasing the effectiveness and efficiency of group support is the provision of the advanced technologies for natural language translation, natural language processing in the form of artificial intelligent agents for information retrieval and comment analysis, speech recognition, hypermedia, and advanced telecommunication Some of the technologies are developed and experimented, and the others are still on study The technologies discussed earlier will make GDSSs more flexible and will serve as powerful aids for group collaborative work.

Existing GDSSs incorporating a wide variety of tools are limited in their ease-of-use Thus, integrating the advanced technologies with GDSSs will simplify the use of GDSSs and will increase these systems' utilization. The technologies discussed will be incorporated with GDSSs in the near future and the prototype GDSSs proposed in this paper promises the wide spread, easy-of-use, and familiarity of GDSSs by supporting group work effectively and efficiently

The technologies discussed in this paper do not constitute an exhaustive list of possibilities for the future uses of GDSSs, but constitute an excellent starting point for further research. More technologies that can be combined with GDSSs should be studied in the future research. This paper does not give a comprehensive review of the technologies, but rather present the salient features of the technologies with respect to their use within the area of GDSSs. So more detailed and comprehensive studies should be followed

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