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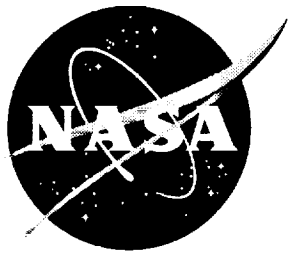

Advanced Group Support Systems and Facilities

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December 1999

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Preface

This document contains the proceedings of the Workshop on Advanced Group Support Systems and Facilities, held at NASA Langley Research Center, Hampton, Virginia, July 19-20, 1999. The workshop was jointly sponsored by the University of Virginia's Center for Advanced Computational Technology and NASA. Workshop attendees came from NASA, other government agencies, industry and universities. The objectives of the workshop were to assess the status and effectiveness of different advanced training technologies and learning environments.

Certain materials and products are identified in this publication in order to specify adequately the materials and products that were investigated in the research effort. In no case does such identification imply recommendation or endorsement of products by NASA, nor does it imply that the materials and products are the only ones or the best ones available for this purpose. In many cases equivalent materials and products are available and would probably produce equivalent results.

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Future Trends – Collaborative Distributed Engineering Environments

Rapidly developing technologies and changing economic realities promise to have a profound impact on engineering environments and practice, as well as on engineering organizations, over the next few years. The forces driving a paradigm change in engineering practice are described subsequently. Among the influences taking shape today are the convergence of computing, communication, and information technologies; advances in modeling, simulation and manufacturing technologies, and in knowledge-based engineering (the incorporation of artificial intelligence and expert systems into product development processes).

As a result of technological advances, globalization of markets, and heightened competitive pressures, the early twenty-first century will witness dramatic changes in the way high-tech engineering systems are designed, produced, operated, maintained, and eventually, disposed of. Future environments will permit collaboration among teams in several engineering disciplines at widely distributed locations, and will enable them to rapidly apply novel technologies, create better products in less time, and better manage risks. The teams will be provided with groupware tools and facilities (which are the focus of this workshop) to significantly improve their ability to explore, generate, track, store and analyze alternative product development processes.

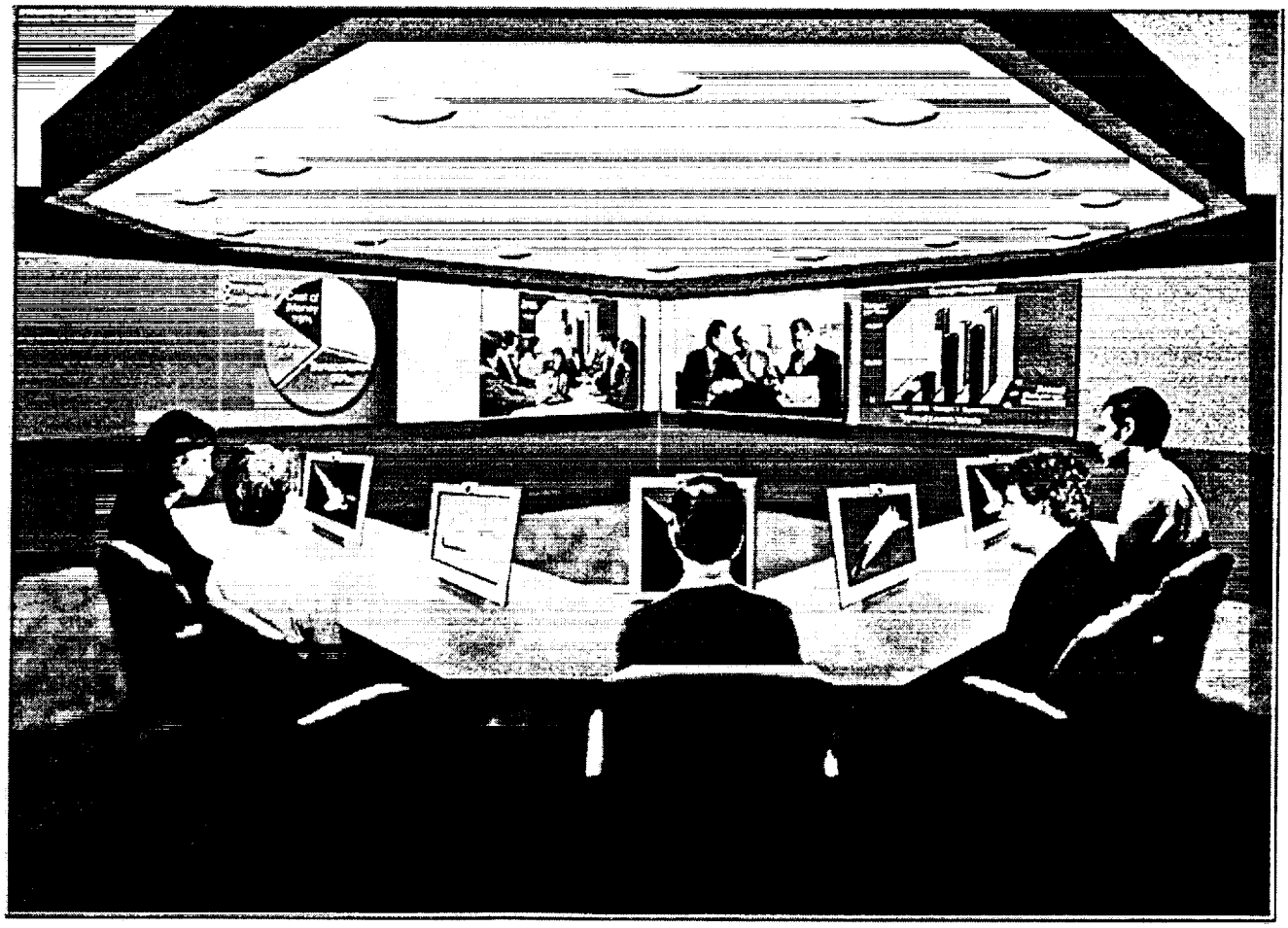


Figure 1

Forces Driving a Paradigm Change in Engineering Practice

There are four categories of forces that are driving a paradigm change in engineering practice (Fig. 2):

- Development in organizations and workplaces. In the 1980's the focus of engineering organizations was on quality through reduction of defects and use of TQM models. In the 1990's the focus shifted to reengineering and streamlining the processes through the use of virtual product development (VPD) and enterprise resource planning (ERP) systems. As we move from the industrial to the knowledge era, engineering organizations will make radical changes in the workplaces, use electronic performance support systems (EPSS), and create virtual organizations with the overall goal being to achieve very high performance workplaces. Workplaces will be transformed from stationary offices centered around desktop computers and workstations into intelligent networked environments that enable diverse geographically dispersed teams to collaborate in real time.
- Economic pressures. To remain competitive, engineering organizations will move from mass production to mass customization. In addition, the rapid technology changes will continuously change the knowledge requirements of workers (continuous need for learning).
- Growing interdependence among technology, workplace and learning. Technology will significantly impact workers by providing just-in-time information and skills, and will change the workplace by making learning and work synonymous. It will help in transforming engineering organizations into learning organizations.
- Resistance to change. Because of the increasing number of older learners and the need for just-in-time training, flexible delivery systems have to be used. Also, engineering organizations need to have realistic expectations from, and provide incentives for, using new technologies.

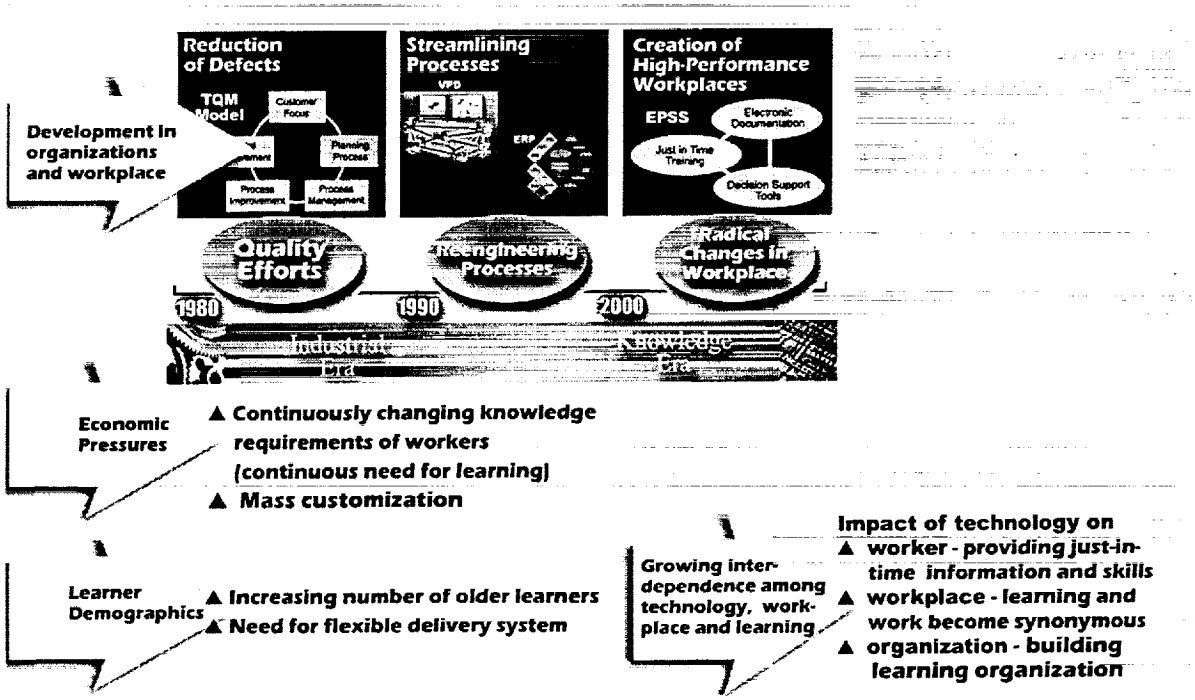


Figure 2

Groupware

The term groupware refers to both the technology for managing relationships and information and the software products that support groups of people engaged in a common task or goal. It includes various kinds of computer-based systems that provide an interface to an environment shared by a group, and supports that group in carrying out common tasks.

Three major classes of groupware can be identified; namely, communication facilities; collaborative facilities; and decision making systems. *Communication facilities* include message systems (e.g., electronic mail, bulletin boards and newgroups); conferencing systems (e.g., desktop and real-time data conferencing facilities); and middleware – software that connects separate applications, serves as a glue between these applications, and allows users to work with any server (e.g., suite of services for distributed computing environment (DCE), and common object request broker architecture (CORBA). *Collaborative facilities* include coordination systems, groupware development tools and tele-immersive facilities. *Decision making systems* are described subsequently.

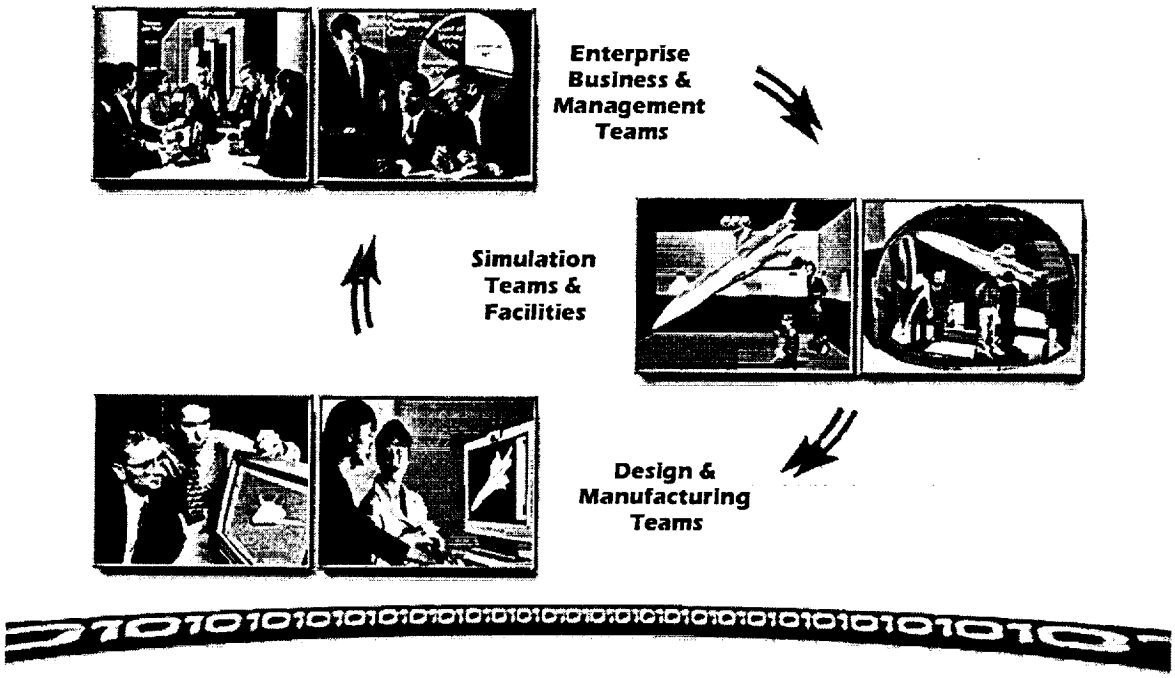


Figure 3

Decision Support Systems

Decision support systems are generally concerned with improving the effectiveness and efficiency of knowledge management activities that occur in the course of decision making. The following objectives of group decision support systems (GDSS) can be identified: supplement the decision making team by helping to answer what-if questions; allow better intelligence, design or choice; facilitate problem solving; provide aid for non-structured decisions; and managing information and knowledge. Two types of information/knowledge are used in GDSS: primary and secondary. The primary information/knowledge types include: descriptive (information or data) – know what; procedural – know how; characterizes how to do things; reasoning – identifying particular circumstances under which certain conclusions are valid. The secondary information/knowledge types include: linguistic, which enables the user to understand incoming messages; assimilative, which is a filter to keep out low quality knowledge and prevent knowledge overloads; and presentation, for constructing outgoing messages and decisions.

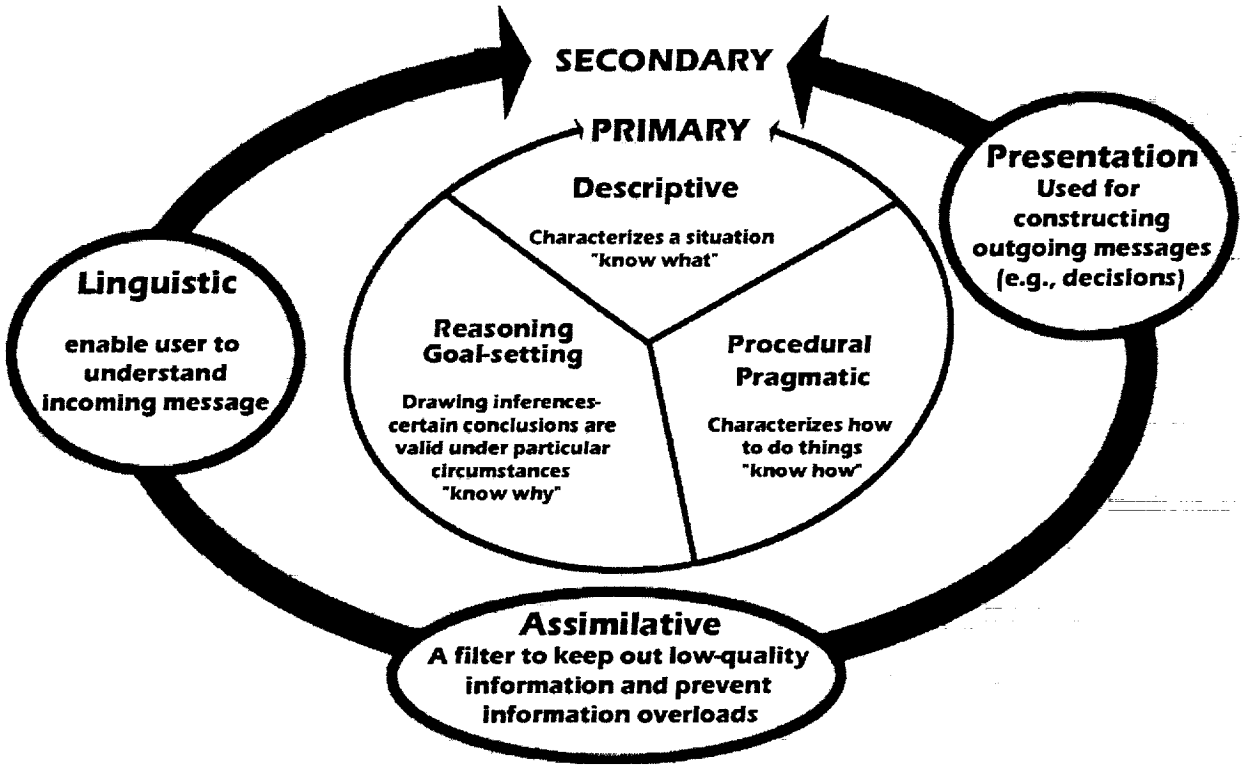


Figure 4

Evolution of Decision Support Systems (DSS)

Decision support systems can be traced to the data processing systems of the 1950s and 1960s, including both the automatic data processing (ADP) and electronic data processing (EDP) systems. These systems evolved into the management information systems (MIS) of the 1970s and 1980s, which had very limited decision support facilities. In the late 1980s, decision support systems (DSS) were developed to automate the various knowledge management tasks, and had the following characteristics: they could interact directly with a decision maker or decision making participant; they often held descriptive and other types of information/knowledge; they had the ability to acquire and maintain each of the information/knowledge types listed in Fig. 5; and, they could derive new knowledge from existing ones for recognizing and/or solving problems. The 1990s witnessed a growth in DSS. Some of the current DSS incorporate high capacity communication and networking technologies, expert systems, and brainstorming facilities. The trend is towards adding advanced user interfaces, including natural language and multi-lingual communication; soft computing (fuzzy logic, neural networks and genetic algorithms); and intelligent agents. Decision support systems play an important role in many business computing and enterprise resource planning (ERP) systems.

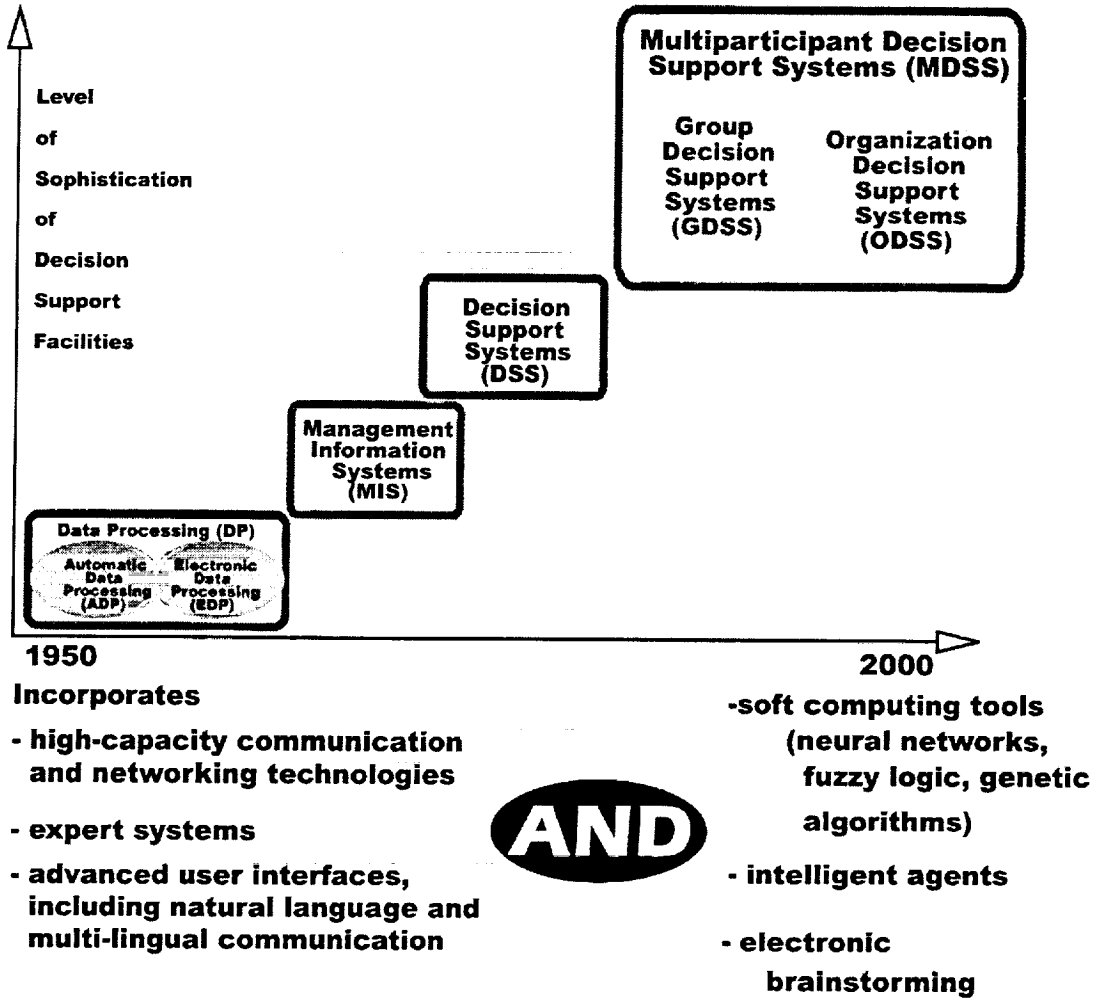


Figure 5

Some Categories of Business Computing Systems

Task support systems (TSS) form a broad class of business computing systems for supporting management, personnel, research terms, consumers and suppliers of a business. Multi-participant decision support systems (MDSS) constitute an important category of TSS. It includes both group and organization decision support systems (GDSS and ODSS) The distinction is based on the functional and authority differences in roles between the participants. Four categories of MDSS can be generated by varying displacement in time and place.

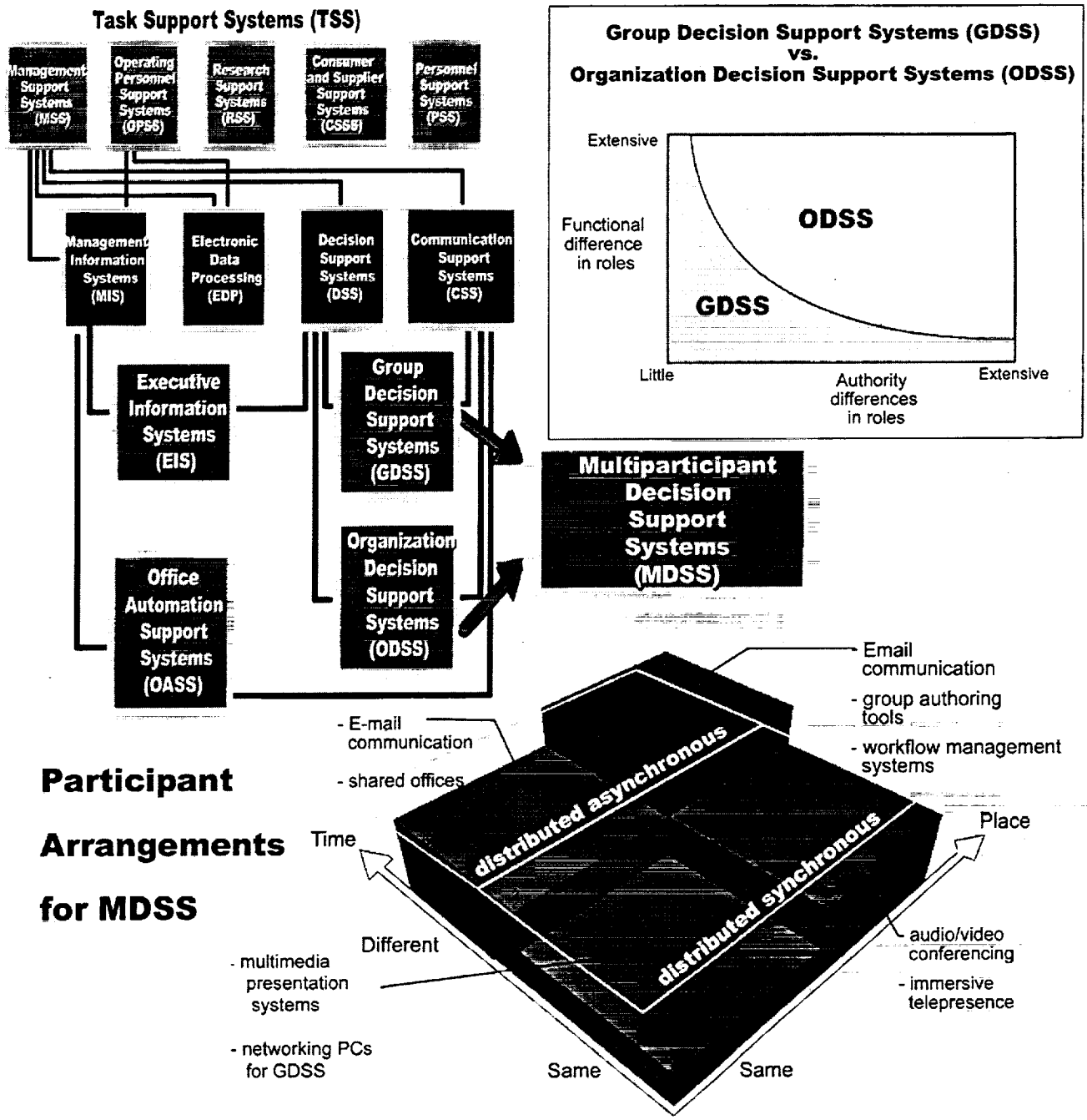


Figure 6

Enterprise Resource Planning (ERP)

Enterprise Resource Planning (ERP) systems are integrated software systems that enable the planning of resources at and among the strategic, tactical, and operational levels of an enterprise. They provide transaction management to enable accurate and timely execution of decision support systems to plan the design and manufacturing, human resources, finances, and marketing and sales across an enterprise.

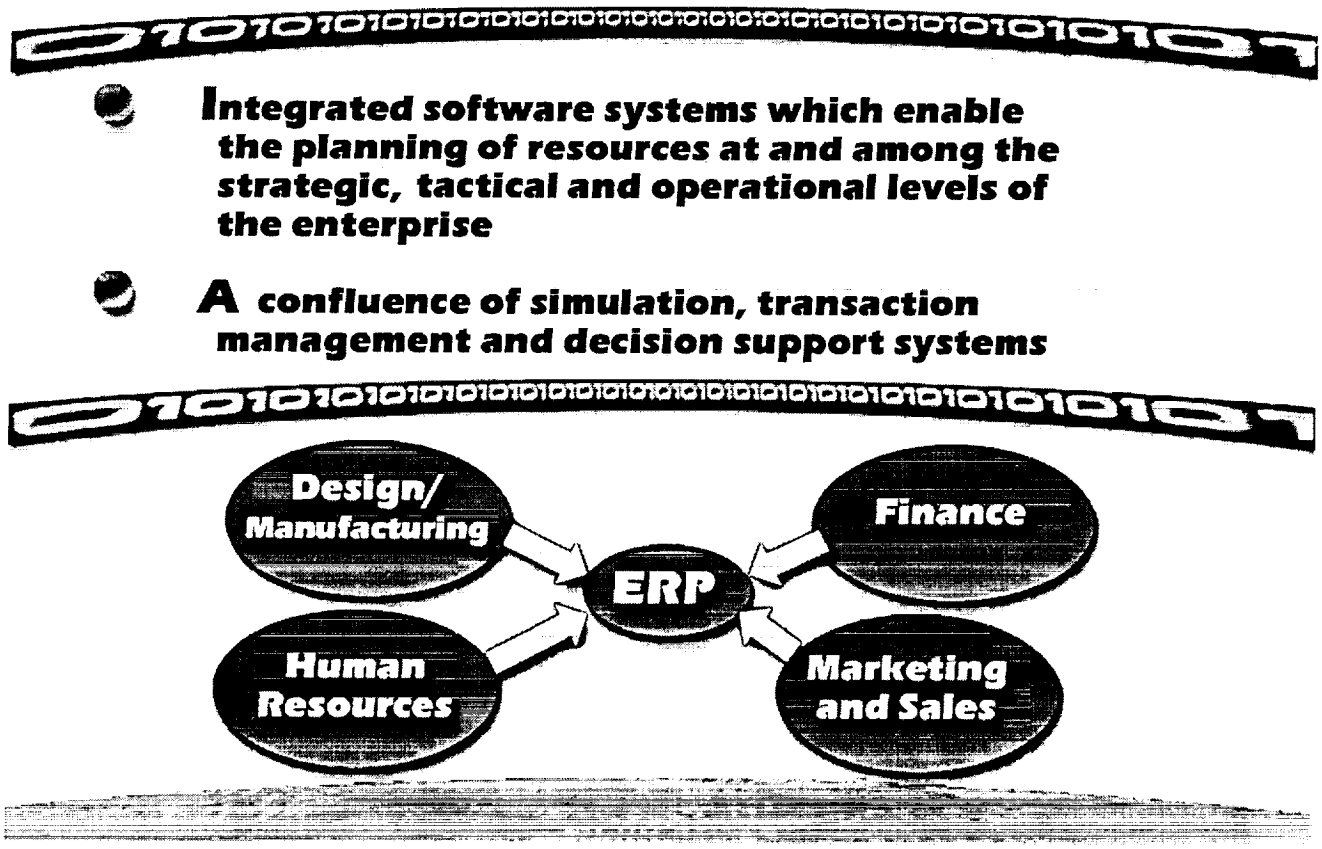
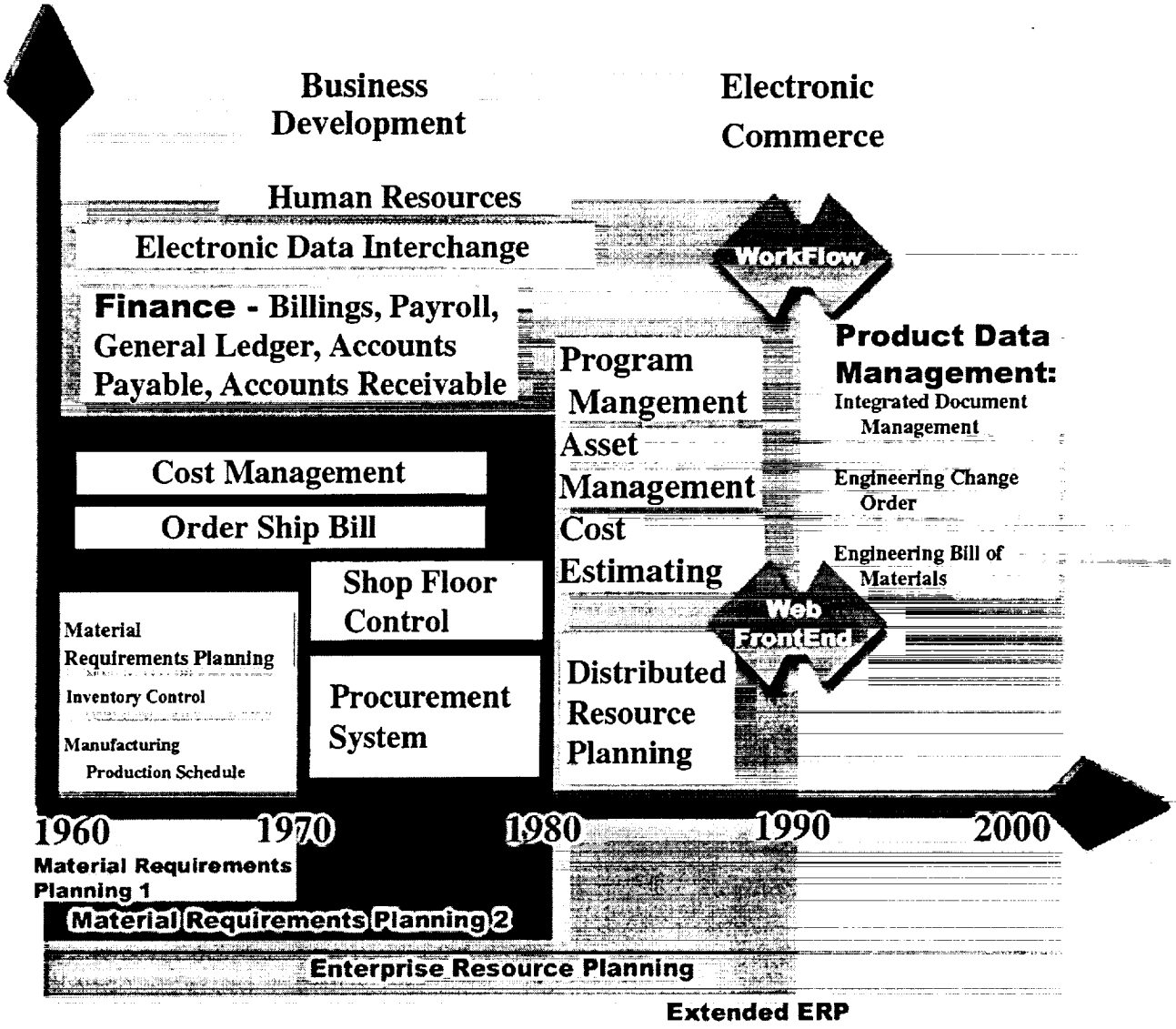


Figure 7

Evolution of ERP

ERP systems evolved from several domains: manufacturing, finance, human resources, and marketing/sales. The development of ERP dates back to the material requirement planning (MRP) systems of the 1960's and 1970's. Current ERPs go beyond manufacturing and financial functions. They include multi-plant and supply chain views. They support different production environments (e.g., job shop, intermittent, repetitive, continuous, mixed mode), and include simulation capabilities at various levels of an enterprise. Future ERPs will include facilities for supply chain integration, business development and electronic commerce.



The Growing Reach of ERP

Figure 8

Group Support System Vendors

The goal of current group support systems (GSS) is to enhance and facilitate productivity improvements in daily problem solving and idea exchange situations. The two major components of GSS are shared objects and group dynamics. Most of the GSS in use today have one or the other. A partial list of the GSS vendors is shown in Fig. 9. The typical setup in some of the GSS is a room for teleconferencing or meeting with projection screens and facilities for everyone to view the contributions of other participants.

Figure 9

Government Activities Using Requiring GSS

The potential benefits for product development and scientific research have led many organizations to initiate programs to design collaborative distributed virtual environments Among the government activities that either use, require, or can benefit from GSS, are the knowledge and distributed intelligence (KDI), and the Advanced Computational Infrastructure and Research of the National Science Foundation; the Intelligent Collaboration and Visualization Program (IC&V) of the Defense Advanced Research Projects Agency; the Digital Library Initiative (DLI) which is in its second phase; the Manufacturing Collaboratory of the National Institute of Standards and Technology; and the Intelligent Synthesis Environment (ISE) of NASA, ISE is described subsequently.

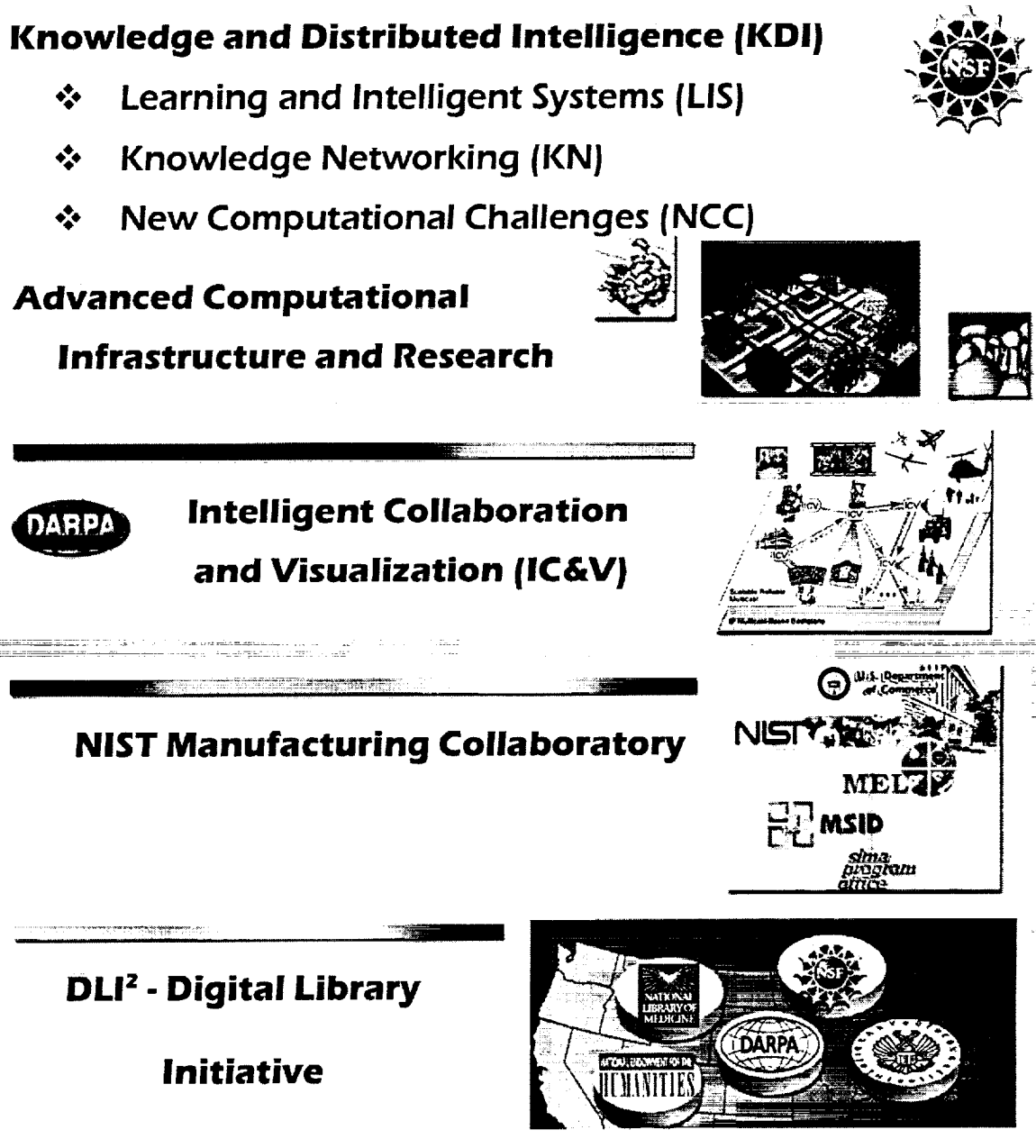


Figure 10

Intelligent Synthesis Environment

The Intelligent Synthesis Environment (ISE) Project of NASA attempts to meet the needs of future systems and missions. The ultimate goal of ISE is the seamless integration of teams, processes and disciplines, thereby enabling an end-to-end simulation of the product life cycle and mission scenarios before the mission begins. ISE will link design teams, manufacturers, scientists, suppliers and consultants in the creation and operation of an aerospace system and in synthesizing its missions. The teams will use robust systems engineering approaches, and will be provided with tools and facilities to significantly improve their ability to explore, generate, track, store and analyze different mission scenarios and alternative product development processes. These may include group support systems. ISE has five major components: rapid synthesis and simulation tools; cost and risk management technology; life cycle integration and validation; collaborative engineering environment; and cultural change – training and education.

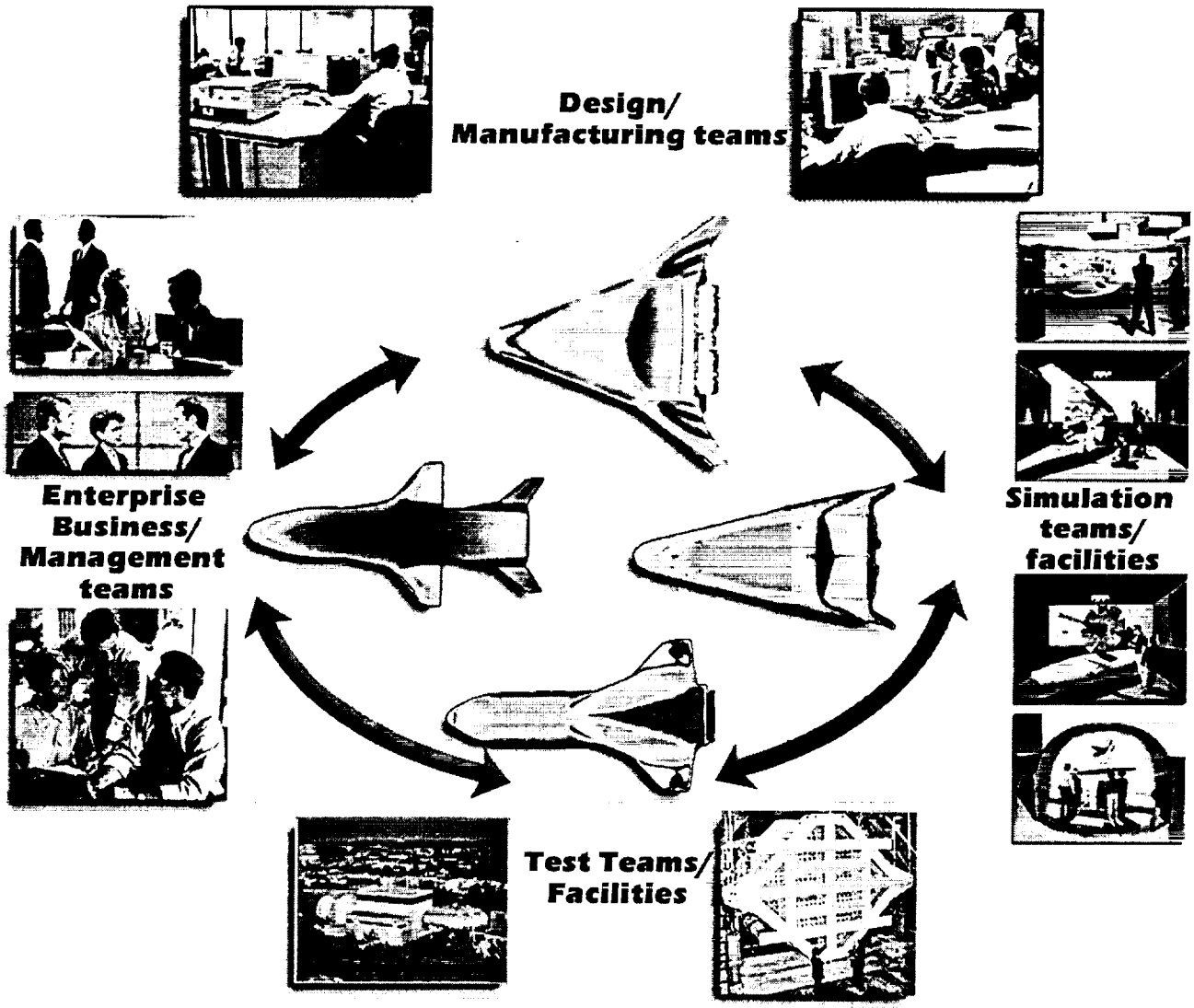


Figure 11

Distributed Learning Environment (DLE)

Two activities are performed as part of the ISE program. The first is the development of distributed learning environment and the second is simulation of diverse team structures and processes. The distributed learning environments will incorporate state-of-the-art multimedia, immersive facilities and multi-sensory interfaces, and will be tailored to each individual learner's needs. The environment enables learning anywhere and at any time. The use of GSS can enhance the effectiveness of the distributed learning environment.

Dynamic process improvement can be performed by: a) simulation of the procedures, processes and coordination/integration mechanisms involved in the distributed interactions between instructors and learners as well as the information flow during these interactions; and b) development of metrics for assessing the effectiveness of learning (Fig. 12). The effective deployment of DLE can result in a skilled workforce able to sustain technological growth.

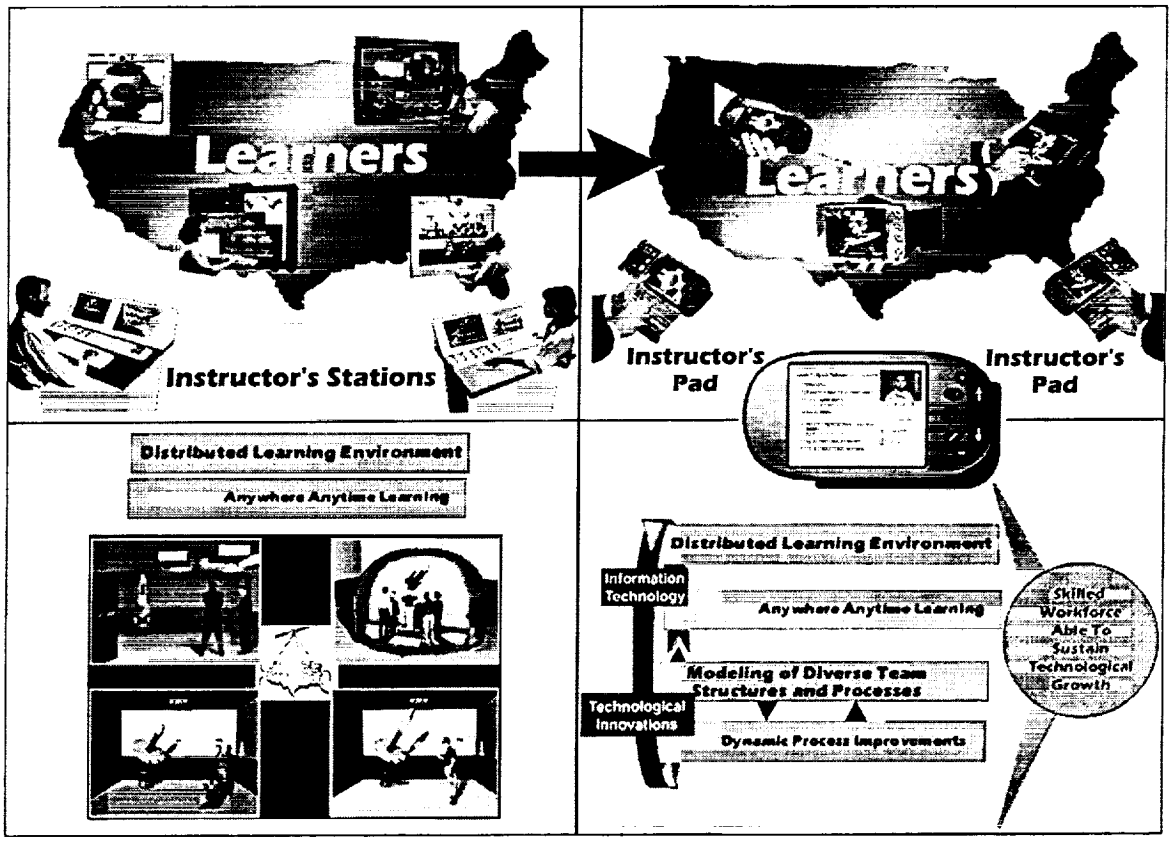


Figure 12

GroupSystems: Software for Team Productivity

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GroupSystems: Software for Team Productivity

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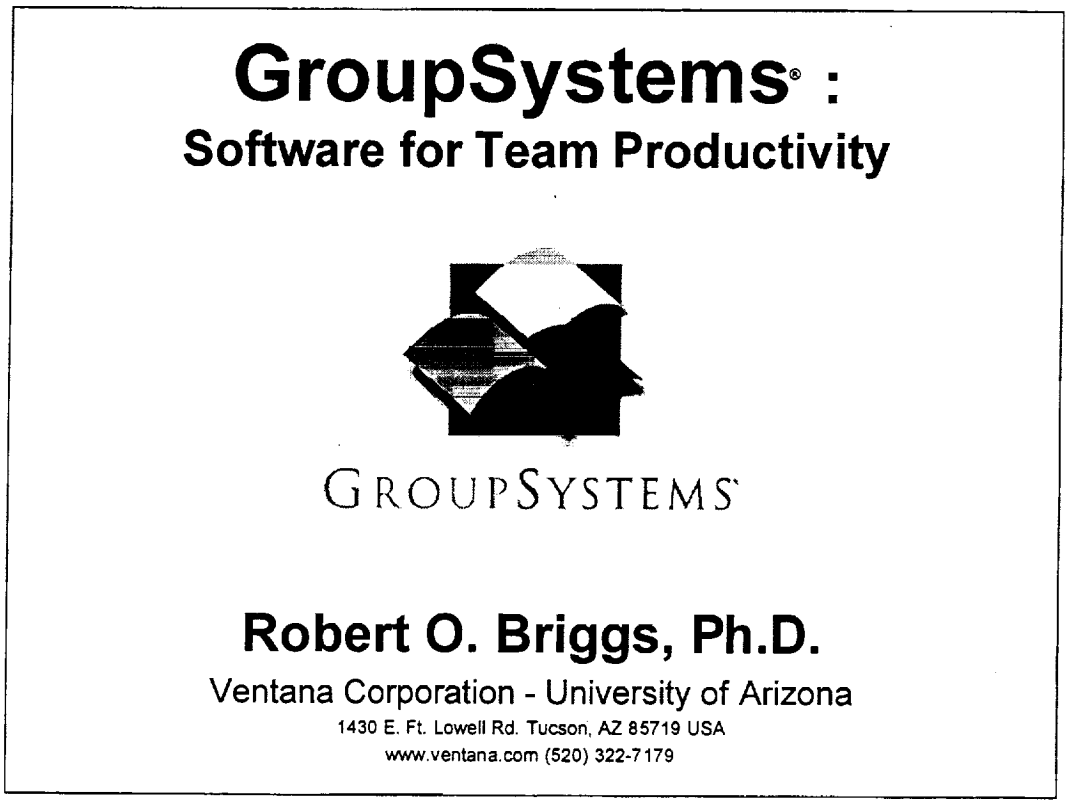
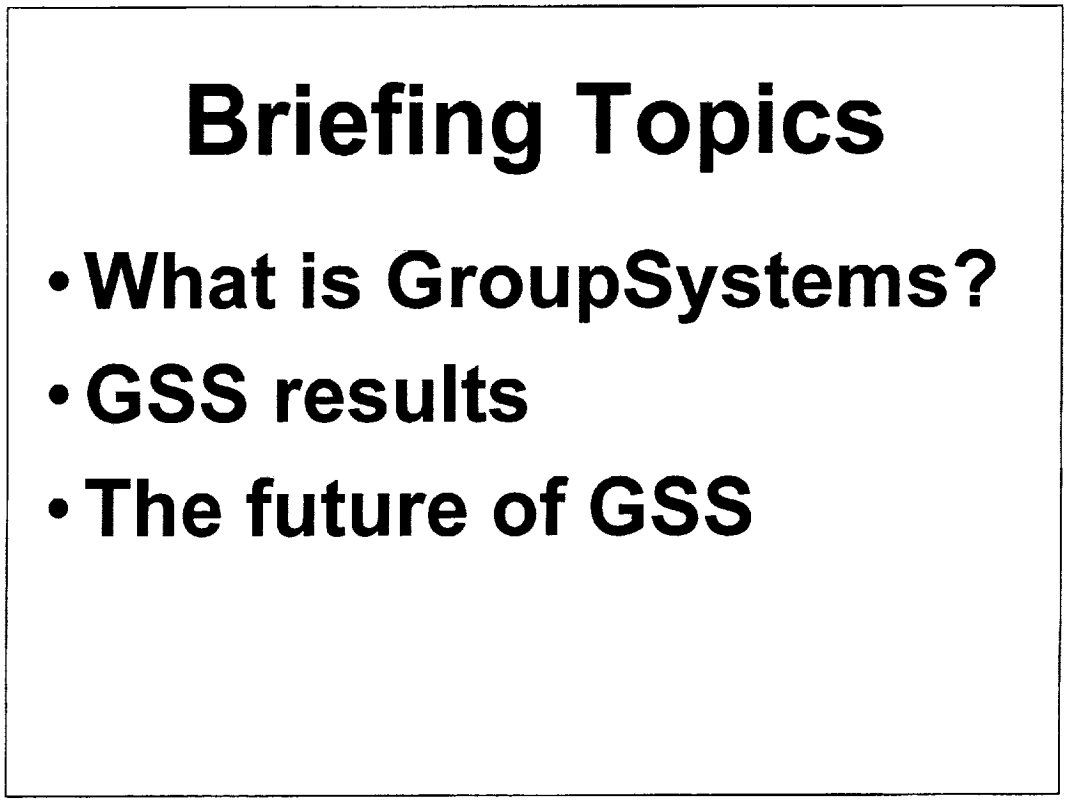
Dr. Robert O. Briggs is Director of Product Management at GroupSystems.com, a spin-off company of the University of Arizona. He is also Research Coordinator for the Center for the Management of Information at the University of Arizona. As a researcher he investigates the theoretical foundations of collaborative effort. He has published more than fifty scholarly works on group productivity, creativity, satisfaction, learning, and has published a landmark model of technology transition to explain the causes of self-sustaining and growing communities of users for technology transition. He conducts laboratory field studies to develop and test new collaborative technologies, new concepts of operation, and new work environments that foster collaboration. As Director of Product Management at GroupSystems.com he plots the future development trajectory of collaborative software products.



Briefing Topics

This briefing covers three key topics. First, it explains GroupSystems software and positions it within the groupware domain. Next it presents the results of extensive field experience with GroupSystems in government, military and private sector deployments. Finally, it offers a glimpse of the future directions of group support systems in general.

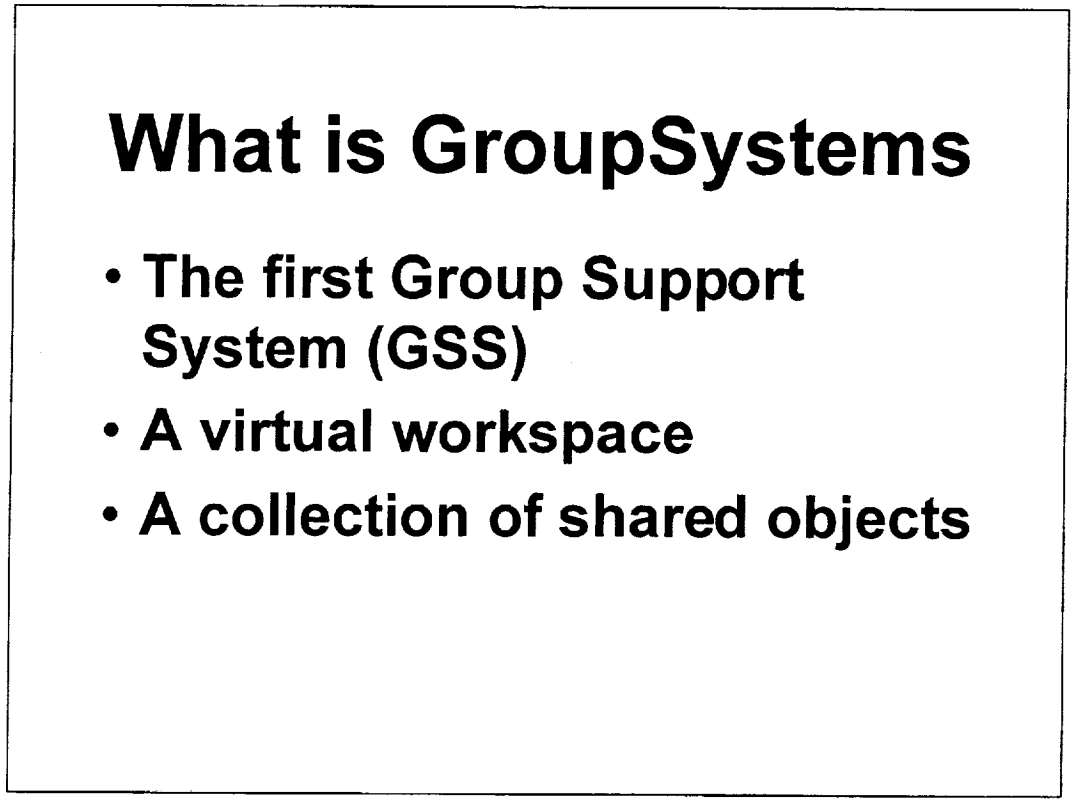


What is GroupSystems?

GroupSystems was the world's first Group Support Systems (GSS), developed at the University of Arizona, and commercialized by GroupSystems.com, a spin-off from the University. It is by far the most sophisticated GSS with respect to the variety and power of group dynamics it can create and sustain.

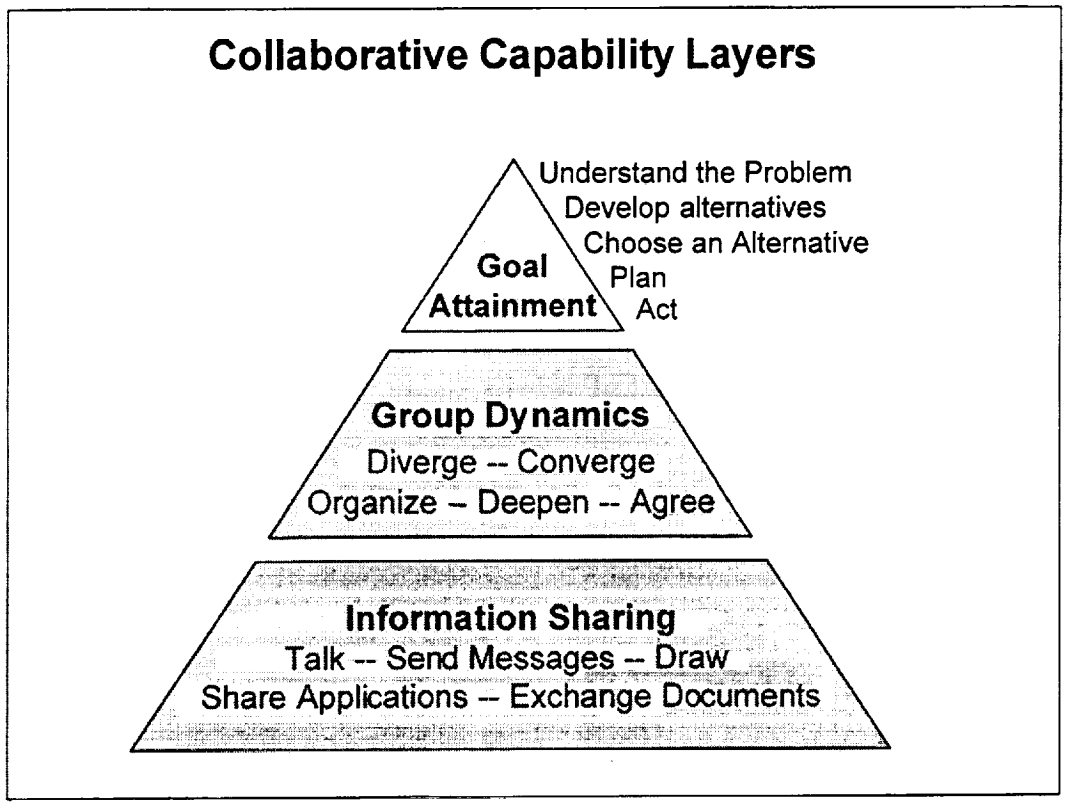
You might think of GroupSystems as a virtual workplace, where geographically separated team members can meet and work together in cyber space. But its collaborative capabilities are far more.

You might think of GroupSystems as a collection of shared objects, things that everybody on the team can work on. But this framing, too, would overlook its power. To understand it better, consider the triangle model on the following slide.



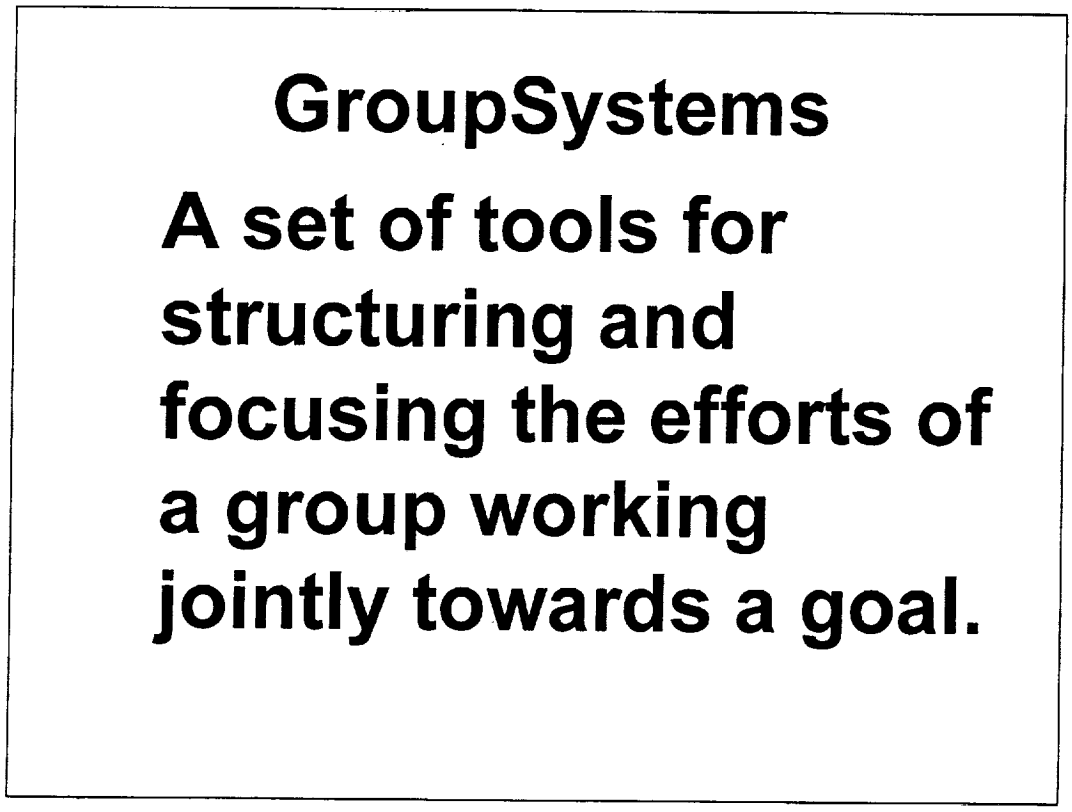
The Collaborative Capability Layers

Collaborative technology can offer functionality in three layers: information sharing, group dynamics, and goal attainment. Technology in the information sharing layer allows people to exchange information. There are many products in the information sharing layer. Examples are teleconferencing, application sharing, chat and e-mail. Technology in the group dynamics layer allows a group to predictably create and sustain useful patterns of interaction. For example, sometimes a group needs to diverge from customary thinking patterns. Other times it might need to converge on key issues, or to deeply explore a tightly focused set of issues in great depth and detail. GroupSystems offers a suite of tools that may be used by a team to create the dynamics they need to support their work. Technology in the goal attainment layer can help a group step through a carefully crafted series of activities that will let them achieve their goal. For example, a group might want to create a strategic plan, or conduct a risk assessment. Each step in the process is made up of dynamics selected from the layer below. The power of GroupSystems lies in its ability to support and sustain a group process through all the steps as the group works toward a goal.



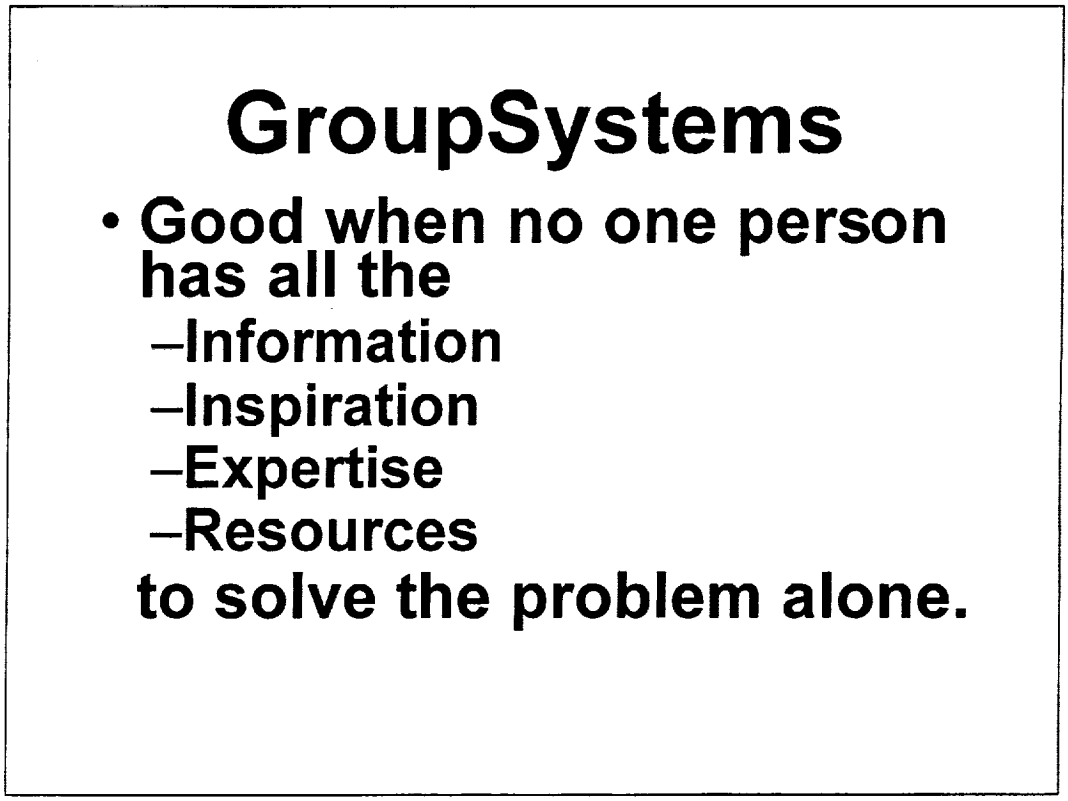
Another Way to Think of GroupSystems

GroupSystems is a set of tools for focusing and structuring efforts of a group working jointly toward a goal. It is one of the few technologies that offers capabilities in all three layers.



When Do You Need GroupSystems?

GroupSystems is not a panacea. It is massively useful under some circumstances, and not as useful under others. GroupSystems is most effective for a task where no one person has all the information, inspiration, expertise, or resources to achieve the task alone. If there is a single expert you can go to for an answer, do it. GroupSystems won't help. If you need to get the group to buy into an answer you already have, don't use GroupSystems. It won't convince people to see things your way. On the other hand, if you want to get honest feedback on a solution you are considering, GroupSystems is an outstanding way to collect it quickly, in well-organized detail. If you don't even understand the problem, much less have a solution, GroupSystems is for you. Under these circumstances teams find that by using GroupSystems they can complete in a day work that used to take more than a week.



GroupSystems Outputs

You know what you get out of spreadsheet software - a spreadsheet - mathematical model. You know what you get out of a word processor - a typed document. What do you get out of GroupSystems? There are two kinds of outputs from GroupSystems: collaborative objects and group dynamics.

Collaborative objects are tangible - you can see them on the screen. They are very easy to demonstrate and understand. Group dynamics are patterns of interaction among group members. Group dynamics are also tangible, in that you can observe them and measure them. They are the more important kind of output from GroupSystems, but I cannot show them to you on a slide or on a computer screen. I can't demonstrate them on the podium, because, of course, they only emerge when teams are working together toward a goal. Nonetheless, I can tell you about them, and you can see them for yourself when you use the software. First, however, let's look a little more closely at the collaborative objects.

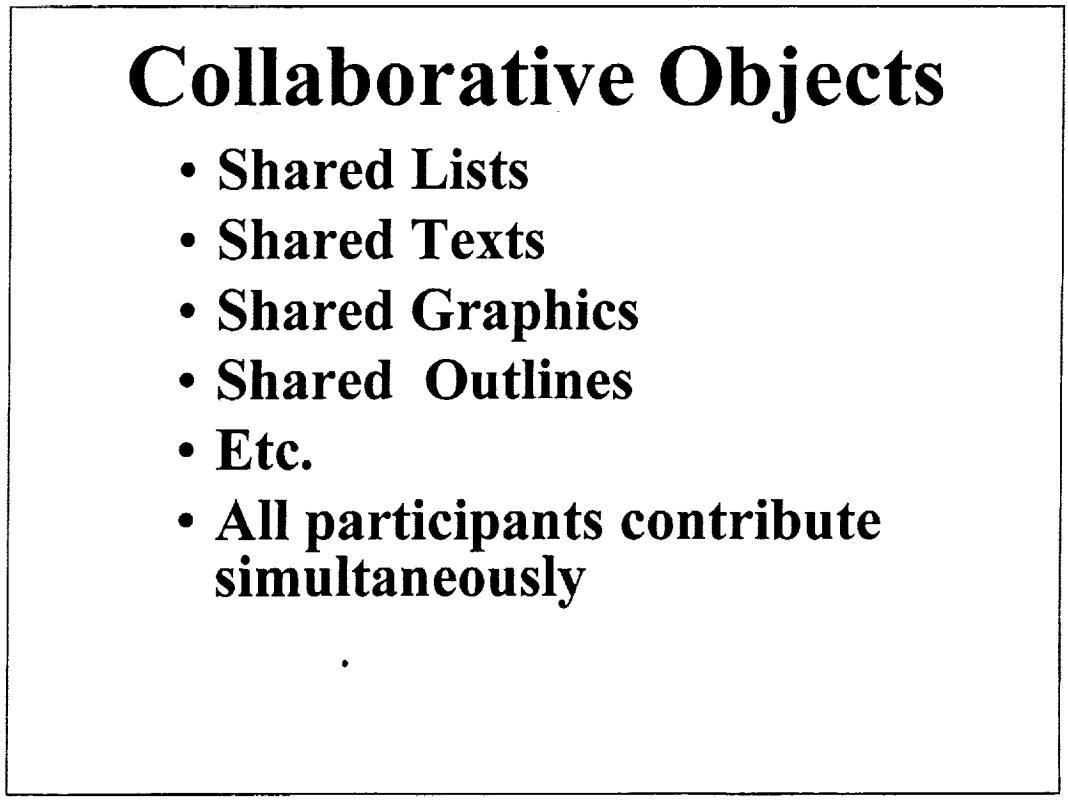
Two Kinds of Outputs From GroupSystems

- **Collaborative Objects**
  - **Tangible**
  - **Easy to understand**
- **Group Dynamics**
  - **Just as tangible**
  - **Probably more important**

Collaborative Objects

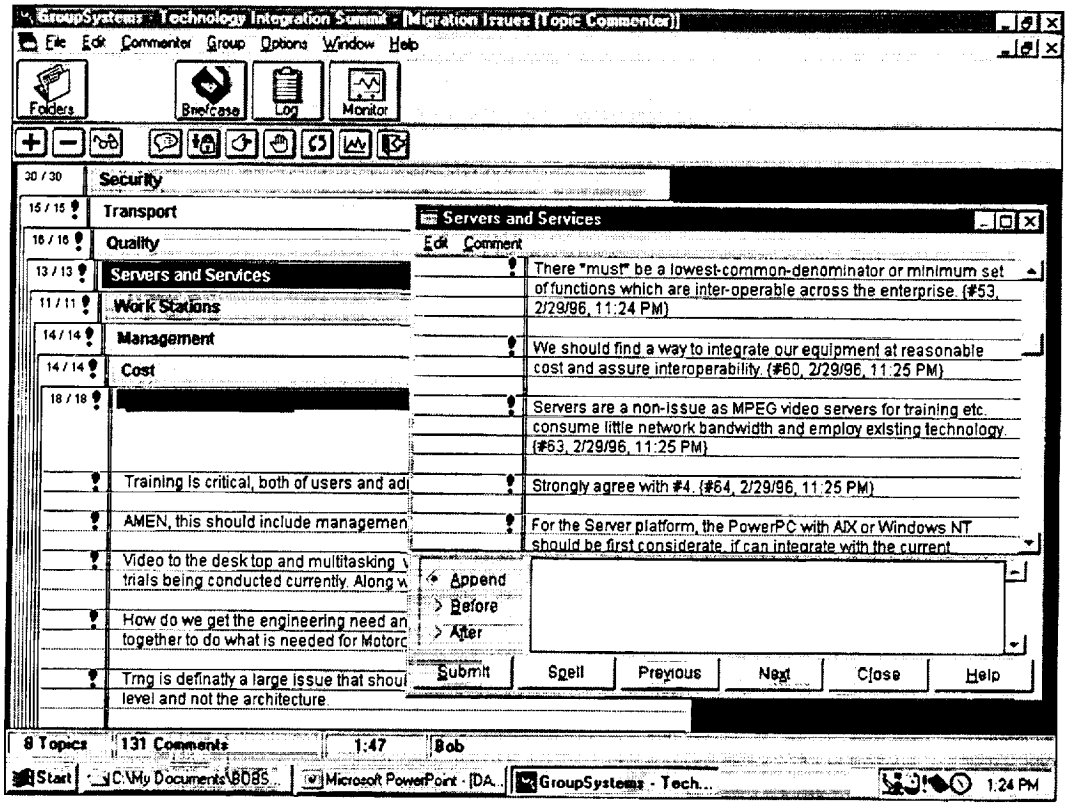
A collaborative object is a digital *thing* that many people may contribute to simultaneously. I don't mean that one person can look at it while another person works on it. I mean that every team member has his/her own cursor in the object at the same time. Each person works on a different computer, but they all see the same object, and any contribution from one person is immediately available to the other people on their own screens.

GroupSystems offers a variety of shared objects, including lists, texts, graphics, outlines, and several others. The next two slides show examples.



Topic Commenter

This is the GroupSystems Topic Commenter. It offers the users a stack of electronic cards. The participants may add cards to the stack. They may also click open any card and write on it. Any cards added by one participant appear on the screens of the other participants. Any comments by one person appear on the screens of all the other participants. That is why we call this a collaborative object.

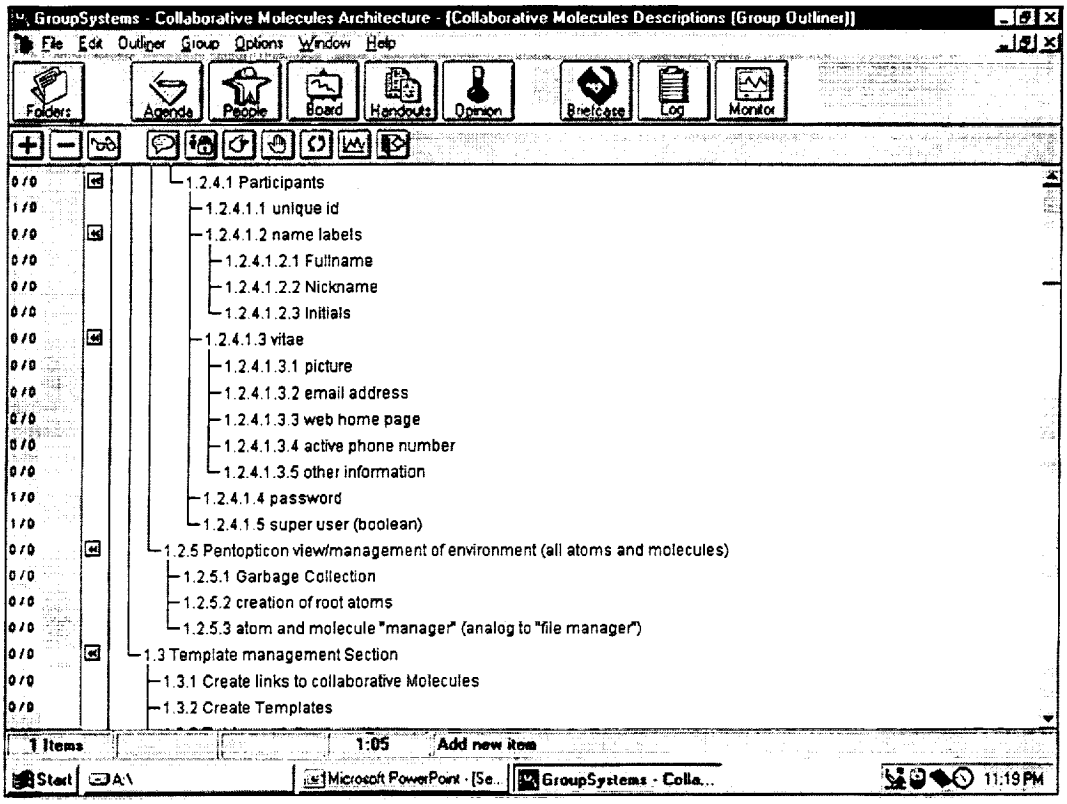


Group Outliner

Here is another collaborative object from the GroupSystems toolkit. This is the Group Outliner. All members of the team may contribute headings and subheadings to the outline. They may work together to rearrange the outline until they have it as they like it.

Every heading on the outline links to a shared text window where all team members may contribute. All team members may view the same text, or each may work on a different part of the outline.

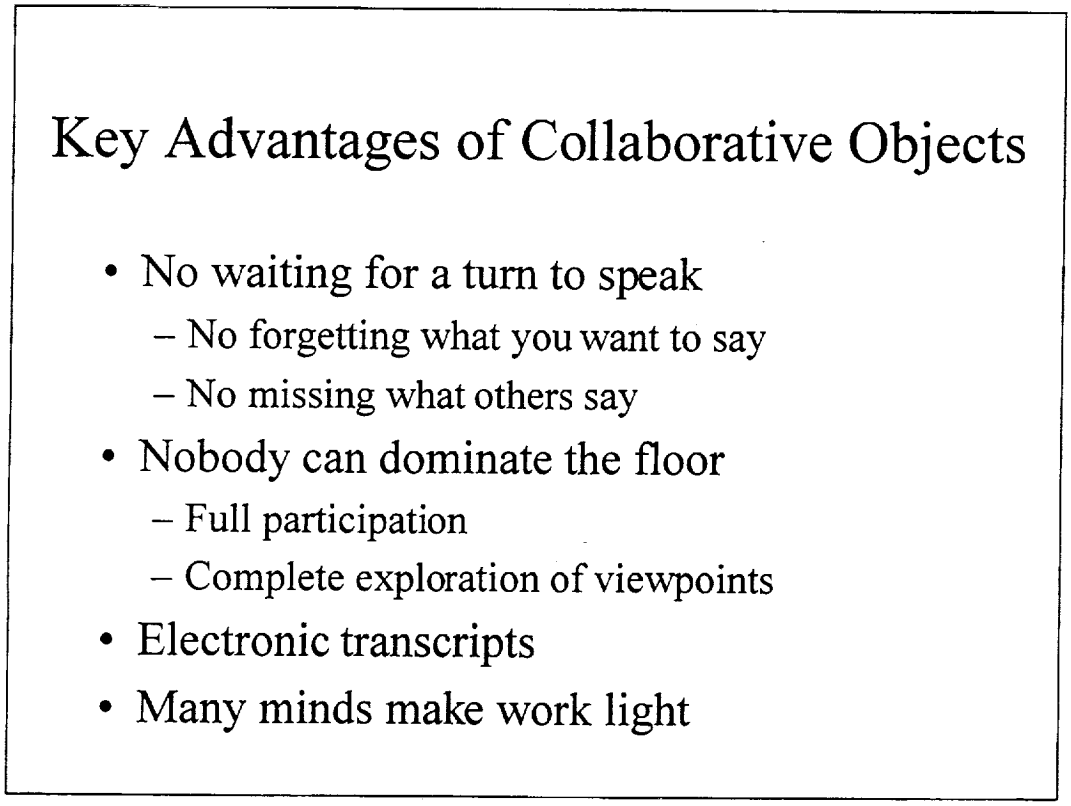
Topic Commenter and Group Outliner are examples of the collaborative objects from the GroupSystems toolkit.



Key Advantages of Collaborative Objects

There are several advantages to working with collaborative objects instead of stand-alone computer tools and standard meetings. First, nobody must wait for a turn to speak. People contribute their ideas as soon as they think of them, so they don't forget them while waiting for the floor. Further, they don't miss what others are saying because they are trying to remember what they want to say themselves. If they stop to think about something, they still don't miss what others are saying because it will all be there on the computer.

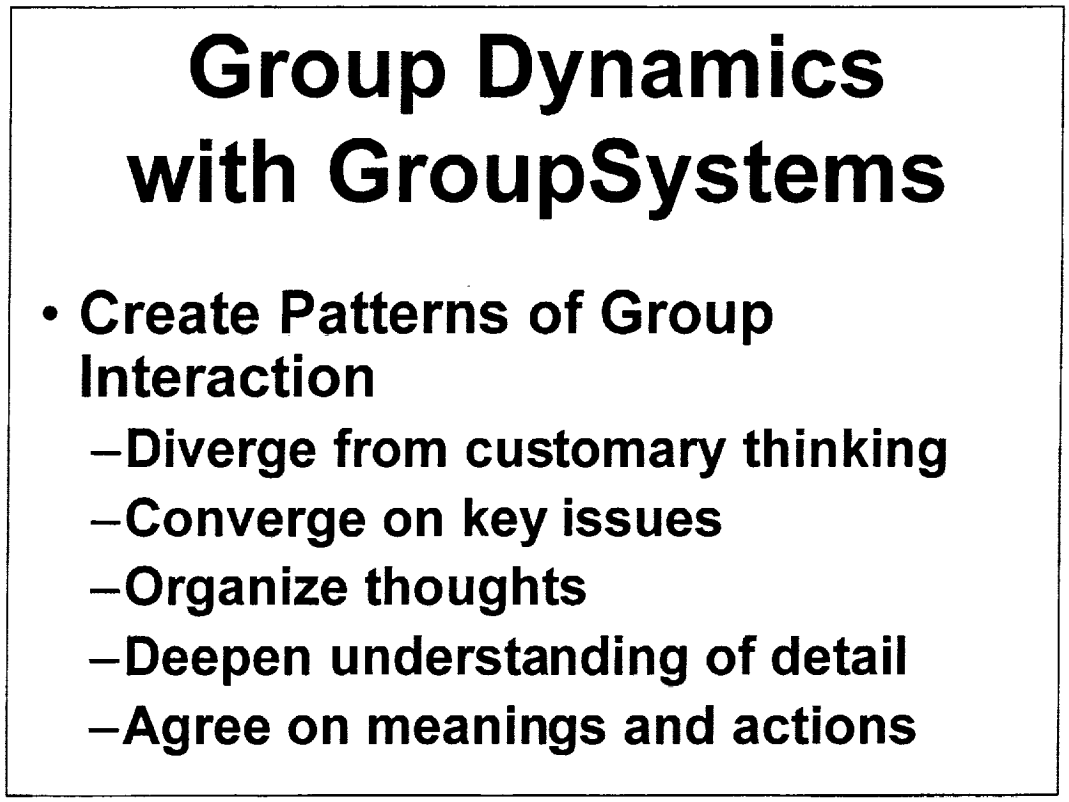
Ever been in a meeting with that one person who can suck the oxygen out of the room. You know, the person who gets half the airtime no matter what is being discussed. That can't happen with GroupSystems. No matter how much anybody says, the rest of the people go right on contributing. Studies show that people using GroupSystems participate far more equally and fully, and that each additional participant does, indeed, add to the intellectual bandwidth of the effort. More people, more view points, more information, more solutions, better results. When the work is done, the system has an electronic transcript of the results that can be searched and used later. No good ideas are permanently forgotten.



The Important Output: Group Dynamics

Collaborative objects like Topic Commenter and Group Outliner are useful and interesting, but the true power of GroupSystems lies not so much in the object itself, but in what the object can do to group dynamics. Each tool in the GroupSystems suite can be used to create predictable patterns of group interaction on demand. Some of the basic patterns are: Diverge, Converge, Organize, Deepen, and Agree. For example, the GroupSystems Electronic Brainstorming tool encourages a group to diverge from comfortable thinking patterns to go farther and farther afield in search of new ideas. The Categorizer tool, on the other hand, encourages a group to converge quickly on just the key issues that should get their attention. The Topic Commenter encourages depth and detail. The polling tools can reveal patterns of agreement, or highlight patterns of disagreement.

GroupSystems supports the basic group dynamics listed below and allows the team to select variations and nuances to those dynamics to suit their purposes.

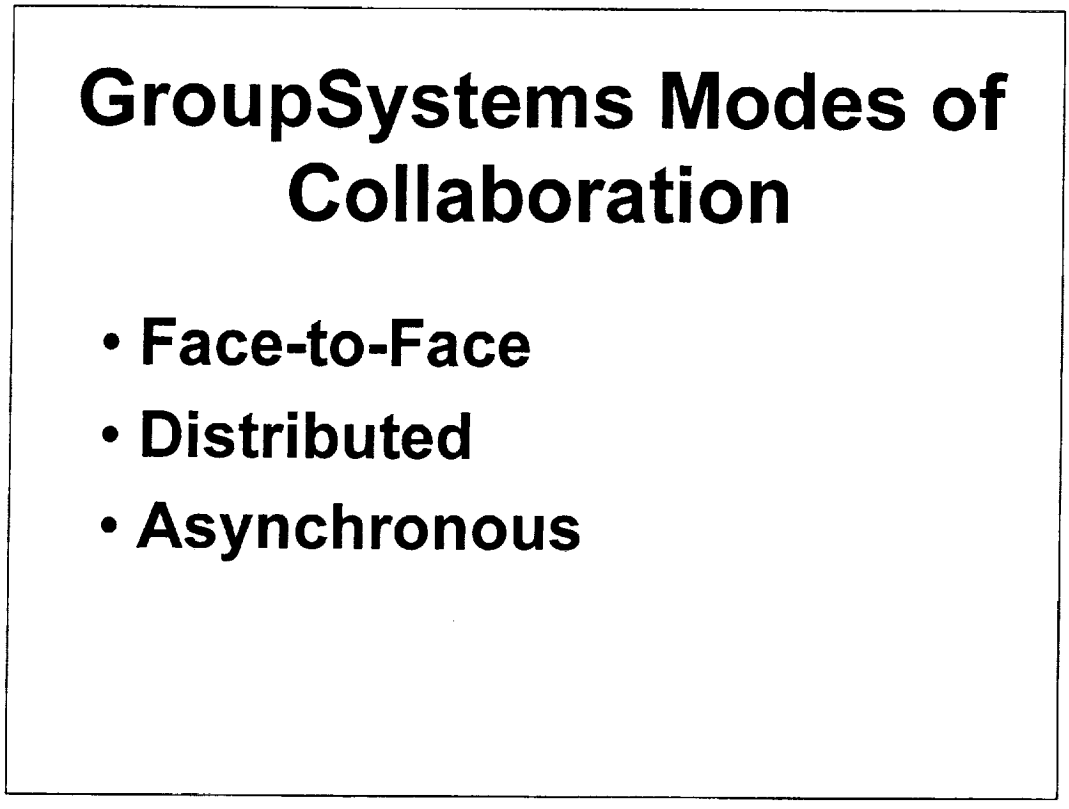


GroupSystems Modes of Collaboration

Teams use GroupSystems in a variety of modes. Sometimes they use it as they work face-to-face, wrestling with knotty issues or working together to create detailed plans and documents.

Other times it isn't possible or necessary for a group to gather face to face. In those cases they often use GroupSystems over the Web supported by a conference call or a video teleconference.

It is not unusual for teams to use GroupSystems to work together asynchronously - different place, different time. Each team member contributes when they can - day or night, regardless of time zone.

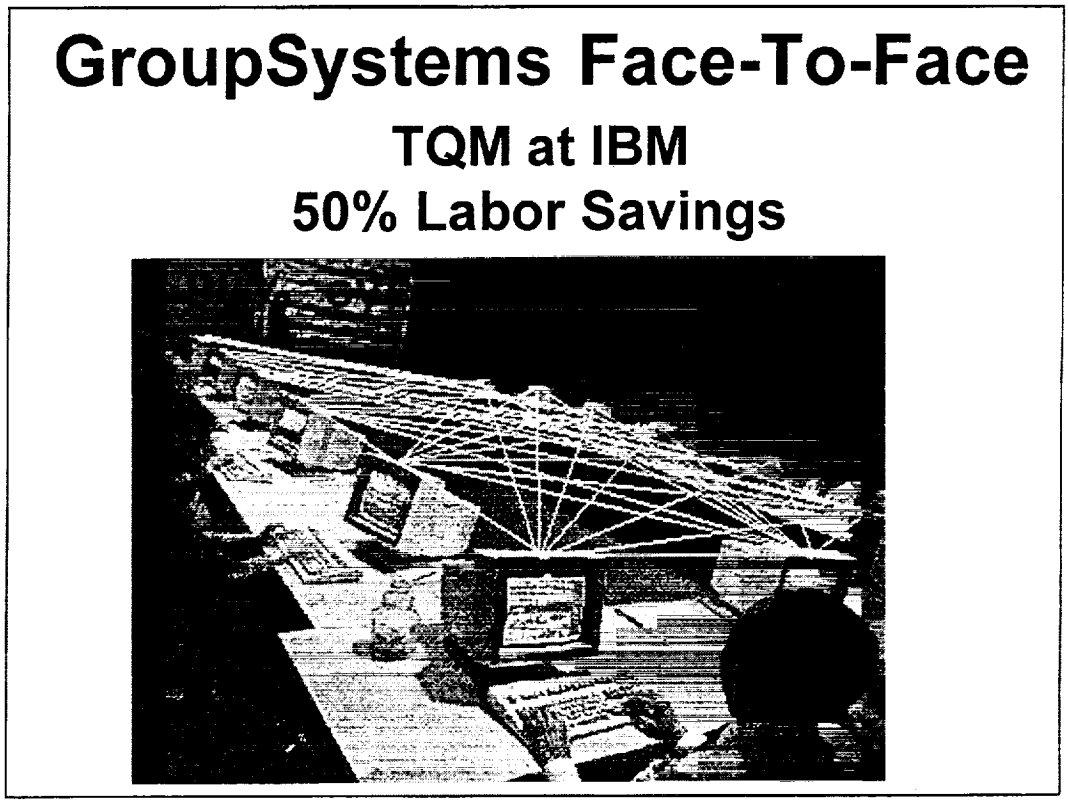


The IBM Owego Case

Earlier I promised to tell you about some of the results obtained by people using GroupSystems in the field. One of the earliest high-profile successes happened at IBM's plant in Owego, New York. Teams there met regularly to try to solve production quality problems on the factory floor. IBM had extensive historical records of how much time these teams spent to solve their problems.

We worked with IBM's quality teams to create a repeatable GroupSystems process for solving quality problems. Over the first year IBM tracked the work of thirty teams who used GroupSystems. These teams had an average labor saving of 50%, and cut the number of calendar days in their projects by an average of 90%.

The results were so dramatic that IBM suspected it might be a fluke, so they conducted a study at six more sites the following year. Results at those six sites slightly exceeded the first year's benefits.



GroupSystems in Government

The gentleman third from the left in this picture was the President of the newly liberated country of Slovenia when this photograph was taken. Slovenia managed to talk its way out of Yugoslavia and out of the Bosnian conflict without firing a shot. When they had gained their independence, the president and cabinet used GroupSystems to hammer out their monetary policies and for other crucial issues.

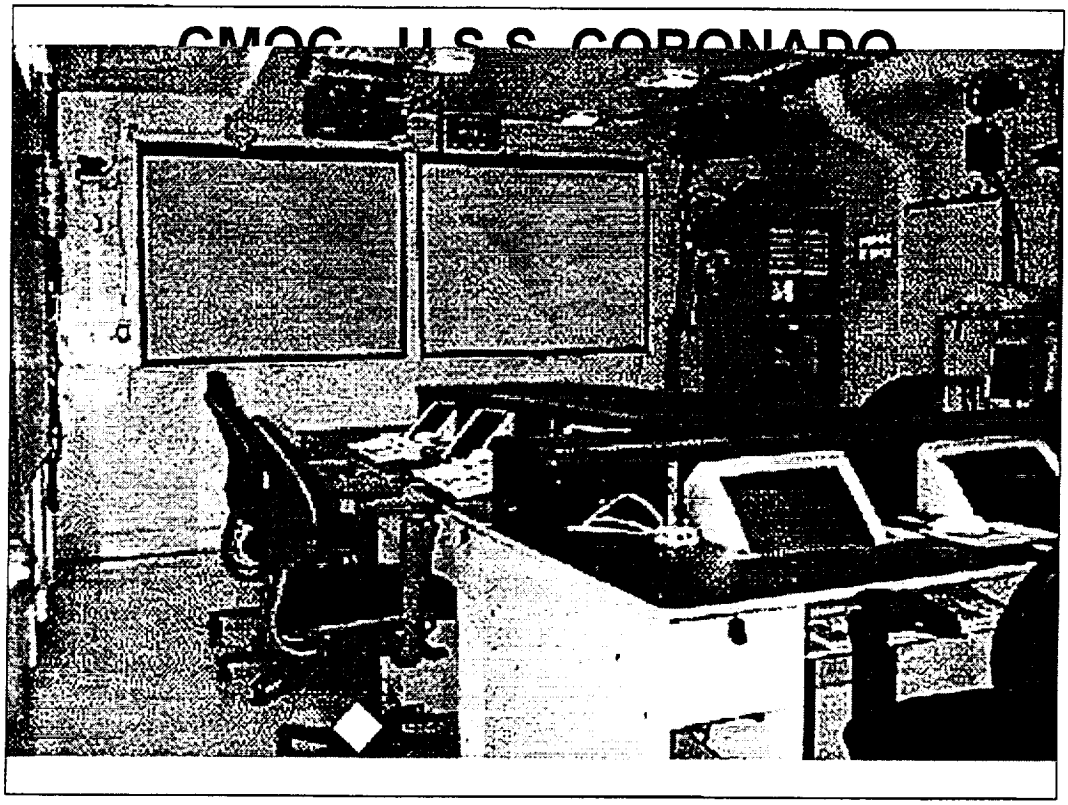
Closer to home, when Vice President Al Gore initiated his National Partnership for Reinventing Government, he invited eight groups to come to Washington for a major kick-off event. He asked each group to produce a White Paper on some important aspect of government. One of the eight groups, a team of forty people, elected to use GroupSystems during the three-day kickoff event. At the end of the three days, that group had produced the first draft of their White Paper. The other seven groups had produced plans to reconvene at a later time to finish planning how they would produce theirs.

GroupSystems in the Military

All four branches of the military and the Department of Defense use GroupSystems for a variety of mission critical tasks. This is the U.S. Air Force Innovation Center at the Pentagon. High-ranking officers meet here to work out new, more effective ways to maintain the readiness and capabilities of the Air Force.

USS Coronado Civil Military Operations Center

This is the Civil Military Operations Center aboard the U.S.S. Coronado, the Command Ship of the U.S. Navy's Commander, Third Fleet. It was the first GroupSystems collaborative decision space afloat. It offers a host of collaborative capabilities including secure and open phone and radio channels, video teleconferencing, secret and open Internet, and a variety of multimedia display equipment. It was designed to support teams who must respond quickly to a crisis as it unfolds.



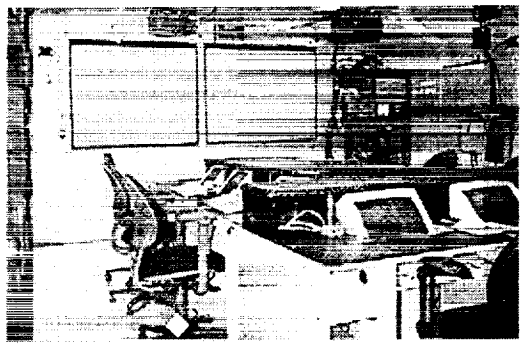
COMTHIRDFLT - J5 PLANS

Aboard the U.S.S. Coronado, the J5 Plans Group was tasked to produce possible courses of action for the Joint Task Force Commander any time the situation required it. J5 had a good process that let them provide recommendations to the Admiral within ninety minutes.

They decided to try GroupSystems. We worked with them to create a repeatable GroupSystems collaborative Course-of-Action development process. The new process took only thirty minutes. In that thirty minutes the officers were able to consider many times more possible courses of action, and were able to develop the courses of action they recommended to the Admiral in far more depth and detail.

J5 Plans

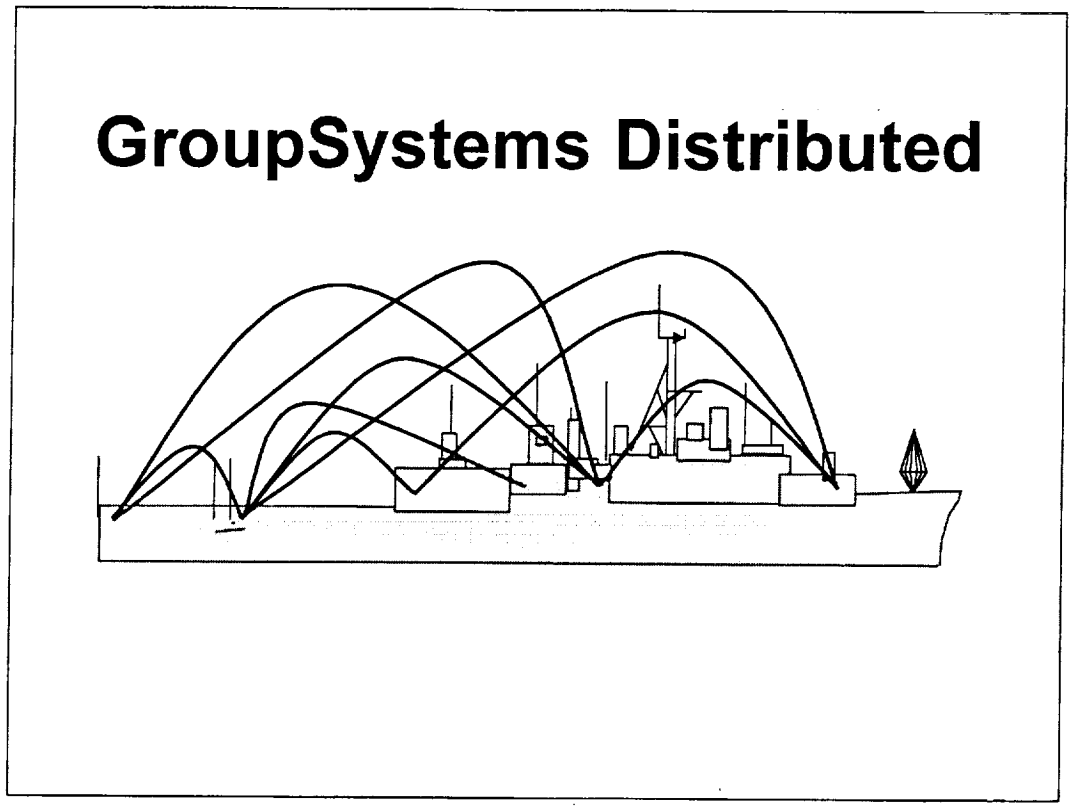
- **Course of Action Development**
- **Reduced from 90 to 30 min.**
- **7 X times more breadth**
- **4 X more depth & detail**



COMTHIRDFLT - J2 Intelligence

COMTHIRDFLT's J2 Intelligence Department had cryptologists scattered around the ship in small spaces across three decks. The cryptologists would scan the environment for intelligence information, which they would enter into their paper logbooks. The intelligence analysts would circulate among the cryptologists, read the logbooks, and make entries in their own paper logbooks recording their interpretations and analyses. The senior watch officer would circulate among the analysts, synthesize a situational awareness, and brief the Admiral. This cycle took about thirty minutes.

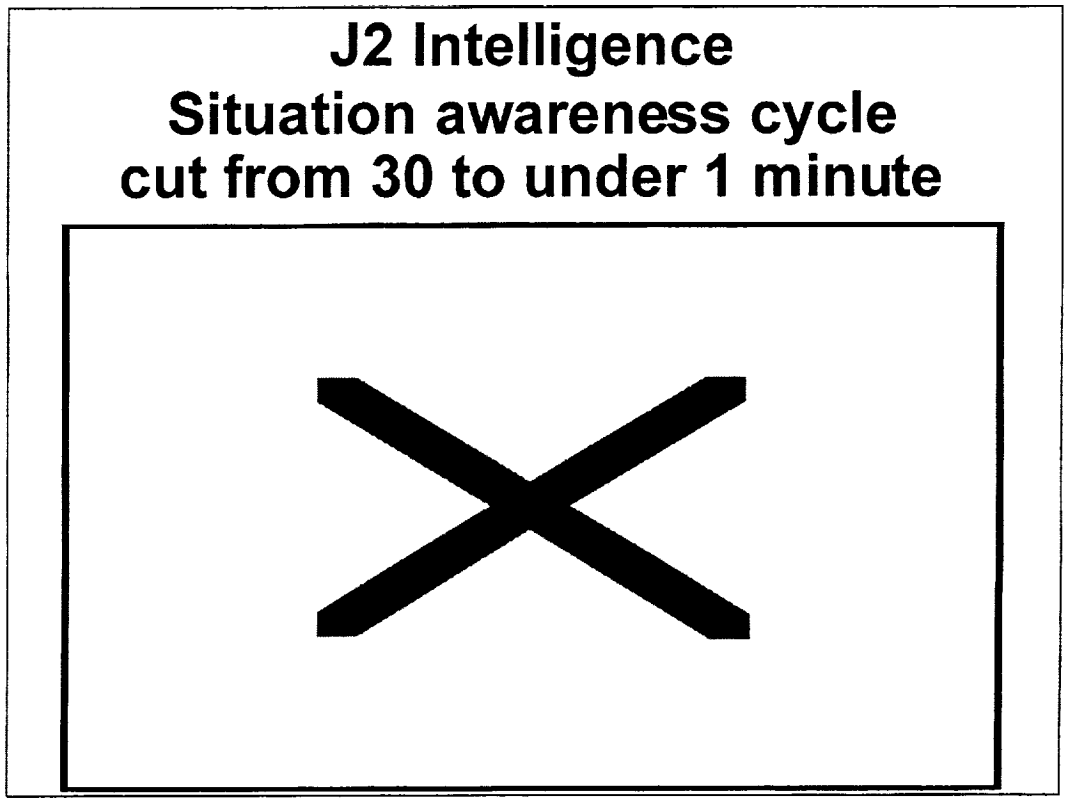
We worked with J2 to create a repeatable GroupSystems intelligence analysis process. The cryptologists entered their findings into GroupSystems. No matter where they were on the ship, the analysts could see the entries immediately. They would begin their analysis in GroupSystems. The senior watch officer could immediately see the analyses and request clarifications. The Admiral could watch all this unfold from his own terminal.



Situational Awareness Cycle

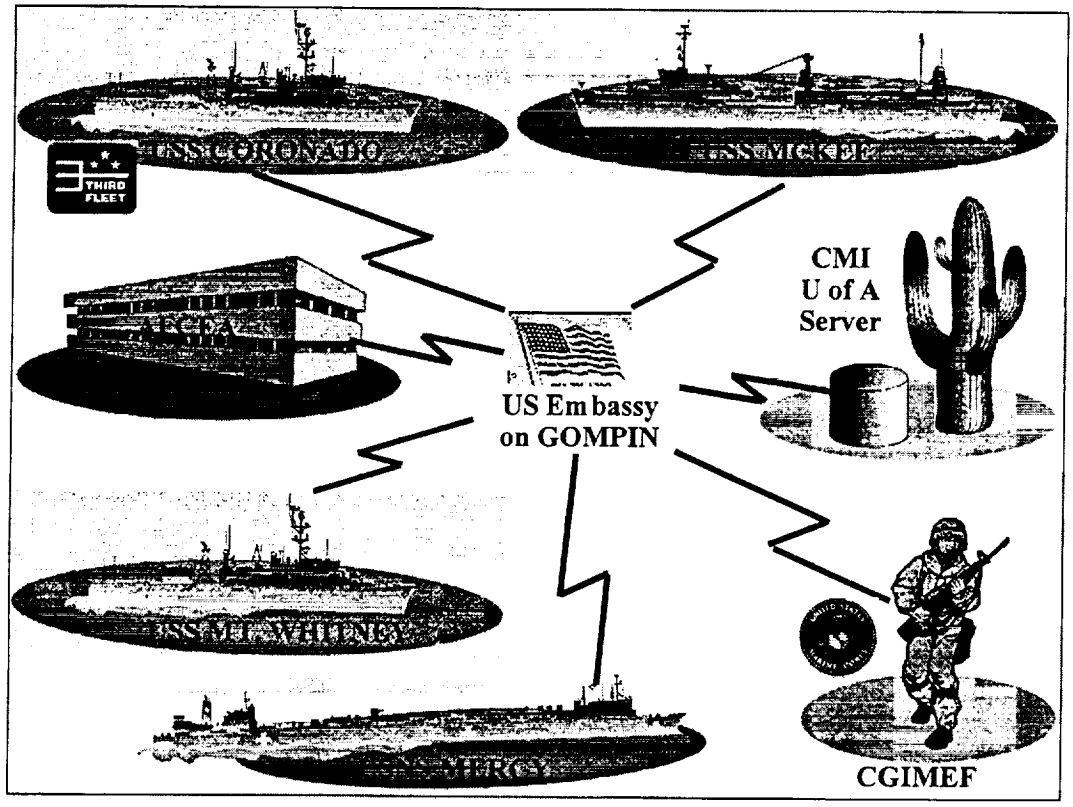
By using GroupSystems the J2 Situational Awareness Cycle was cut from thirty minutes to under a minute. When bullets are about to fly, that extra twenty-nine minutes makes a difference.

Other units on the ship began to keep their own logbooks in GroupSystems, including the Land Forces Commander, the Battle Watch Captain, the Air Forces Commander, and the Fleet Fires Cell.



Multi-Point Distributed Interactions

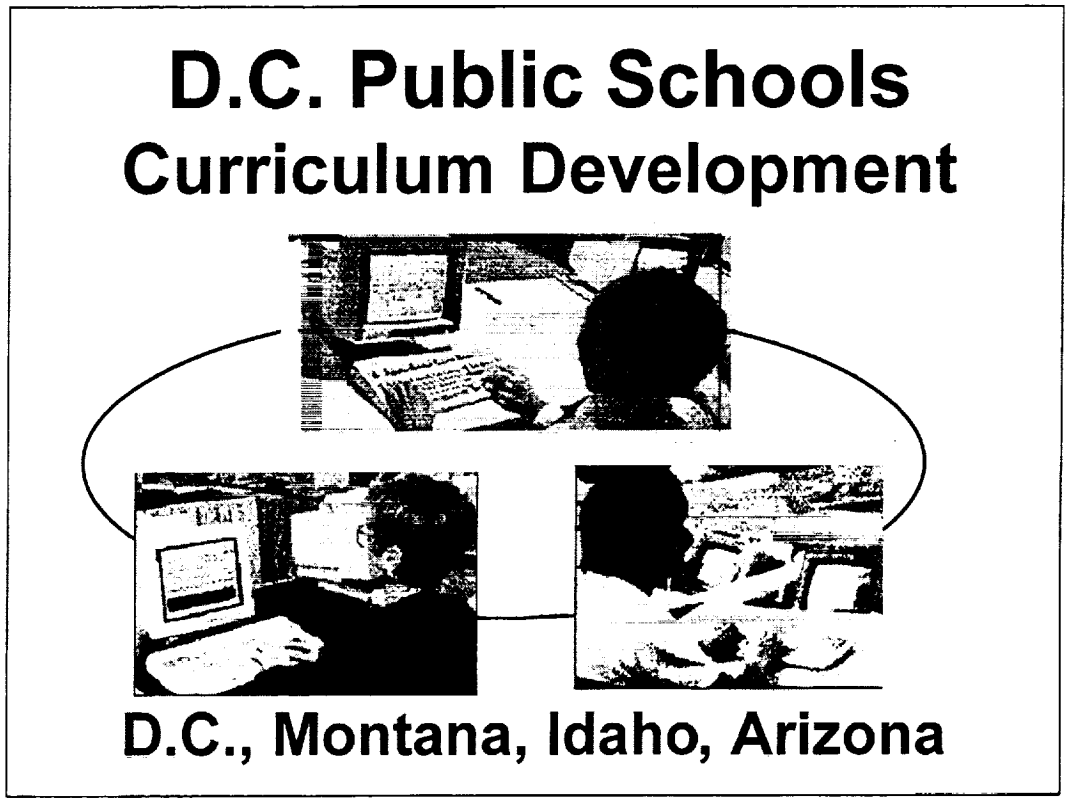
Having tested GroupSystems aboard one ship, we extended the concept to multiple ships. This diagram shows the participants that used GroupSystems to resolve emergencies in simulated disaster relief exercises.



GroupSystems at School

GroupSystems is the foundation of a new pedagogy now finding its way into educational institutions across the country. It is being used successfully in grammar schools, junior high and high schools, and in universities. The pedagogy, called "High Stakes Learning™, " gets the learners involved in solving real problems in which they perceive a vested interest. The teacher carefully selects the problems so that the learners must learn what the teacher wants them to know in order to achieve the outcome they want. The teacher does not provide the answers. Rather, the teacher guides the learners through the problem-solving process as they dig out information and make sense of it. Results have been superb. Reading and writing scores have climbed. Problem solving and critical thinking skills skyrocket. The drop-out rate declines among high-risk learners.

The pedagogy depends on GroupSystems for its success because GroupSystems provides the learners with the edge they need to get through real problems in the time available to them in class.

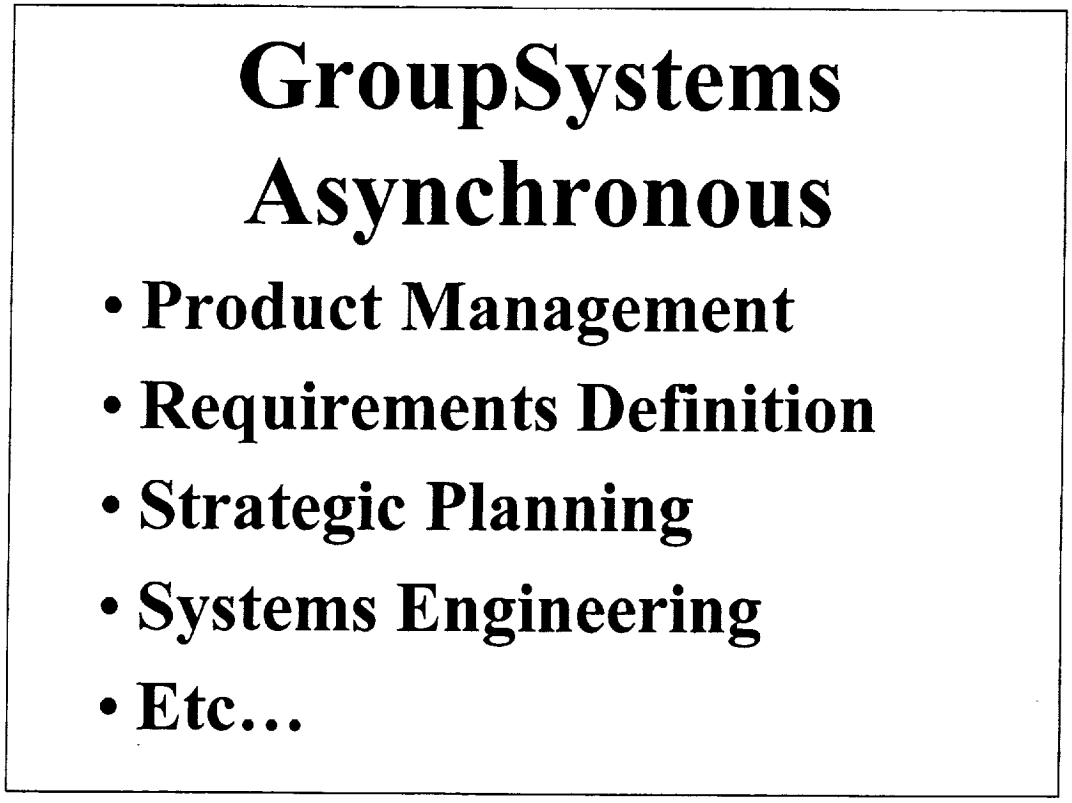


Asynchronous Tasks with GroupSystems

People use GroupSystems over the Web to support a vast array of collaborative tasks that they execute asynchronously. People participate as they can, regardless of time-of-day or time zone. Some of those tasks include:

Product Management
Requirements Definition
Strategic planning
Systems Engineering
Risk Management

The list is nearly endless.

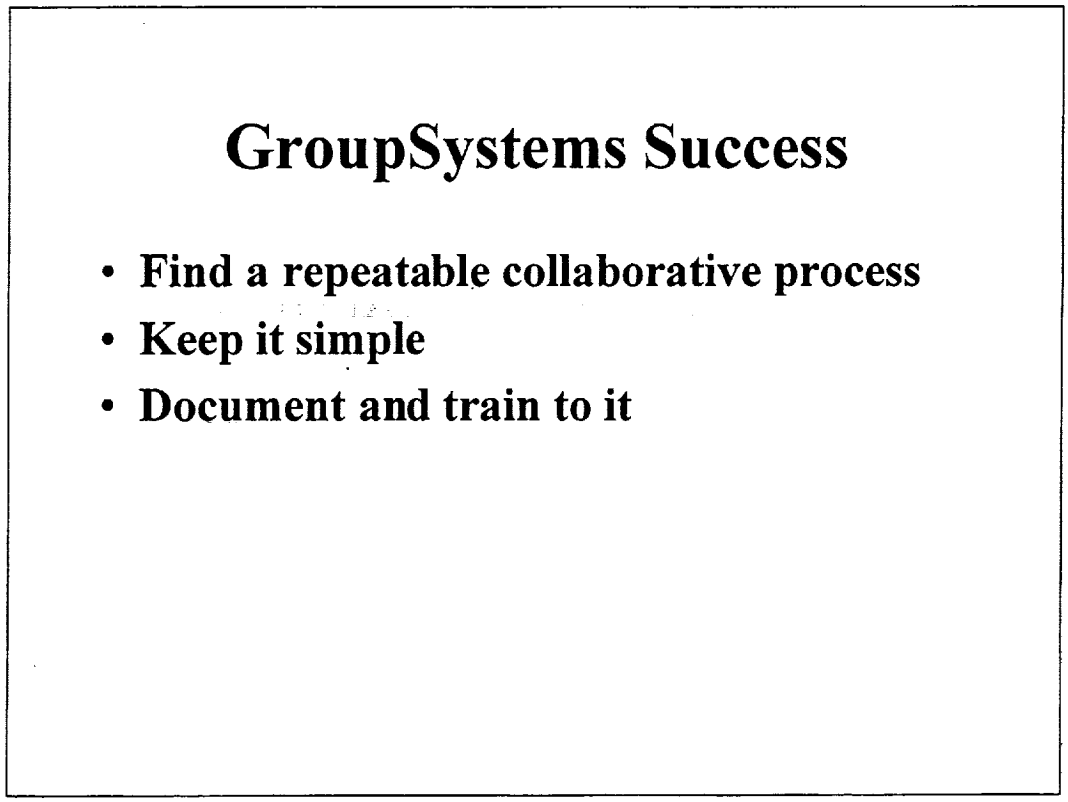


Critical Success Factors for GroupSystems

Over the years we have learned some key points for creating a self-sustaining and growing community of users for GroupSystems. First and foremost, it is important that a team find a repeatable process that they do over and over with GroupSystems. They will find many other ways to use the tools over time, but the repeatable process becomes the anchor that makes it possible for them to succeed in other tasks. Teams that only use GroupSystems for solving ad-hoc or non-routine problems tend not to be self sustaining.

Second, keep the processes simple. GroupSystems offers a rich and powerful variety of possibilities. Sometimes people fall in love with the possibilities and create unnecessarily complex processes just because they can. The teams that find simple ways to use the power of GroupSystems tend to succeed.

Finally, when you have established and tested a repeatable process, get it documented in a manual, and then formally train people to do it. That way the process can remain even as the people move on.

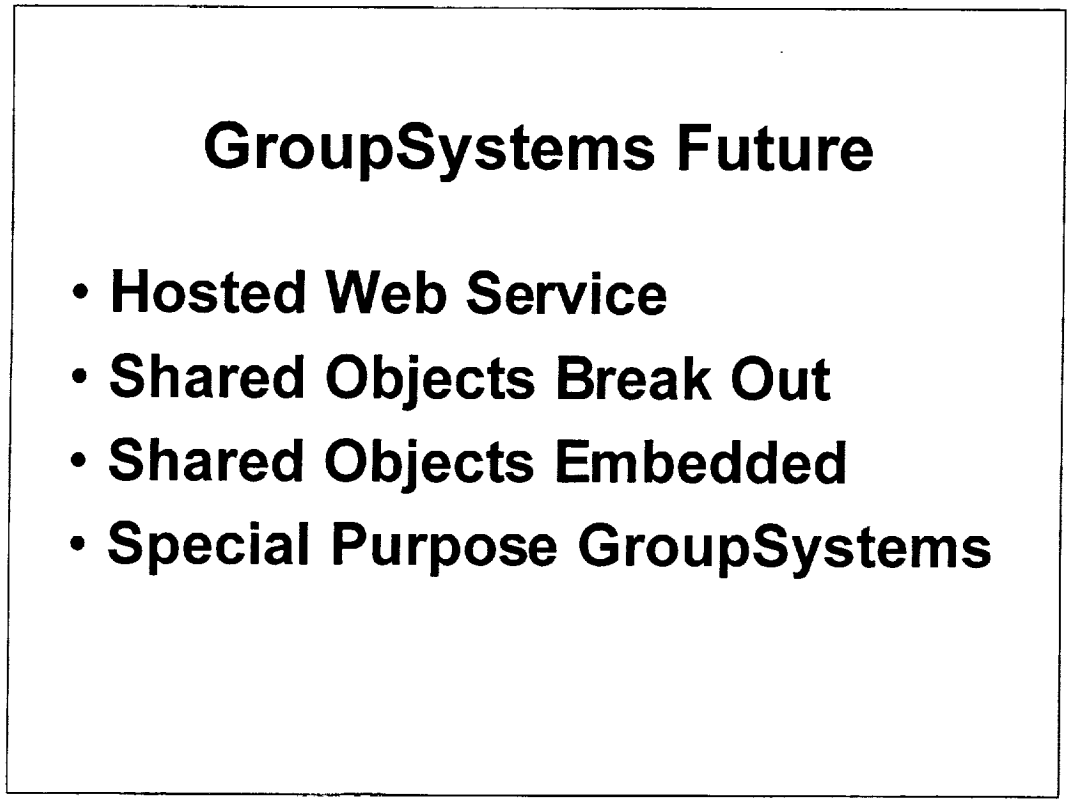


The Future of GroupSystems

There are some exciting developments on the GroupSystems horizon. By 2000 GroupSystems will be available as a hosted service on the web. People will be able to purchase the service by the minute, by the day, month, or year.

The collaborative objects now embedded in the proprietary GroupSystems environment will soon break free and be available as independent to embed in other people's application environments.

Finally, in the near future, there will be task-specific GroupSystems collaborative applications.



What We Know and What We Don't: Twenty Years of GSS Research

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Twenty Years of GSS Research

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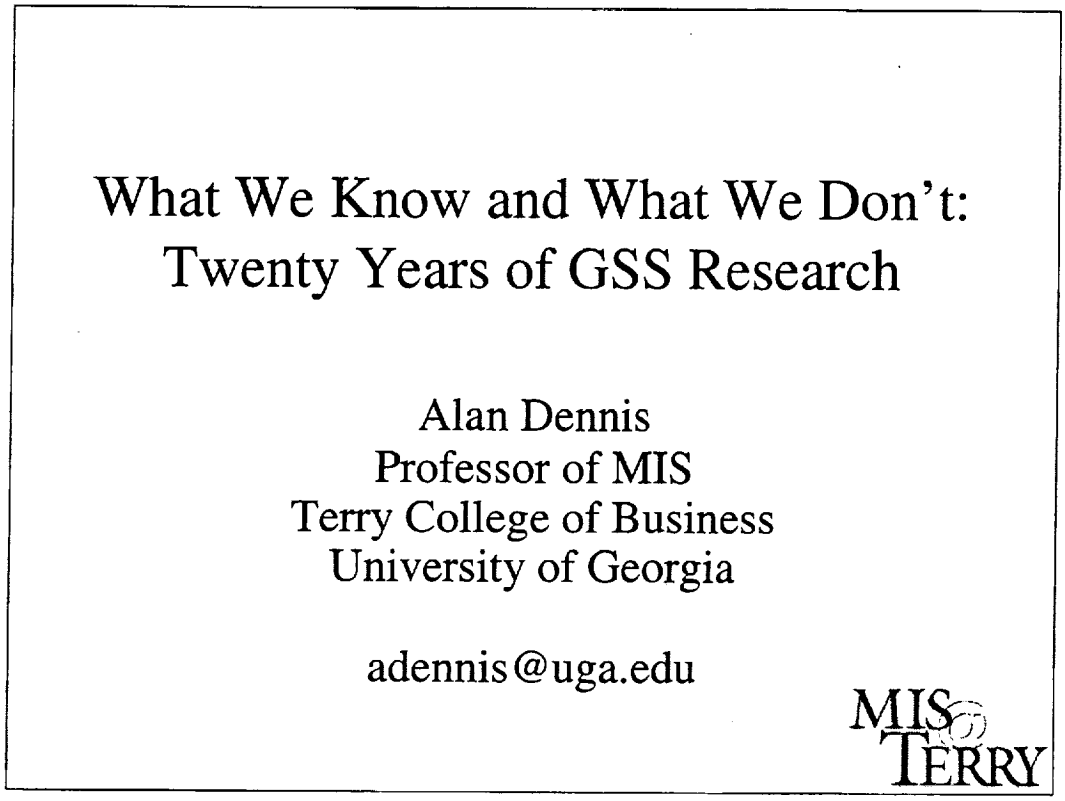
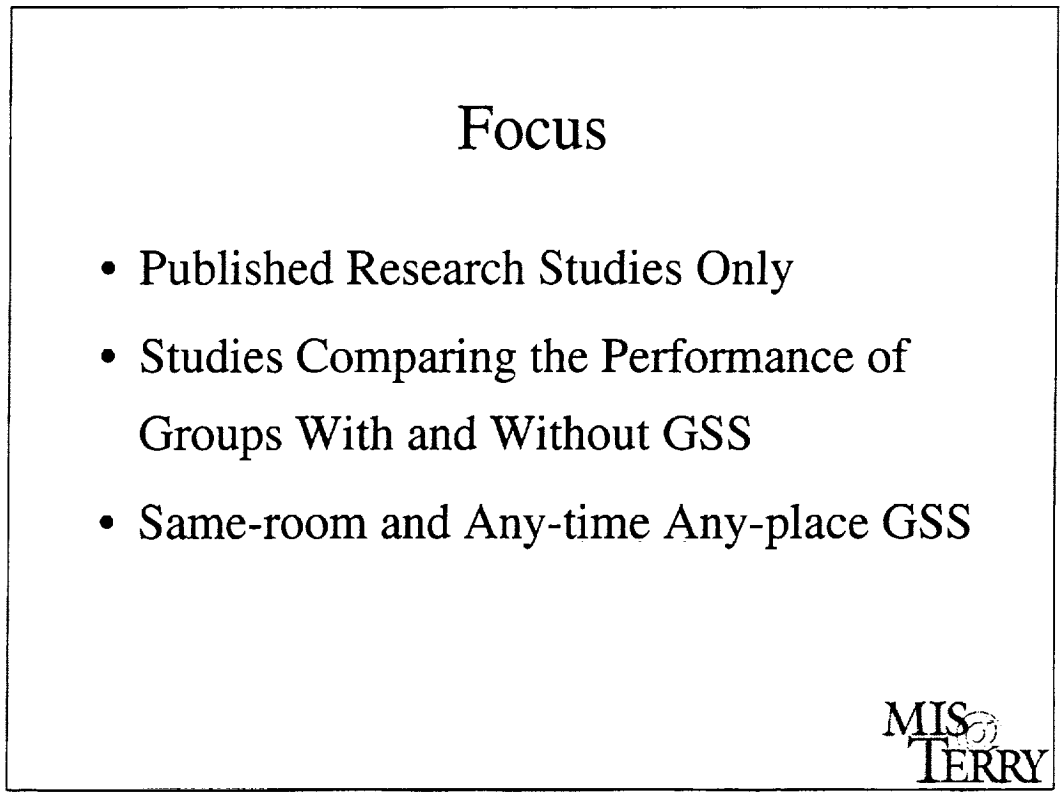


Focus of Presentation

This presentation summarizes published research on the use of GSS using statistical meta-analysis techniques. As such, it discusses what scientific evidence can "prove," as opposed to those things we believe to be true but cannot prove, although I will at times speculate on what I believe to be true.

Meta-analysis requires the direct comparison of groups using GSS to groups not using GSS within the same study, so this presentation focuses only on studies that directly compare two or more groups. This has the unfortunate effect of producing a set of studies that is almost entirely laboratory experiments rather than field studies, but there were no significant differences between the lab studies and field studies.

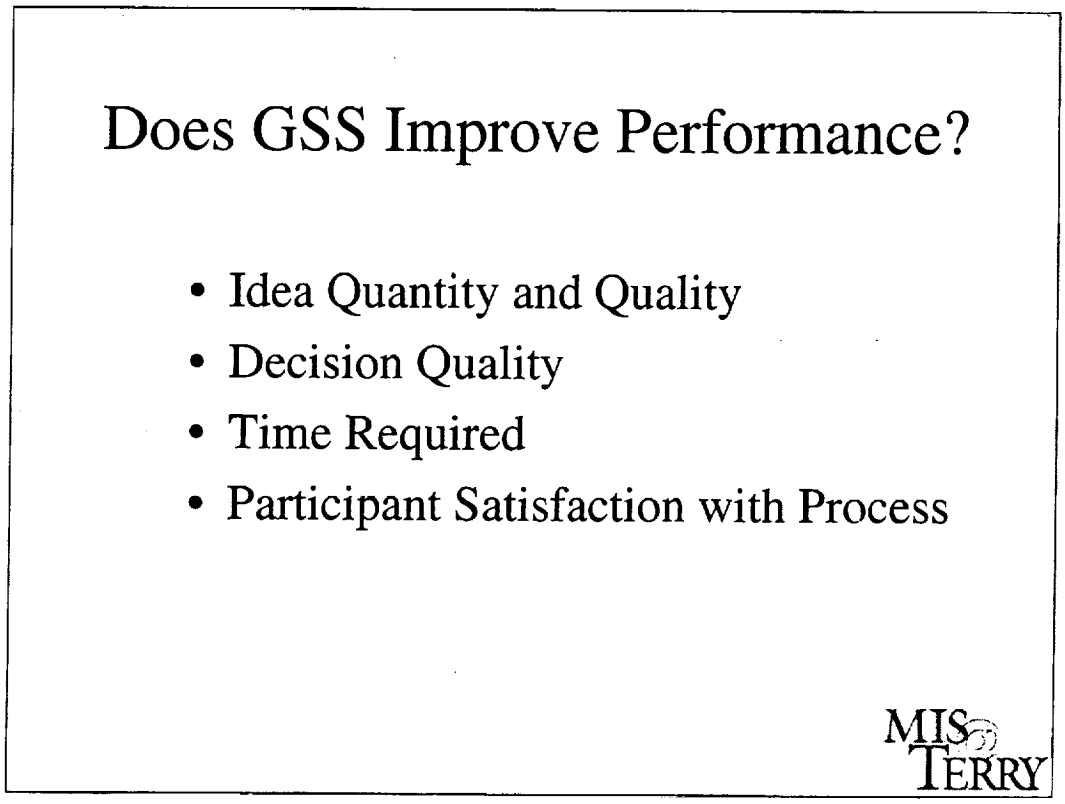
This set of studies includes both situations in which all group members worked in the same room at the same time, as well as those in which some (or all) participants worked in different places at different times.



Performance Measures

The focus of the analysis was to understand how GSS use affected four measures of group performance:

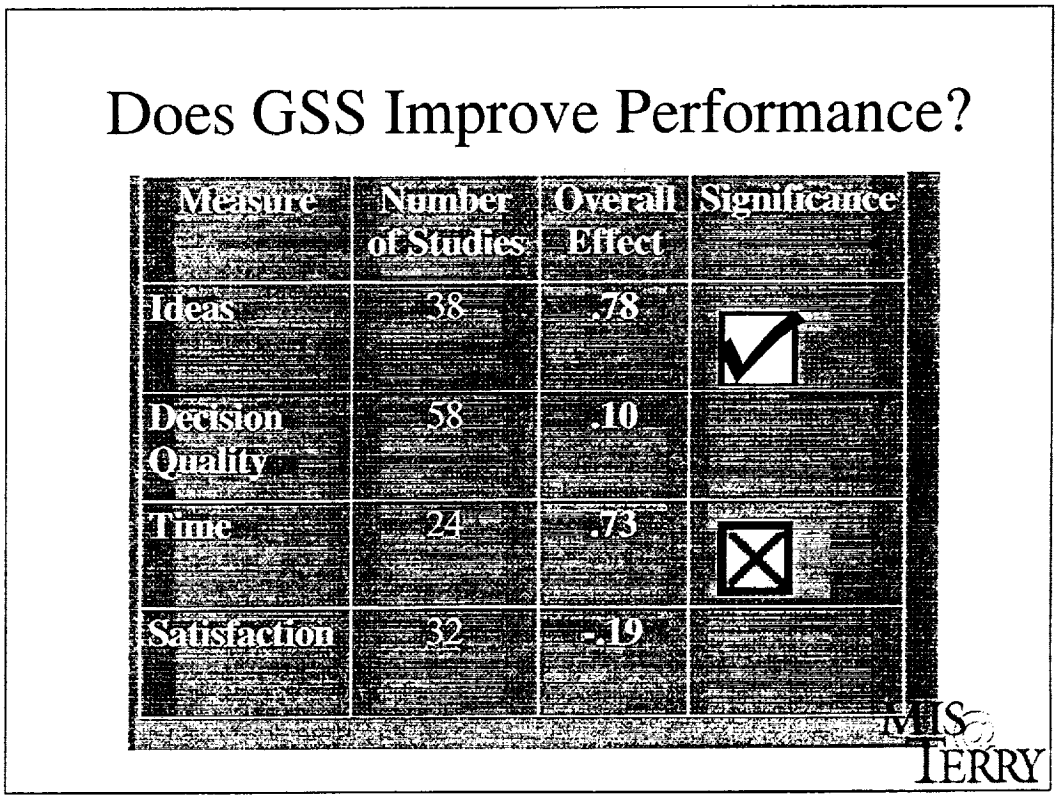
- The quantity and quality of ideas generated.
- The quality of decisions made.
- The time taken to complete the task.
- Participants' satisfaction with the meeting process.



Overall Results

The overall effect size for idea generation was .78, which was statistically significant. The effect size is measured in terms of the number of standard deviations by which GSS groups differed from non-GSS groups (a positive number indicates that GSS groups had higher values on this measure). In other words, groups using GSS produced much higher quality ideas and/or more ideas than groups without GSS. However, GSS use had no significant effect on the quality of decisions. Groups with and without GSS made similar quality decisions. Groups using GSS took significantly longer to perform tasks than groups without. There were no significant differences in participant satisfaction.

More importantly, there was little consistency in results, suggesting that there are factors in the way in which the GSS is used that affect performance.

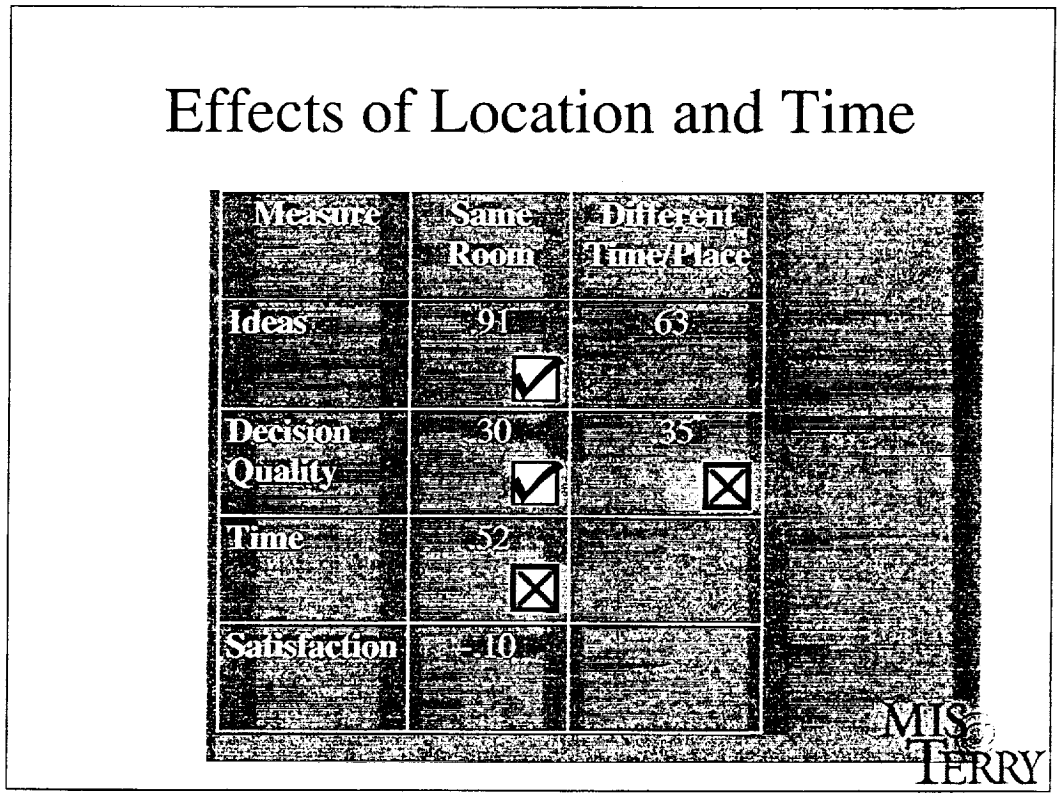


Effects of Location and Time

The key question then is, when does GSS improve performance? One factor that may affect performance is whether participants work together in the same room at the same time, or whether they work in different places and/or at different times. The next analysis was to split the data into two parts by location and time.

Groups using GSS in the same room at the same time produced significantly more ideas and made significantly better decisions than groups working without GSS. However, they still took significantly longer.

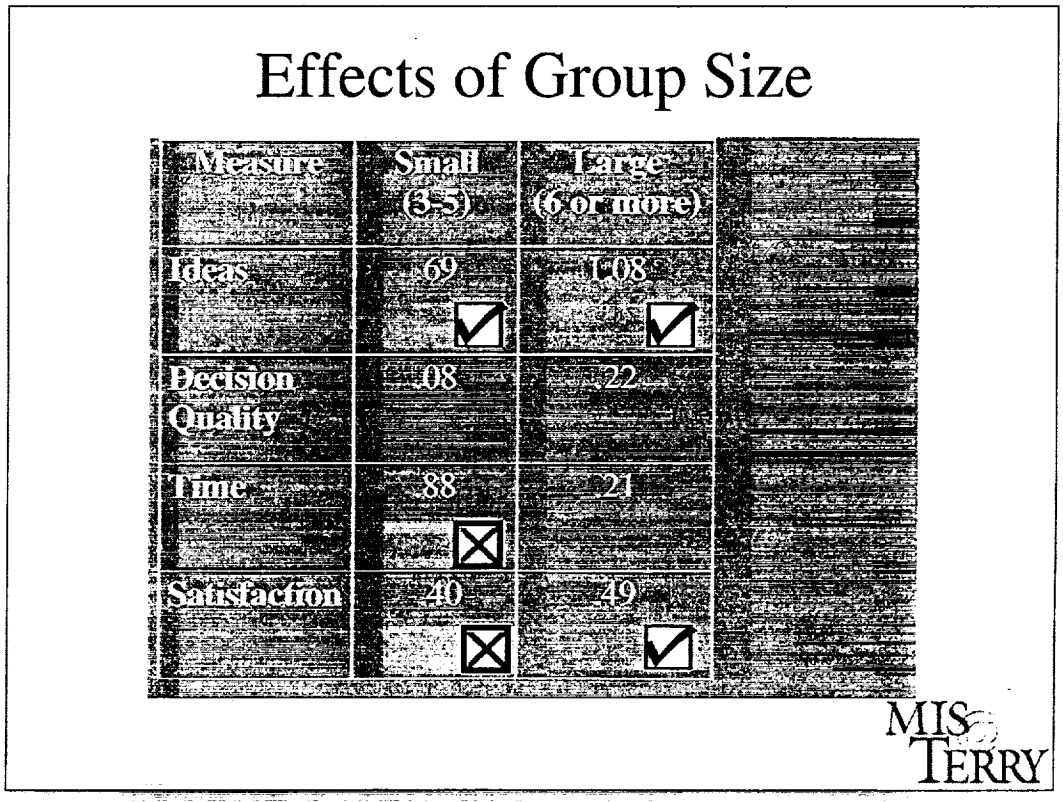
Groups working in different places/times produced significantly worse decisions than groups working without GSS.



Effects of Group Size

Small GSS groups produced significantly more/better ideas than small groups working without GSS, but took significantly longer and were significantly less satisfied.

Large GSS groups produced significantly more/better ideas than large non-GSS groups and were significantly more satisfied. Interesting, there were no differences in time; large GSS groups do not take longer than non-GSS groups.

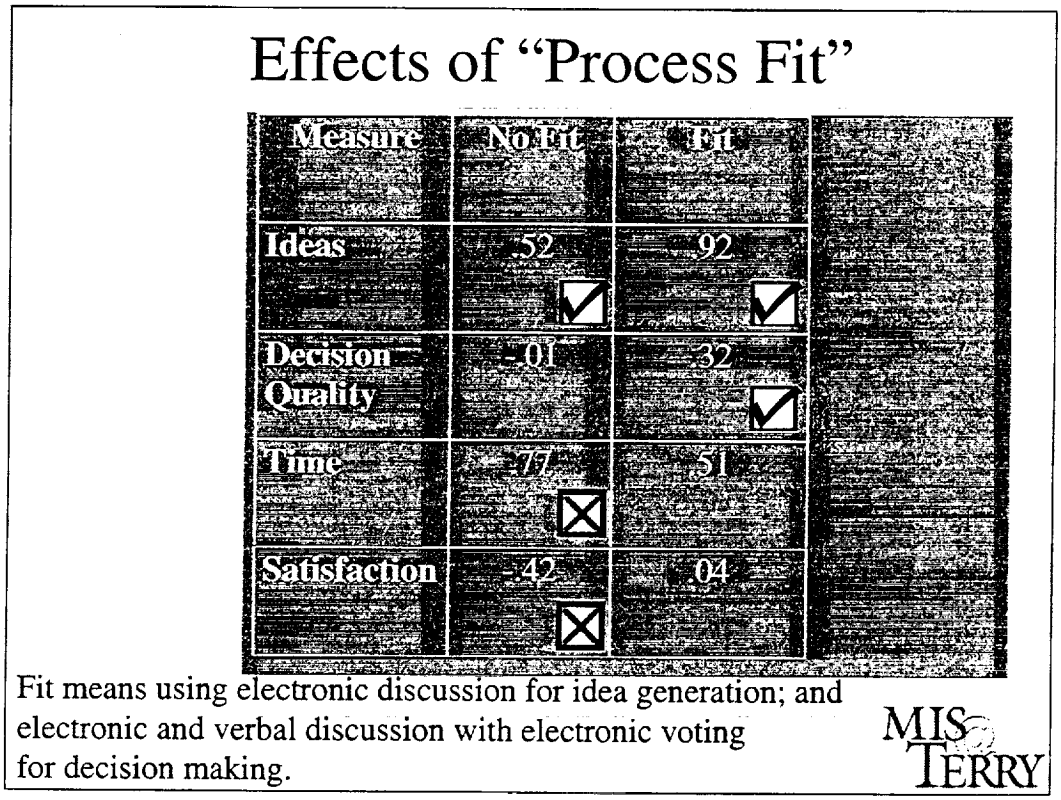


Effects of Process Fit

Theory suggests that some GSS processes "fit" better some tasks than others. A process was considered a fit for the task if electronic discussion was used to generate ideas, and a combination of electronic and verbal discussion, and formal voting or rating of alternatives, were used for decision making tasks.

In cases where the process fit the task, GSS groups produced significantly more/better ideas and better decisions than non-GSS groups.

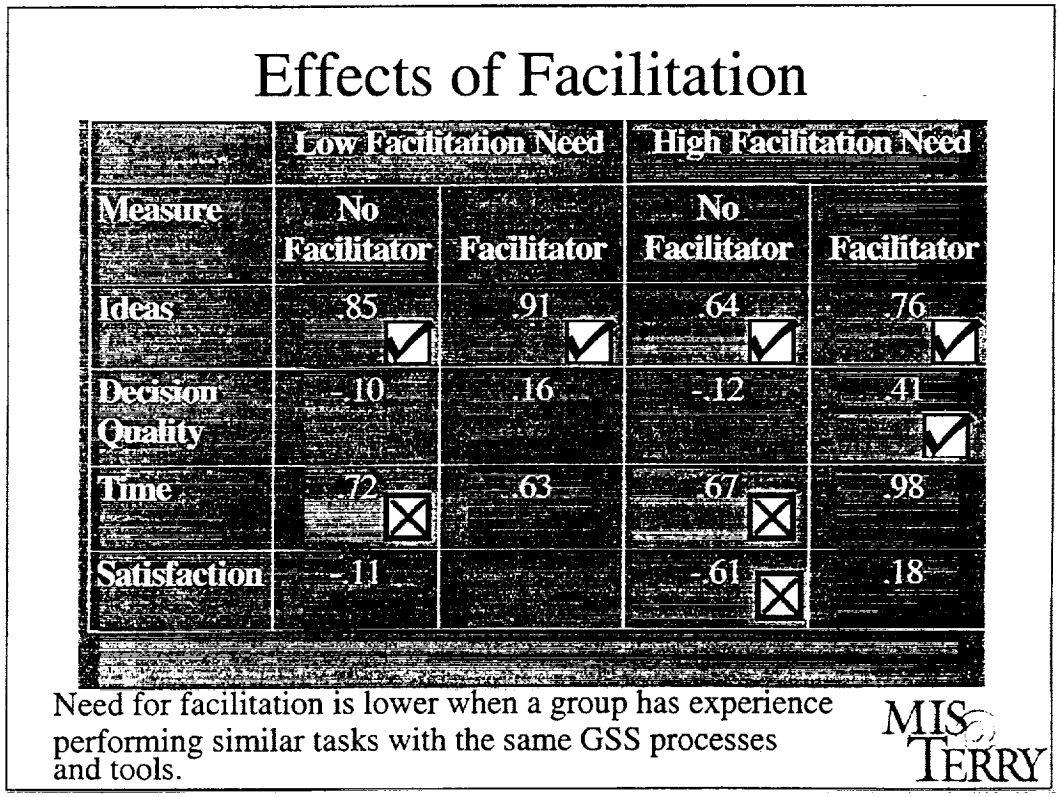
In cases where the process did not fit the task, GSS groups still produced significantly more/better ideas, but took significantly more time and were significantly less satisfied.



Effects of Facilitation

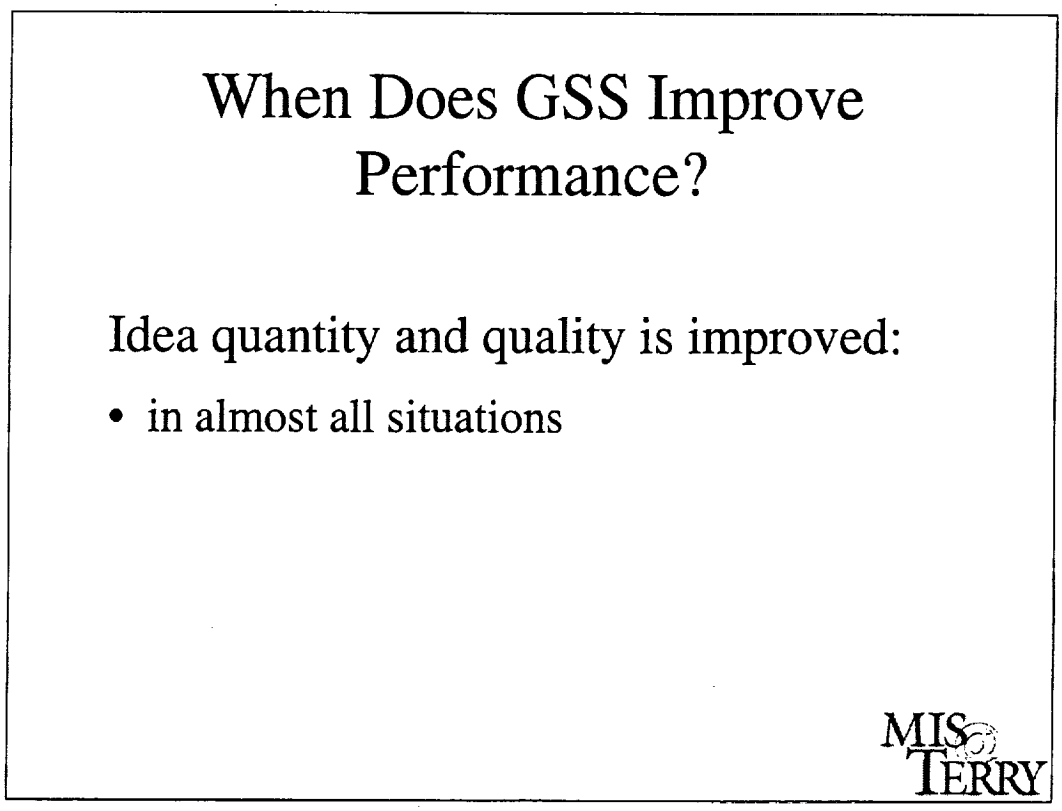
The data were partitioned into situations with a low facilitation need (the group had used the same tool previously to perform similar tasks) or high facilitation need (the groups had either previously not used the tool or had not performed similar tasks).

GSS groups produced significantly more/better ideas regardless of the situation or the presence/absence of a facilitator. The high facilitation need groups with a facilitator produced better decisions. GSS groups took longer than non-GSS groups with no facilitator, while high need groups without a facilitator were significantly less satisfied than non-GSS groups.



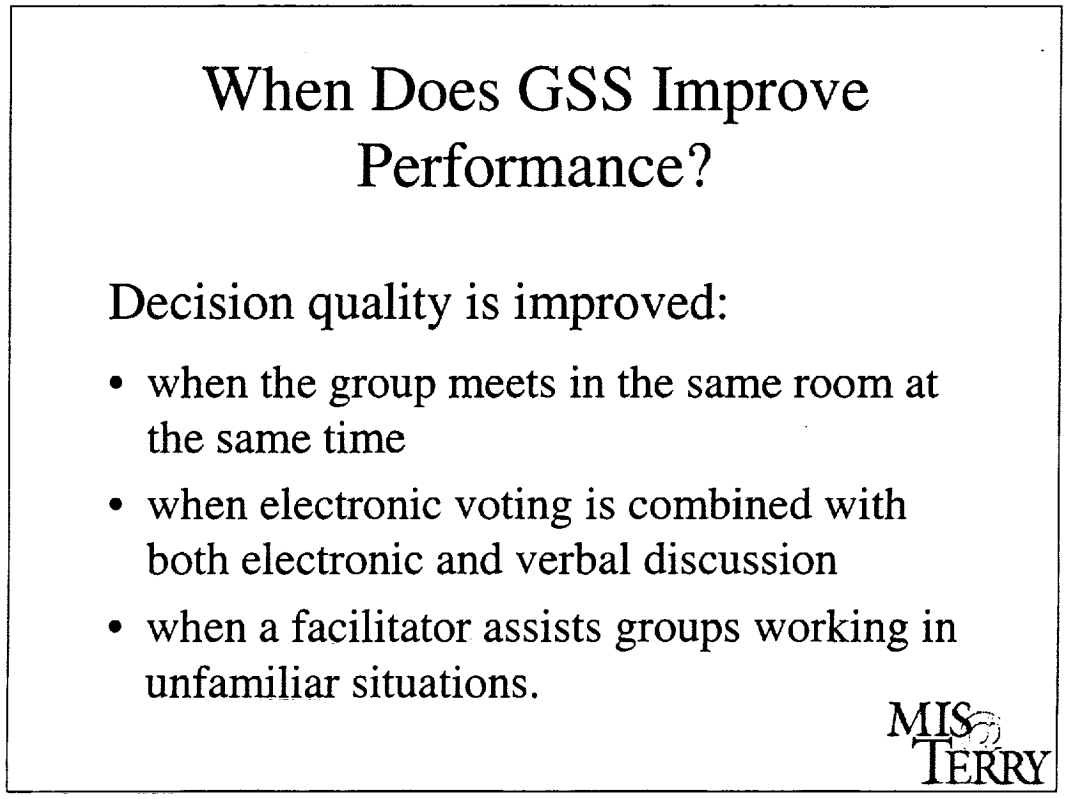
Summary

In summary, GSS use improves the quantity and quality of ideas in almost all situations.



Summary

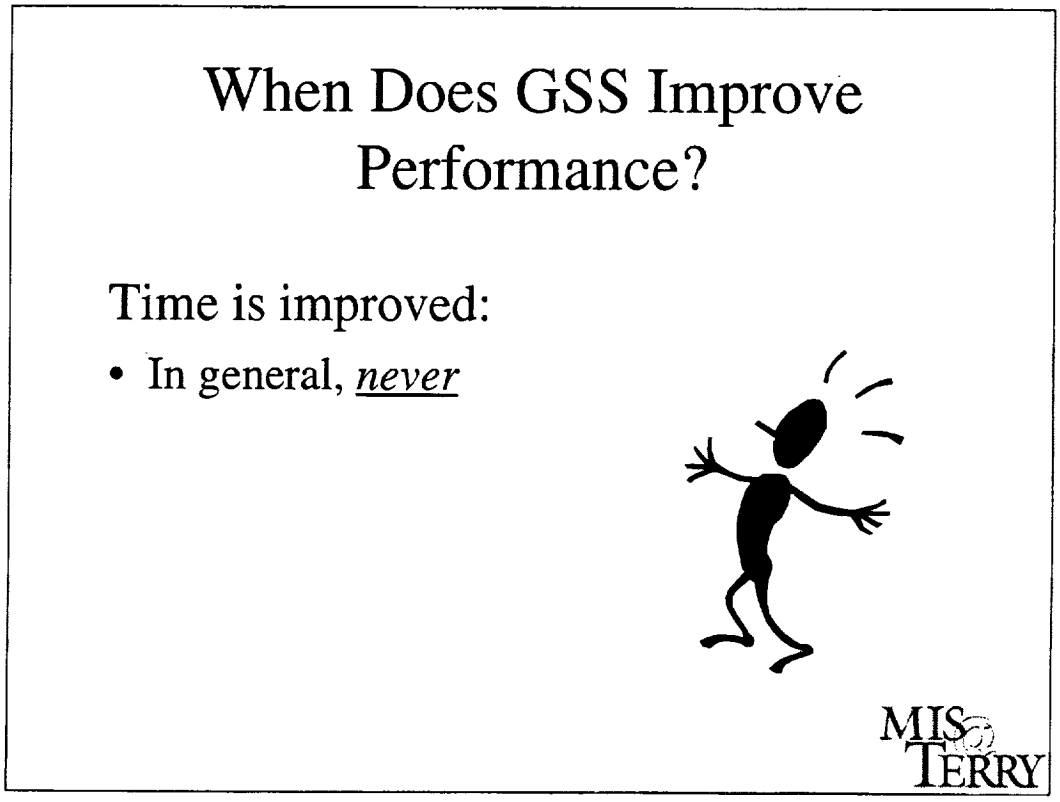
GSS use improves decision quality when the group meets in the same room at the same time, when electronic voting and both electronic and verbal discussion is used, and when a facilitator assists groups who are new to the GSS tool being used or the task being performed.



Summary

In general, over a wide variety of situations GSS use does not reduce the amount of time taken to complete the task. I found this surprising, because this is a benefit claimed by many users and vendors of GSS technology.

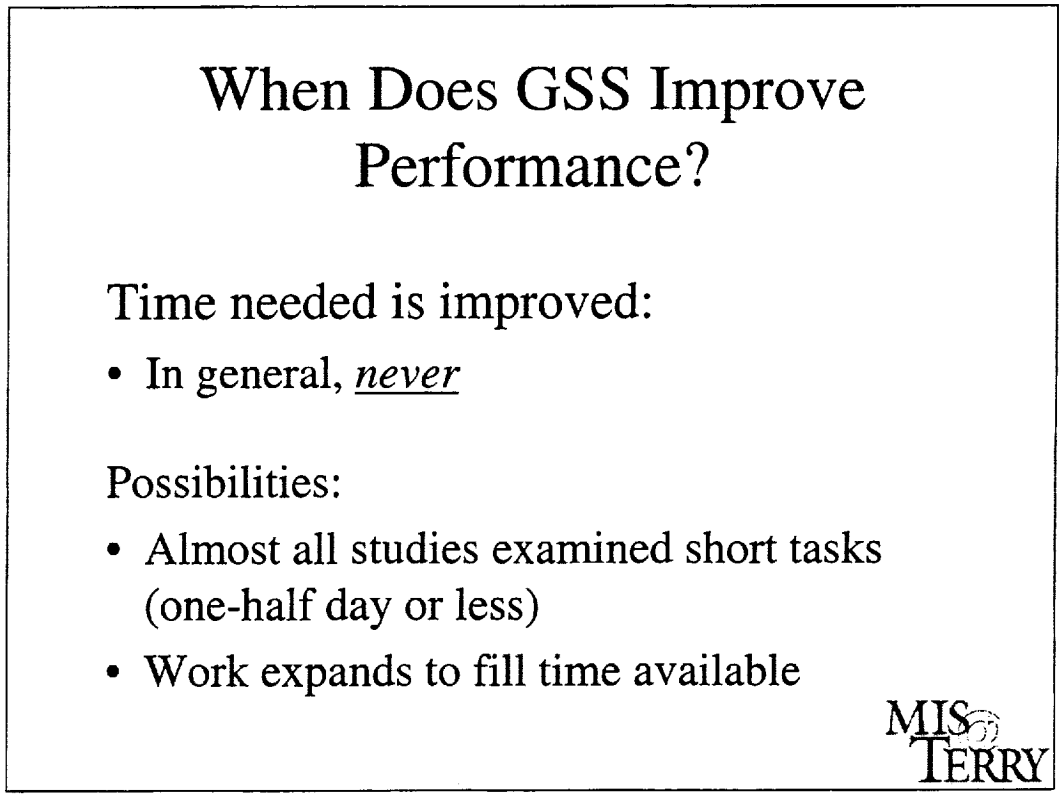
There are at least two possibilities which may explain this anomaly.



Summary

One possibility, which I believe to be true but cannot prove, lies in the duration of the tasks. Most studies (in these analyses) examined very short duration tasks (one-half day or less). It may be that GSS can reduce the amount of time to complete tasks, but only for "long" tasks that would normally exceed one-half day of work. In a study I did of 18 DoD task forces working on projects taking five days or longer to complete, GSS use reduced the time required by 75%. Thus, I believe GSS use reduces time for "large" tasks but not for "small" ones.

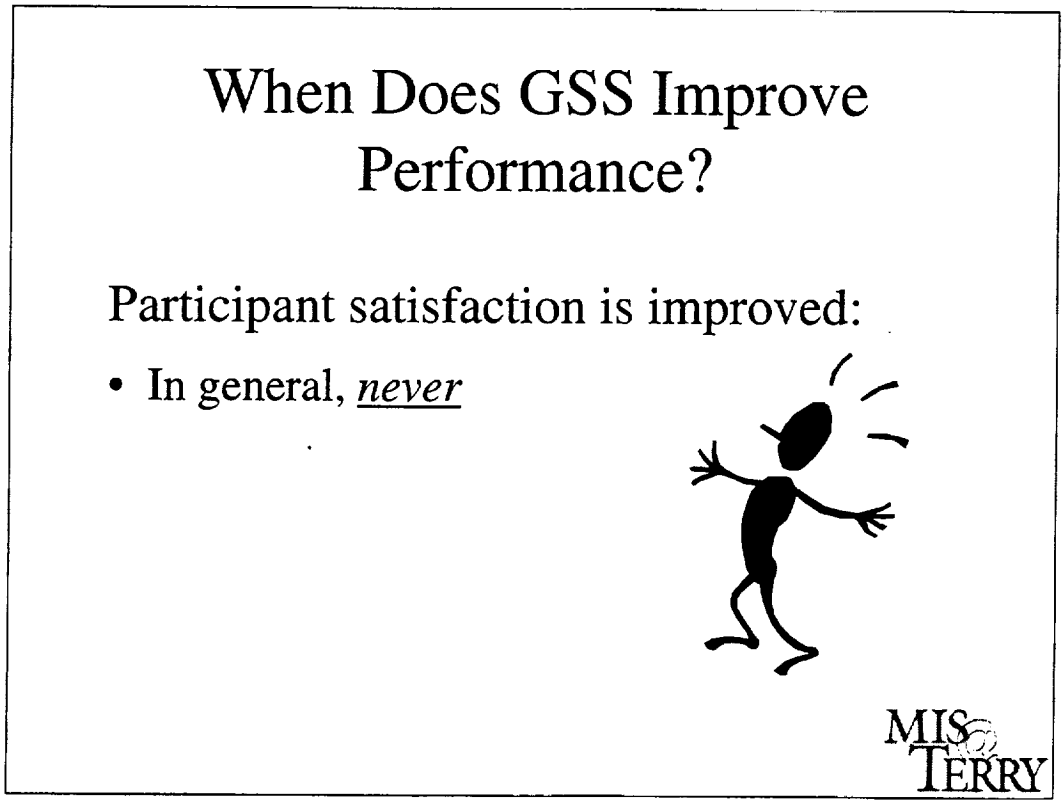
A second possibility is that work expands to fill the time available. In a study I did of six project teams in a hospital that worked over a seven week time period, the GSS teams spent more time in meetings than did non-GSS teams, but worked harder and produced a better quality product.



Summary

In general, over a wide variety of situations GSS use does not increase participant satisfaction. Once again, I found this surprising because this is a benefit claimed by many users and vendors of GSS technology.

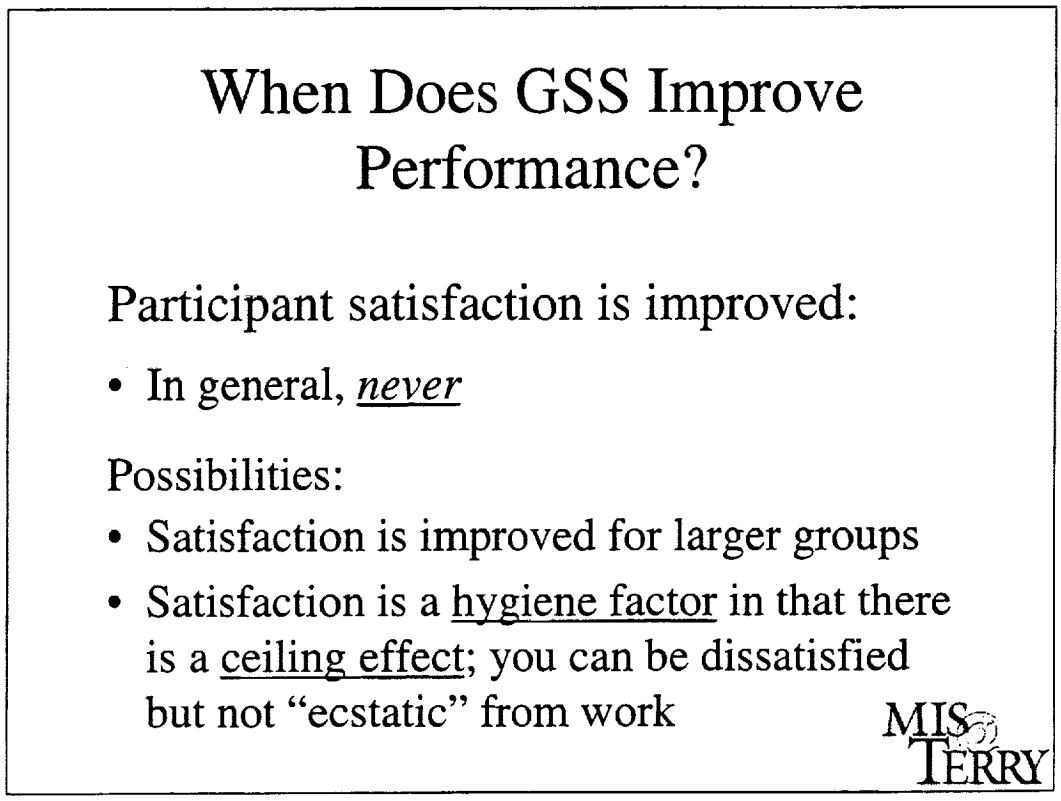
There are at least two possibilities which may explain this anomaly.



Summary

One statistically supported possibility is that satisfaction is only improved for large groups.

A second, theoretically more powerful possibility, which I believe to be true but cannot prove, is that there is a ceiling effect; satisfaction is a hygiene factor. The term hygiene factor comes from the idea that some factors can only "hurt." A super clean restroom in a restaurant will not increase your satisfaction of visiting the restaurant and increase the chance you will return, but a dirty restroom might decrease satisfaction. GSS is just a tool, and in general, one can never be more than "satisfied" with a tool. However, if the tool does not fit the task (you need a hammer when you have a screwdriver) you can become dissatisfied. The satisfaction differences found for large groups may reflect the fact that non-GSS groups are extremely dissatisfied with their process, and thus GSS groups, which are merely satisfied, are significantly better.

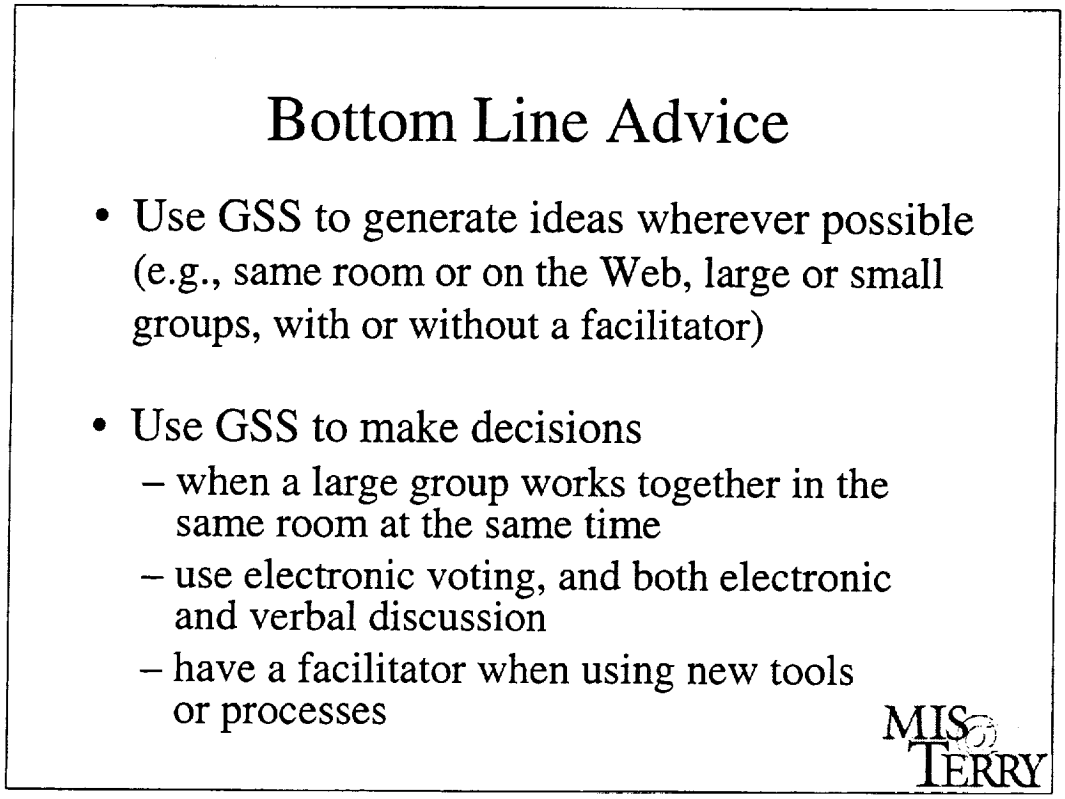


Bottom Line Advice

Since GSS groups outperform non-GSS groups in the quantity and quality of ideas in a wide variety of settings, GSS should be used for idea generation wherever possible.

Decision making is more tricky. GSS should be used only for large groups working in the same room at the same time, when participants discuss issues electronically and verbally, and electronic voting is used. A facilitator is important when groups use a new GSS tool or perform an unfamiliar task.

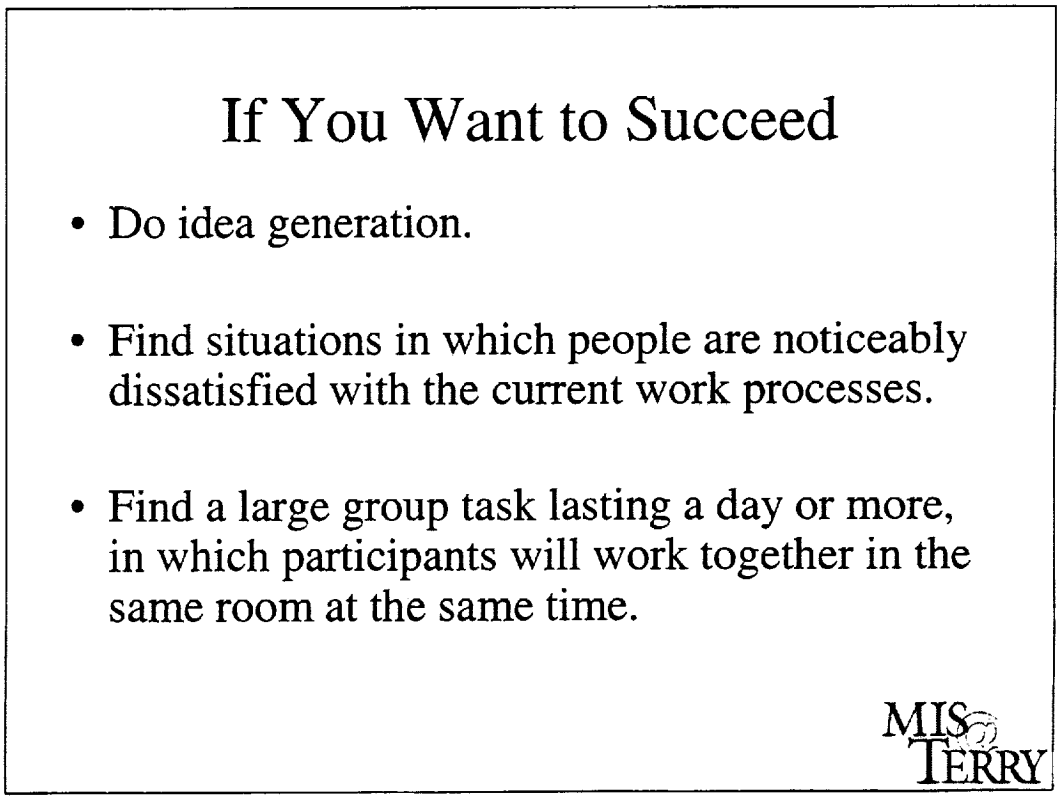
The corollary to this is that it makes sense for groups to discuss issues and generate ideas over the web, but when it is time for a critical decision, they should come together face-to-face. It may be possible to use newer video-conferencing technologies, or just those that provide audio (e.g., conference telephone call), but this may be risky.



If You Have a Pilot Project to Test GSS

If you want to succeed:

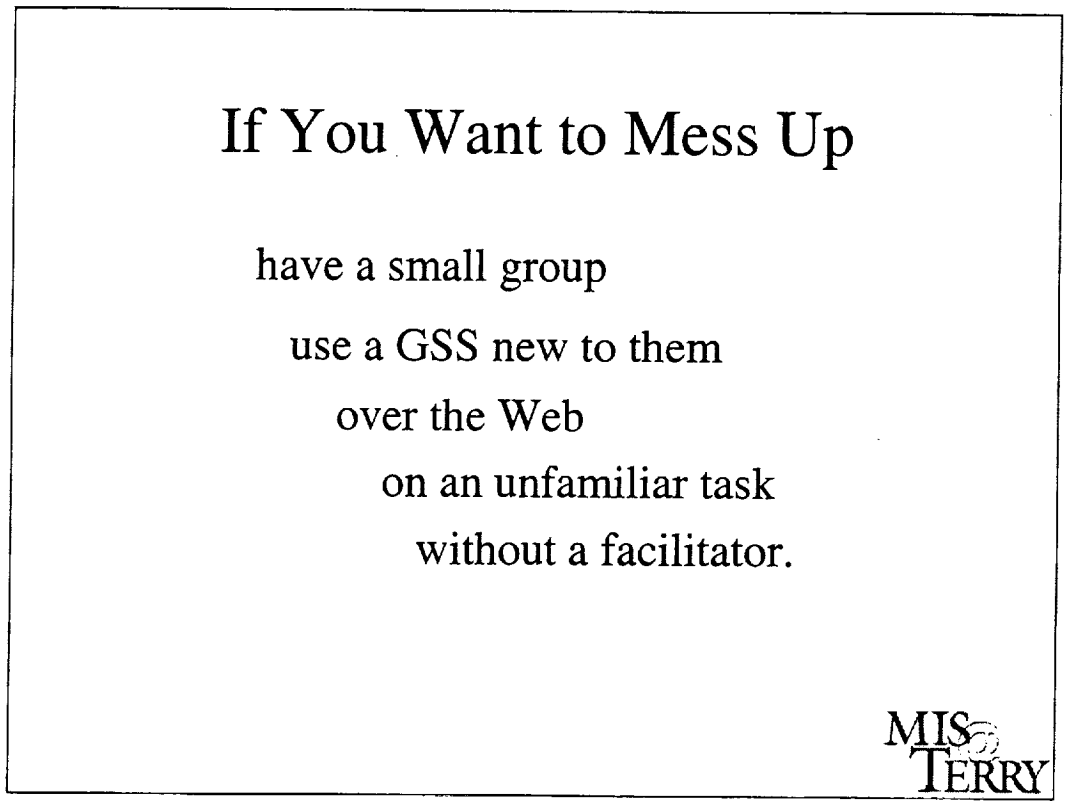
- do idea generation
- find a large group and have them work together in the same room at the same time
- find a dissatisfied group and work with them.



If You Have a Pilot Project to Test GSS

If you want to fail:

- have a small group
- use a GSS new to them
- over the Web
- on an unfamiliar task
- without a facilitator.



Meetings in the Next Century: Any Time, Any Place

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Meetings in the Next Century: Any Time, Any Place

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A variety of Group Support Systems (GSS) have been developed over the last fifteen years to help improve the process of group decision making and problem solving. *MeetingWorks for Windows* is a GSS that provides a comprehensive and flexible set of tools that can be used to design a wide variety of meeting processes. The tool set includes modules for idea generation, list discussion and organization, item comparison and cross-impact analysis, evaluation of alternatives (selecting, ranking, rating), and multiple criteria analysis. Traditionally, these tools have been used to support face-to-face meetings (same time/same place). Recently, new versions of *MeetingWorks* utilize the communications capabilities of the Internet to allow for participation from remote sites at varying times. This allows for different time/different place meetings, as well as same time/different place meetings. These capabilities will become increasingly important as organizations become more geographically dispersed and integrated through telecommunications networks.

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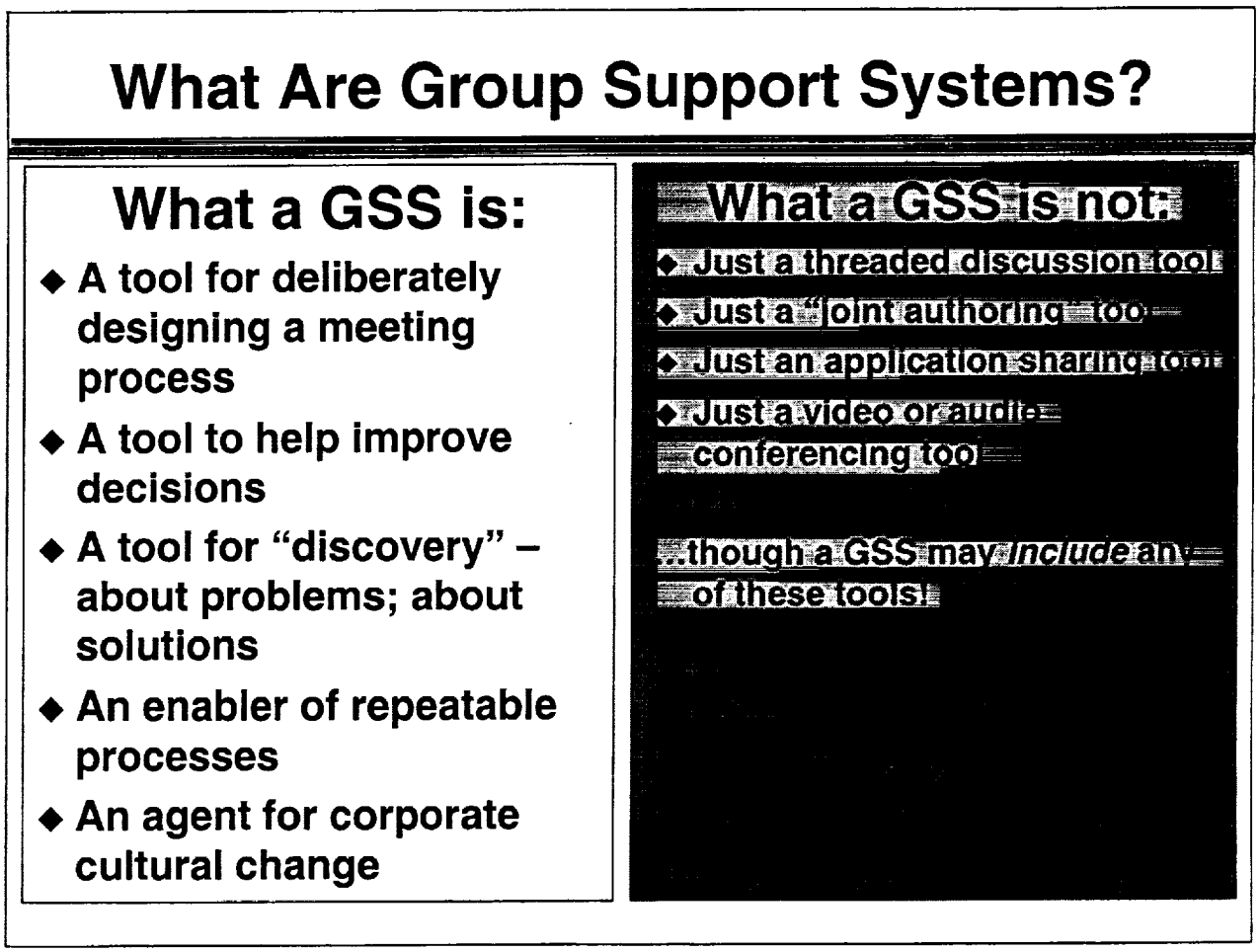
meetingworks™

What Are Group Support Systems?

A Group Support System (GSS) includes computer hardware, specially-designed software, and unique procedures that allow a knowledgeable group facilitator to design processes to support group decision making and problem solving. This can be an effective method for improving group decisions, and often involves discovering new dimensions to the problem, and/or finding new approaches to solving problems. Group support systems are ideally suited for situations where organizations engage in repeatable processes. A GSS can be used to "capture" a process, and then help ensure the same approach is used each time the process is repeated. The participatory team orientation of a GSS can be a powerful agent of cultural change in an organization. It can also be a barrier to adoption in organizations that do not have a commitment to a participatory approach. Most of the comments in this presentation relate to the use of a particular GSS system: *MeetingWorks for Windows*.



What is a Face-to-Face GSS Meeting Like?

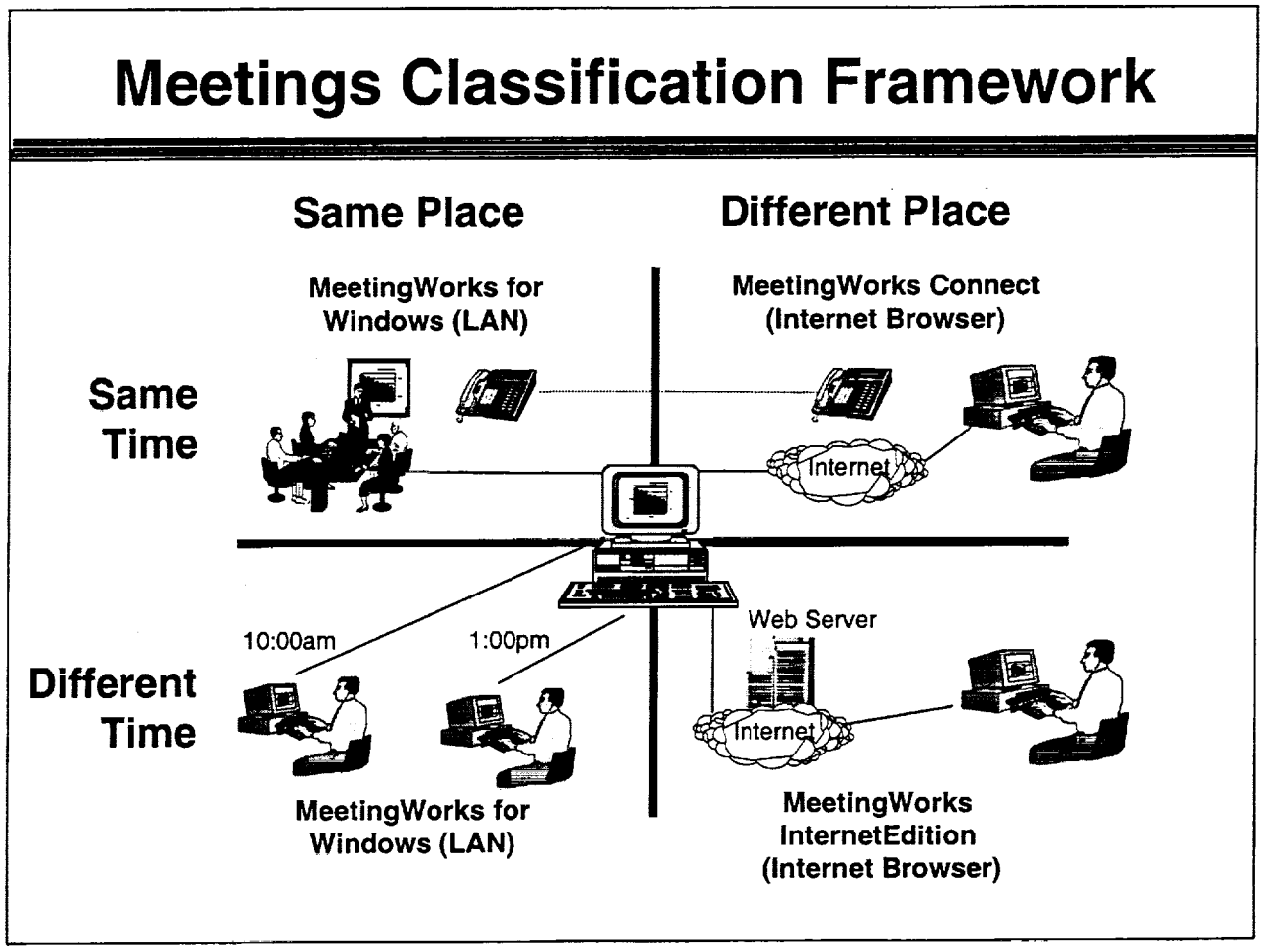
The GSS process usually begins when a knowledgeable GSS facilitator holds a discussion with someone who wishes to initiate a meeting. When the purpose and desired outcomes are clearly articulated, the facilitator (possibly aided by a technical assistant or "chauffeur") will design a meeting agenda which incorporates some of the GSS tool modules at appropriate steps. When the GSS meeting takes place, the participants typically gather in a decision room where at times they may enter ideas and/or numeric evaluations through a computer. Most GSS meetings also include some face-to-face oral discussion about the ideas or evaluations that have been submitted. At times, a display of some kind (like a summary list of ideas, or a graph showing the results of an evaluation) may be projected to a screen at the front of the room, and the facilitator often leads a discussion of this material. Typical meetings may flow back and forth several times between these types of activities during one or more sessions.

What is a Face-to-Face GSS Meeting Like?

1. **A meeting initiator meets with a facilitator to articulate the desired outcomes and purposes of the meeting.**
2. **A facilitator/chauffeur team map meeting tasks to MeetingWorks tools.**
3. **At times during the meeting, participants may enter ideas and/or evaluations into a laptop or desktop computer.**
4. **At other times, the group may engage in verbal discussions of the ideas or evaluation results.**
5. **Summary list or graphs are displayed to participants, and the facilitator leads a discussion to assure common understanding and clarity.**

Meetings Classification Framework

Most GSS meetings have taken place in a face-to-face mode, where participants meet in the same place at the same time. However, the rapid growth of the Internet has made it possible to support other modes – different times and/or different places. One version of *MeetingWorks* (the InternetEdition) now supports meeting processes where participants can log into a web site at different times from different places using a standard web browser. This could be appropriate when participants are asked to contribute a list of ideas for later discussion, or to rate a set of ideas that they have previously discussed. Another new version of *MeetingWorks* (Connect) can be used when some participants are unable to attend a live meeting, but they may be able to connect via the Internet during the meeting. They can then contribute material, evaluate ideas, and even see the summary results of the meeting in real time using a standard web browser. Teleconferencing may be especially useful in supplementing this mode. These distributed GSS approaches are especially useful for supporting virtual teams that may be geographically dispersed.

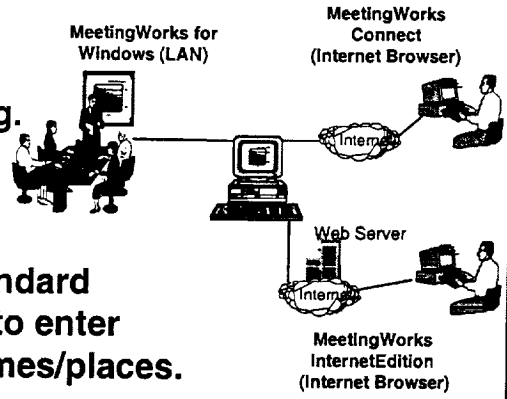


What is a Distributed (Web) GSS Meeting Like?

A distributed GSS meeting will start out just like a face-to-face meeting, with a discussion between the meeting initiator and a facilitator. However, when GSS tools are mapped to the process steps required by the client, some or all of the tools will be Internet-enabled. Participants will be told that they can complete certain steps by logging on to a particular web address with their browser. Typically, a time frame is given such as "please contribute to the list of product requirements by 5:00 p.m. Thursday." Participants can then control the time and place of their involvement. If a step requires a face-to-face meeting, but not everyone can attend, a tool version can be used that allows a remote group member to participate in real time over the Internet. In this case, the remote participant can contribute ideas and evaluations, and will see the group summary displays on their own remote systems as soon as the face-to-face participants do.

What is a Distributed (Web) GSS Meeting Like?

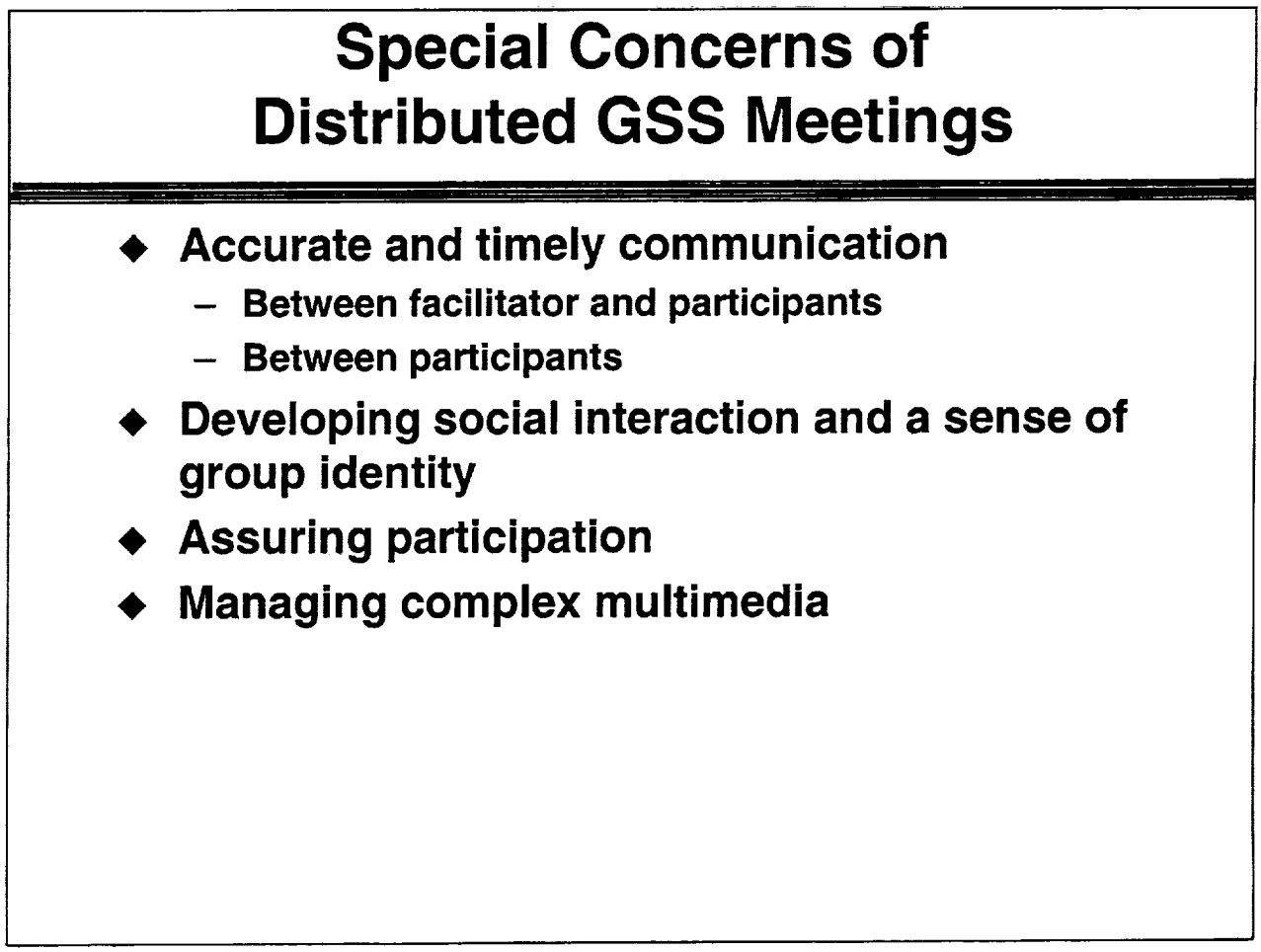
1. **A meeting initiator meets with a facilitator to articulate the desired outcomes and purposes of the meeting.**
2. **A facilitator / chauffeur team maps meeting tasks to MeetingWorks tools.**
3. **For some steps, participants use a standard browser to log into a meeting website to enter ideas and/or evaluations at different times/places.**



4. **The group may use chat, email, threaded discussion tools, or a face-to-face meeting to discuss the ideas or evaluation results.**
5. **Summary lists or graphs are displayed to local and remote web participants, and the facilitator leads a discussion to assure common understanding and clarity.**

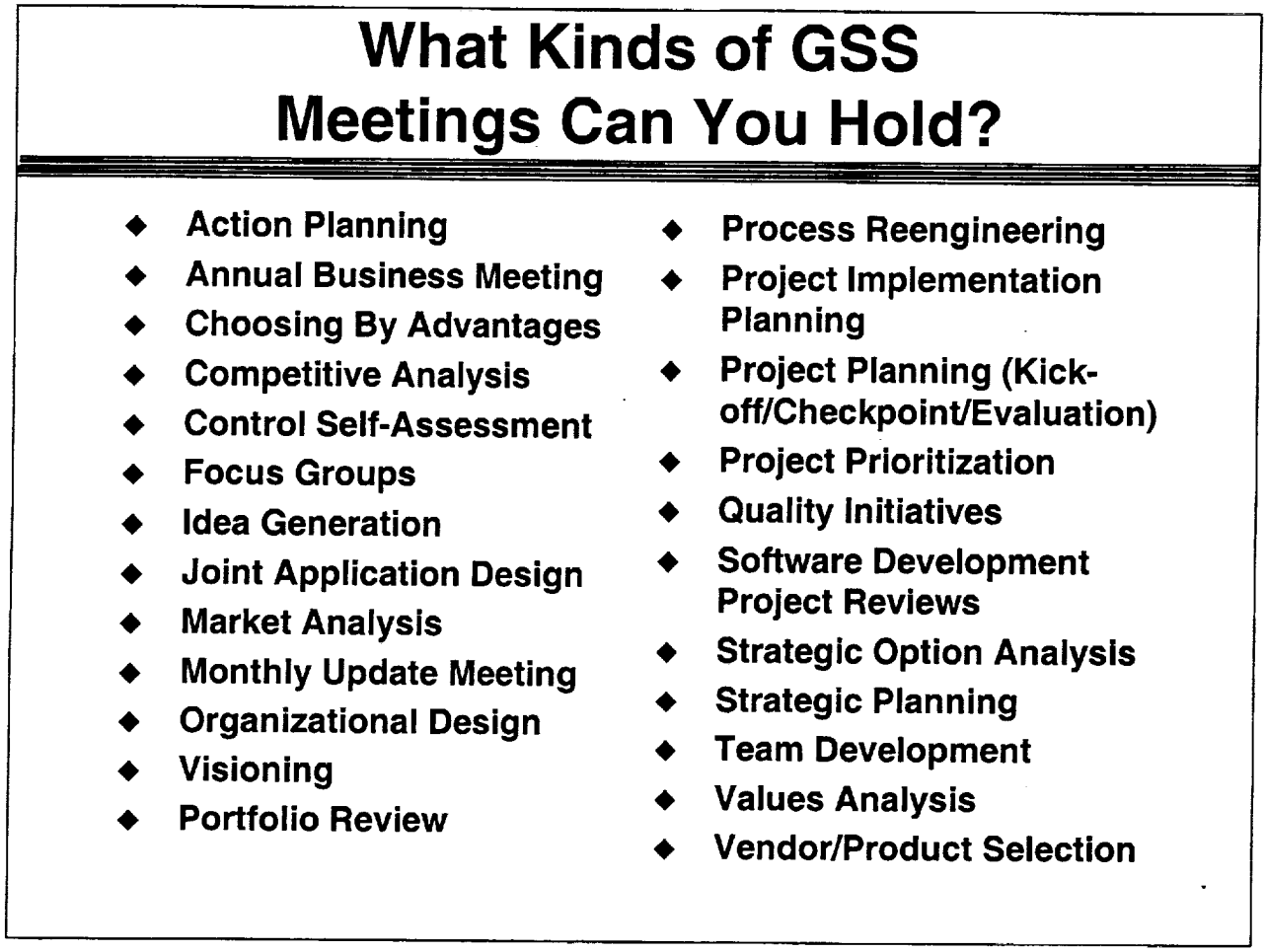
Special Concerns of Distributed GSS Meetings

Distributed GSS meetings are not the same as face-to-face meetings – they have their own unique advantages and challenges. In a different time/different place meeting where all participants are dispersed, it is more important but also more difficult, to communicate clearly about what is needed in each step of the process. A facilitator tries to do this with clear written instructions, but handling the inevitable questions by email and phone is not as satisfactory as immediate verbal interaction in a face-to-face setting. If the group has never met face-to-face, it may be hard to provide for social interactions that can help the group develop a sense of identity and shared purpose. It may be easier for some members to "drop out" in a distributed meeting, especially if they do not feel a sense of connection. The facilitator may have to work harder to encourage participation. If the group will be using audio and/or video conferencing, the management of these additional technologies add to the complexity of the process, and may tax the ability and energy of the facilitator. Developing new techniques for facilitating distributed meetings should be a high priority in the near term.



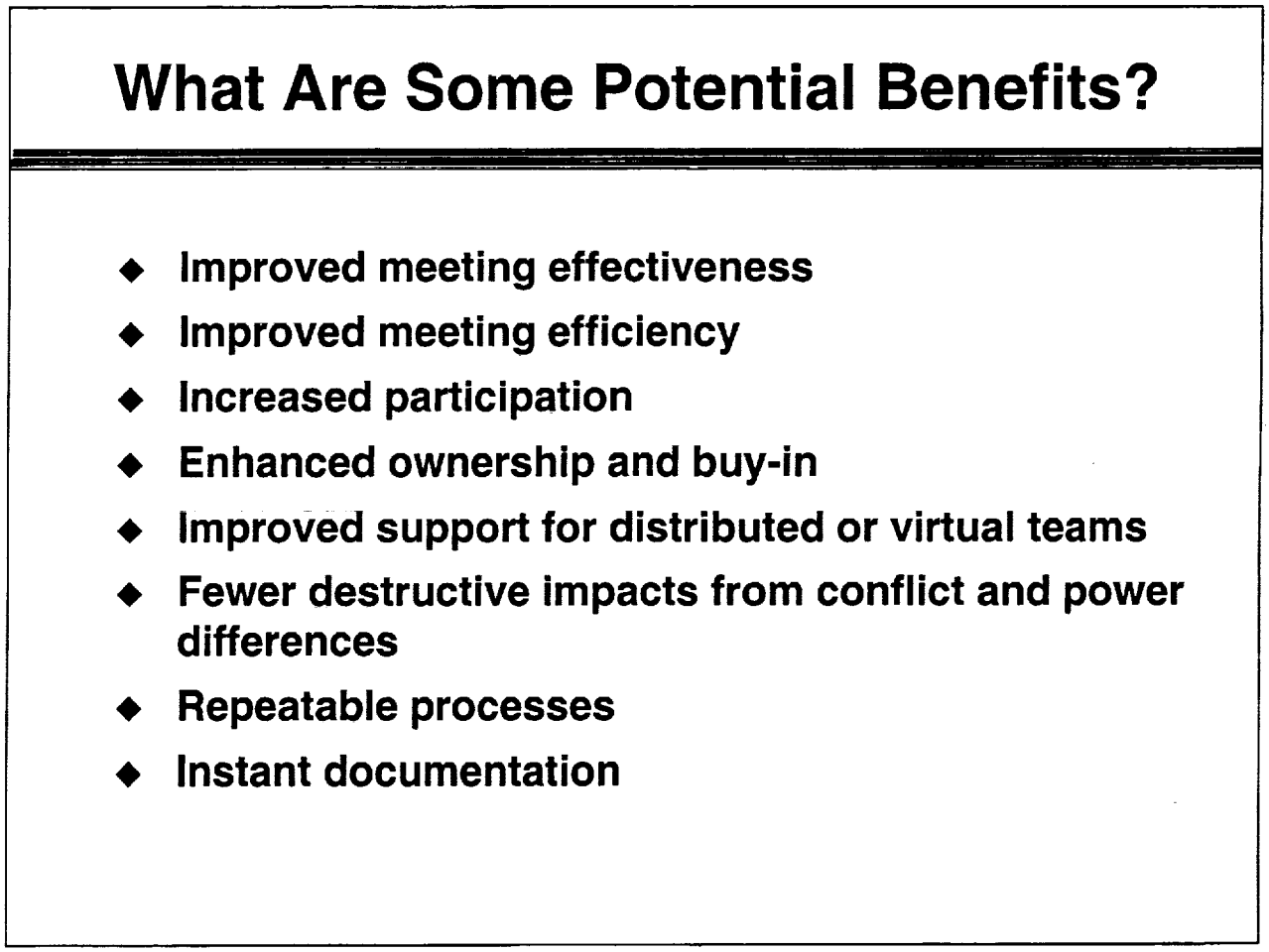
What Kinds of GSS Meetings Can You Hold?

The key word here is "variety." A typical GSS tool set is generic and fundamental, and can be used to develop an endless number of different meeting processes. In some ways, asking what kinds of meetings you can hold with GSS is like asking, "what can you write with a pencil and paper?" The list on this slide contains examples of GSS meetings already successfully held; it is not a complete list of all possible meetings. This general purpose characteristic of GSS can make it hard to describe to those unfamiliar with the tools. Saying that something can do "anything" may make it sound like it does nothing in particular! A related problem is that someone who attends a demo of a GSS is understandably likely to go away thinking of GSS as "the system that does what I just saw in the demo." If any generalization can be made it is probably that GSS is most often used in meetings where the purpose includes some type of planning.



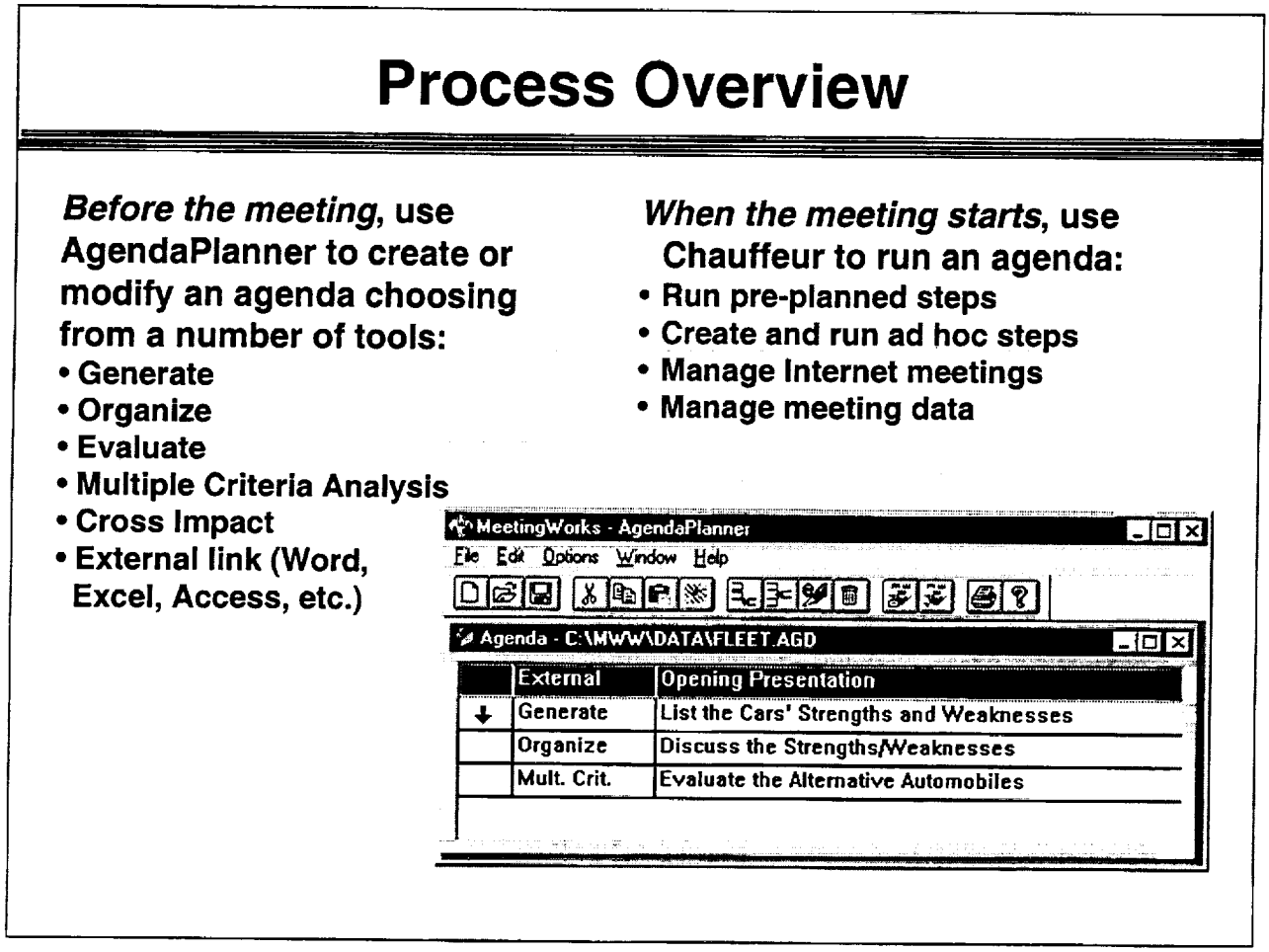
What Are Some Potential Benefits?

Over the years, a number of benefits have been found to potentially result from GSS use. Not all benefits are forthcoming from every meeting. In reality, given the complexity of meeting processes, none can be absolutely guaranteed for a particular situation. However, most GSS sessions do result in some of these benefits, sometimes most of them. The list shown here includes benefits that have been identified by *MeetingWorks* users in their meetings over the last ten years. Many report that GSS meetings can be more effective – more likely to achieve the goal of the group. Others find that over an entire process (which may include multiple GSS sessions), significant efficiencies can result. Some of the features of a GSS (like anonymous keyboard entry of ideas and evaluations) may encourage more participation by members who might be reluctant to speak up in a traditional meeting. Some have observed that this can reduce destructive conflict in groups, which could lead to greater buy-in to a final decision. The Internet features provide new forms of support for virtual teams. Clients with group processes that are repeated on a regular basis like the way a GSS can capture these processes and make them available throughout an organization.



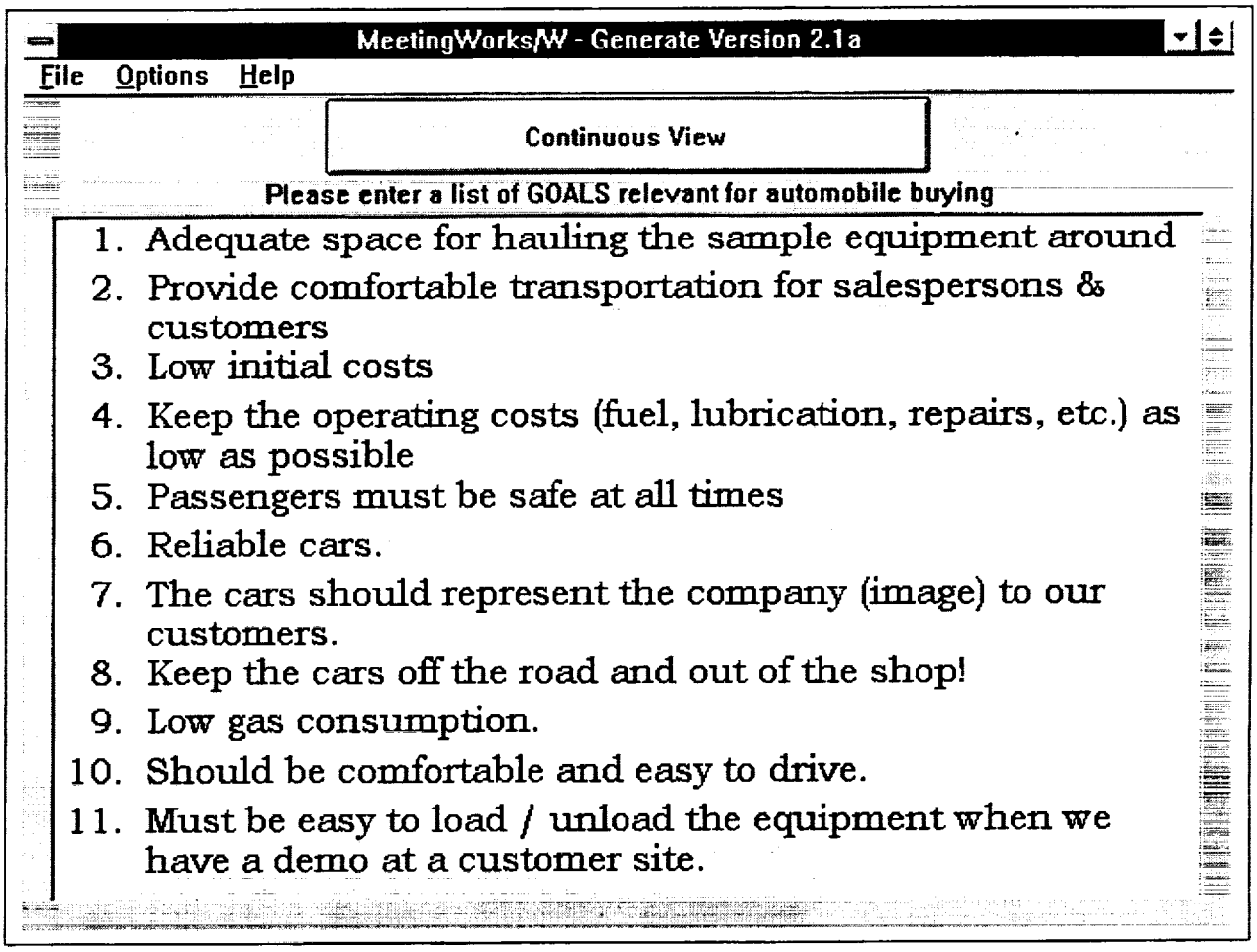
Process Overview

As a first step, the AgendaPlanner tool allows the facilitator to create a custom agenda for a group process that may take one or more meetings and may include one or more steps using the Internet. The Generate tool is used to gather text material from participants (e.g., a brainstormed list of solution alternatives, or a set of critical comments about a marketing plan). The Organize tool is used to process initial raw lists by editing and structuring the lists into outlines. Several approaches to evaluation are available - voting, selecting, ranking, rating, etc. For complex or mission-critical decisions, Multiple Criteria Analysis allows the group to define and weigh the importance of multiple criteria for a decision and then apply the criteria to multiple alternatives. The Cross-Impact tool can be used to compare any two lists of ideas (e.g., indicate the likely impact from each policy option on a list of stakeholders). Any Windows-compatible software can be added to a *MeetingWorks* agenda. This allows a facilitator to bring spreadsheets, databases, documents, etc., as needed into a meeting. When a meeting starts, the agenda is executed step-by-step by using the Chauffeur tool. Ad hoc steps can be included during a meeting as the need arises. An example of a short GSS meeting agenda for an automobile "fleet purchase" is shown on this page. The next few slides show the *MeetingWorks* tools in use for the Multiple Criteria step of this agenda.



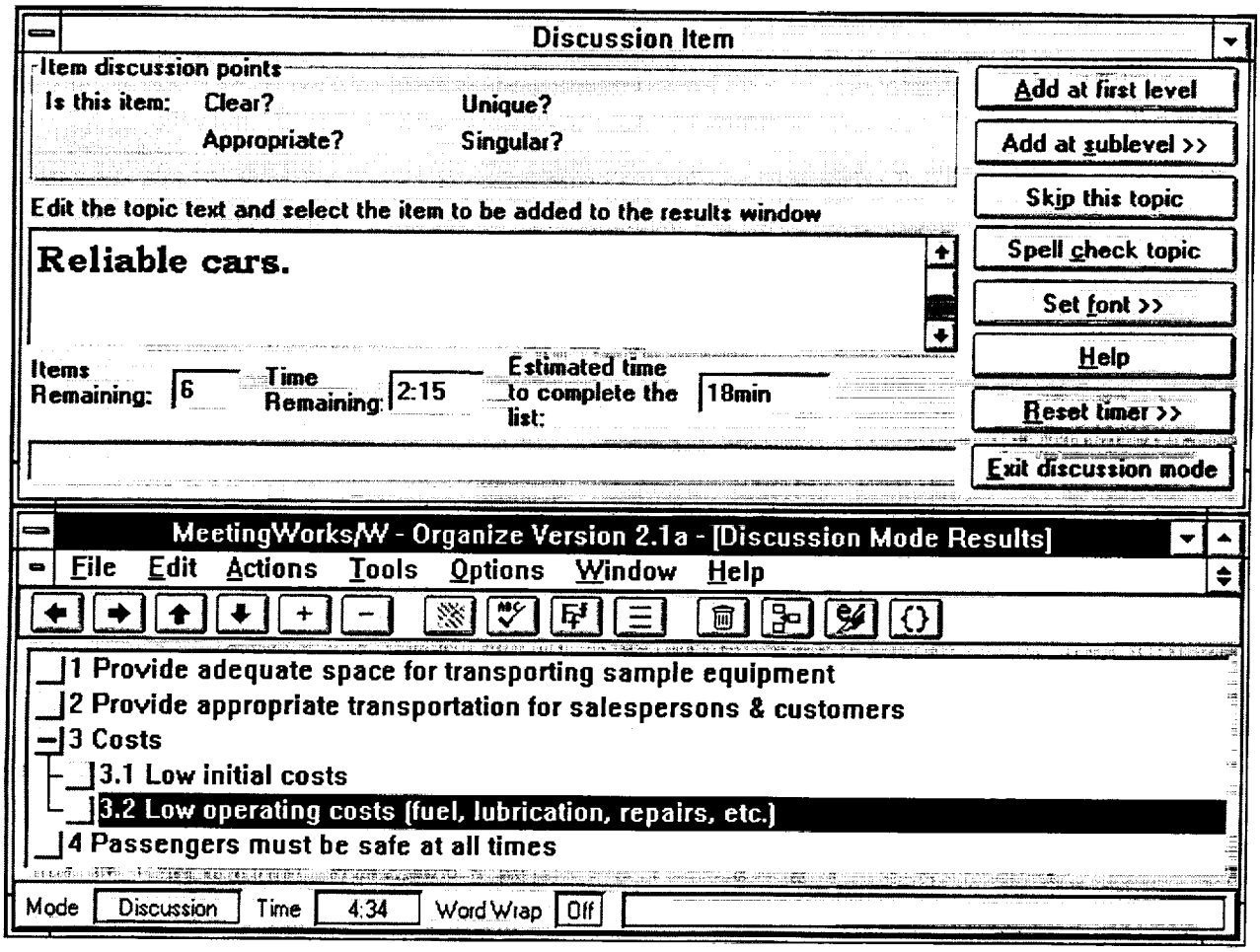
Creating A List of Potential Criteria with the Generate Tool

This slide is a screen capture of the display projected to the front of the room during the use of the Generate tool. Meeting participants were asked to contribute to a list of goals or potential criteria that could be used to select the best automobile for the company. Each participant would type an idea on their own computer, then send it to a common shared group list (as shown below). This list is typically projected onto a screen at the front of the room, which helps reduce redundant contributions, and allows participants to "piggyback" on each others ideas. While this example shows Generate being used for a single topic, it is also possible to have multiple topics defined for a Generate step. Participants can then choose and move between topics depending on their interests and rate of input.



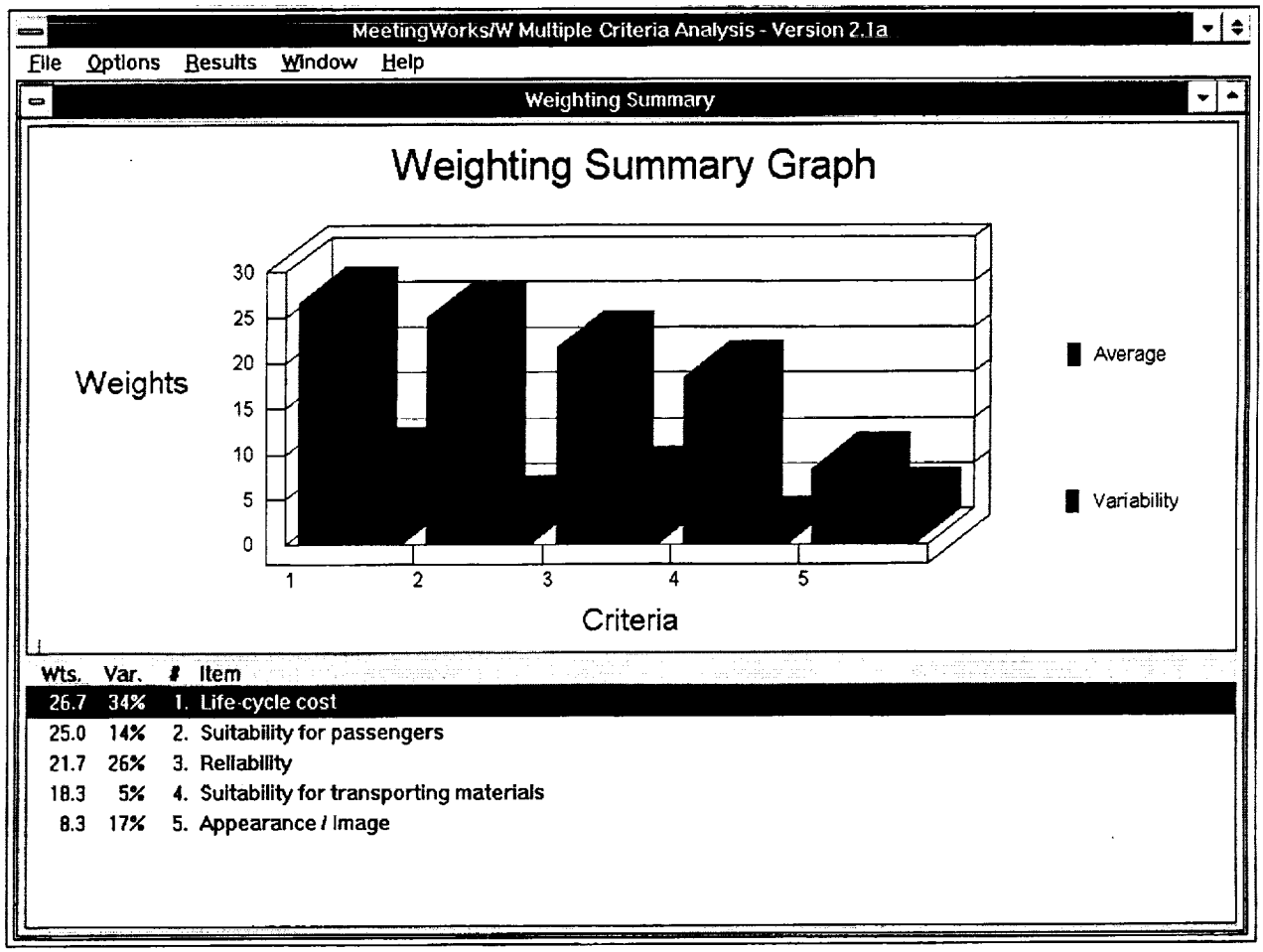
Using the Organize Tool with the Initial List

Initial raw lists typically need a fair amount of discussion, editing and organization. The *MeetingWorks* Organize tool helps the group with this process. The approach shown in this example uses a two part display. At the top, each idea from the original list is presented, one at a time. To help manage the group's time budget, this window shows how many ideas remain on the list, how much time remains for working with the current item, and an estimate of the amount of time remaining to complete the list. While an item is display in the top section, the group will verbally discuss it to reach a common understanding of the meaning, and may edit or delete it as appropriate. When an idea has been processed, it can be added to the outline in the bottom half of the window. This allows the group to work with the structure of the ideas as well, by the way they are organized in the outline.



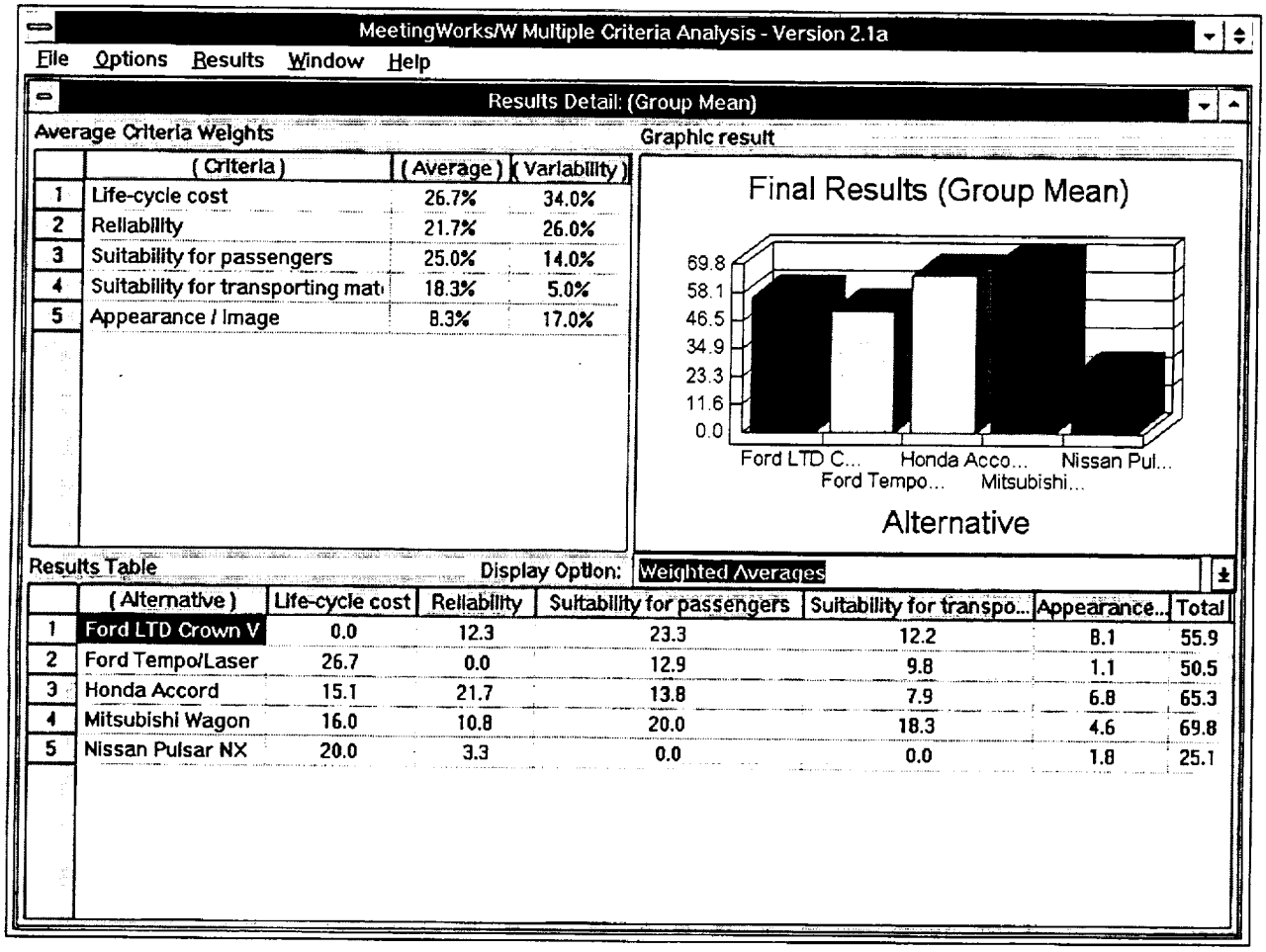
Assigning Weights to Evaluation Criteria

This screen shows a typical summary display for an evaluation. This example is part of a step where participants were asked to distribute 100 points between five criteria to indicate their relative importance. The table and graph summarize the same information in two forms. The criteria at the top of the list (Life Cycle Cost) achieved the highest average weighting, and is also shown as the highest blue bar on the left side of the graph. The level of variability in the scores is also shown in the table. This measures the spread in the scores assigned by the participants. If every participant gave the same score to each criteria, the variability would be very low – zero in fact! As participants assign different values to the criteria, the variability score will rise to a maximum of 100%. The red bars on the graph show the variability scores. This can allow a group to quickly identify areas of disagreement where further discussion is needed. When entering their weights, participants can enter a comment for each item, explaining their rationale for the evaluation. This information is then available while viewing the summary results, though the identity of the author of the comment is not revealed.



Summary Display From Multiple Criteria Analysis

The slide shown below is a screen capture of the summary display in the Multiple Criteria Analysis tool. Using the criteria defined in the previous steps, participants evaluated several alternatives. Each alternative is rated on each criteria. Then the software combines all the criteria weights and alternative ratings for all participants to produce the summary tables and graphs shown here. Summary displays like this make it possible to manage complex issues and to understand why various alternatives do well or poorly. This kind of analysis is likely too complicated to attempt using manual methods like blackboards or flipcharts. Once the original evaluation is completed, the Multiple Criteria Analysis tool allows the group to explore the results further, changing specific weights or ratings to see what difference it might make in the final decision. This sensitivity analysis deepens the understanding of the group and allows them to see the robustness of the decision.

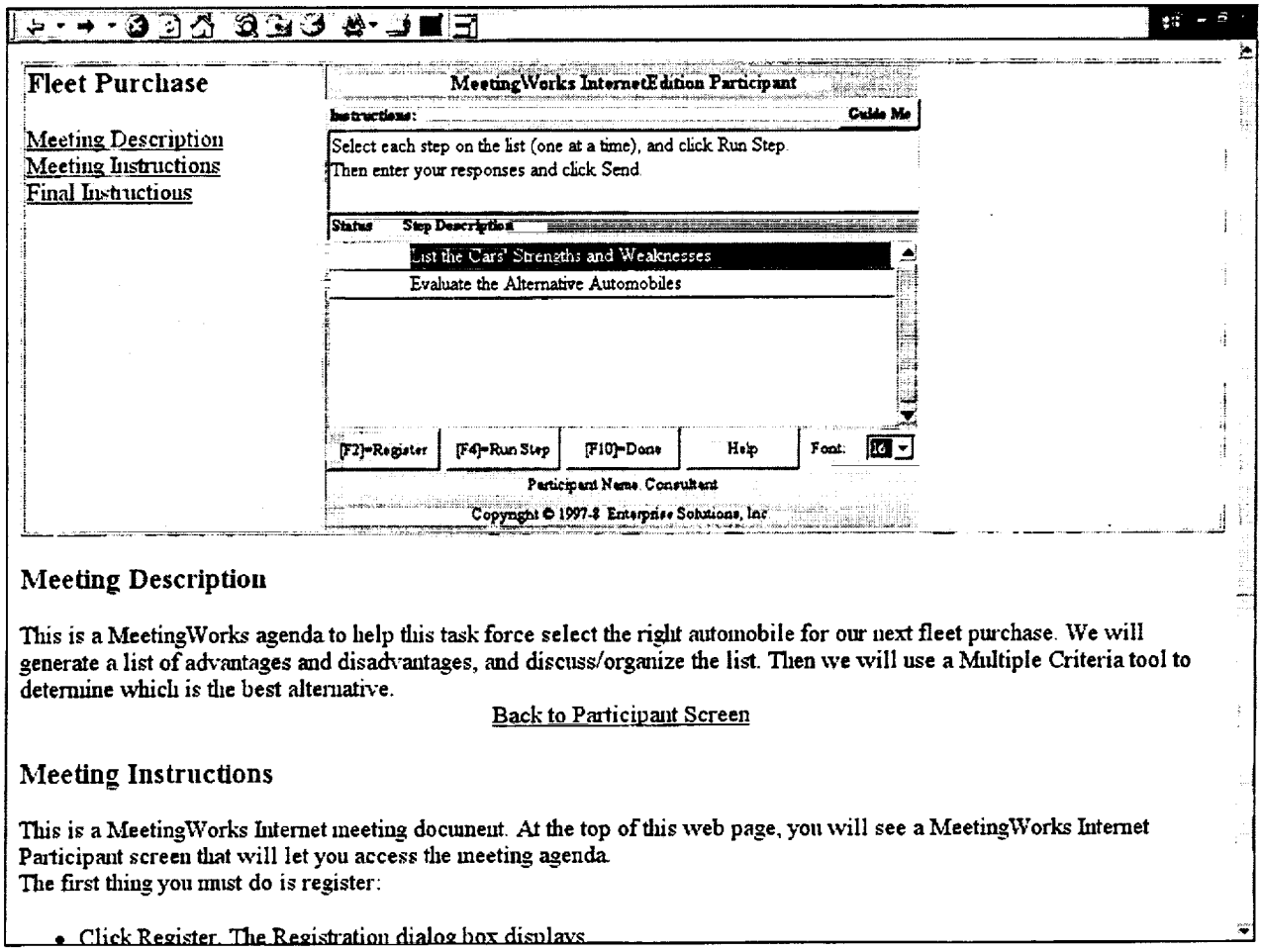


	Criteria	Average	Variability
1	Life-cycle cost	26.7%	34.0%
2	Reliability	21.7%	26.0%
3	Suitability for passengers	25.0%	14.0%
4	Suitability for transporting mat	18.3%	5.0%
5	Appearance / Image	8.3%	17.0%

	Alternative	Life-cycle cost	Reliability	Suitability for passengers	Suitability for transpo...	Appearance...	Total
1	Ford LTD Crown V	0.0	12.3	23.3	12.2	8.1	55.9
2	Ford Tempo/Laser	26.7	0.0	12.9	9.8	1.1	50.5
3	Honda Accord	15.1	21.7	13.8	7.9	6.8	65.3
4	Mitsubishi Wagon	16.0	10.8	20.0	18.3	4.6	69.8
5	Nissan Pulsar NX	20.0	3.3	0.0	0.0	1.8	25.1

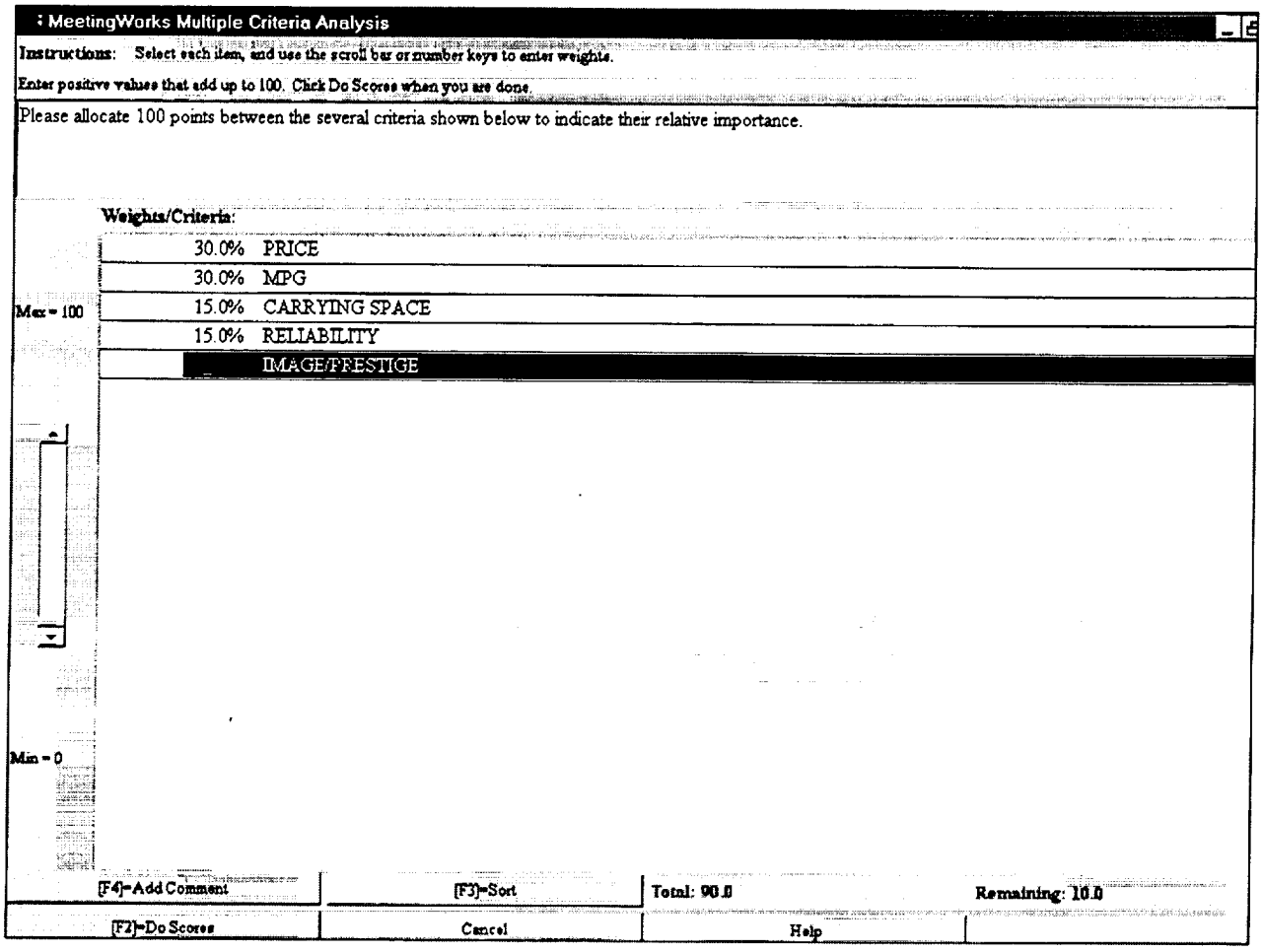
Agenda for Distributed GSS Session

If a group decides to hold distributed sessions through the Internet, they would use a standard web browser to log into a site for the meeting. The screen below shows what the participant would see if they were using *MeetingWorks* InternetEdition to work on the fleet purchase problem. A participant who is familiar with this tool would click on the control buttons or use the function keys to register for the meeting and then carry out the steps in the agenda. A novice might click the "Guide Me" button, which takes the user through the same process in a step-by-step fashion. No software installation is required at the participant station beyond the standard web browser.



Using the InternetEdition to Enter Criteria Weights

This screen captures the display a participant sees when using the InternetEdition to enter criteria weights for the fleet purchase problem. By using a mouse or arrow keys, a participant can move up and down to enter values for the weights. In addition, a participant can enter a comment for each item, explaining their rationale for the evaluation. This information is then available while viewing the summary results. The user interface is kept clear and simple, and as close as possible to identical with the version used in a face-to-face meeting, so there is no additional learning required of the participants. On line help is available at all times, as can be seen from the command buttons at the bottom of the screen.

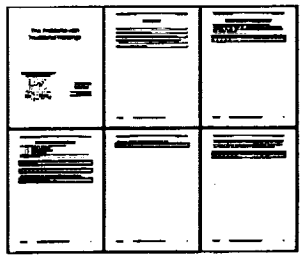


Instant Final Report

MeetingWorks provides support for the easy production of sophisticated reports at the immediate end of a GSS session. Using the tools provided in *MeetingWorks*, along with a word processor like Microsoft Word, a facilitator can prepare a document shell prior to the meeting. This shell simply describes the meeting data the facilitator wants in the final report. After the meeting, the facilitator can simply execute the macros contained in the document shell, and the software will gather the information from each step in the meeting (including graphs and tables), add it to the document, format it appropriately, and print a finished report. Rather than wait for two weeks for someone to type up the minutes of the meeting, a full report is available immediately at the end of the session.

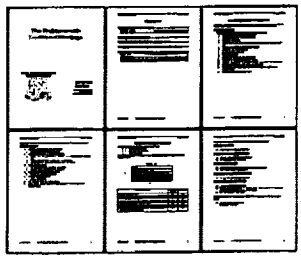
Instant Final Report

Use Word processor to create or modify a meeting document "shell":



- **Select meeting steps**
- **Insert any other text or files**
- **Use your desired format**

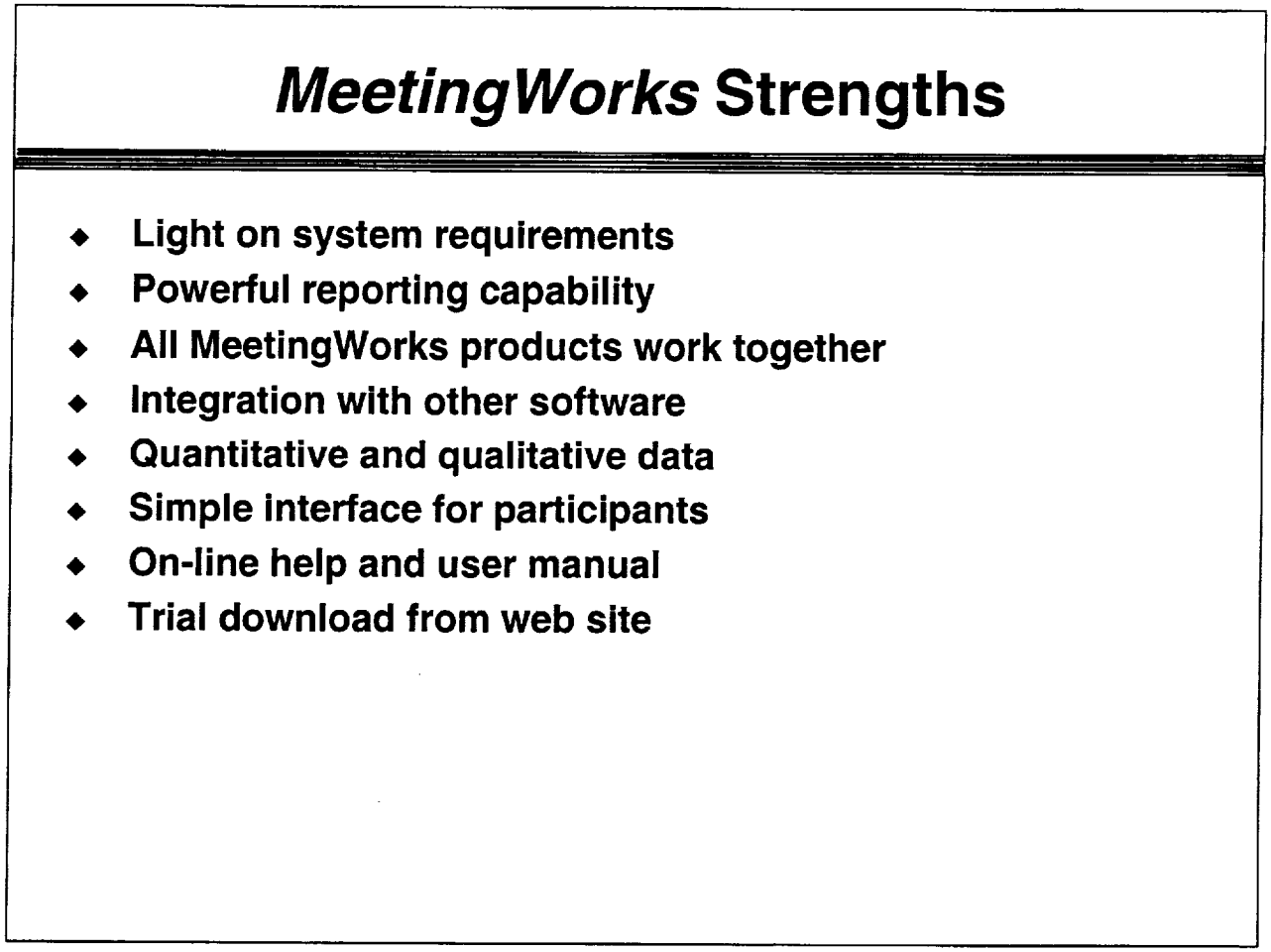
A set of Formatting commands (macros) will format meeting data in your final document:



- **Electronic flip chart contents**
- **Graphs & tables**
- **Participant comments**

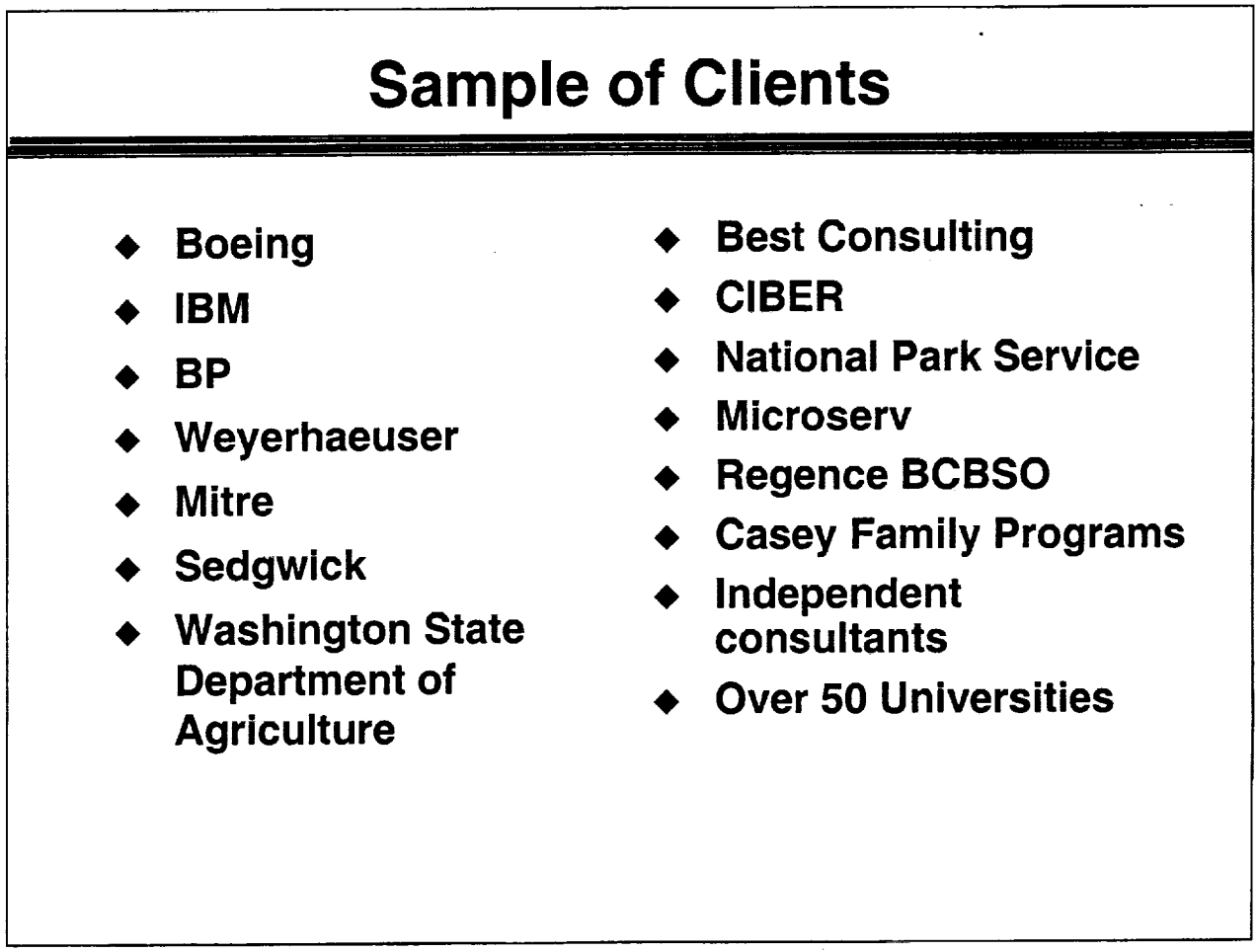
MeetingWorks Strengths

While all GSS systems share many common features, each has some unique strengths as well. One of the major strengths of MeetingWorks is its modest requirements for computer hardware. Low-end Windows PCs work fine for participants, with a more powerful Pentium system to act as a network server and chauffeur station. MeetingWorks is designed to work very well with wireless LANS. The software is also compatible with virtually all network operating systems, giving users great latitude in the choice of their preferred NOS. If a group process would benefit by moving back and forth between face-to-face and distributed meetings, it is simple to implement since all the MeetingWorks tools are compatible, and the results of any step can be moved to any other tool module. It is also possible to use other Windows software with MeetingWorks, and to move meeting data into other programs for further processing. Meeting output can saved in multiple formats such as HTML, JPEG, MS Excel, MS Project. Allowing participants to enter qualitative explanations of their quantitative evaluations improves the group's understanding of the evaluation process. A major design emphasis of MeetingWorks continues to be the provision of a simple and intuitive user interface for participants. The software can be evaluated for free by downloading a version limited to 8 participants from the web site.



Sample of Clients

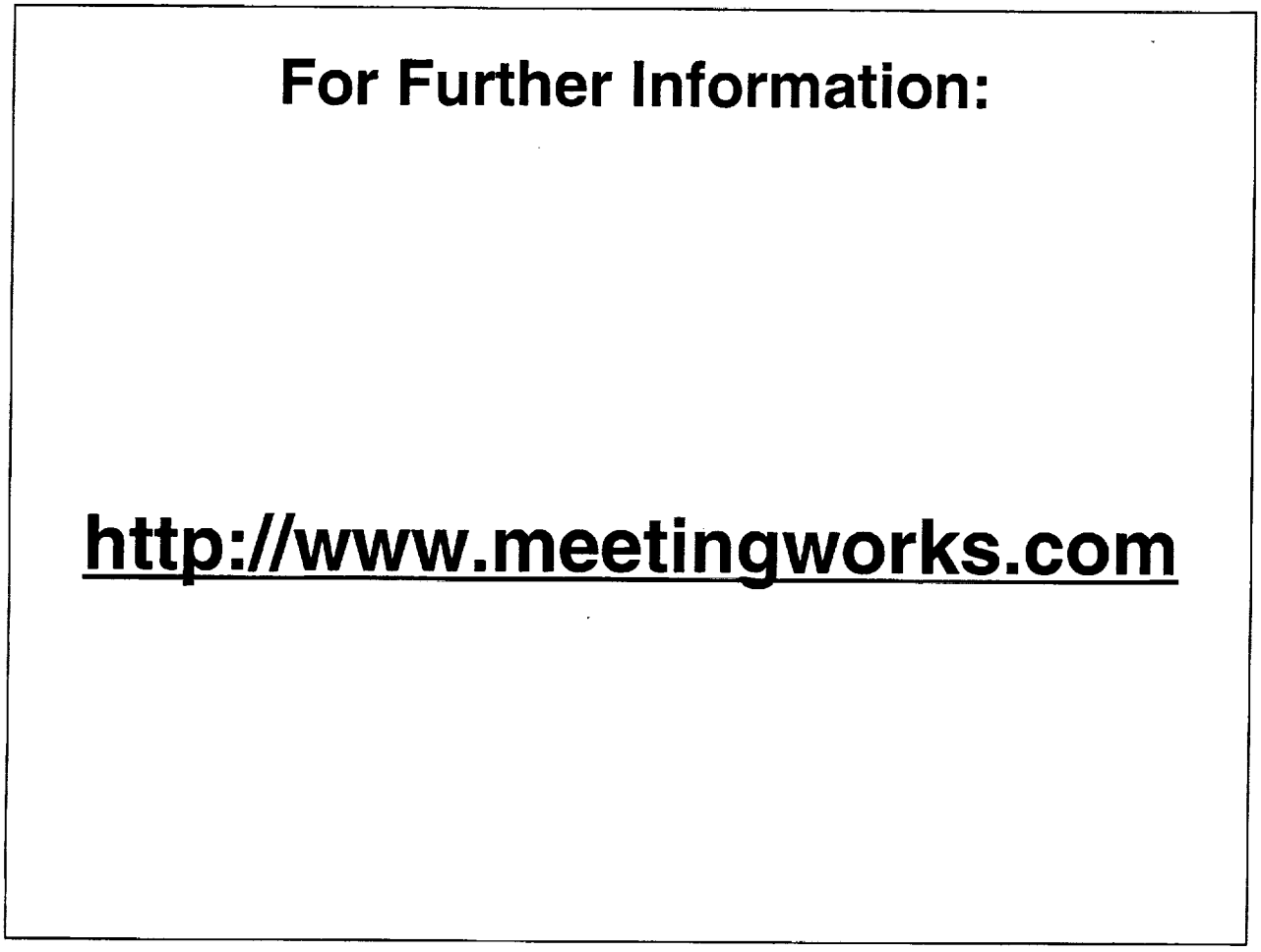
MeetingWorks is a mature product that has been in continuous development and use for over fifteen years. It has been used by real clients in thousands of meetings to solve real problems and make real decisions. A partial list of *MeetingWorks* clients illustrates the range of companies that have found it useful.



For Further Information

Further information about MeetingWorks, including a free downloadable evaluation version, can be found at the following web site:

www.meetingworks.com



Collaboration Technologies: New Directions and Issues

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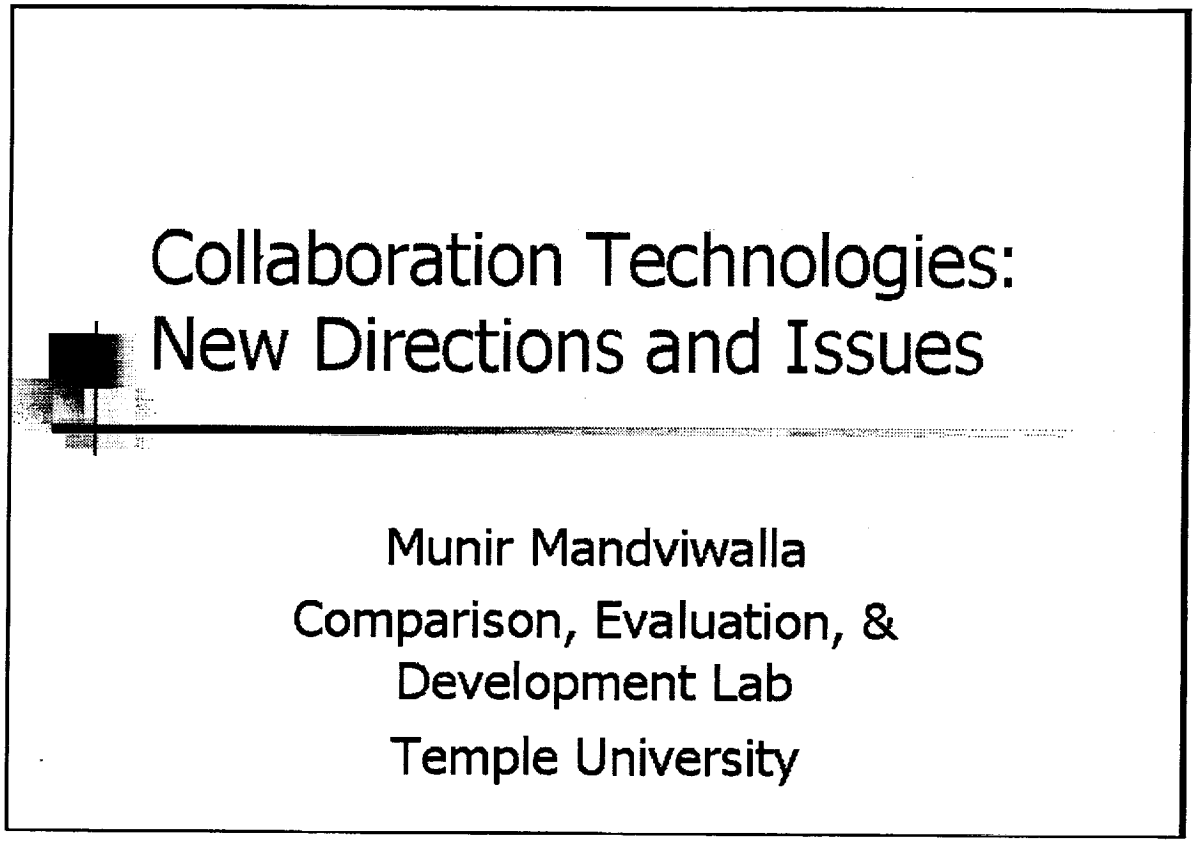
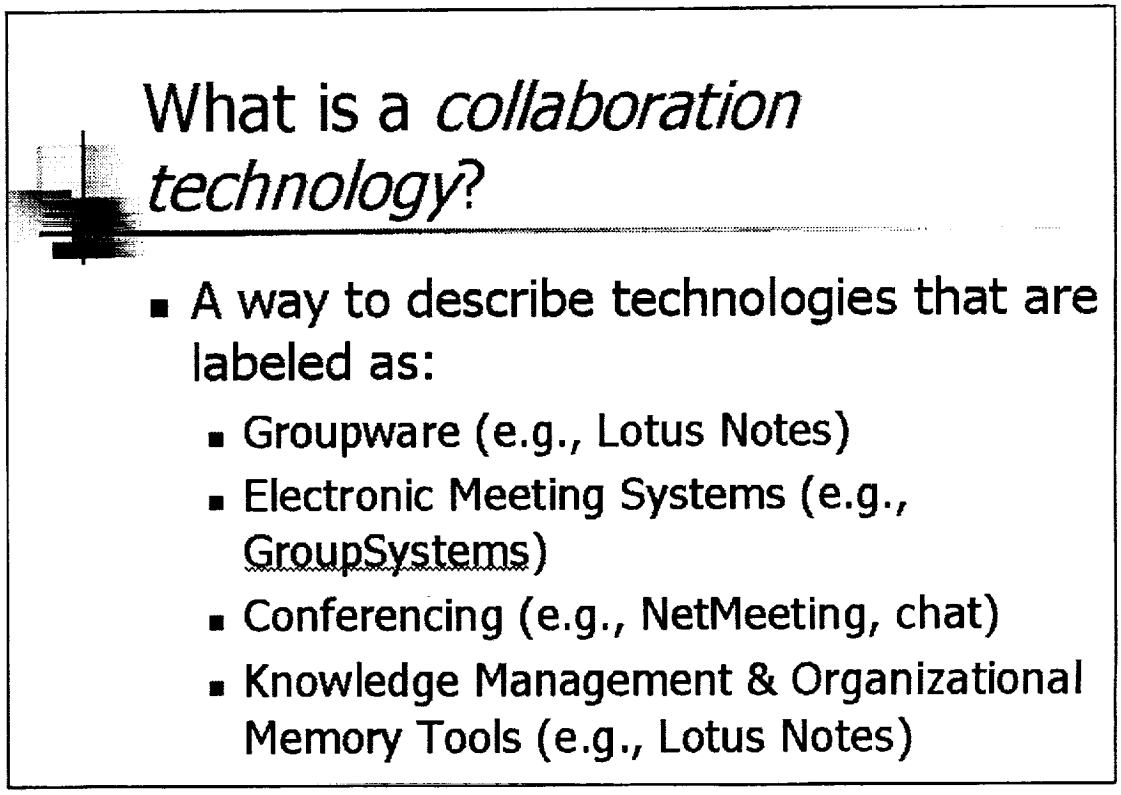


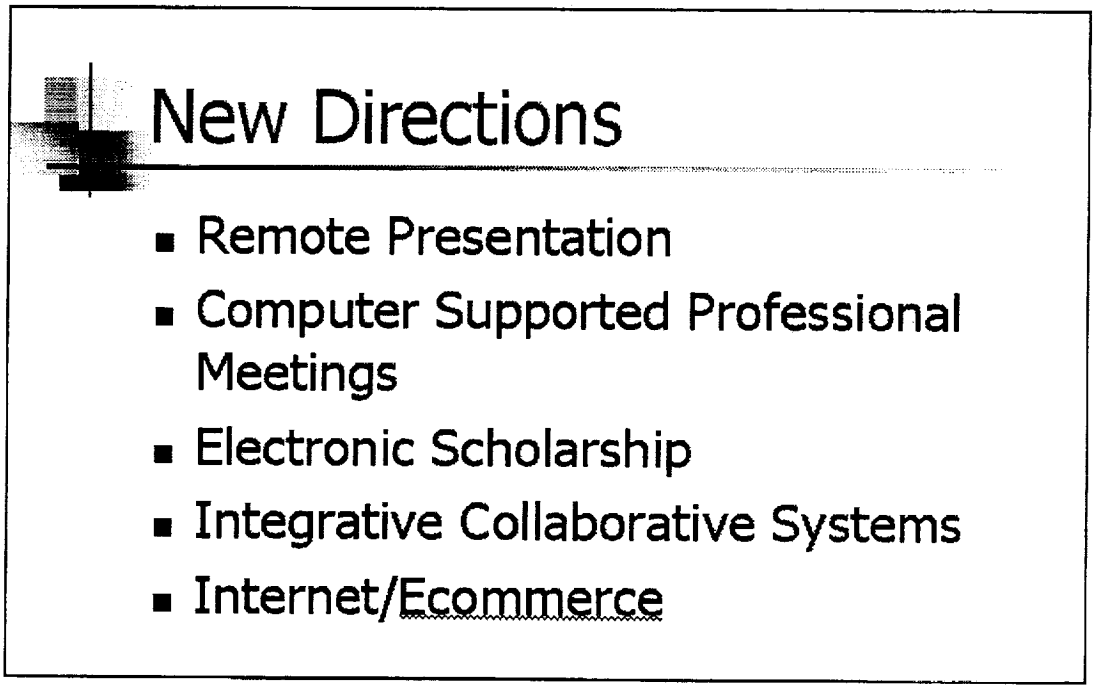
What is a Collaboration Technology?

A collaboration technology is a way to describe technologies that are labeled as Groupware (e.g., Lotus Notes), Electronic Meeting Systems (e.g., GroupSystems), Conferencing (e.g., NetMeeting, chat), Knowledge Management and Organizational Memory Tools (e.g., Lotus Notes). There has been quite a bit of research in this area in various disciplines, and as a result, each discipline has a slightly different term and perspective on the technology.



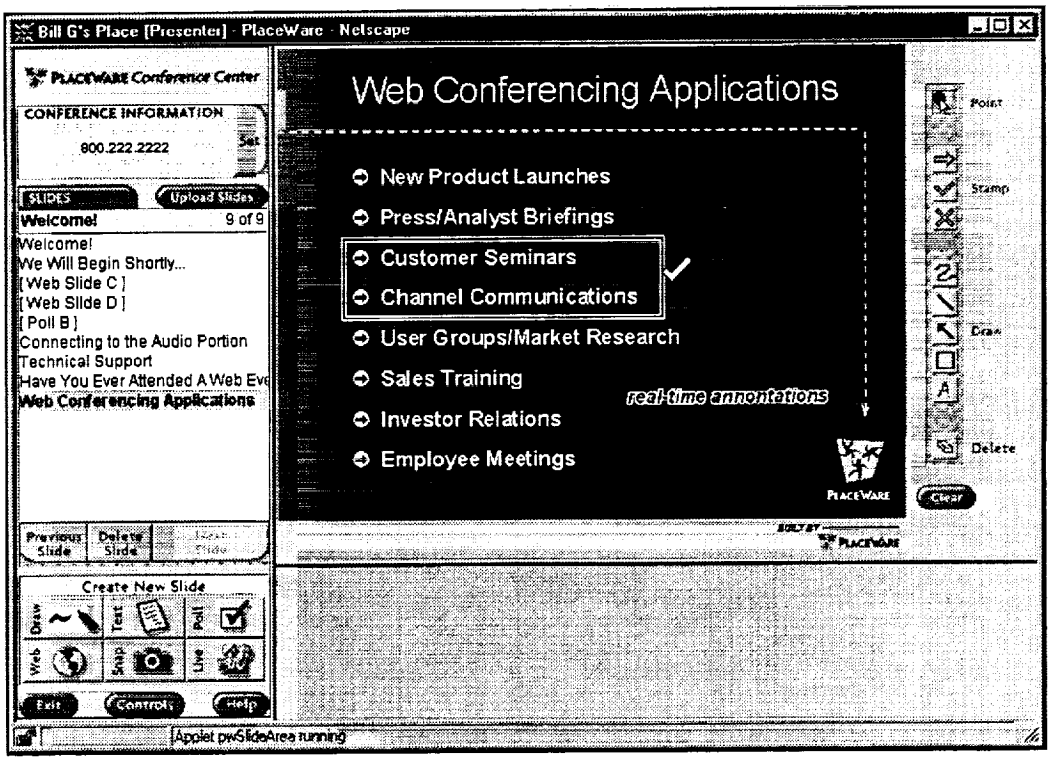
New Directions

It is time to consider new directions for collaboration technology. These new directions are needed because new technology is becoming available, thus providing new opportunities. The needs of users are changing and they are demanding fresh or revisited applications of the concept.



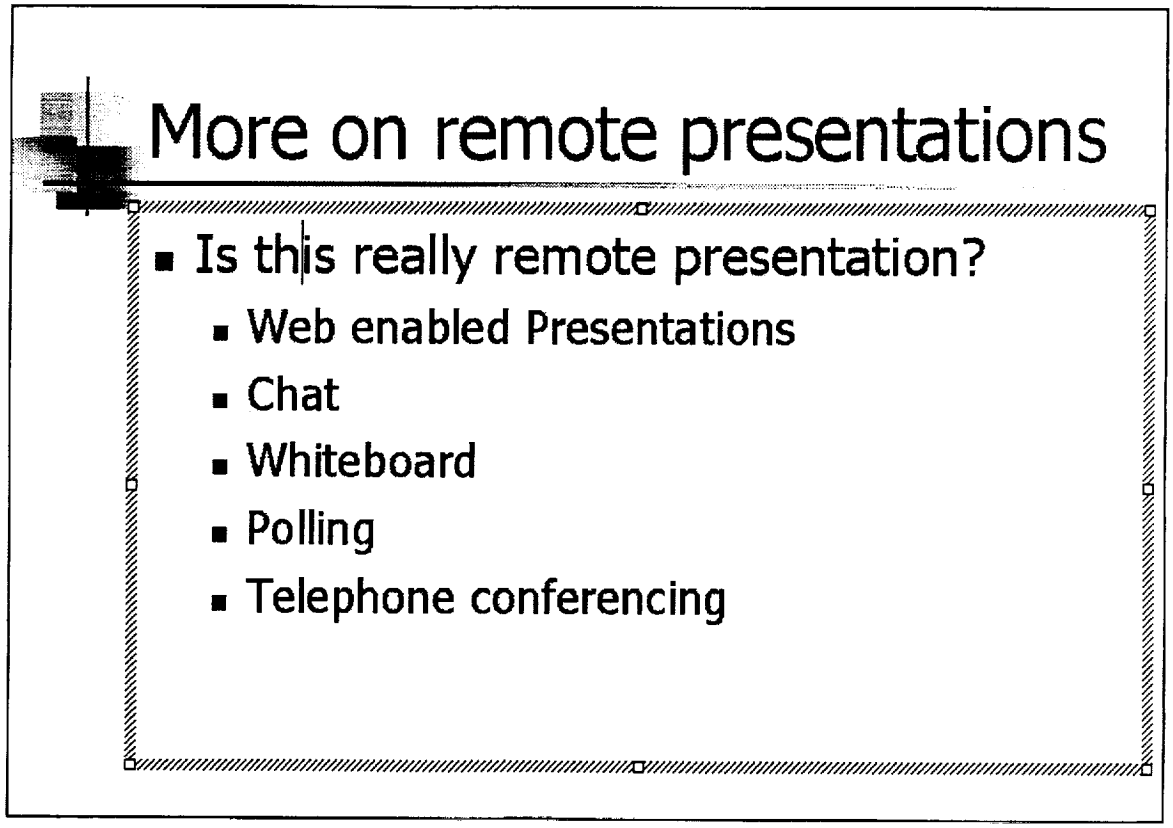
Remote Presentation

One example of a new direction and use of collaboration technology is remote presentation – where a presenter can show a slide to a large number of distributed users. The presenter can annotate the slide and draw on it along with using polling features. Users can interact with the presenter through chat based voice conferencing tools built into the remote presentation tool. The screen print below is from a product called Placeware.



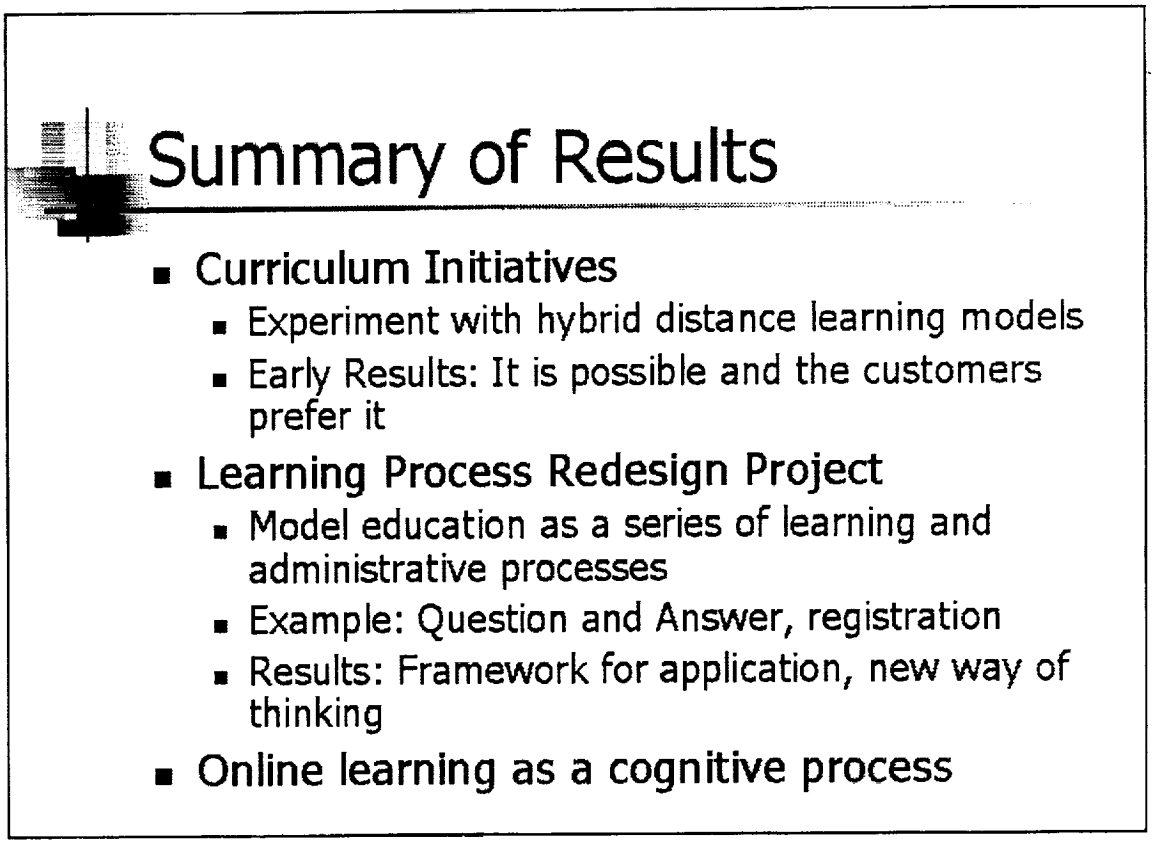
More on Remote Presentations

In one sense a remote presentation tool is a collaboration tool because it includes chat, whiteboard, polling, and telephone conferencing technologies. All of these technologies are fundamental to collaboration technology.



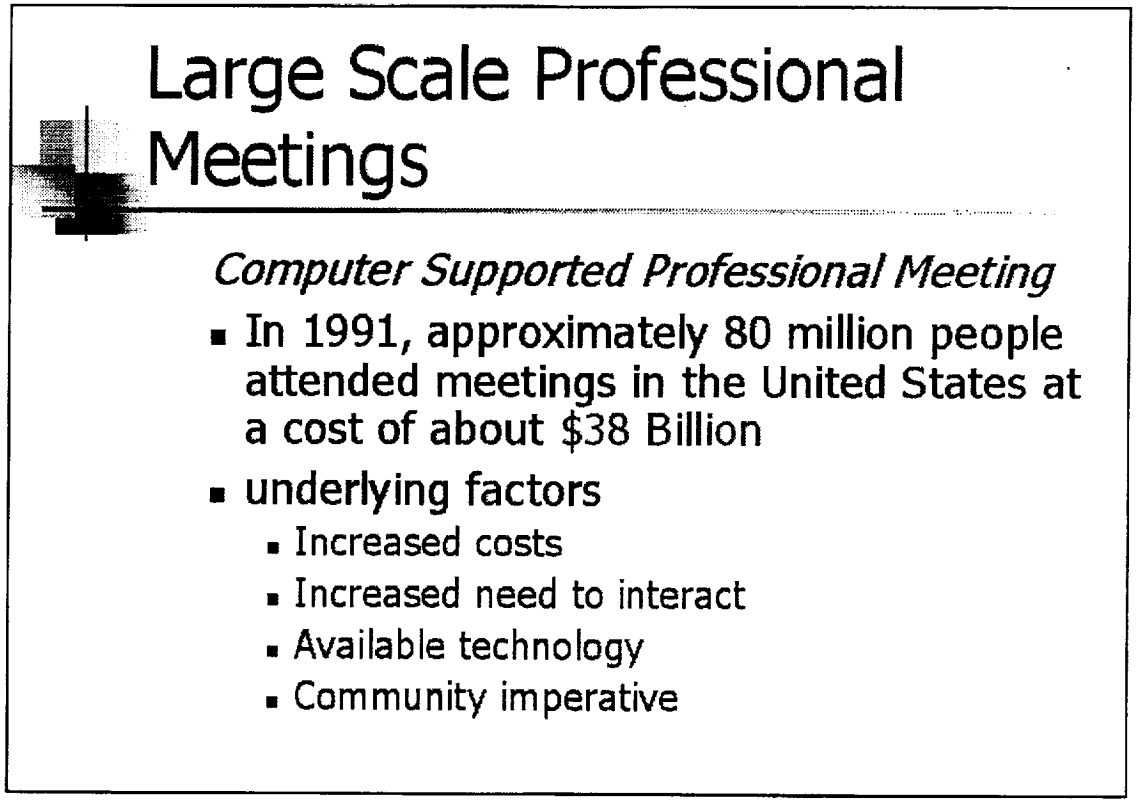
Summary of Results

We are applying and studying remote presentations at the CED Lab at Temple University. The projects include experimentation as a distance learning tool. Early results indicate that the students prefer this approach. Another project has to do with applying business process redesign concepts to education and matching learning processes with technologies such as remote presentation.



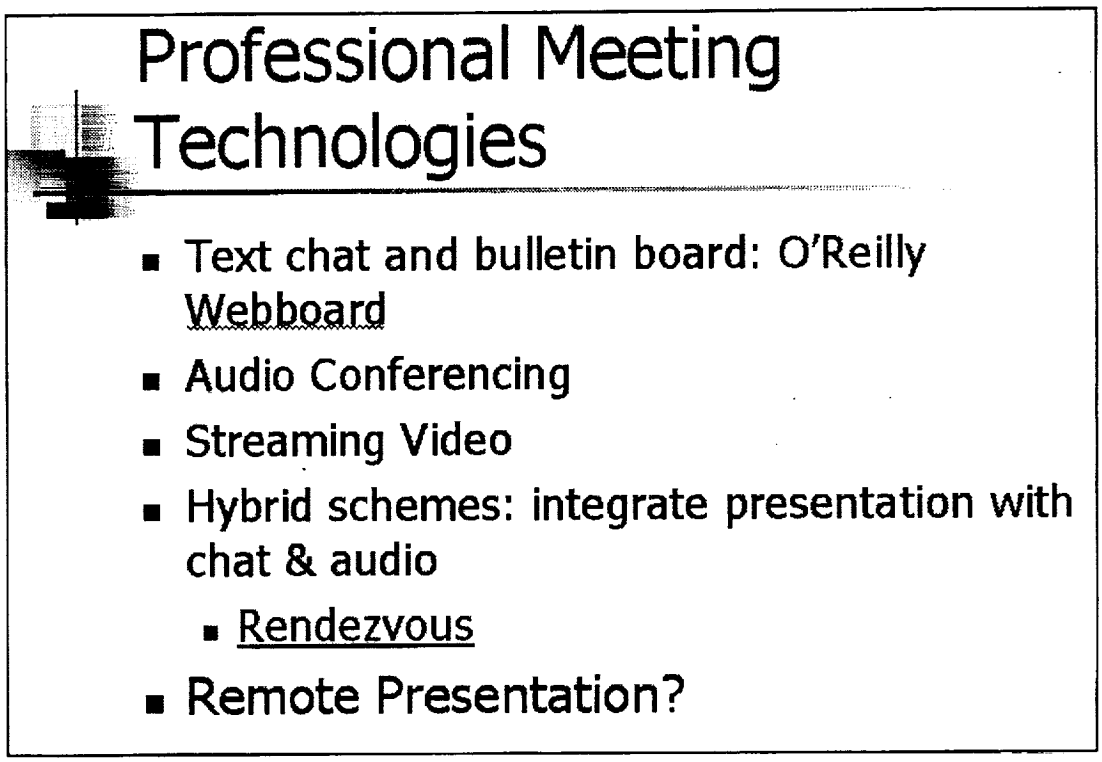
Large Scale Professional Meetings

Another interesting area of application for collaboration technology is in large scale professional meetings – conferences, workshops, and other professional gatherings. This is a large untapped area of application. There are some compelling underlying factors that suggest the importance of this area.



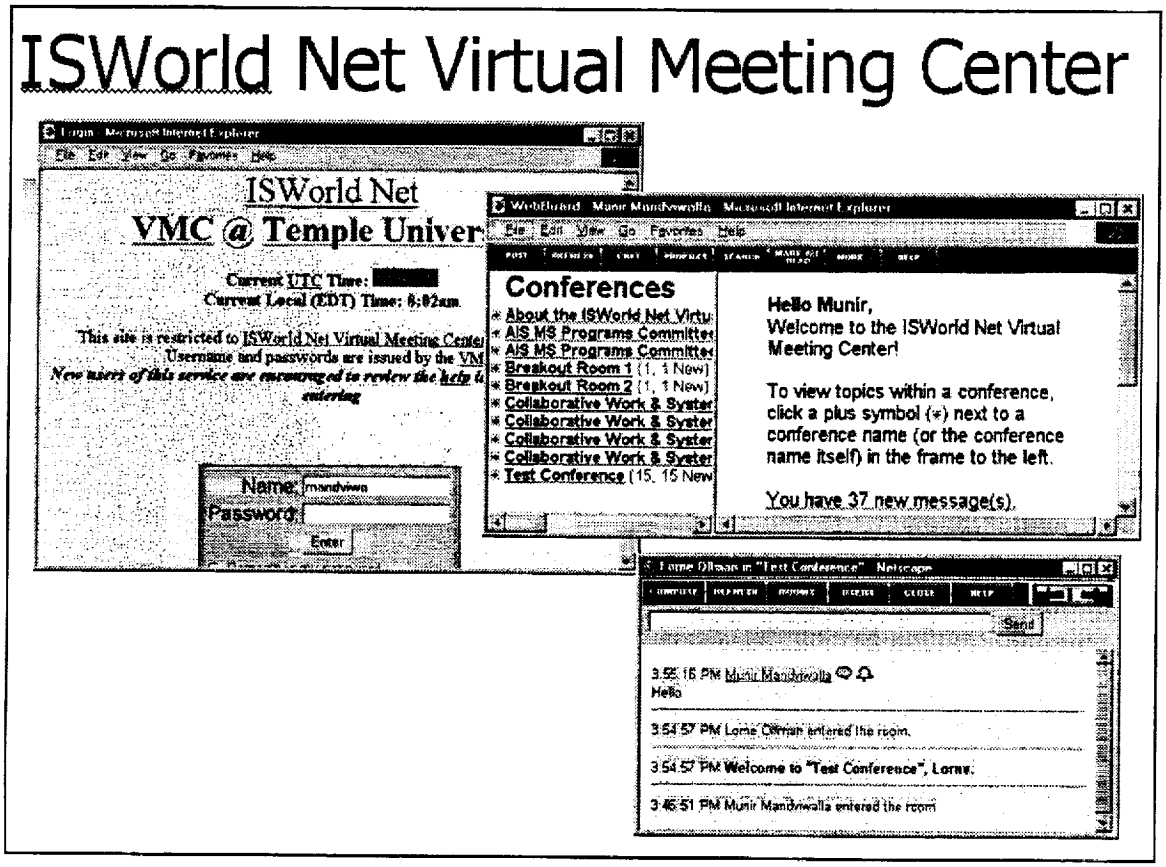
Professional Meeting Technologies

Examples of professional meeting technologies include applying existing tools such as text based chat or bulletin boards, and new audio conferencing tools mixed with streaming video. The most interesting are hybrid schemes, some of which overlap into the area of remote presentation.



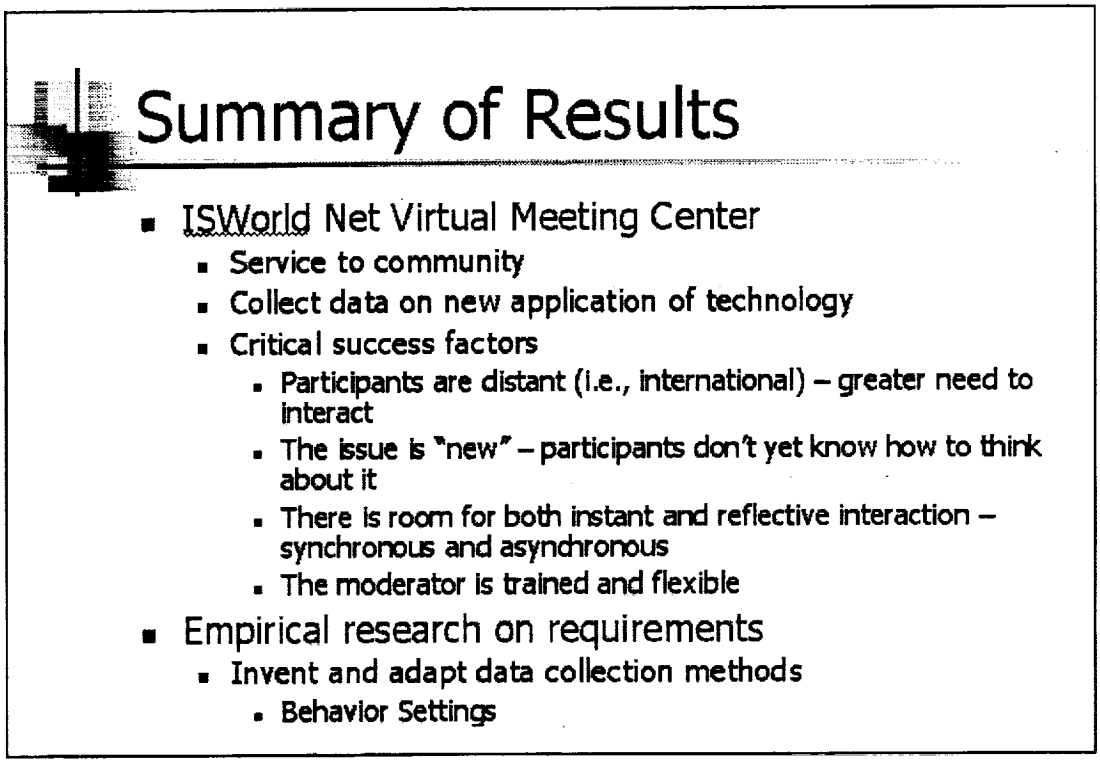
ISWorld Net Virtual Meeting Center

The screen shots below show an experiment for the ISWorld virtual meeting center (VMC) (http://www.isworld.org/vmc). The VMC hosts short conferences and workshops for professionals in Information Systems. Starting from the top left, the first screen shows the login screen, followed by the list of individual conferences available and then, finally, the contents of one particular conference that is currently in progress. What is interesting about this project is that it is a new application of a widely used technology.



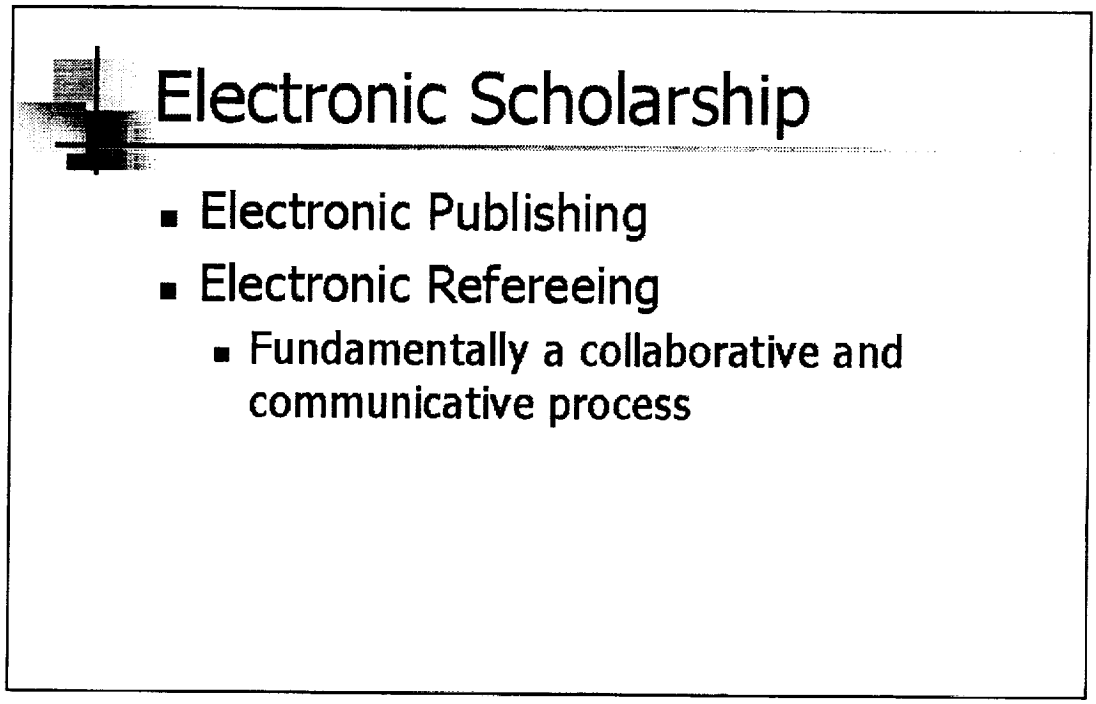
Summary of Results

The screen below shows our results with this technology. The key result is that the application seems to be most useful for people who are very far away from each other, such as on different continents.



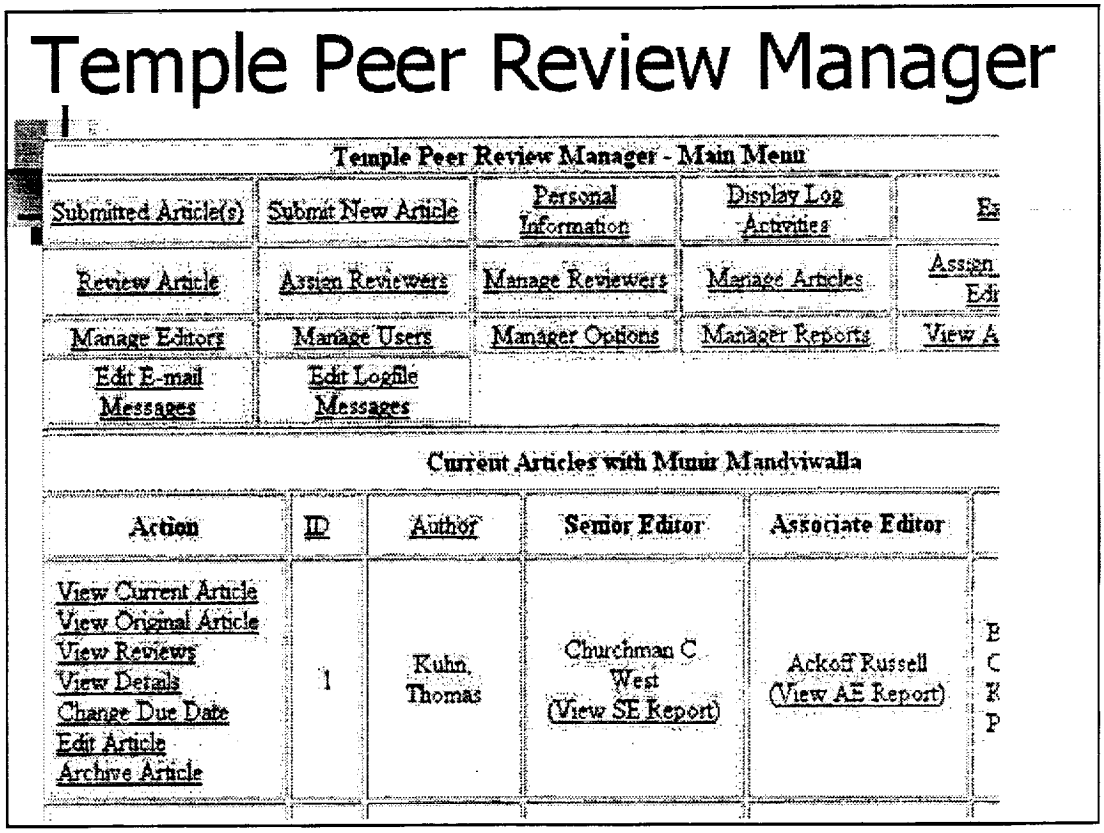
Electronic Scholarship

Another new application of collaboration technology is in electronic scholarship; specifically, the area of electronic publishing and refereeing. This presentation will concentrate on the peer review process which is viewed as a basic collaborative and communicative process.



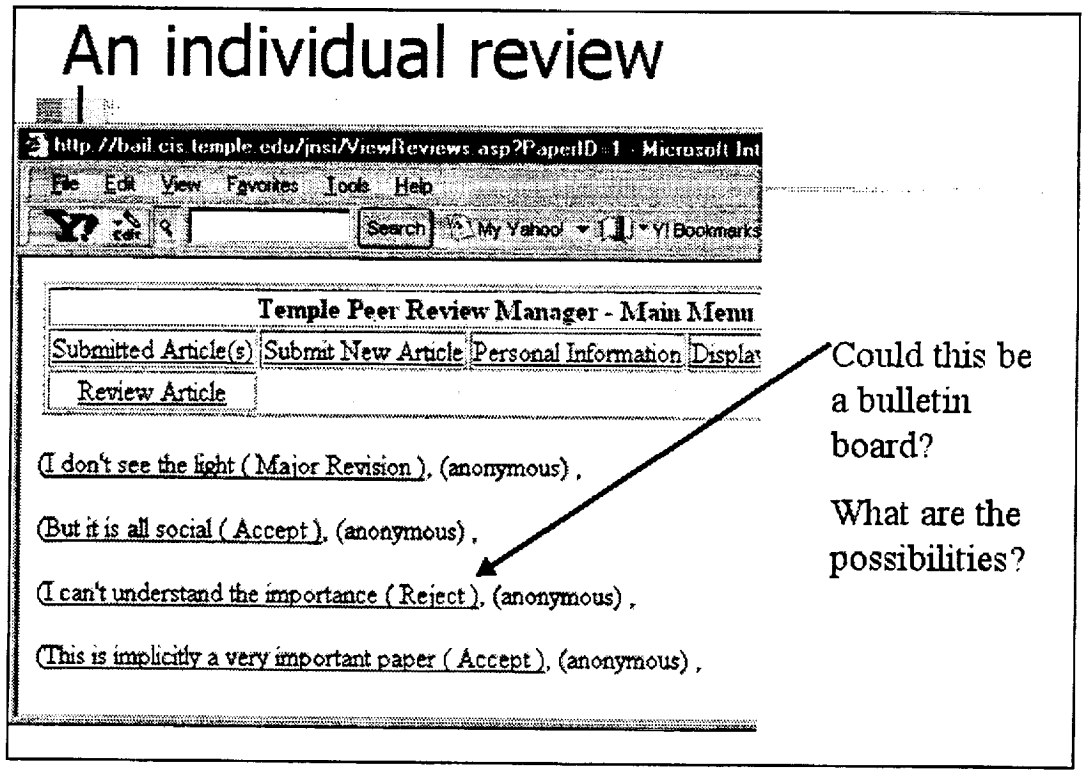
Temple Peer Review Manager

The screen below shows the Temple Peer Review Manager (TPRM) (http://peerreview.temple.edu). TPRM is a web-based knowledge management software that automates and changes the process of managing and reviewing documents such as scholarly articles. TPRM is also useful for contract review, grant review, and any other activity that is centered on the submission and review of documents.



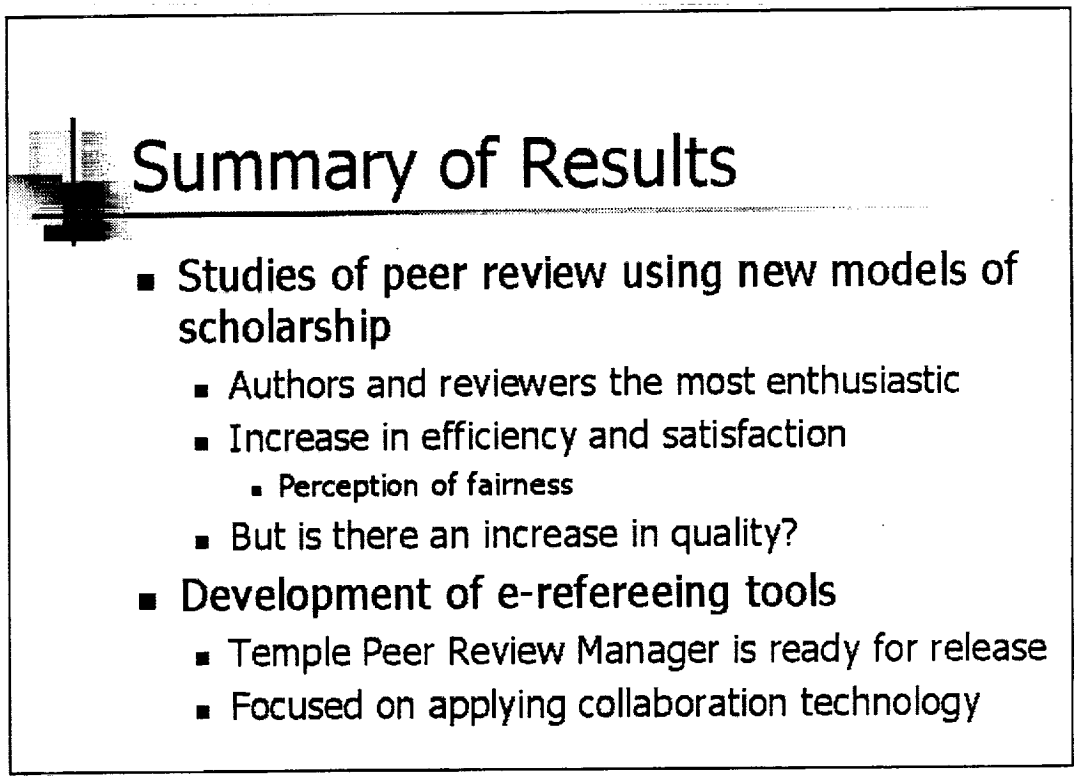
An Individual Review

The software enables an author to submit a document electronically to a publication such as a journal or conference. A managing editor appoints senior and associate editors who coordinate and track the reviewing process. Appointed reviewers download the article, submit comments to an electronic bulletin board, and respond to other reviewer's comments until the senior editor submits his/her report. The author can use the system to track the status of the article. The software can be customized to existing and new reviewing processes.



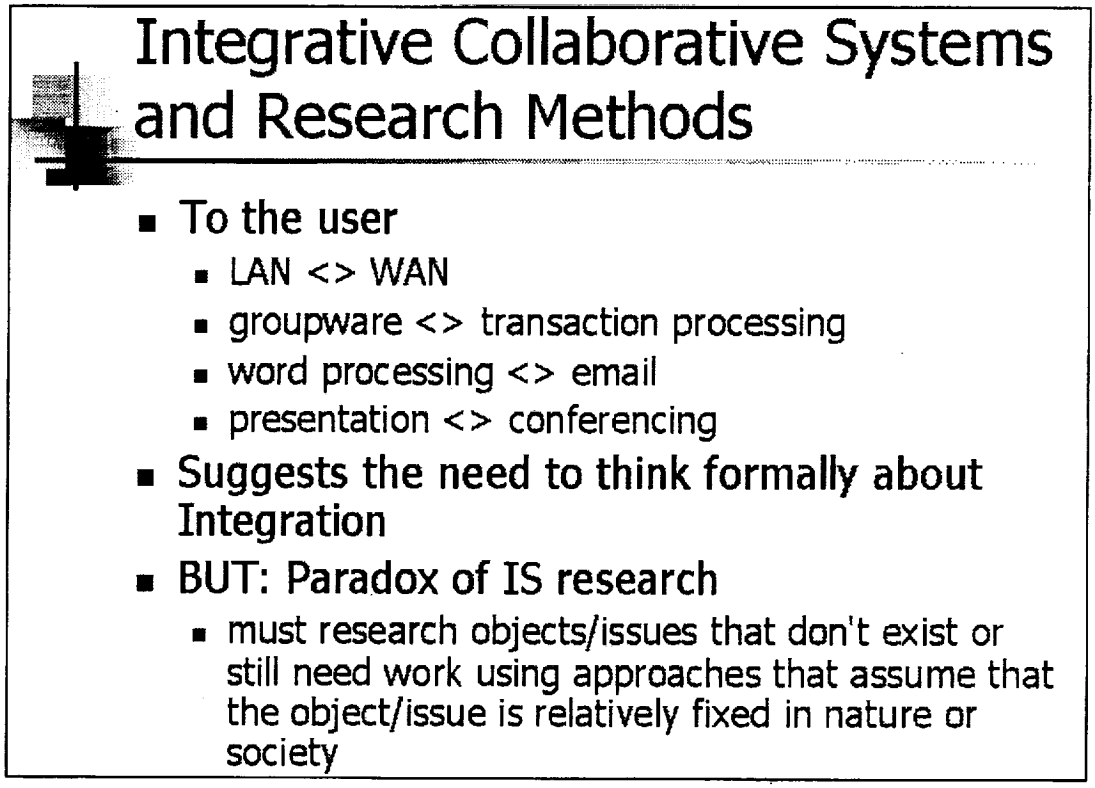
Summary of Results

The slide below summarizes our results from using and building TPRM.



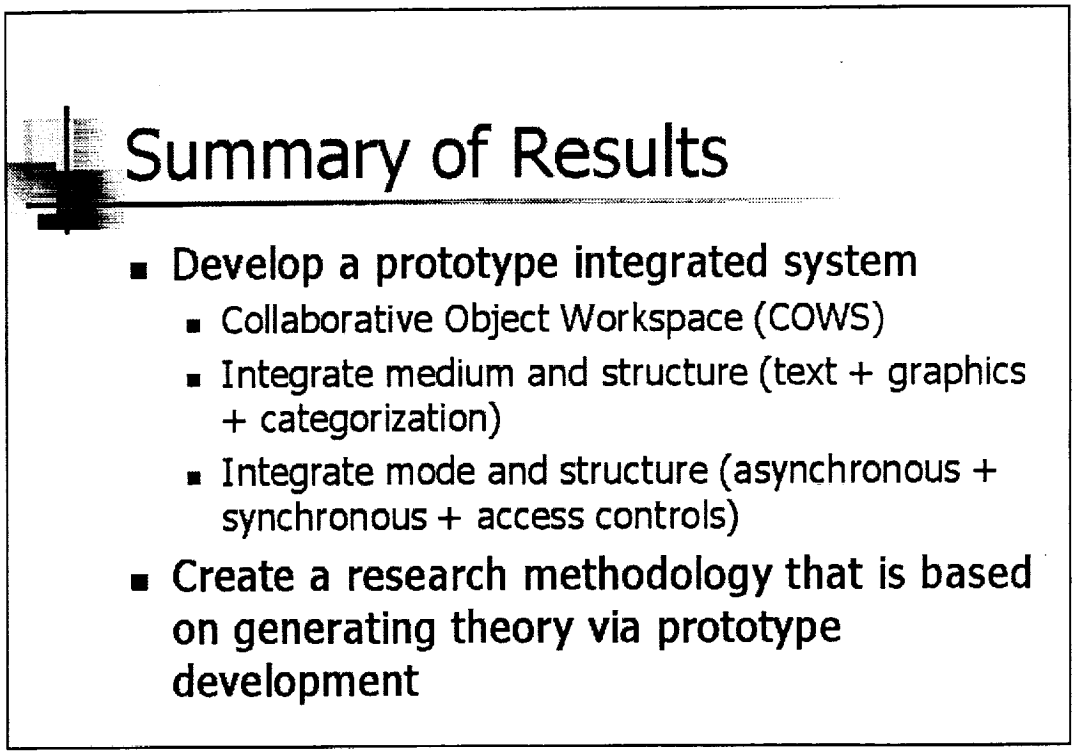
Integrative Collaborative Systems and Research Methods

Another new direction for collaborative systems is integrating existing features.



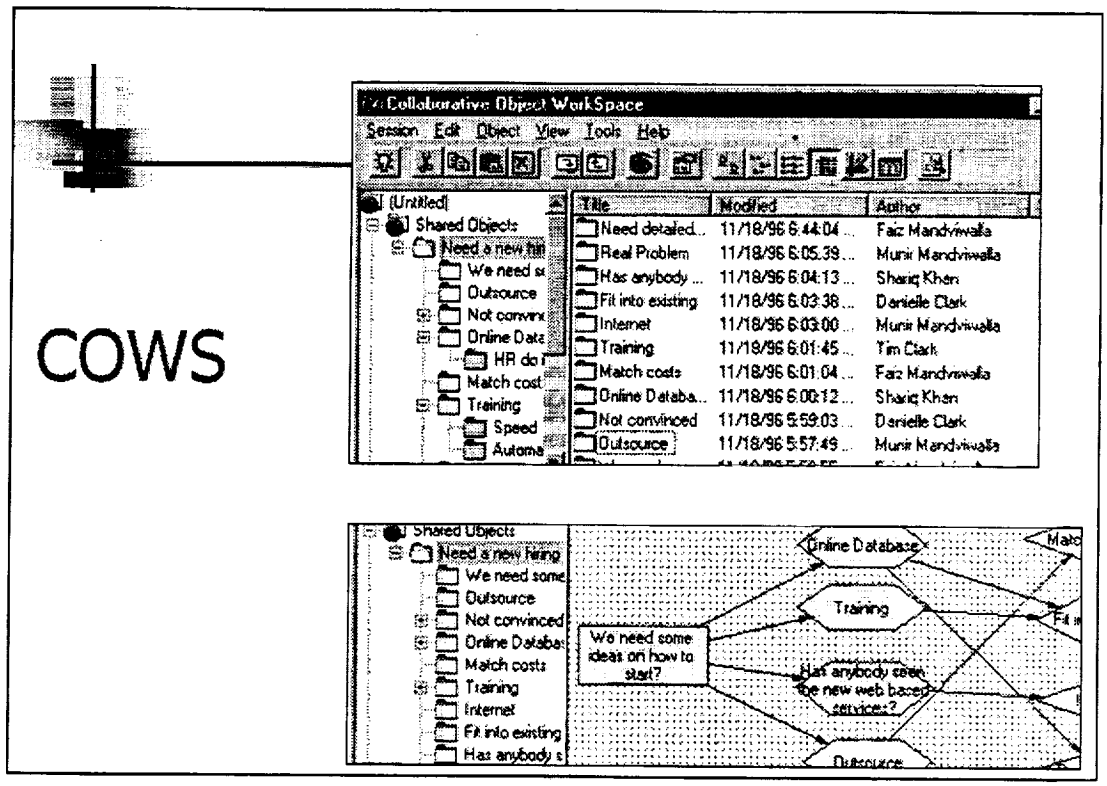
Summary of Results

At Temple we have been developing a prototype integrated collaborative system called Collaborative Object WorkSpaces (COWS) (http://ww2.cis.temple.edu/cows). The current COWS prototype integrates multiple mediums such as text and graphics, modes such as face to face and distributed, and structures from low to high, into a relatively simple user interface based on the Windows 95/NT 4.0 Explorer.



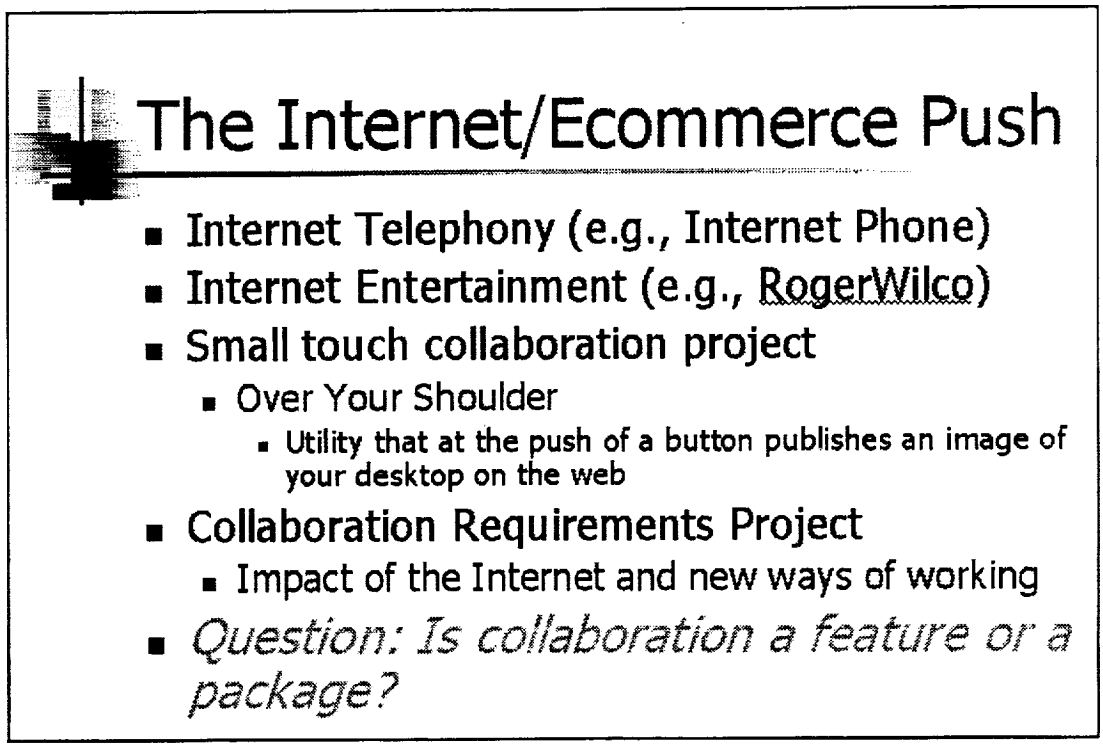
COWS

The screen below shows the two major views in COWS – text based lists and outlines AND graphical sketch oriented diagrams. Both views refer to the same data.



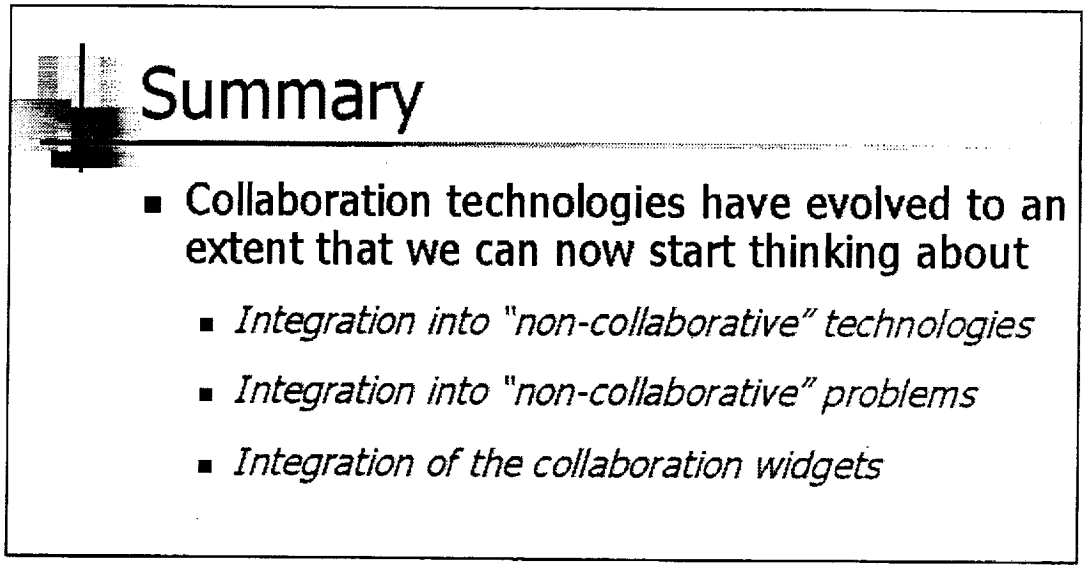
The Internet/Ecommerce Push

Another important area of new collaboration technology is the Internet. The slide lists some examples that are based on Internet use including a project by a Temple student.



Summary

Collaboration technologies are now evolving into new areas and applications. This presentation included a description of these areas along with examples of projects at Temple University's CED Lab that are exploring the ideas presented here.



Process and Outcome Effects of Group Support Systems: A Focus on Group Polarization

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Process and Outcome Effects of Group Support Systems

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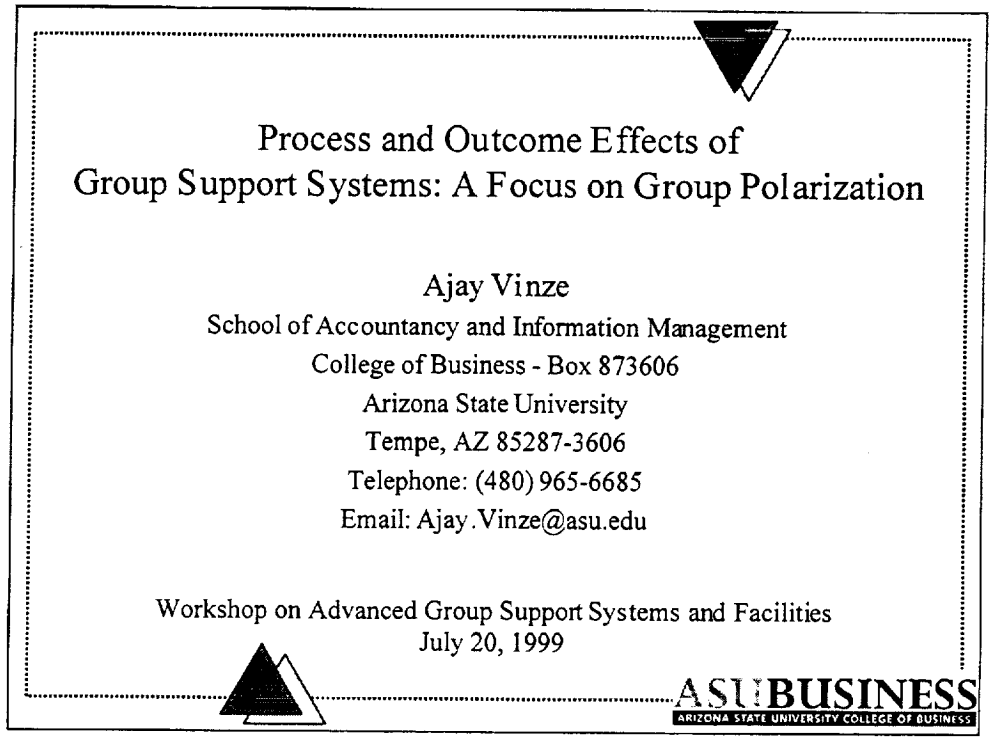
Over the years group support systems have been credited with enhancing the quality of group communication. The impact of these systems on both the outcomes from group discussion and its effect on the process of communication deserves close scrutiny. This research effort studies the characteristics of group decision making from an outcome as well as a process-based perspective.

Implications of changes to decisions without changing the underlying facts has relevance to most organizations. Group polarization is an outcome that has been studied extensively in the social psychology literature. The phenomenon has, however, received only limited attention for technology mediated settings.

In this presentation, insights from my previous research, as relevant to the polarization context, are provided. The focus of my prior research has been on decision making in general.

Theoretical foundations are provided from both the social and psychology literature. A good reference in this context is a meta-analysis conducted by Isenberg (1986).

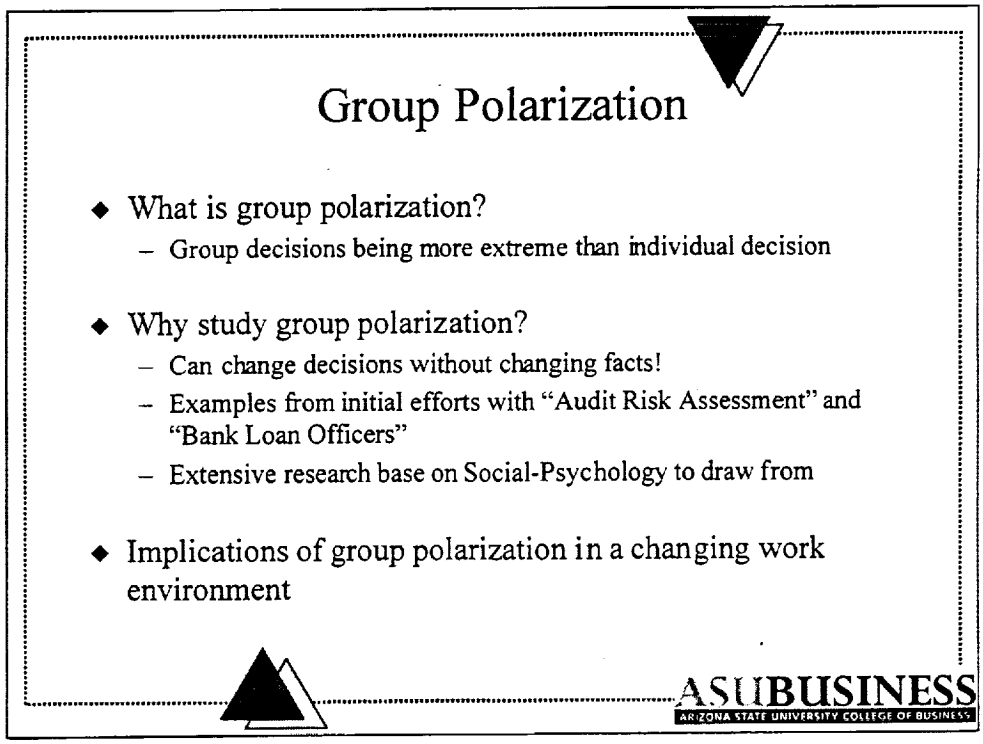
The results presented here focus on both the outcome and the process that describes such an outcome.



The Notion of Group Polarization

Group polarization is the tendency of individuals in a group setting to engage in more extreme decisions than their original private individual decisions (Myers and Lamm, 1976). The group polarization phenomenon was discovered by Stoner in 1961 when he observed that group decisions are riskier than private decisions of individuals comprising the group. He labeled his observation as, "risky shift." Subsequent researchers, however, observed that changes in group decisions occur in the direction of risk *as well as* in the cautious direction and, as such, this phenomenon has been re-labeled, "group polarization" (Myers and Lamm, 1976).

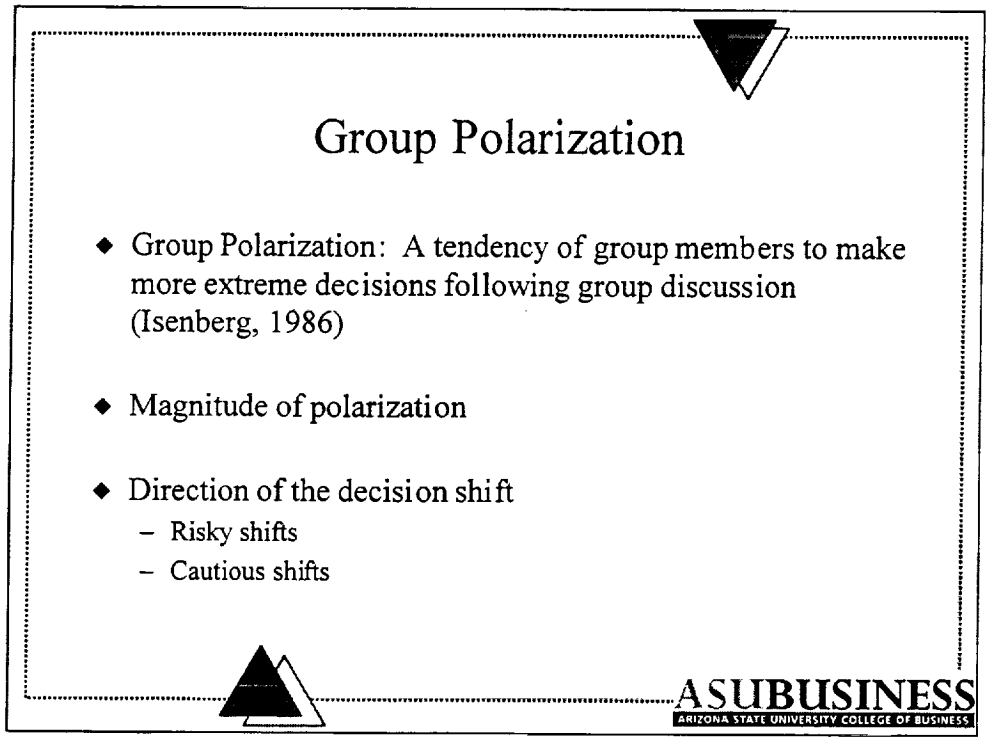
The implication of group polarization is that group dynamics have the potential of changing the group's final decision without necessarily changing any of the underlying facts that lead to the decision. Group polarization can be viewed as having many potential benefits as well as detrimental effects. A number of historic fiascoes have been attributed to group polarization including: decisions made by President Nixon's inner circle regarding the handling of the Watergate cover-up (Green and Conolley, 1974), and the Challenger space shuttle disaster. On the positive side, group polarization is beneficial in group counseling situations such as quitting smoking, diet programs, alcoholics anonymous, and for charitable giving situations where there is a need for group consensus in an extreme position.



Approaches to Group Polarization

The purpose of this study is to examine group polarization in a contemporary context. As critical decisions in organizations are made in task-focused teams rather than by isolated individuals, the phenomenon of group polarization takes on additional importance. This situation is further complicated with the acceptance of group technologies and their potential for altering the group interaction. This research synthesizes and draws upon frameworks from both the group polarization and GSS literature.

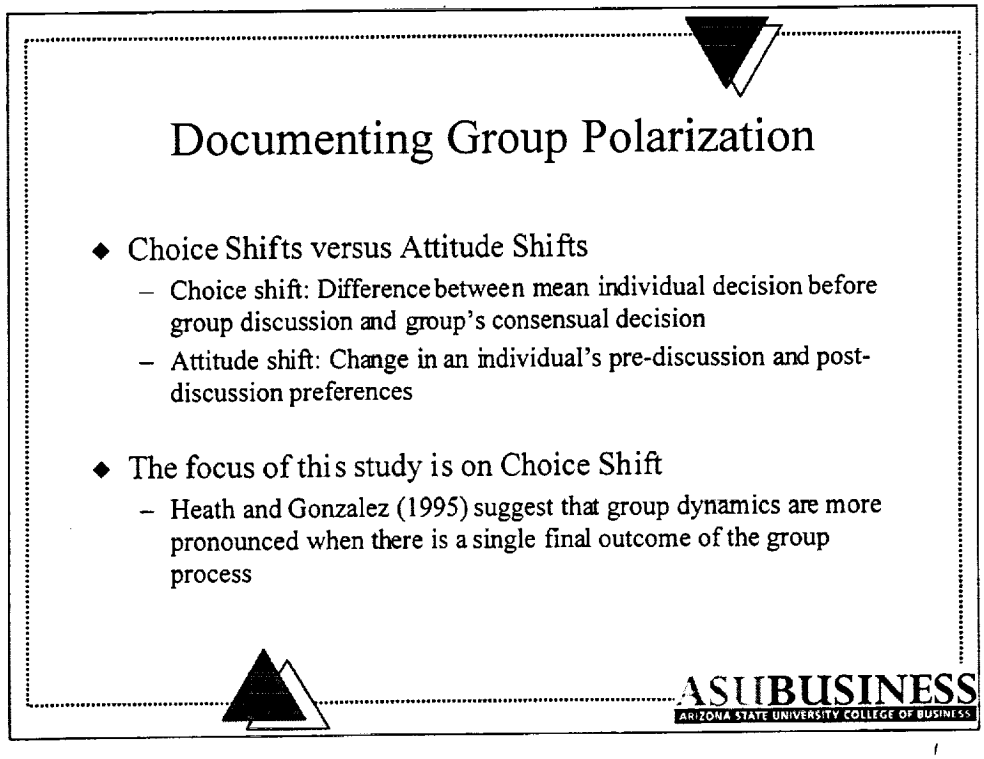
Three variables appear to be critical determinants of group process and outcomes: the communication medium used, the characteristics of the task being addressed, and the characteristics of the group (Lim and Benbasat, 1993; Dennis, et al., 1988; Burnstein, 1969). Examining this phenomenon from an outcome perspective, we report on the effects of communication medium (GSS or Face-to-Face), task characteristics (Intellective or Judgmental) and group composition (Assertive-Directing or Flexible-Cohering) and their interactions on the level and direction of group polarization. To gain insight into the nuances of the actual group process, we examine and further analyze the group discussion that ensues, for persuasiveness of content in each of the dimensions of interest.



Documenting Group Polarization

Over the past thirty years various researchers have studied group polarization by focusing on group discussion and its effect on inducing group polarization both at the level of individual opinions - *attitude shifts* (Hinsz and Davis, 1984), and for group decisions - *choice shifts* (Zuber, et al., 1992).

An example of a choice shift is evidenced when strategic plans are crafted for organizations using expertise from various functional areas; production and sales may have contradictory goals and yet must agree on a common plan that will meet both their requirements (Ackoff, 1967). On the other hand, interest in attitude shift occurs when studying situations where individuals consult with others and yet make their own final decisions, like when buying a car, a house or other items where individuals collect information from others but choose to use or ignore the information collected. While the development of GSS is quite independent of the debate between choice and attitude shift, it is reasonable to suggest that a purpose of this technology is to provide communication and decision support to allow groups to share a vision, build consensus and make joint decisions (Nunamaker, et al., 1991). It can further be argued that GSS can be used to forge joint group decisions regardless of whether individual personal preferences agree with this joint decision. Given our interest in common group decisions in organizations, the more intense group dynamics associated with reaching a common group decision (Heath and Gonzalez, 1995), and the capability of GSS to provide groups with the means for reaching these joint decisions, in this presentation we specifically focus on choice shift as a measure of group polarization.

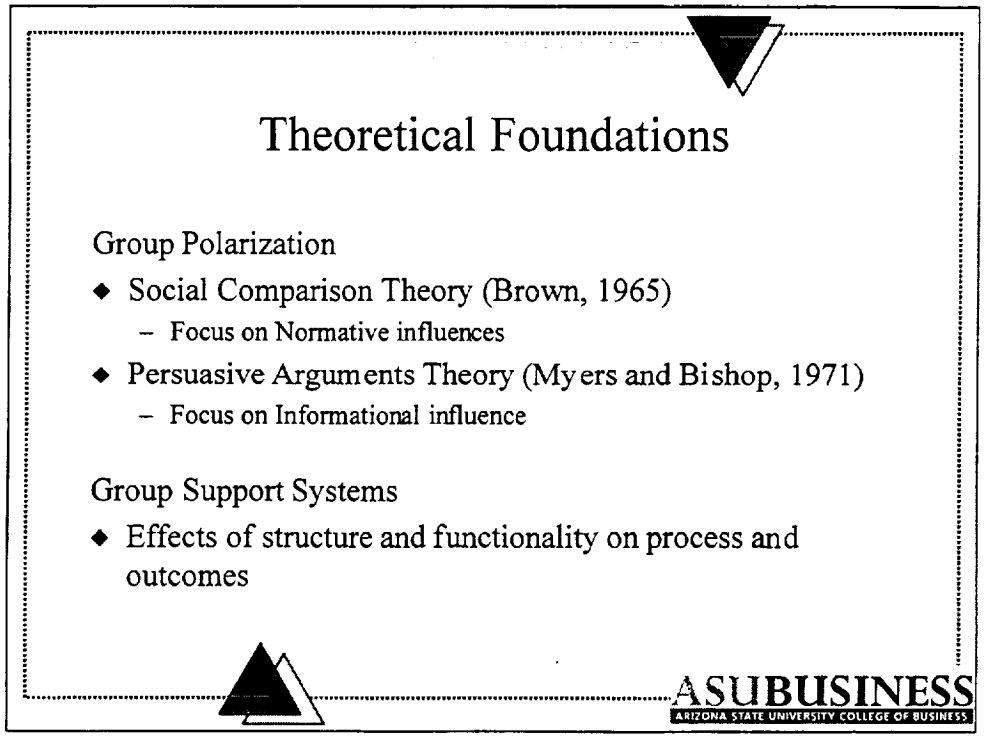


Theoretical Foundations for This Study

Several theories have been proposed as explanations for group polarization (see Lamm and Myers, 1978, and Pruitt, 1971 for extensive reviews). In a meta-analytic study of this phenomenon, Isenberg (1986) indicated that there are two viable explanations, the *Social Comparison theory* and the *theory of Persuasive Arguments*, that need further examination.

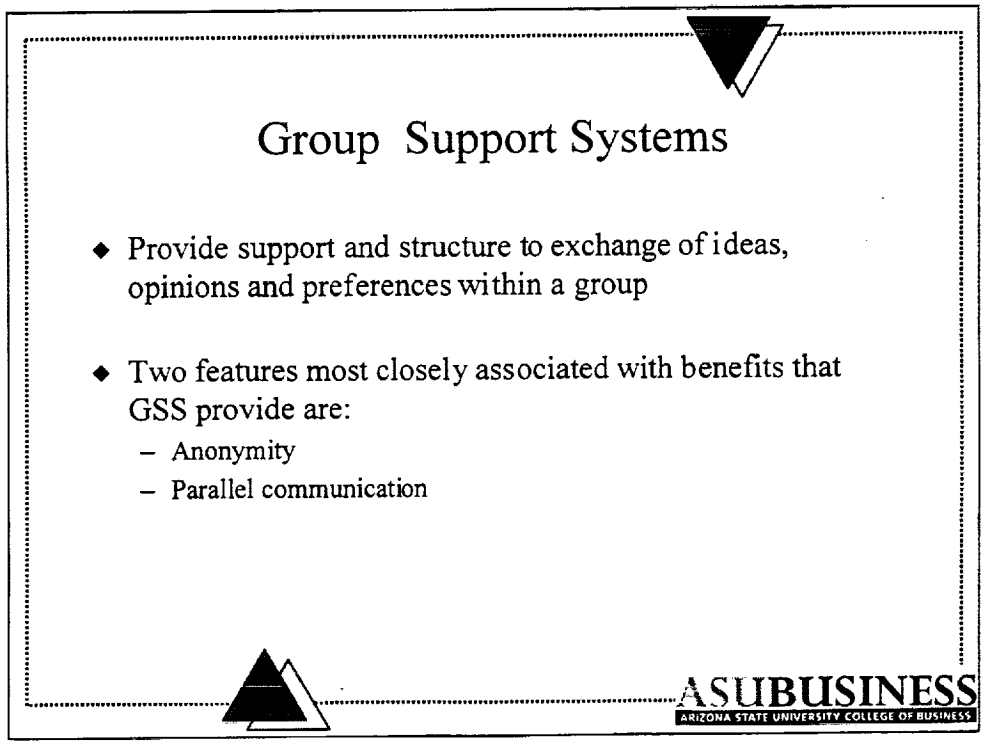
The theory of Social Comparison (Baron and Roper, 1976, and Brown, 1965) suggests that changes in group decisions result from normative influences that occur due to an individual's desire to conform to the expectations of the other members.

The theory of Persuasive Arguments (Burnstein, 1982, Vinokur and Burnstein, 1978), the more prominent of the two theories, focuses on information collection (Heath and Gonzalez, 1995). This theory suggests that shifts in group decisions result from sharing relevant and factual information about the situation at hand.



Key Features of GSS Related to the Group Polarization Phenomenon

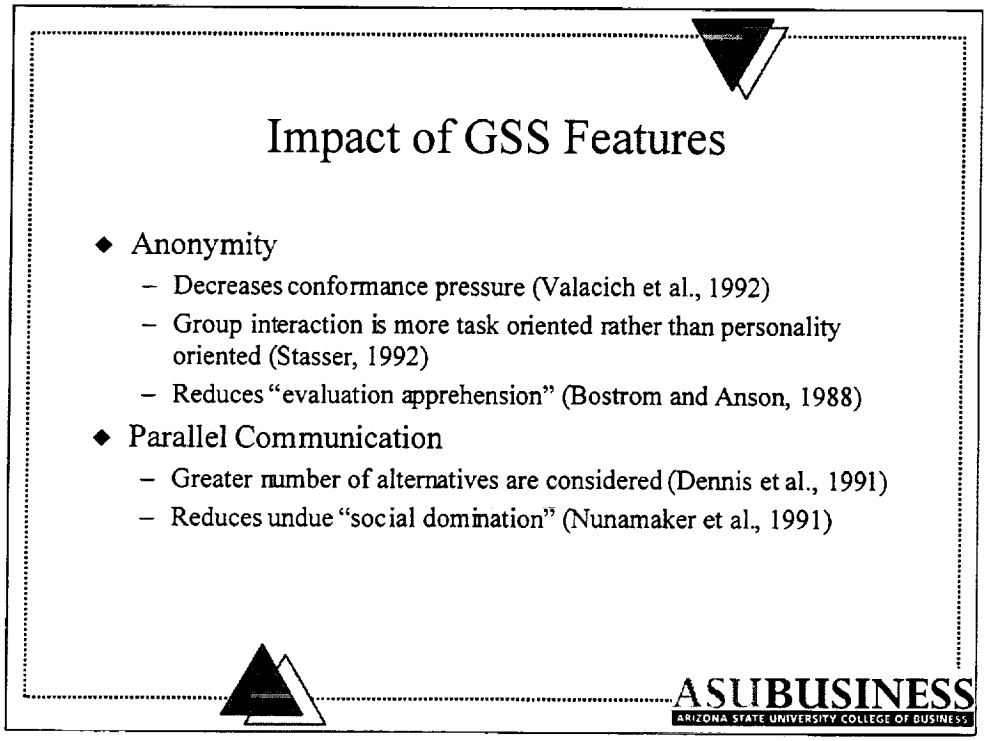
GSS research has reported differences in group decision outcomes when comparing GSS meetings with FTF meetings (Jessup, et al., 1990). A premise of such GSS research is that the difference in the outcomes when comparing GSS with FTF meetings results from the significant differences in the process of decision making provided by the GSS environment when compared with the FTF environment. Two features of GSS that can cause differences in group process and outcomes are anonymity and parallel communication.



Impacts of GSS

The introduction of anonymity in a group process can have contradictory effects. On the one hand, anonymity decreases conformance pressure (Valacich, et al., 1993, and Nunamaker et al., 1991) for the participants in a group setting, and allows participation based on content of communication rather than the source that generated the communication. On the other hand, anonymity has the potential to cause free riding whereby some members of a group rely on others to accomplish the group goals (Nunamaker, et al., 1991, and Diehl and Stroebe, 1987).

In addition to anonymity, GSS also provides parallel processing capabilities (Nunamaker, et al., 1991) which can also affect (both positively and negatively) the group discussion and the informational influence processes at work. The feature of parallel communication should prove to be a liberating experience for most group members. The ability to contribute without having to wait or take turns to present a point of view, and potentially lose a train of thought, typically increases the total number of arguments generated. GSS researchers have similarly suggested that individuals tend to not only create a greater number of total arguments but also are more creative and novel in their problem solving (Nunamaker, et al., 1991). Building on this foundation of work, we are interested in studying whether the functionality afforded by GSS affects the process and outcomes of group decision making when studying choice shifts.



The Research Model

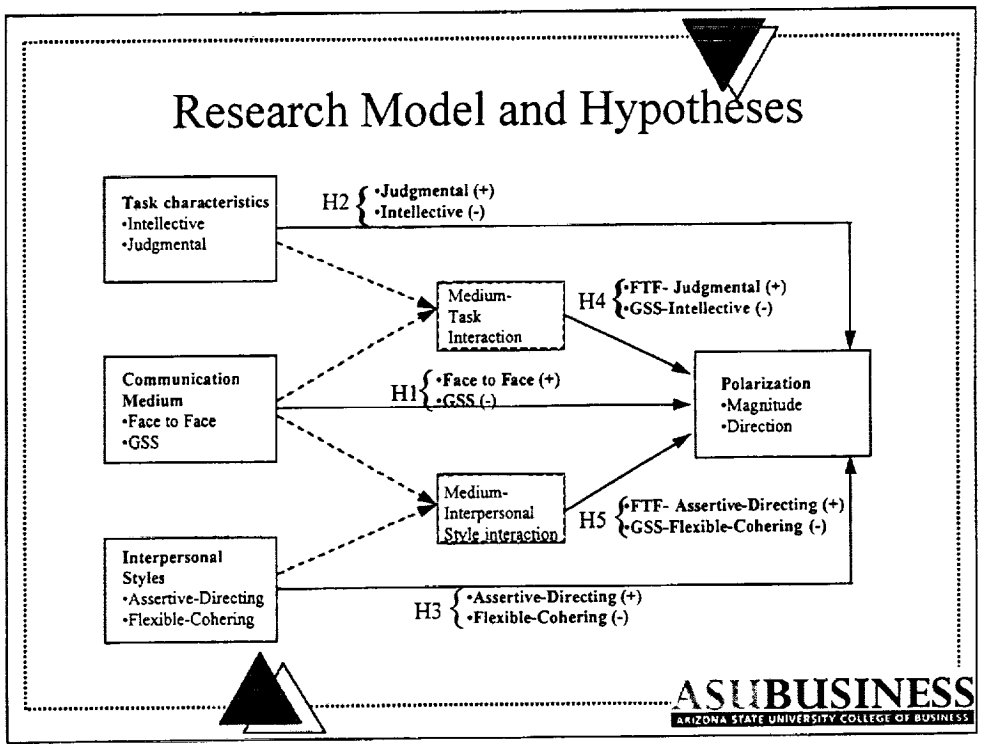
The research model blends together explanatory constructs from the group polarization literature with the contemporary context afforded by the GSS technology to explain group polarization. This model holds that task characteristics and group composition have a direct bearing on group decision processes and outcomes, as stated by both GSS and group polarization researchers. Furthermore, the model posits that GSS will have a direct effect on group polarization and more importantly, that the relationship of task characteristics or group composition with the decision process and outcome will be a function of the communication medium used. In this study we focus on the following questions:

1. Is group polarization only a function of task characteristics and group composition? Or does medium of communication play a role in the outcome and process? In particular,

   a. Do groups polarize in both FTF and GSS settings?

   b. Is persuasiveness of arguments preceding the group decision different when comparing FTF and GSS groups?

2. How does "communication medium" moderate the relationship of task characteristics or group composition with the degree of polarization and the level of persuasiveness of arguments?

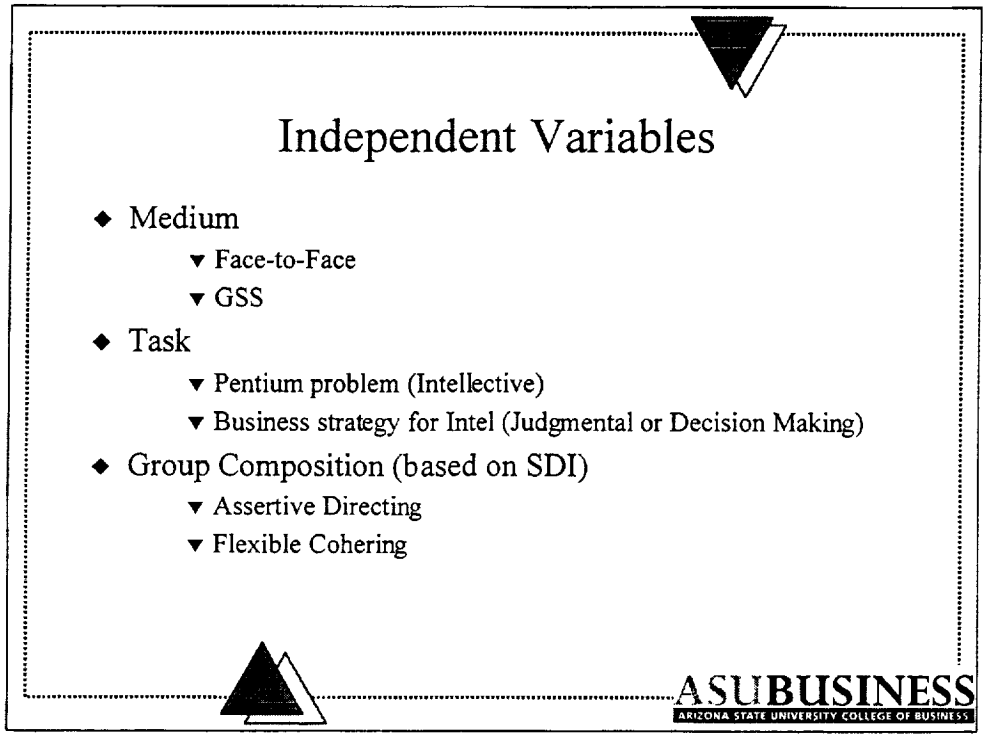


Independent Variables

For Medium in this study we compare face to face decision making with GSS mediated decision making. The role and importance of GSS was mentioned previously.

The importance of task characteristics on group processes and decision outcomes is well documented. Studies have shown that tasks can account for fifty percent of the variance in group performance (Poole et al., 1985). The relationship between task and group polarization was first eluded to by Laughlin (1980) when he proposed a group-task continuum. At one end are *Judgmental* tasks which entail achieving group consensus on tasks that involve "judgmental behavioral, ethical or esthetic judgments for which there are no demonstrably correct answers" (Kaplan and Miller, 1987, p. 307). At the other end are *Intellective* tasks that involve a demonstrably correct solution. For Intellective issues, the group's task is to uncover the correct answer.

The role of group composition has been emphasized in the GSS and group polarization literature. In explaining group polarization, Leadership-Confidence Theory, Pruitt, 1971 suggests that individuals demonstrating greater *assertiveness* in a group setting are more *persuasive* in group discussions and thereby cause other members of the group to shift toward their initial stance. In this study we are interested in how the presence or absence of assertive members in a group setting affects the process and outcomes of group decision making.

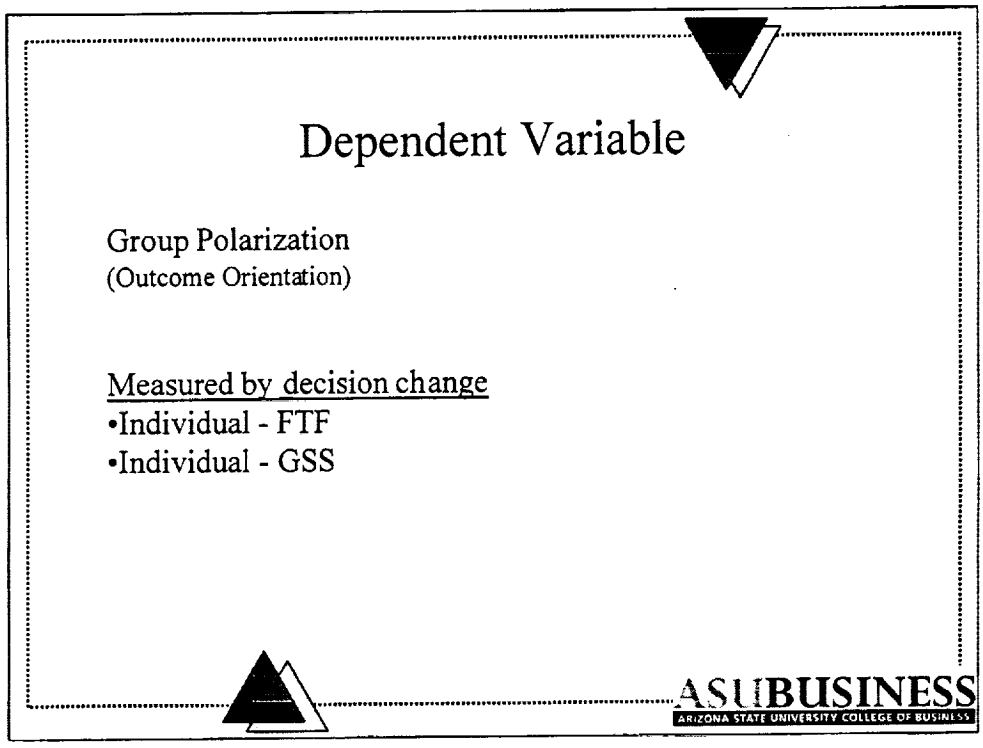


Measuring Polarization

The magnitude of polarization was measured by taking the difference between the consensus arrived at in a group decision and the average of initial individual decisions that participants reported prior to the start of the seminar - P= I - D.

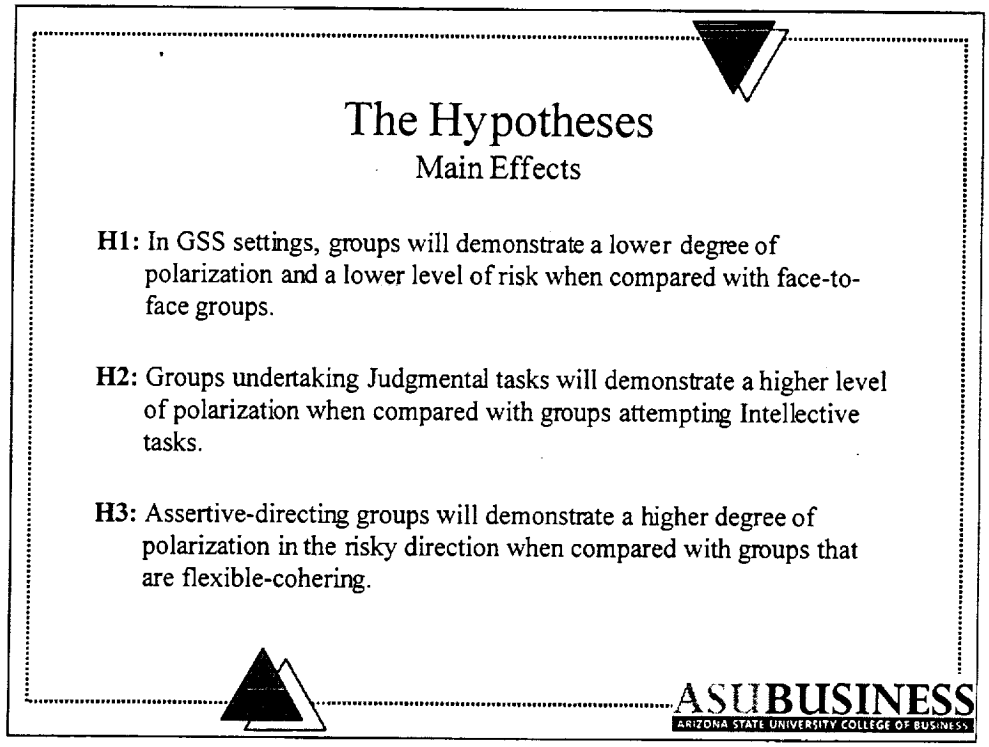
The difference indicates the magnitude of group polarization. Higher values indicate a larger degree of polarization, the sign indicates the direction of the shift. Negative values indicate risky shifts while positive values indicate shifts in the cautious direction.

Note: P= Polarization; I= Average of initial individual decisions in a group; D= Group Consensus



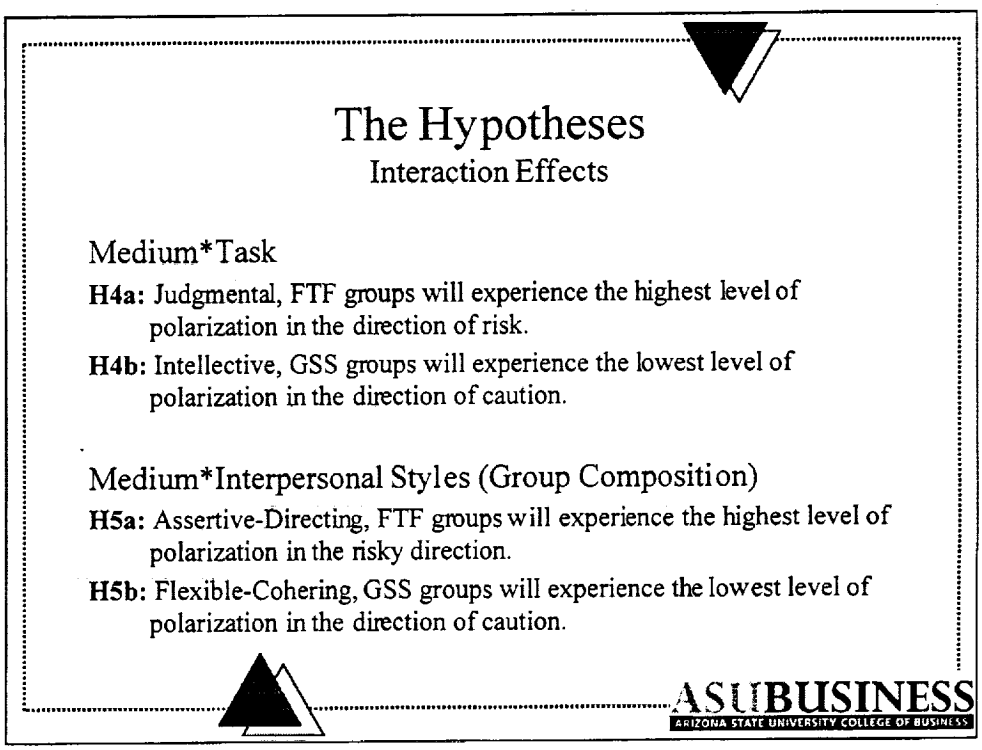
The Hypothesized Relationships

Hypothesis 1, 2 and 3 focus on the main effects that are studied. The focus is on Medium, Group Composition and Task characteristics and how they impact group polarization. The relationships are drawn based on the theoretical foundations and literature discussed earlier.



Hypotheses - Interaction Effects

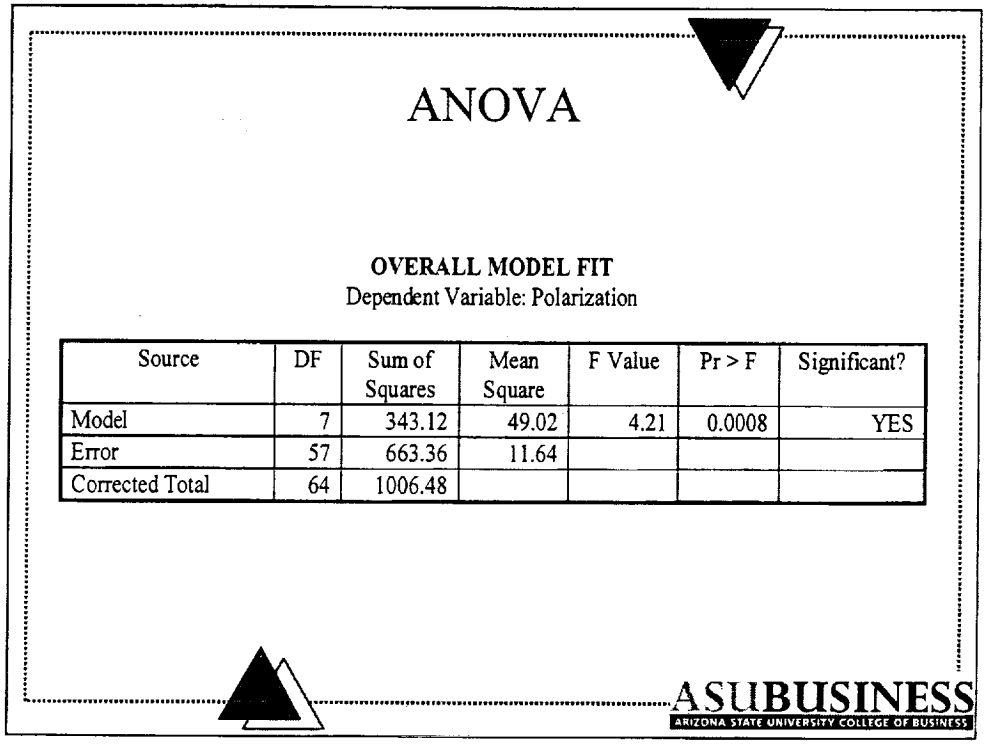
Hypotheses 4a, 4b and 5a, 5b focus on the interaction effects that are studied. The focus is on Medium*, Group Composition, and Task Characteristics*. Medium interactions and the joint impact on group polarization. As with the hypothesis related to the main effects, these relationships are drawn based on the theoretical foundations and literature discussed earlier.



ANOVA - Overall Model Fit

The experiment was designed as a 2 x 2 x 2 (Task x Medium x Group) factorial. ANOVA was used to model relationships between the dependent and the independent variables.

The results suggest at the overall model is valid and statistically significant



Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	Significant?
Model	7	343.12	49.02	4.21	0.0008	YES
Error	57	663.36	11.64			
Corrected Total	64	1006.48				

ANOVA Results and Significant Means

Linear contrasts were used to test hypotheses. The dependent variable was polarization. The independent variables were: communication medium (FTF or GSS); task characteristics (Intellective or Judgmental); and group composition (Assertive-directing or Flexible-cohering).

Interestingly, Medium and Task showed up as main effects, while Group Composition was not statistically significant. Significant interactions, however, cause us not to read too much into the main effects.

ANOVA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	Significant?
Medium	1	60.66	60.66	5.21	0.026	YES
IPS	1	0.344	0.344	0.03	0.864	NO
Task	1	110.19	110.19	9.47	0.003	YES
Med*IPS	1	52.29	52.29	4.49	0.038	YES
Med*Task	1	90.17	90.17	7.75	0.007	YES

Means for Significant Treatments

Treatment	Means	Direction of Shift
FTF	-1.5156	Risky
GSS	0.4167	Cautious
Comparison-poor	-1.7422	Risky
Argument-poor	0.6364	Cautious

Using LSD with: α=0.05, df=57, MSE=11.638

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Planned Contrast - Medium * Task

Hypothesis 4a resulted in a significant outcome. The results suggest that FTF situations are especially potent in their impact on Judgmental or open ended problem situations. GSS has a general muting effect and causes a democratization of the outcome.

Planned Contrasts
(Medium*Task Interaction)

Contrast	df	Contrast SS	Mean Square	F Value	Pr > F	Significant?
H4a	1	258.31	258.31	21.10	0.0001	YES
H4b	1	33.64	33.64	2.75	0.1025	NO

Means for Interaction Effects
(Medium*Task)

Treatment	Level of Medium	Level of Task	Mean	Standard Deviation	Direction
1	FTF	Comparison-poor	-4.34	4.16	Risk
2	FTF	Argument-poor	0.68	1.47	Caution
3	GSS	Comparison-poor	0.28	4.22	Caution
4	GSS	Argument-poor	0.58	3.61	Caution

Using LSD; a=0.05, df=57, MSE=11.64

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Planned Contrast - Medium * Group Composition

While neither of the hypotheses tested proved significant, the interesting contrast shown in the means for interaction effects suggests further work is required in this area. The use of GSS has no real effect for inherently balanced teams, i.e., teams with no "assertive members." However, for teams that included natural leaders, GSS clearly muted the impact these leaders can wield over the group. In FTF situations, leaders are in their element and can bring considerable influence on the group's decision.

Planned Contrasts
(Medium*Interpersonal Style Interaction)

Contrast	df	Contrast SS	Mean Square	F Value	Pr > F	Significant?
H5a	1	0.000	0.000	0.00	0.9992	NO
H5b	1	76.26	78.26	5.27	0.1025	NO

Means for Interaction Effects
(Medium* Interpersonal Style)

Treatment	Level of Medium	Level of Group Comp	Mean	Standard Deviation	Direction
1	FTF	Assertive-directing	-2.65	4.23	Risk
2	FTF	Flexible-cohering	-0.515	3.28	Risk
3	GSS	Assertive-directing	1.464	3.47	Caution
4	GSS	Flexible-cohering	-0.355	4.10	Risk

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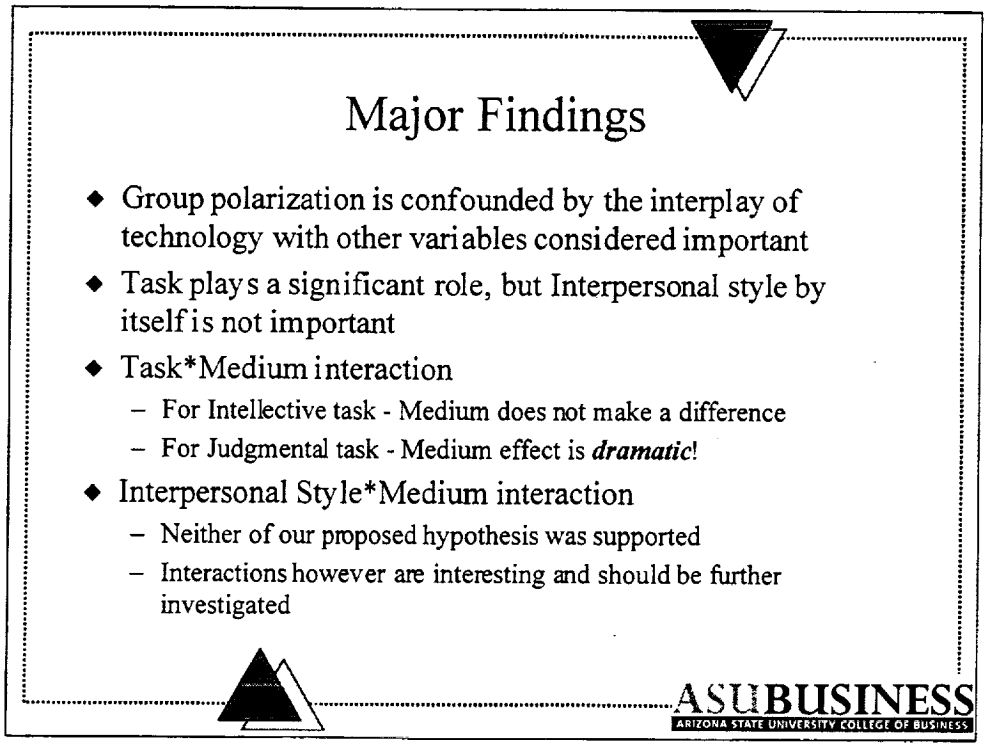
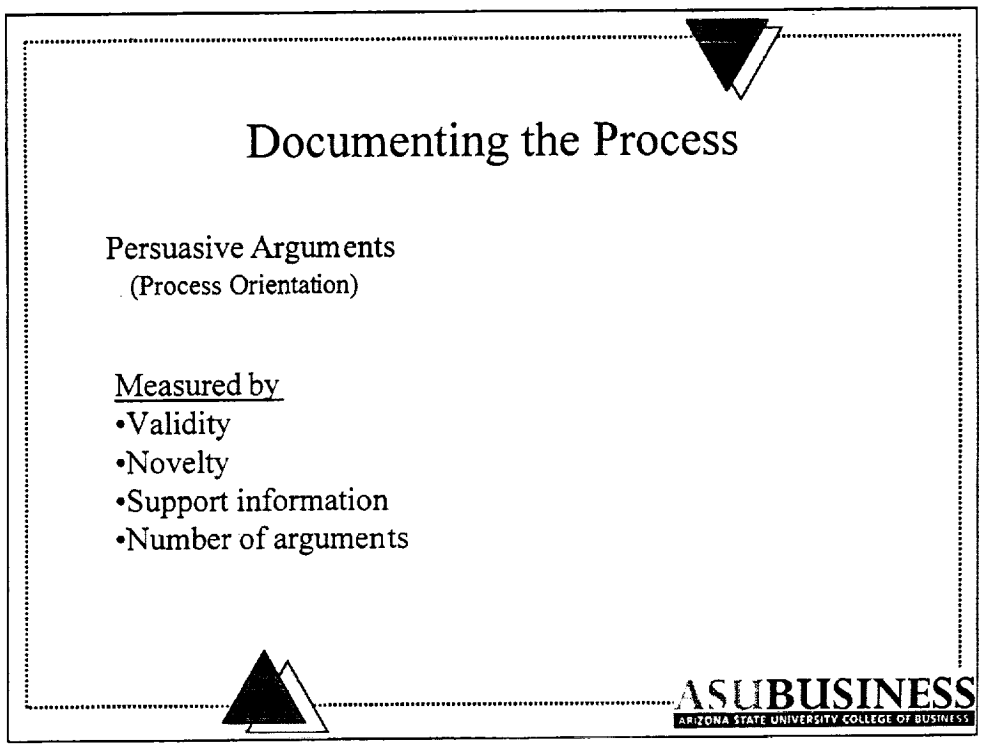
Summary of the Key Findings From the Analysis

Group polarization is a complex phenomenon. Technology, Task and Group Composition all have varying levels of impact on this outcome. There is significant interaction between these independent variables; therefore, attention needs to be focused on cross-play of effects.



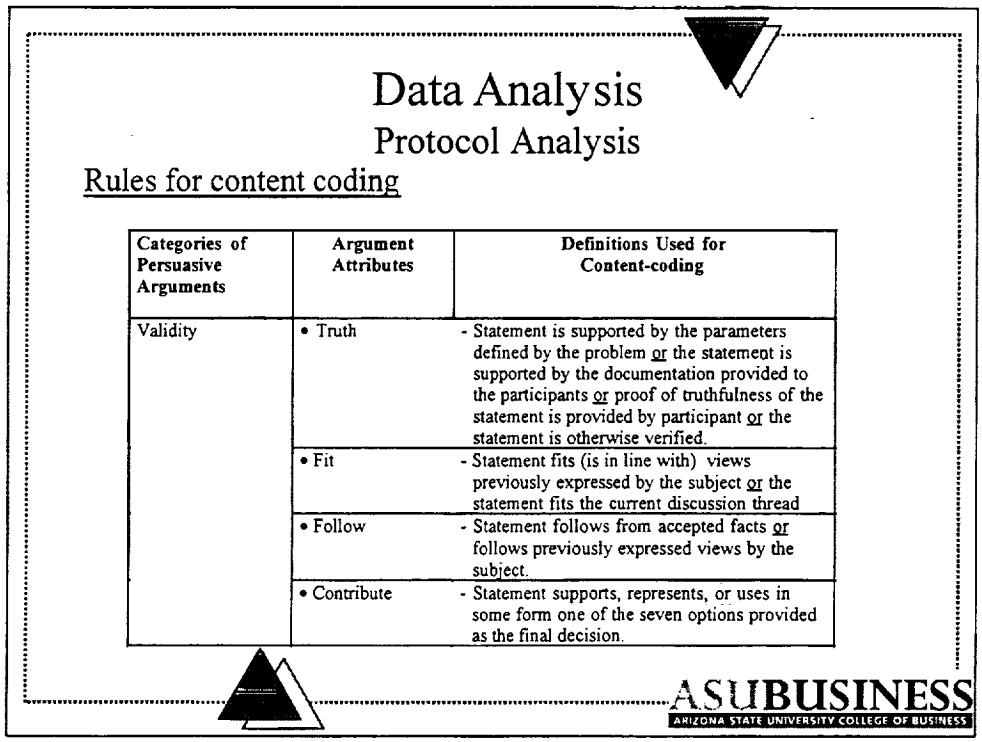
Insights on the Process Leading Up to Group Polarization

A coding scheme was developed *a priori* to document the level of persuasiveness using the theory of persuasive arguments as our basis. The process for coding the transcripts included: defining "arguments" as the unit of analysis, classifying the arguments into different types of statements, and labeling the arguments by attributes of persuasiveness. In the GSS sessions, each separate remark was defined as an argument and used as a unit of analysis. In the face-to-face settings, an argument was defined as each uninterrupted statement/remark by a participant (Ericsson and Simon, 1993).



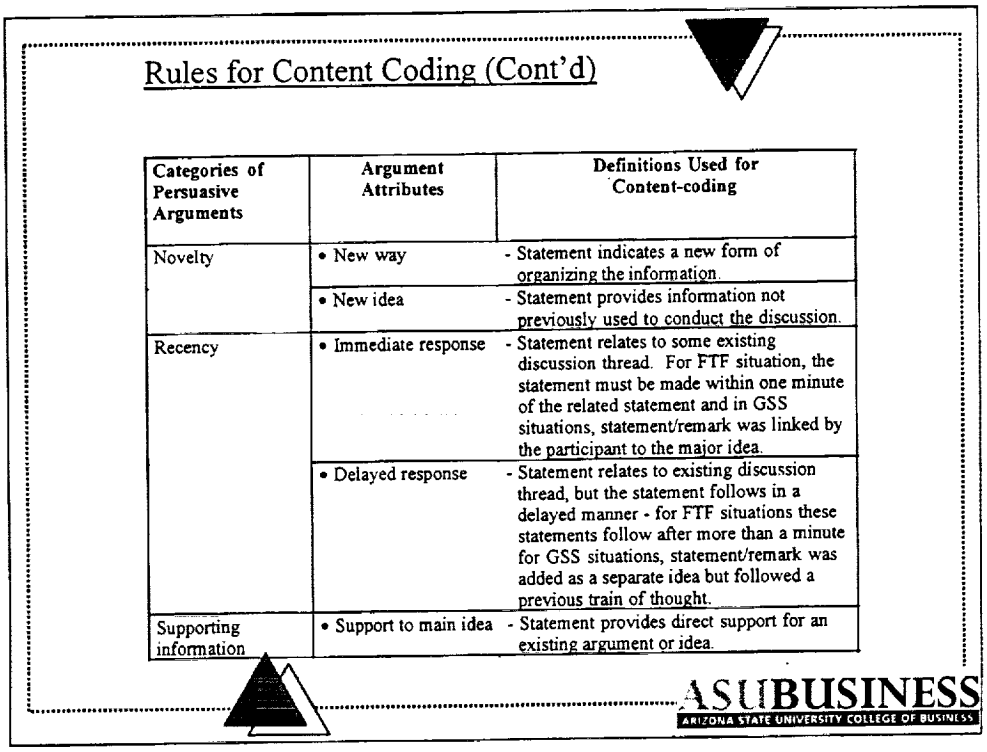
Summary of the Rules for Documenting Persuasiveness of Arguments

The following slides indicate that Persuasiveness is a compound variable and the different facets of persuasiveness can be documented. The listing on the slide and the accompanying definitions are the basis for extracting the level of persuasiveness in an argument that is exchanged prior to a decision being made.



Additional Facets to Persuasiveness

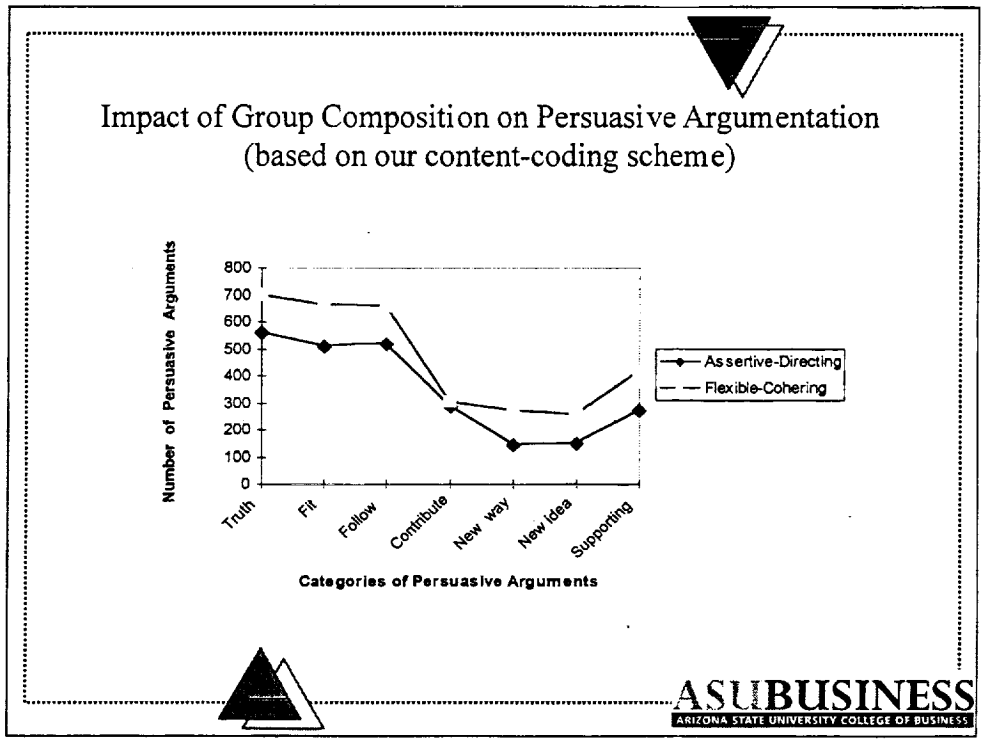
The following are additional aspects relating to persuasiveness of arguments. These rules were used to document the persuasive content of arguments exchanged both in the FTF and the GSS settings.



Categories of Persuasive Arguments	Argument Attributes	Definitions Used for Content-coding
Novelty	• New way	- Statement indicates a new form of organizing the information.
	• New idea	- Statement provides information not previously used to conduct the discussion.
Recency	• Immediate response	- Statement relates to some existing discussion thread. For FTF situation, the statement must be made within one minute of the related statement and in GSS situations, statement/remark was linked by the participant to the major idea.
	• Delayed response	- Statement relates to existing discussion thread, but the statement follows in a delayed manner - for FTF situations these statements follow after more than a minute for GSS situations, statement/remark was added as a separate idea but followed a previous train of thought.
Supporting information	• Support to main idea	- Statement provides direct support for an existing argument or idea.

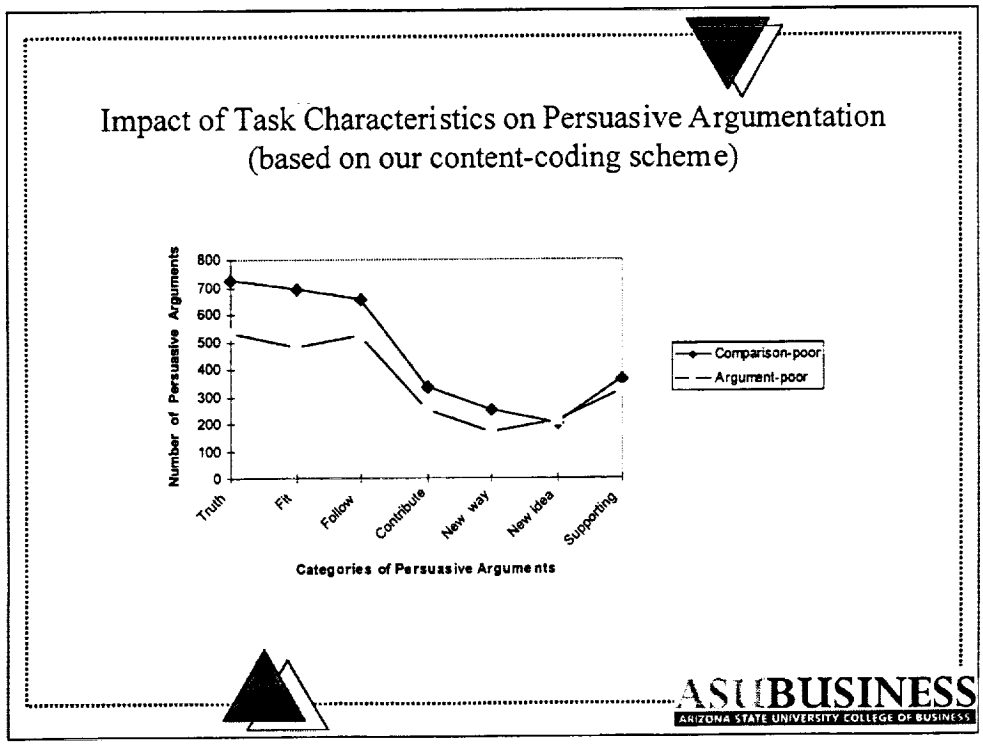
Graphical Depiction of the Level of Persuasiveness - Group Composition

The accompanying slide demonstrates that Flexible-Cohering groups typically exchange a higher level of persuasive argument than groups dominated by an assertive member.



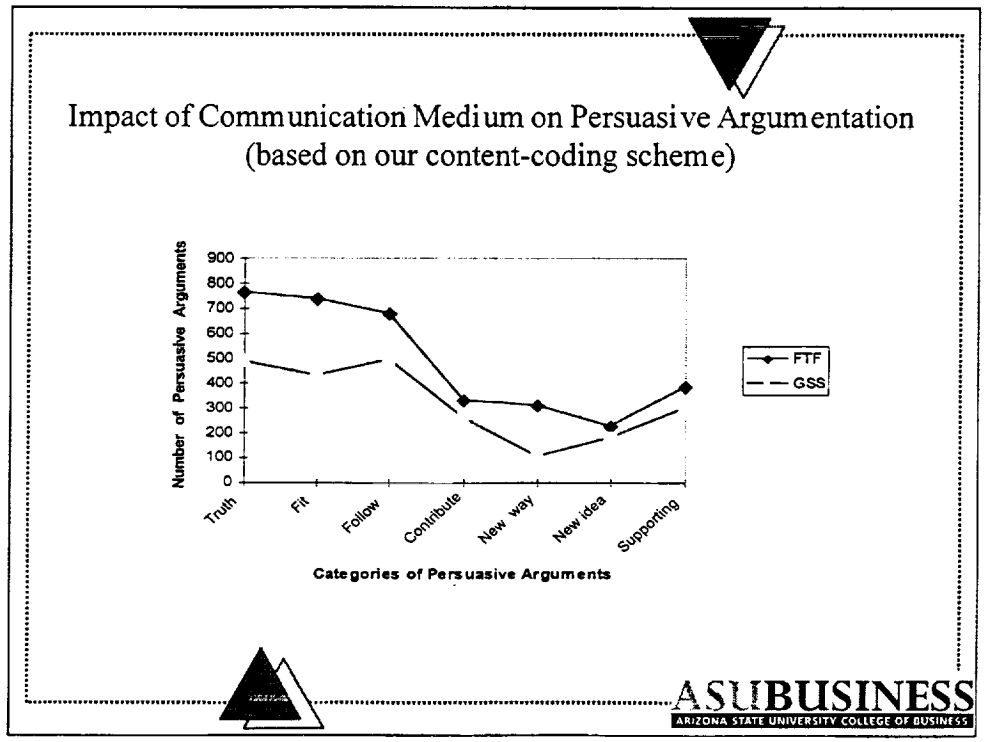
Graphical Depiction of the Level of Persuasiveness - Task Characteristics

This graph suggests that Judgmental or Open-ended tasks typically cause more persuasion to occur among the group than for tasks that have a more clear cut answer associated with it.



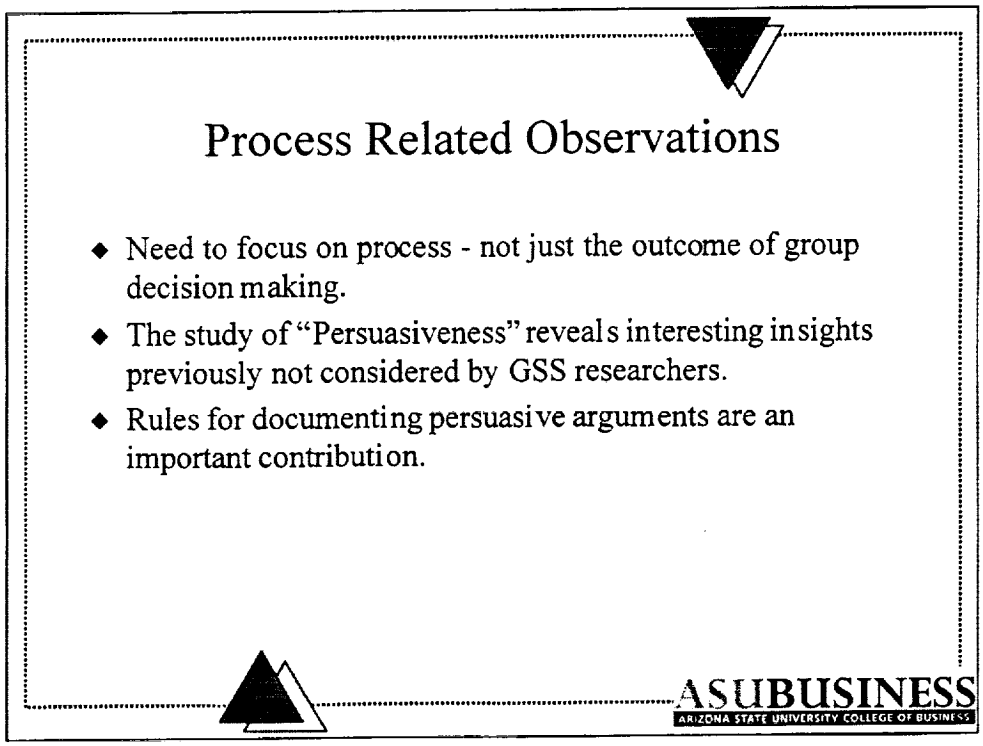
Graphical Depiction of the Level of Persuasiveness - Effect of the Medium

This is perhaps one of the most significant findings from this study. Contrary to the prior assertions in the GSS literature, technology mediation does not cause groups to evaluate or exchange a larger number of persuasive arguments. In fact, an FTF setting is a better environment for the exchange of ideas. While GSS had a larger number of arguments exchanged, the persuasive content was lower!



Process Related Observations

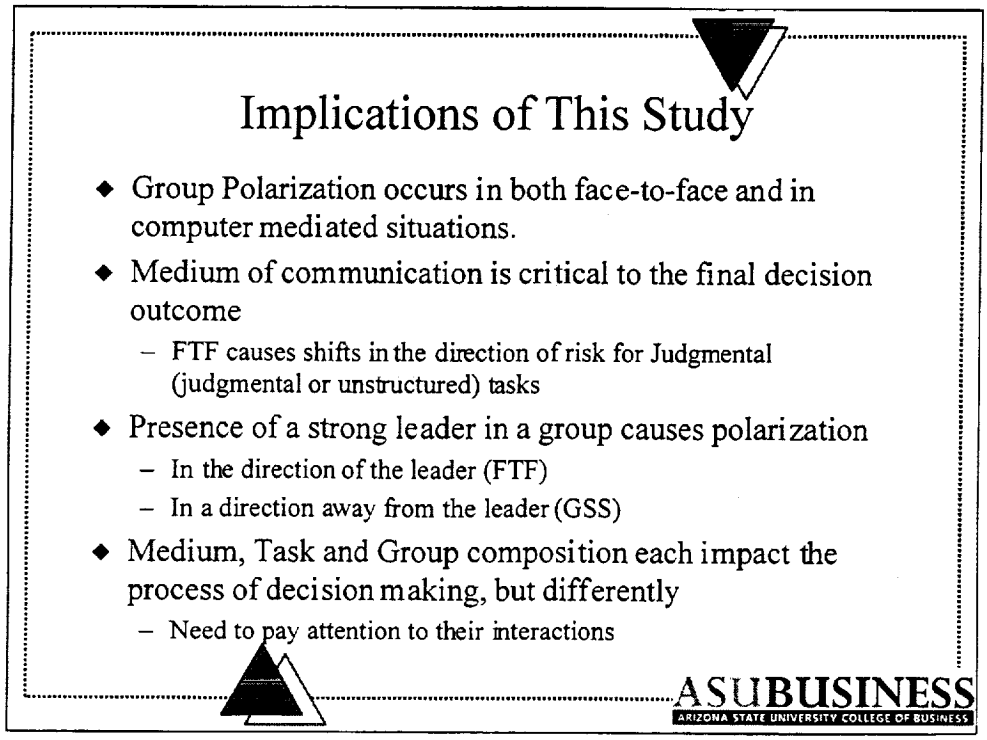
Our study of the process of group decision making in terms of persuasiveness is a major contribution of this presentation. Protocol analysis, while a painstakingly detailed method of analysis, proved to be a useful technique in allowing us to unravel the process. Protocol analysis revealed an intriguing result; the level of persuasiveness was not as different as we had expected in the context of the dramatically different levels of polarization we reported. Since persuasiveness is considered a primary determinant of group polarization, this result is particularly curious. We believe this result opens up multiple avenues for future research. One such avenue is related to the *nature* of persuasive arguments. We have documented similarities in the persuasiveness of argument pools at the aggregate level; however, we have also found that distinctions can be made at a finer level of granularity. The rules that we have developed will allow researchers to further pursue this line of inquiry. Future researchers would be well advised to use process tracing methods to further study persuasiveness by examining the elements that comprise it, what affects the nature of these elements and, finally, the impact of each of these elements on the group outcome of polarization.



Conclusions and Implications of This Study

An objective in this research was to study group polarization. The model used to study group polarization and the process that precedes it, uses variables (task characteristics and group composition) from the group polarization literature, and introduces technology as a new variable affecting group dynamics. While our results did not support all our hypotheses, one of our major findings is that Medium of communication interacts with Task to play a critical role in explaining the process and outcomes of group decision making.

Our results indicate that group polarization is a complex phenomenon with Medium of communication playing a central role. Clearly, any explanation of group polarization in today's team-based technology-supported workplace will be confounded by the interplay of technology with other variables previously deemed important by group polarization researchers. An interesting observation is that regardless of Task characteristics or Group Composition (see Figs. 2 and 3), GSS either does not alter or dramatically reduces polarization. When using GSS, decision makers should consider the nature of the task as well as the desired outcome. Low levels of polarization may not always be a positive outcome. For example, in some situations, the democratic process of reaching group consensus may not be the most effective, especially in situations where it is necessary to draw and identify individual member expertise and allow social dynamics to flourish. Decision makers should thus identify their particular situation with the knowledge that the Medium may interact with the Task to alter the nature of the process and the extent of the outcome.



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Computer-Supported Collaboration for High Performance Teams at Marshall Space Flight Center

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Huntsville, AL

Computer-Supported Collaboration for High-Performance Teams at Marshall Space Flight Center

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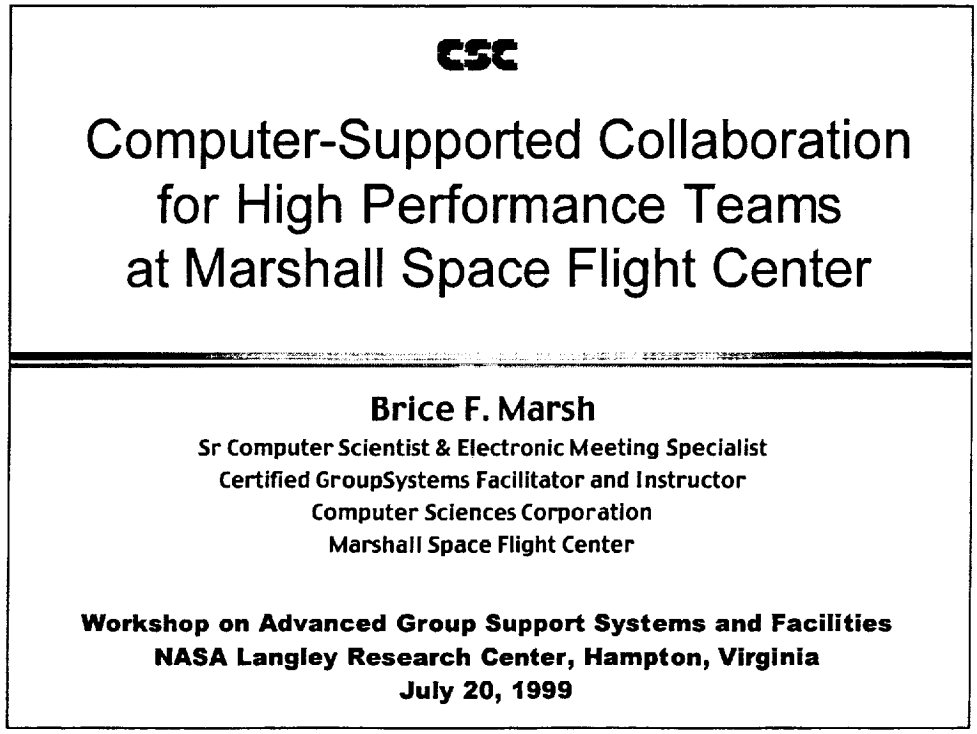
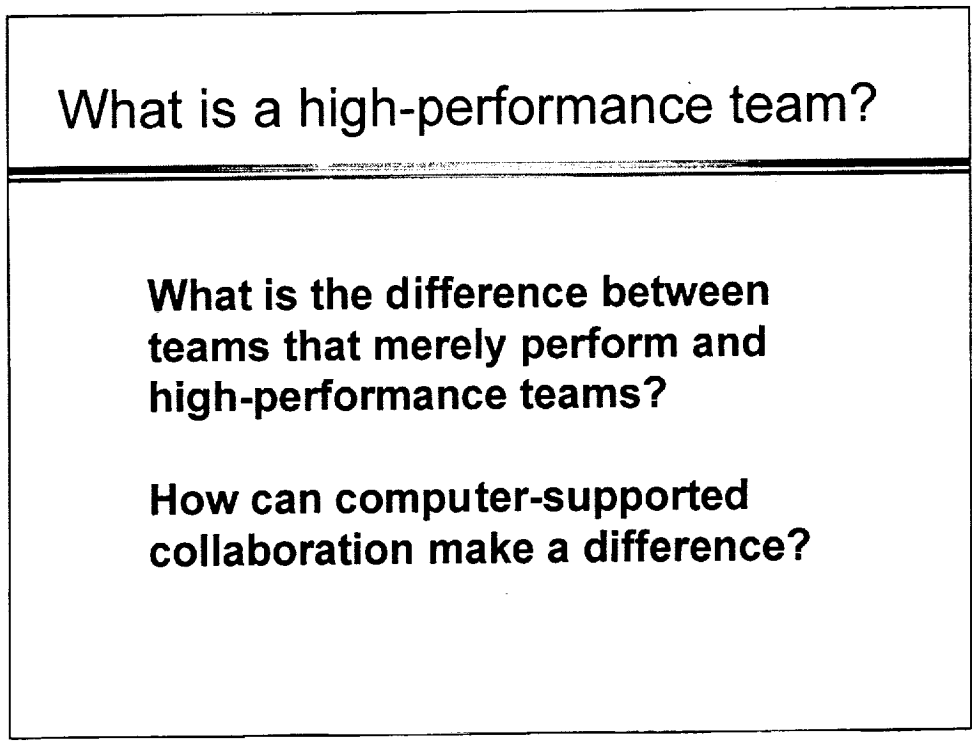


What is a High-Performance Team?

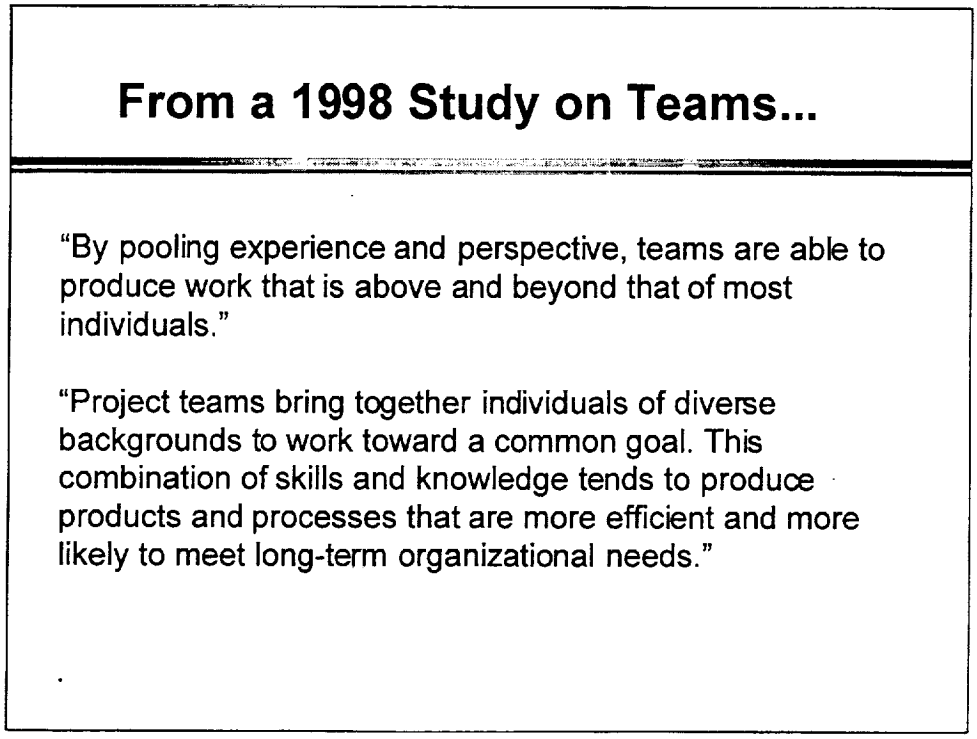
This presentation describes a technique using collaborative software to improve the productivity and effectiveness of high performance teams. Some questions that need to be explored are:

What is the difference between teams that merely perform and high-performance teams?
How can computer-supported collaboration make a difference?



From a 1998 Study on Teams...

Here are some observations from a recent study about why individuals working as members of a team may be more effective in producing measurable results than if they were working independently.



More About Teams...

The 1998 study entitled, "High Performance Teams," was published by Kevin Cole, a consultant with Linkage, Inc.

The premise that an organization needs to create a support system that encourages the team to forge their individual efforts into a collective, directed effort may be realized by using a type of computer-supported collaboration called an "electronic meeting system."

More about Teams...

"Teams that ... do not allow opposing viewpoints will have a greater tendency toward groupthink. Effective teams develop the interactions to integrate differing perspectives while working together to meet organizational goals."

"To transform an average team into a high performance team an organization needs to create a support system that encourages the team to forge their individual efforts into a collective, directed effort."

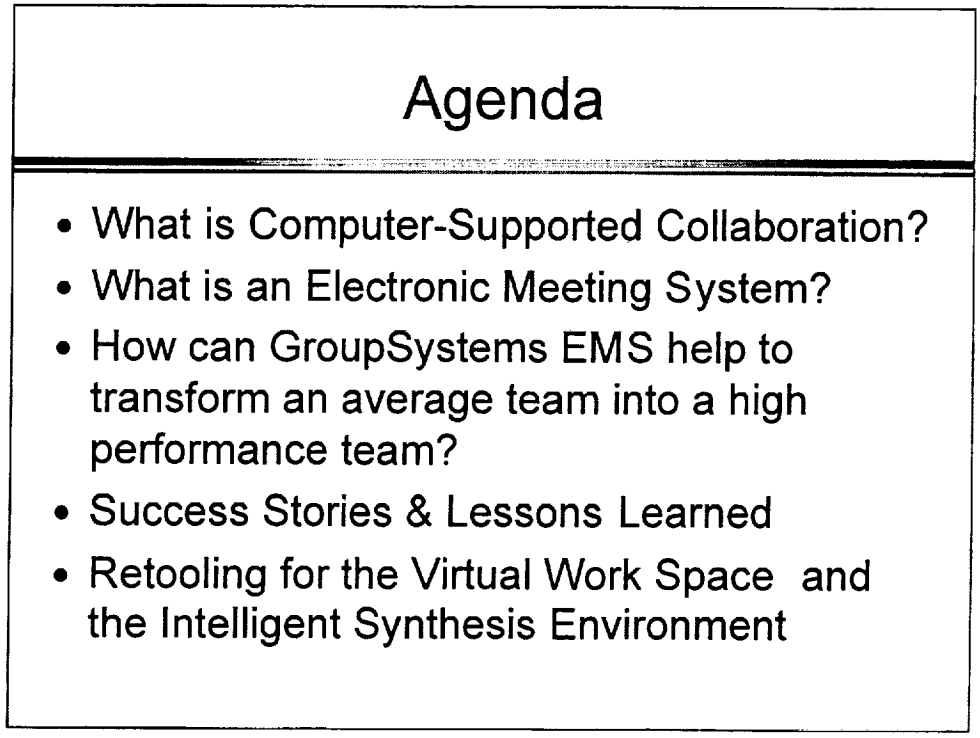
1998 Study - High Performance Teams
Kevin Cole, Consultant, Linkage, Inc.

Agenda

In this presentation, we will explore how a type of computer-supported collaboration or electronic meeting system can help to transform an average team into a high performance team.

We will also describe some success stories and examples of using an electronic meeting system.

This type of collaborative support and productivity booster for teamwork is expected to produce meaningful benefits for virtual teams working in the Intelligent Synthesis Environment.



One of the Challenges of Teamwork...

The challenge of using a team approach to capitalize on the collective skills and strengths of the individual team members is not new. Here we re-visit a quotation from one of America's most revered statesmen and see that he had already encountered some of the travails of working in a high performance team environment.

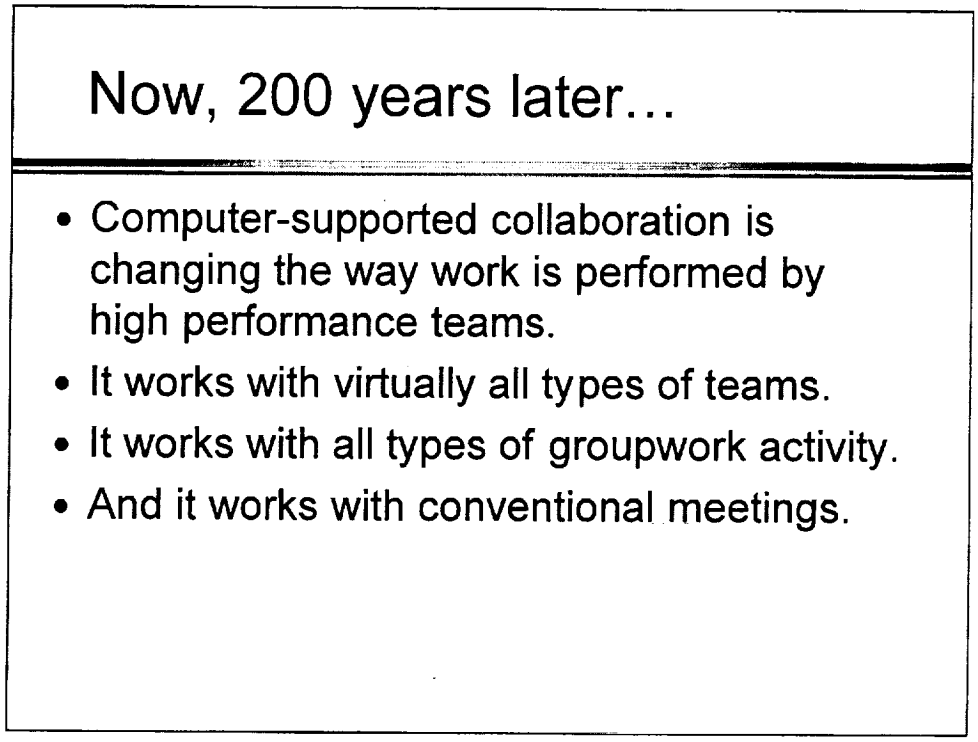
One of the challenges of teamwork...

"When you assemble a group of people to have advantage of their joint wisdom, you inevitably assemble with those people all their prejudices, their errors of opinion, their local interests, and their selfish views. From such an assembly, can a perfect production be expected?"

- Ben Franklin - 1787
U.S. Constitutional Convention

Now, 200 Years Later...

And now, 200 years later, we are encountering similar challenges... but we have the benefit of computer-supported techniques to augment the effectiveness of the teams.



Questions

The questions we should consider as we look for ways to improve the performance of a team focus on meeting time, productivity and achievement of consensus or "buy-in" by members of the team.

Questions

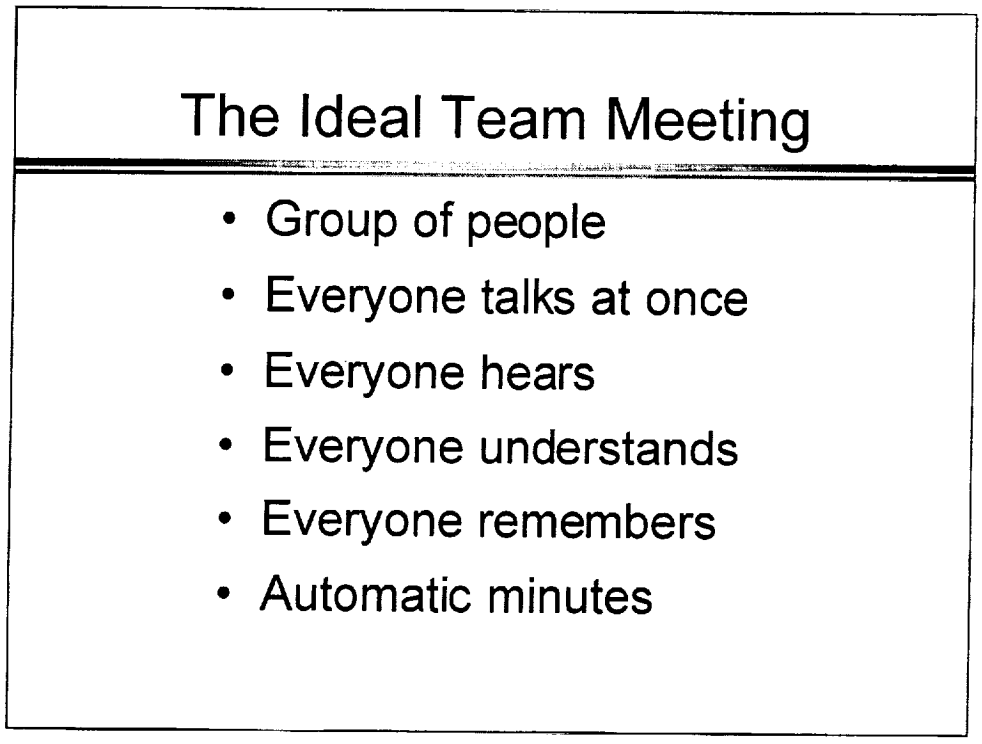
- How much of your teamwork time is spent in meetings?
- Are your meetings highly productive?
- Do you achieve consensus most of the time?

The Ideal Team Meeting

At first, it may seem ludicrous to suggest that the ideal team meeting would allow everyone to talk at once; however, that is precisely one of the primary advantages of an electronic meeting system.

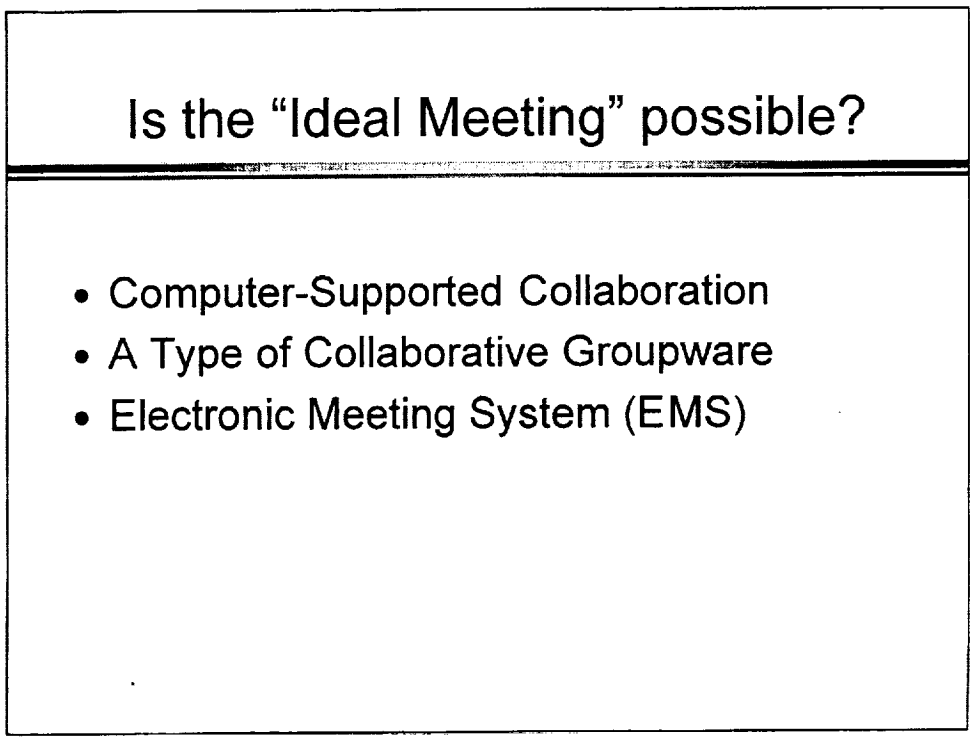
If everyone can talk at once without being confused, and if everyone can hear, understand and remember everything that is said, this must be a powerful way to conduct team meetings.

...And, by the way, it will no longer be necessary for anyone to keep the minutes... or to prepare flipcharts... or to make yellow sticky notes, to maintain a record or group memory of the proceedings of the team meetings. This will be produced as a by-product of the computer-supported approach to collaboration.



Is the "Ideal Meeting" Possible?

The "Ideal Meeting" may not always be attainable, but computer-supported collaboration or an electronic meeting system generally will produce a quantum leap in productivity and effectiveness of most team meetings.

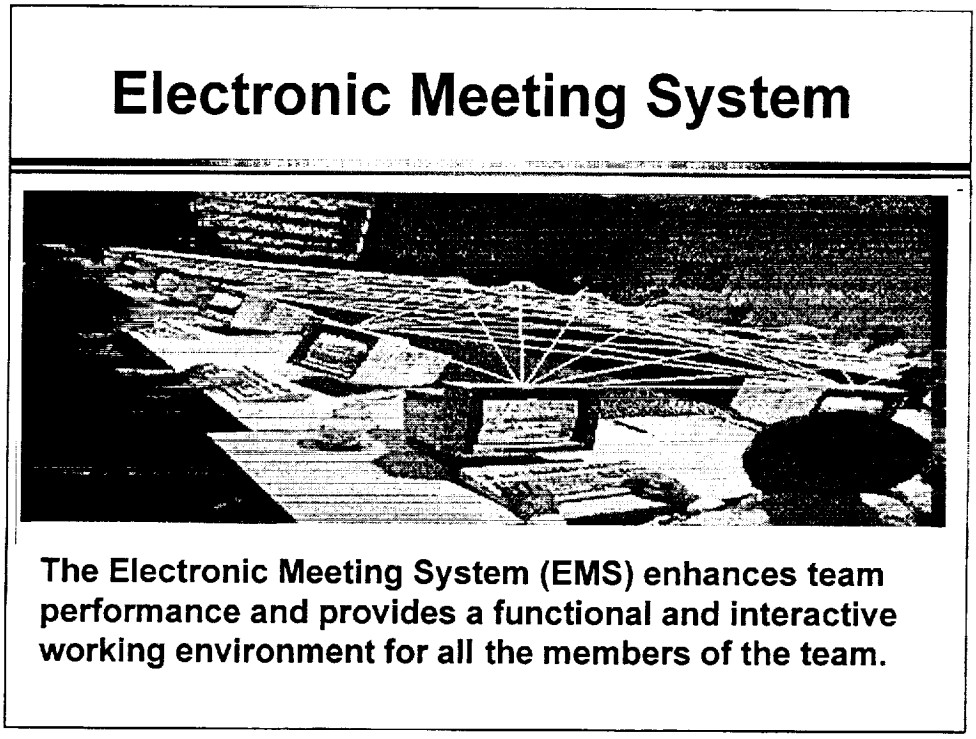


Electronic Meeting System

The Electronic Meeting System (EMS) enhances team performance and provides a functional and interactive working environment for all the members of the team.

Each team member is provided with a computer and a keyboard; and all the members' computers are interconnected in a local area network. Part of the collaborative software resides and runs in the individual networked computers, but the team's database is maintained on the file server.

A public display screen, usually in the form of a data projector, is used for the team members to view the anonymous contributions of other team members.

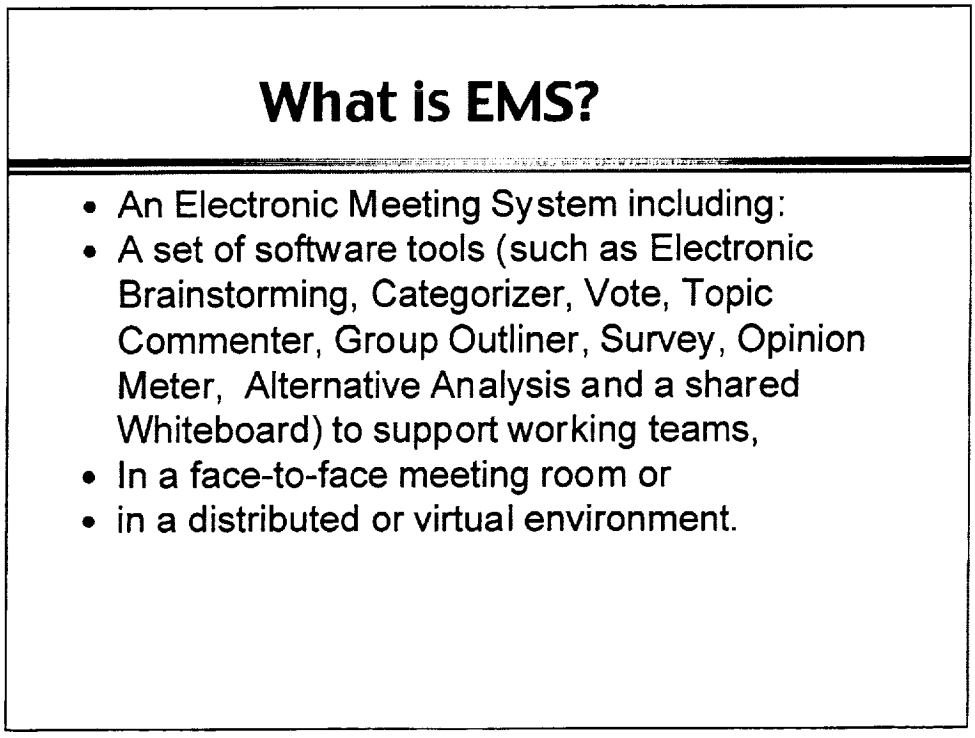


What is EMS?

An Electronic Meeting System includes a set of software tools (such as Electronic Brainstorming, Categorizer, Vote, Topic Commenter, Group Outliner, Survey, Opinion Meter, Alternative Analysis and a shared Whiteboard) to support working teams in a face-to-face meeting room or in a distributed or virtual environment.

Team meetings may be either synchronous or asynchronous; and they may occur in same time/same place settings or in different time/different place settings, or some combination.

However, group dynamics and facilitation issues are much more complex for asynchronous distributed meetings.

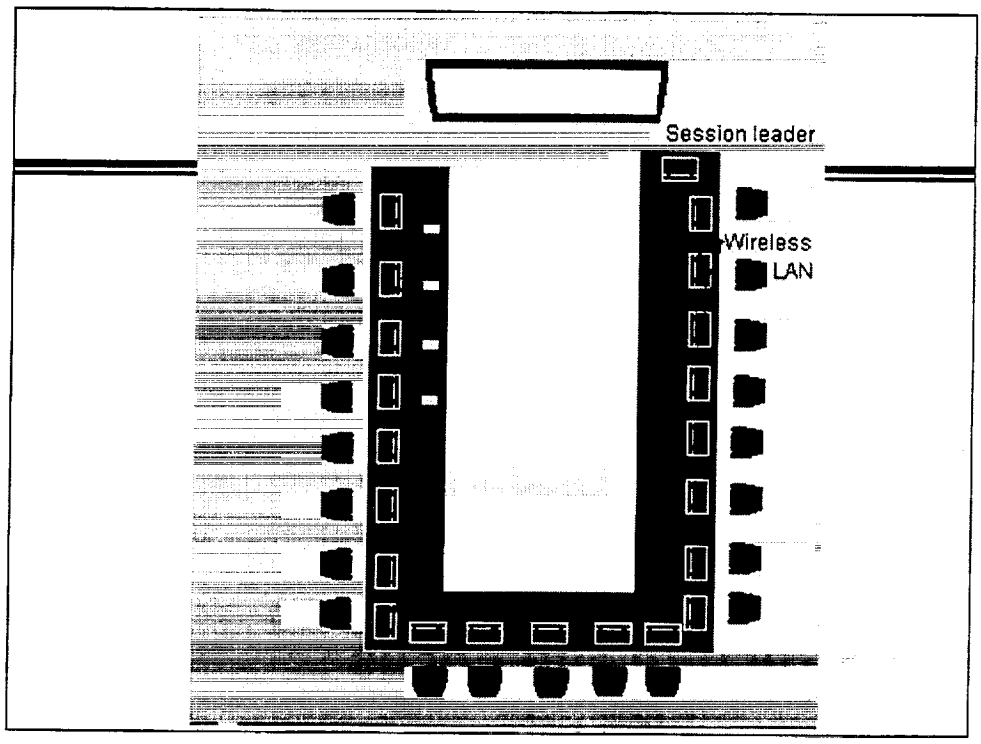


Needs Title

The preferred physical arrangement for same time/same place team meetings is a room with tables placed in a "U-shape." This preserves the confidentiality and anonymity of each team member, yet it is conducive to eye contact and verbal communication.

A public display or projection screen is used to view the collective, yet anonymous, contributions of the team during deliberations.

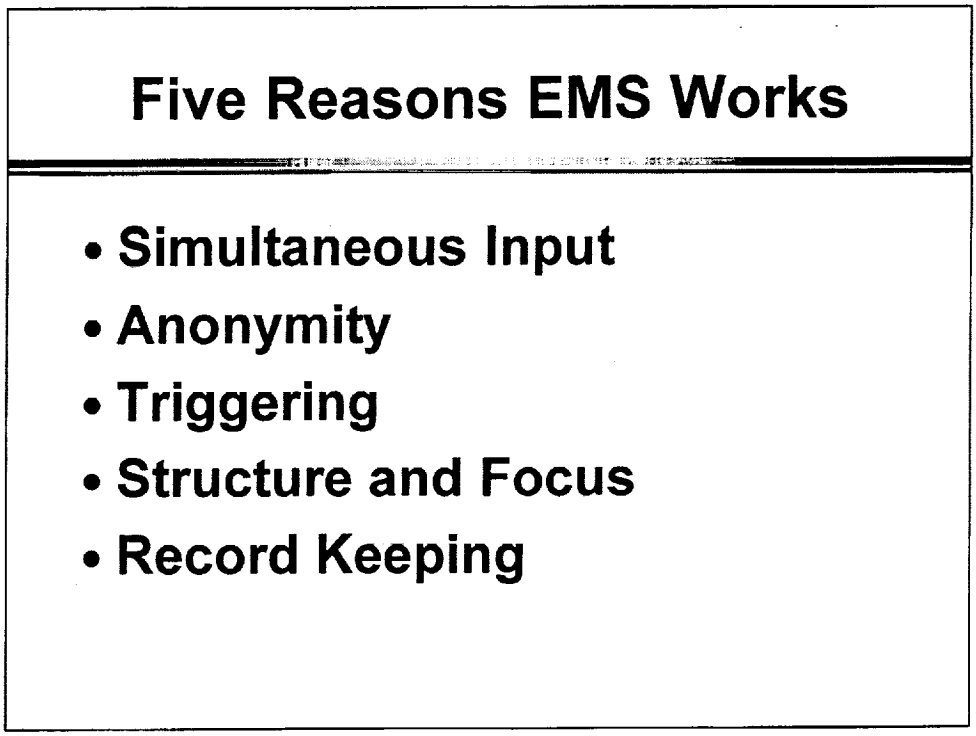
The role of the facilitator is to focus on the process of the meeting while team members focus on the content of the meeting.



Need Title

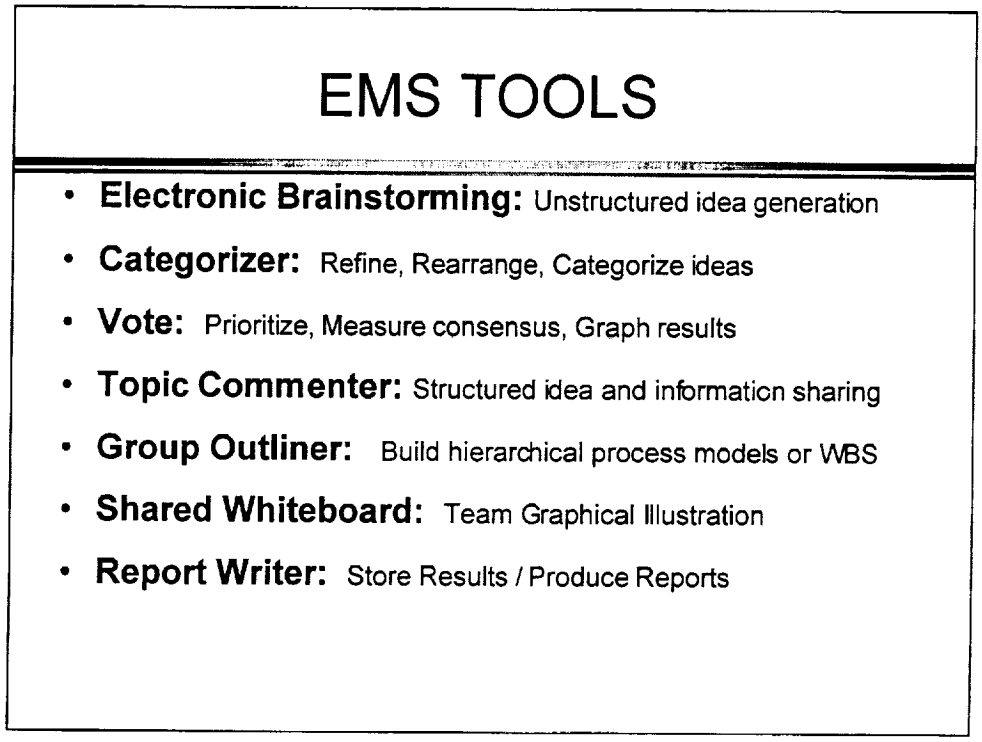
There are five main reasons why EMS produces good results with high performance teams.

1. *Parallel or simultaneous input by all participants.* Since computers allow everyone to "speak at once, electronically," it is not necessary for each person to wait his turn to get the floor or to get his or her "air time."
2. *Anonymity.* Ideas and comments are evaluated on the merits of the ideas and not on the personality or clout of the person who originated the idea.
3. *Triggering.* One member's ideas will trigger other team members to think of things that never would have surfaced in conventional meetings.
4. *Structure and focus.* The facilitation tools included in EMS allow the facilitator to help keep the team "on track and on schedule."
5. *Record keeping.* No longer is it necessary to use flipcharts and yellow sticky notes. The system may be used to produce a printed report of the meeting results immediately at the end of the meeting.



EMS Tools

The Electronic Meeting System (EMS) provided by Ventana Corporation is called GroupSystems WorkGroup Edition. It includes a variety of collaborative tools. The facilitator works with the team leader or the meeting owner during preplanning steps to recommend a selection of tools and techniques to achieve the desired results of a specific team meeting.

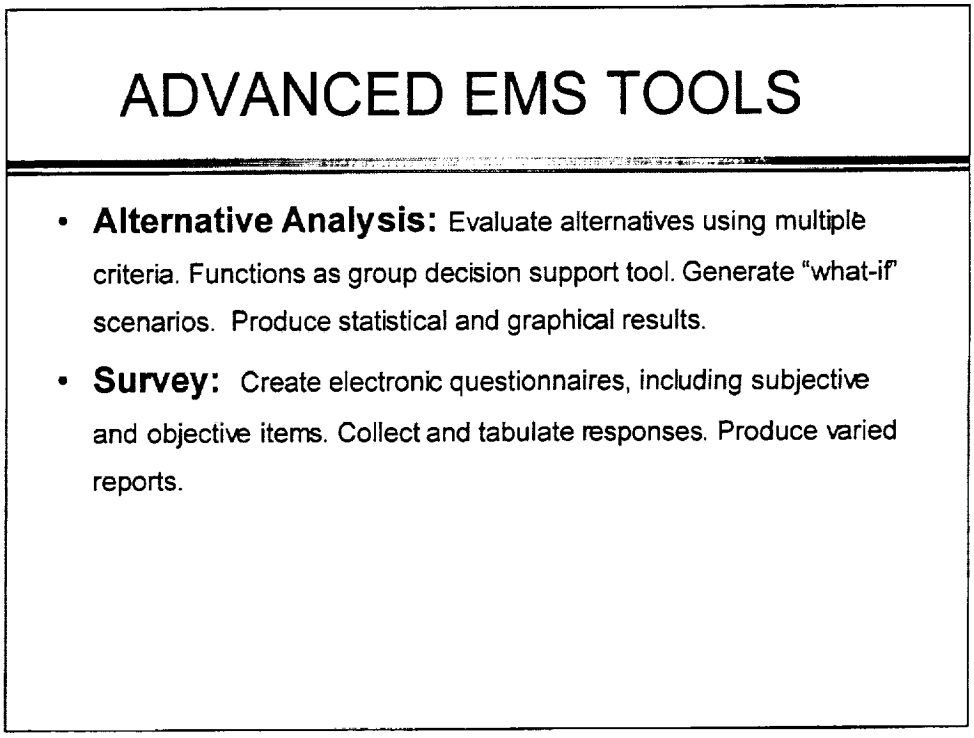


Advanced EMS Tools

The GroupSystem WorkGroup Edition also includes some special purpose advanced collaborative tools. Included are the Alternative Analysis and Survey tools.

Alternative Analysis: Evaluate alternatives using multiple criteria. Functions as group decision support tool. Generate "what-if" scenarios. Produce statistical and graphical results.

Survey: Create electronic questionnaires, including subjective and objective items. Collect and tabulate responses. Produce varied reports.

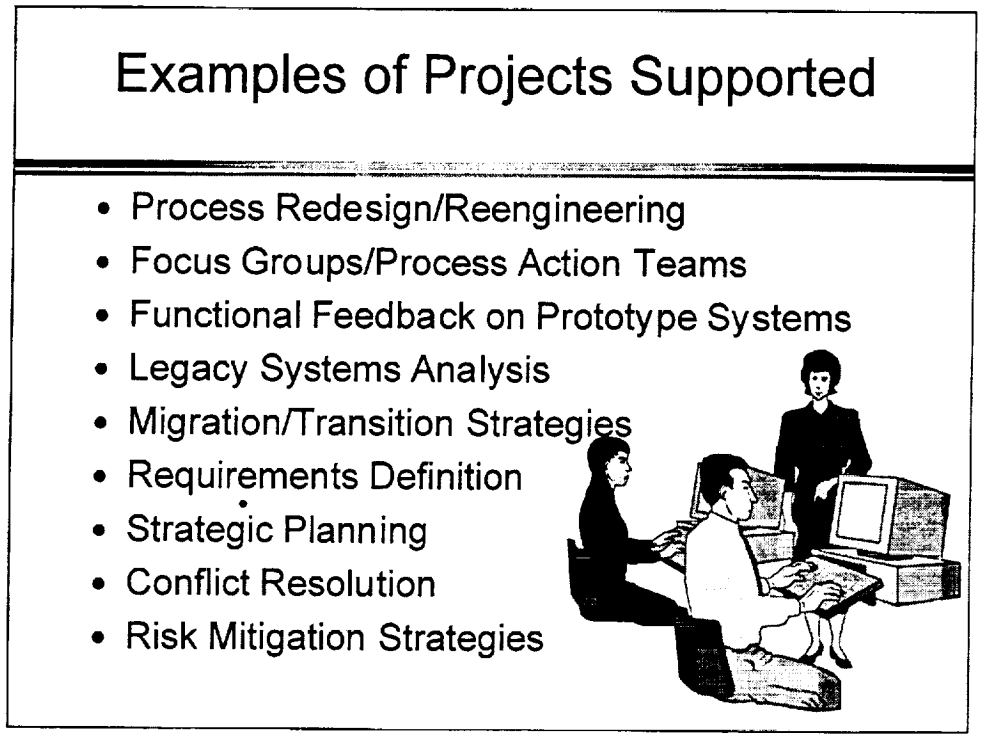


Examples of Projects Supported

A variety of team assignments may be supported using EMS. Each project may have a different process or objective.

Examples of some types of team projects that have been supported with EMS are:

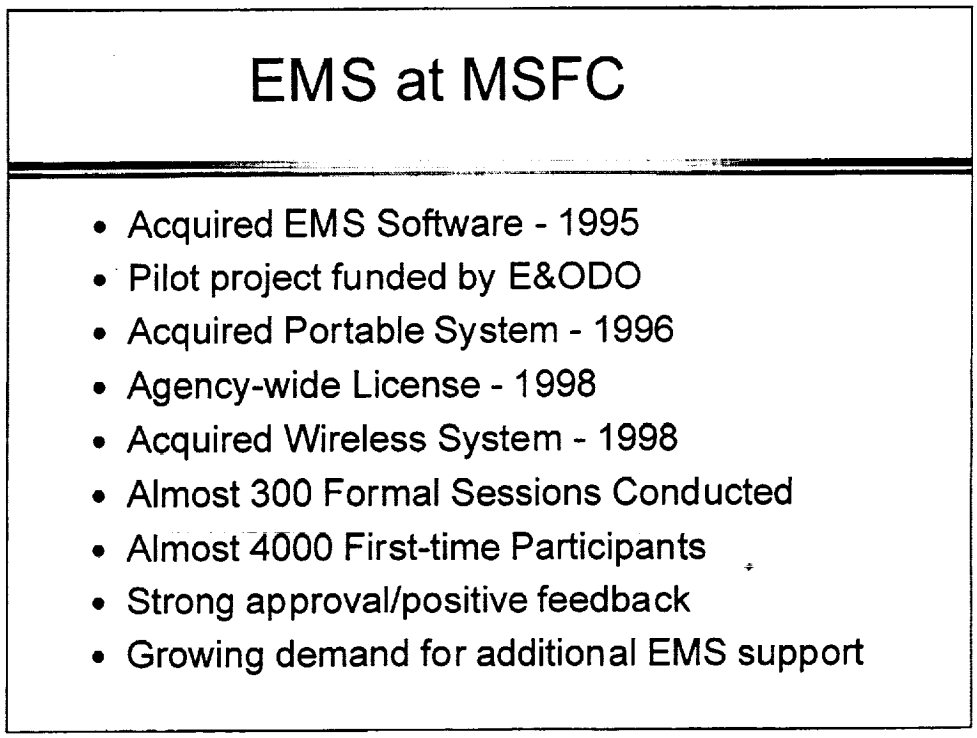
- Process Redesign/Reengineering
- Focus Groups/Process Action Teams
- Functional Feedback on Prototype Systems
- Legacy Systems Analysis
- Migration/Transition Strategies
- Requirements Definition
- Strategic Planning
- Conflict Resolution
- Risk Mitigation Strategies



EMS at MSFC

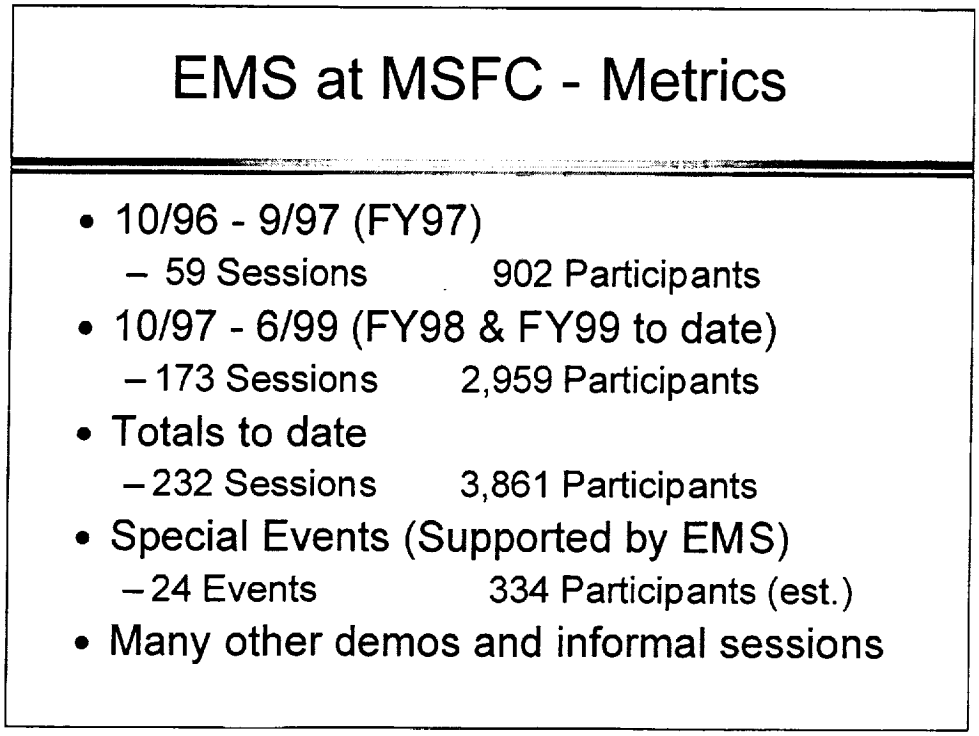
The EMS software was acquired at Marshall Space Flight Center in 1995. Since that time a number of milestones have been reached:

- Acquired EMS software - 1995
- Pilot project funded by Employee and Organizational Development Dept.
- Acquired portable system - 1996
- Agency-wide license - 1998
- Acquired wireless system - 1998
- Almost 300 formal sessions conducted
- Almost 4000 first-time participants
- Strong approval/positive feedback
- Growing demand for additional EMS support



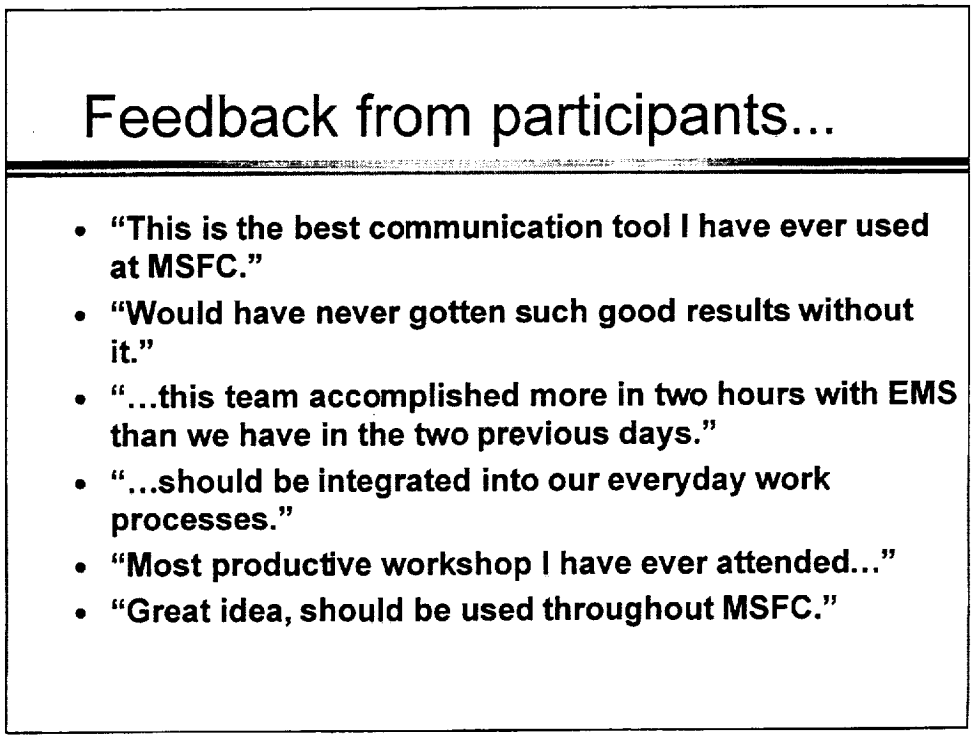
EMS Metrics at Marshall Space Flight Center

- 10/96 - 9/97 (FY97)
  - 59 Sessions 902 Participants
- 10/97 - 6/99 (FY98 & FY99 to date)
  - 173 Sessions 2,959 Participants
- Totals to date
  - 232 Sessions 3,861 Participants
- Special Events (Supported by EMS)
  - 24 Events 334 Participants (approximately)
- Many other demos and informal sessions



Feedback From Participants

Feedback from participants indicates strong support and acceptance of the EMS approach to conducting team meetings.



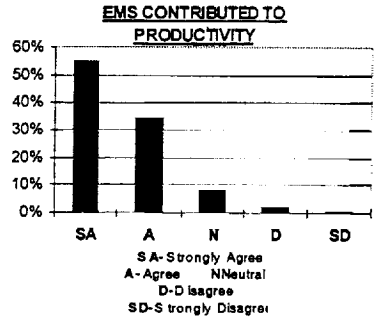
Need Title

One of the survey questions included in the evaluation for each session asks the participants to indicate *"strongly agree, agree, neutral, disagree, or strongly disagree"* with the statement: *"EMS contributed significantly to the productivity of the meeting."*

More than 89 percent of the participants of a substantial number of meetings have responded with *"strongly agree or agree."*

"EMS contributed significantly to productivity of the meeting"

	Responses	%
SA	175	55.0%
A	110	34.6%
N	26	8.2%
D	6	1.9%
SD	1	0.3%
TOTAL	318	100.0%



MSFC Design Center Team

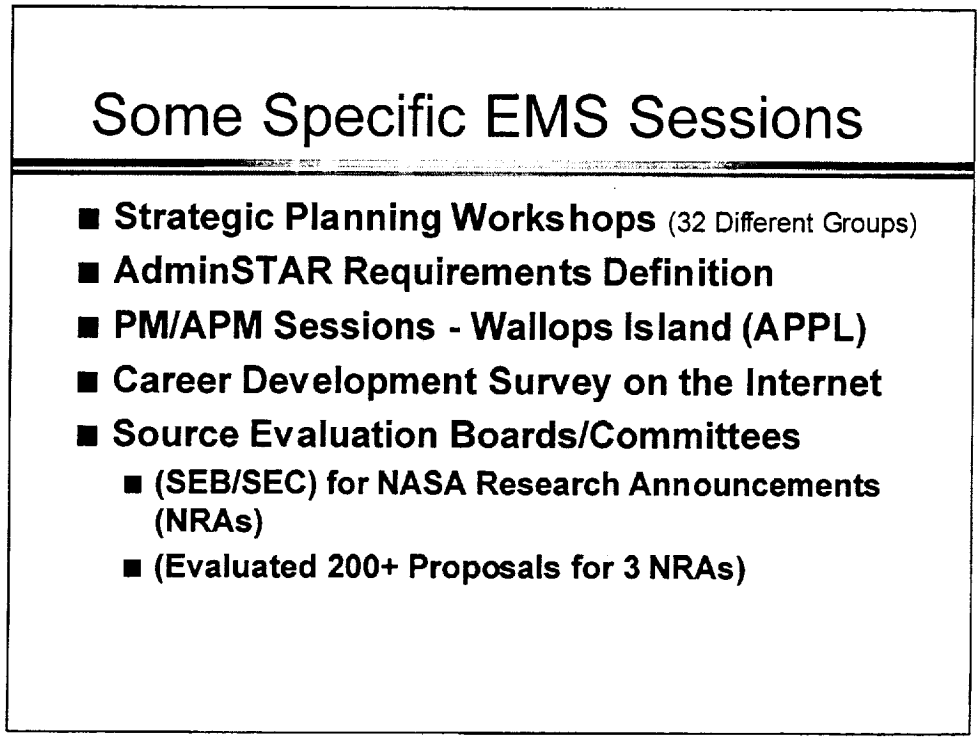
One design center team offered a strong endorsement for EMS.

MSFC Design Center Team

- **"The S&E Design Center Team used EMS on several occasions to facilitate team brainstorming and consensus. All these meetings achieved the desired ends.**
  The general consensus of team members is that the tool and the facilitator effectively cut meeting time in half. Furthermore, the team decided that the capability of tools such as Ventana EMS should be included in the MSFC Design Center tool suite."
  - Dale Thomas, Ph D

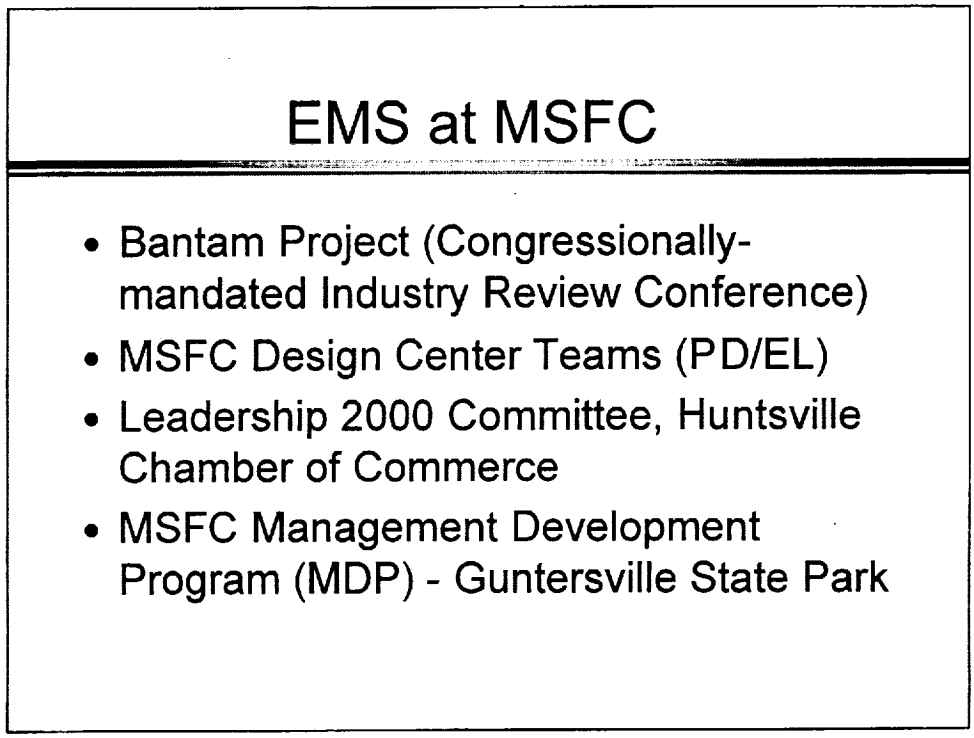
Some Specific EMS Sessions

EMS has been used in a variety of actual team projects at Marshall Space Flight Center.



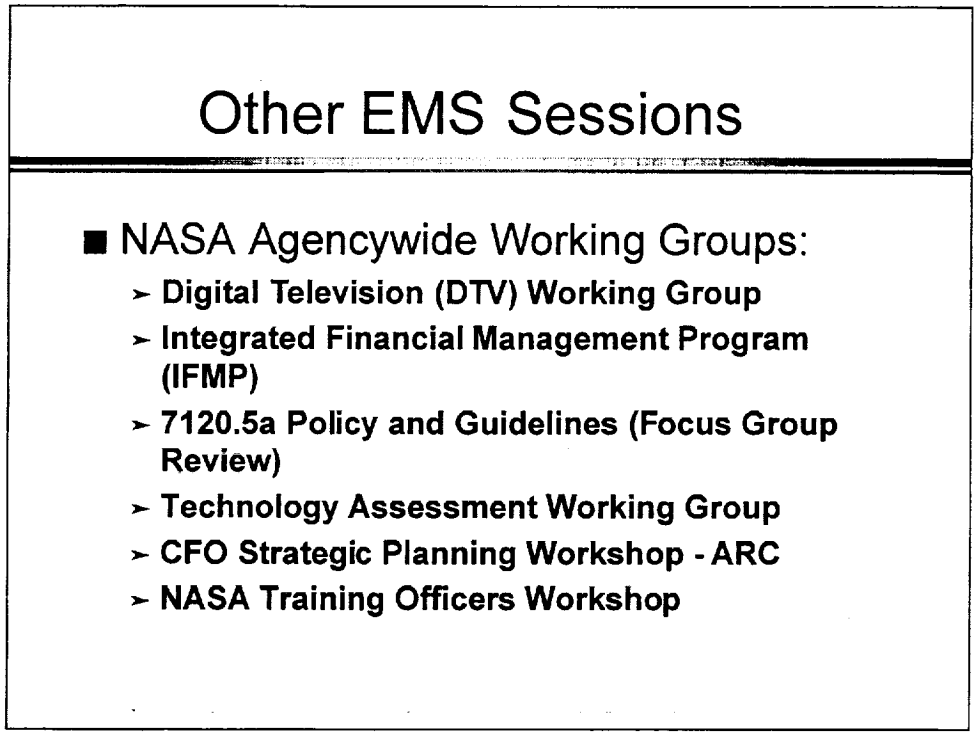
EMS at MSFC

More actual examples of team projects that have used EMS.



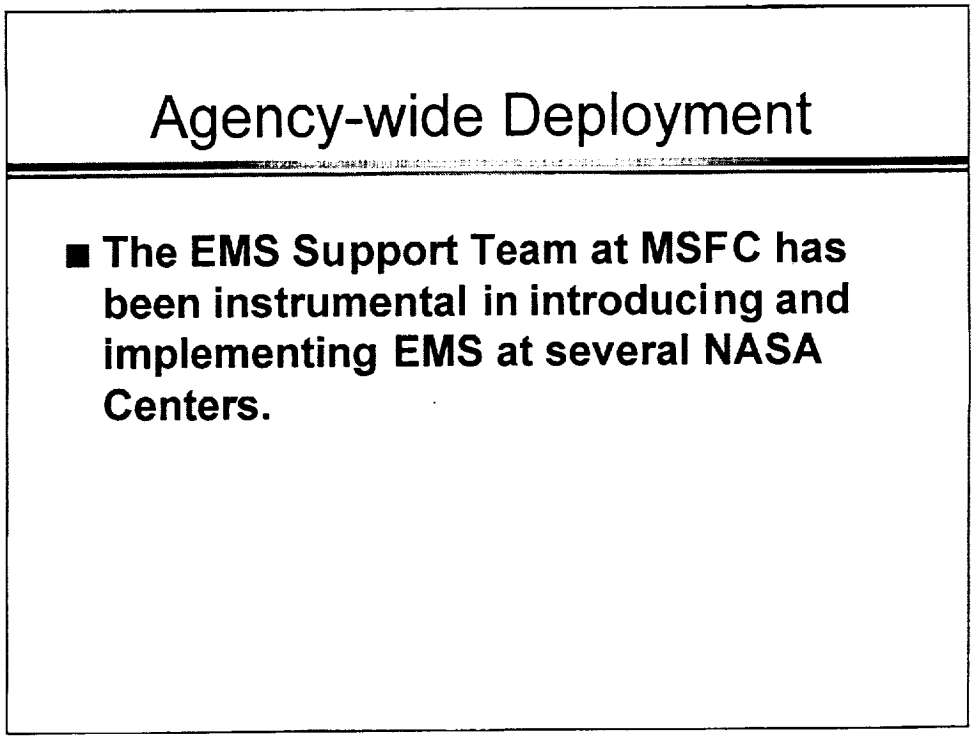
Other EMS Sessions

Still more team projects that have used EMS.



Agency-Wide Deployment

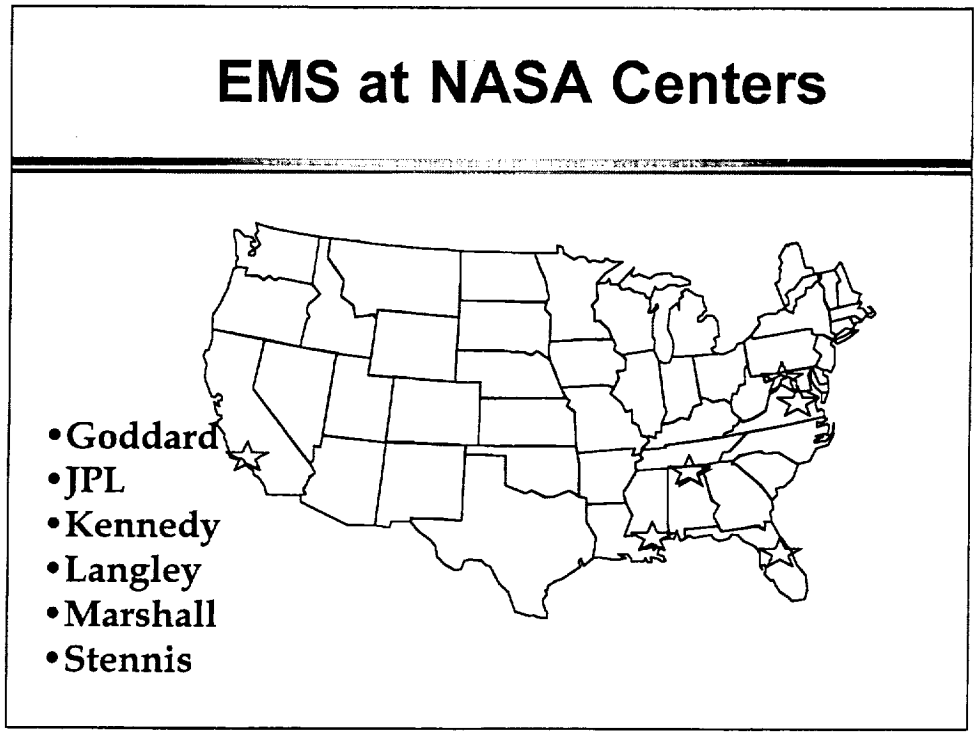
An agency-wide EMS license has been procured for NASA. The EMS support team at Marshall Space Flight Center has been instrumental in introducing and implementing EMS at several NASA Centers. A map on the next slide depicts the NASA Centers who have or who are in the process of implementing EMS. Several cross-Center teams, such as NASA's Intelligence Syntheses Environment (ISE), Integrated Financial Management (IFM) Center Transition Managers (CTMs), and Source Evaluation Committees (SECs), have taken advantage of the EMS facility at MSFC and have expressed a desire to use EMS during follow-on meetings at the other Center locations.



EMS at NASA Centers

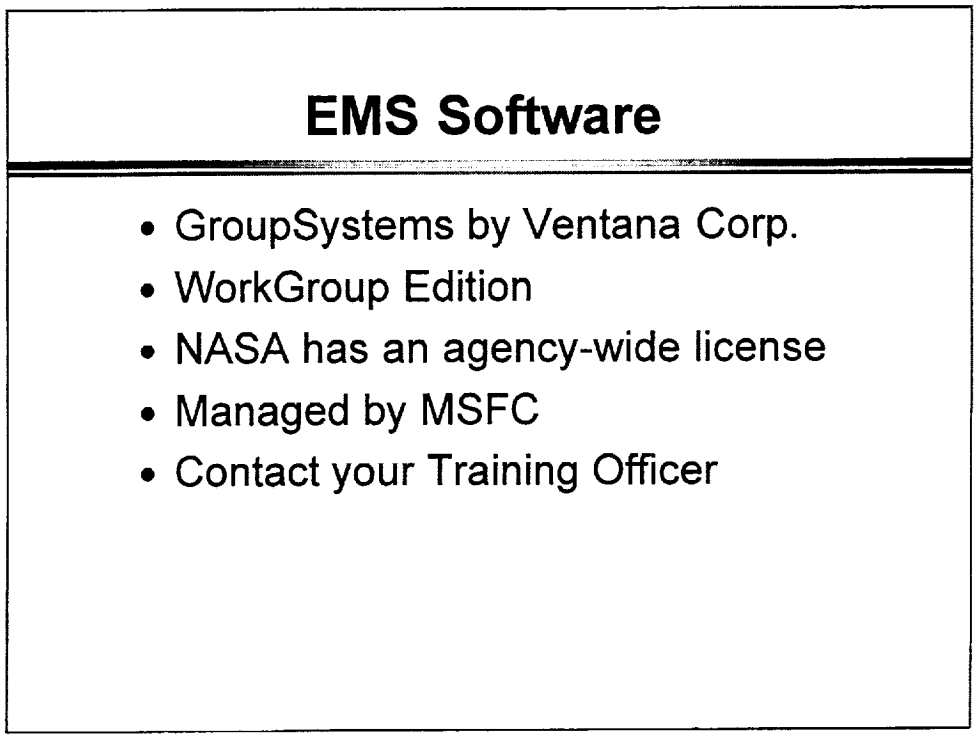
These are the NASA Centers who have or who are in the process of implementing EMS.

The EMS Team from EODD at MSFC has provided briefings, remote and onsite demonstrations, as well as conducted actual working EMS sessions for various departments and teams at several of the NASA Centers. The result has been an increasing interest on the part of these Center personnel in participating in the NASA Master EMS license and in pursuing the acquisition and setup of an EMS capability at their Centers. EODD EMS Team members assist with the deployment of the licensed software to a Center and offer technical and functional assistance to the EMS installation staff in setting up their facility and in conducting initial EMS meetings.



EMS Software

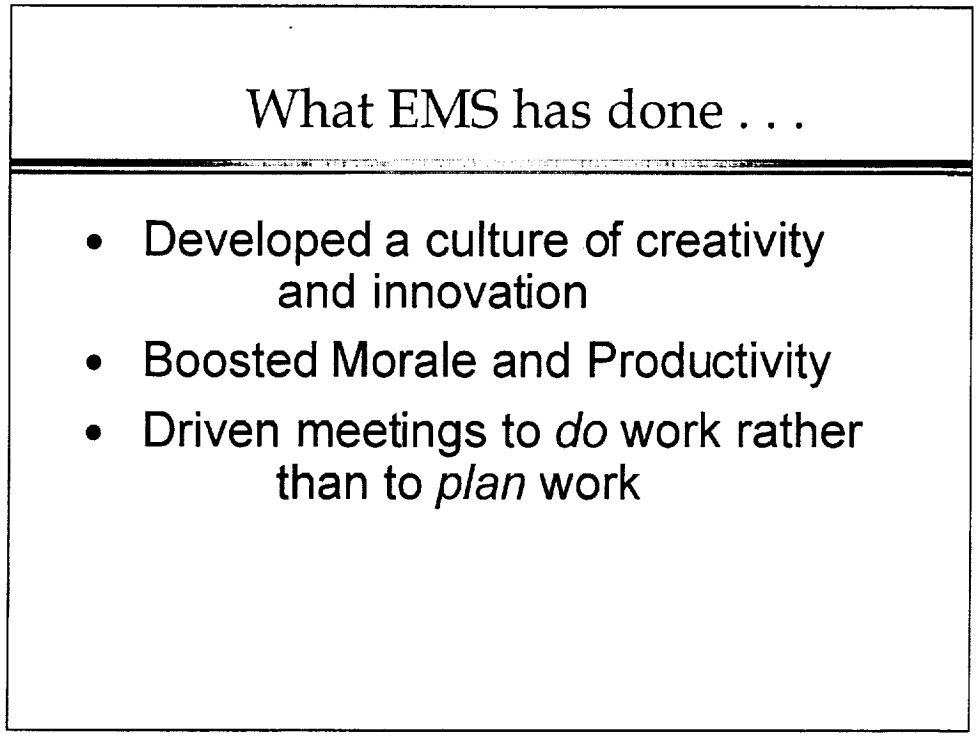
The EMS software used in the agency-wide license is:
- GroupSystems by Ventana Corp.
- WorkGroup Edition
- NASA has an agency-wide license
- Managed by MSFC
- Contact your Training Officer



What EMS Has Done

At NASA, EMS has:

- Developed a culture of creativity and innovation
- Boosted Morale and Productivity
- Driven meetings to *do* work rather than to *plan* work

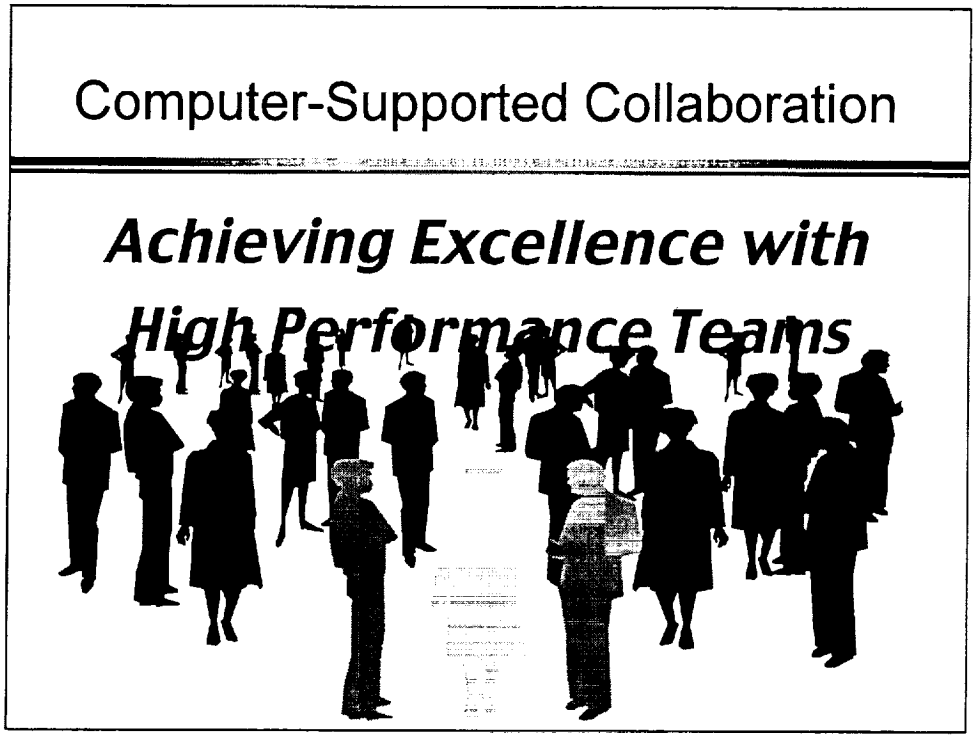


Benefits of EMS

Formal studies have documented significant benefits realized by using EMS.

Benefits of EMS

	Labor Saved/Project	Flow Time Saved	No. of Projects
IBM	55.2%	92%	50
Boeing	72.0%	65%	64


Computer-Supported Collaboration
Achieving Excellence with
High Performance Teams

More Information

Anyone interested in using EMS to enhance team performance should contact the training officer at each NASA Center, or contact:

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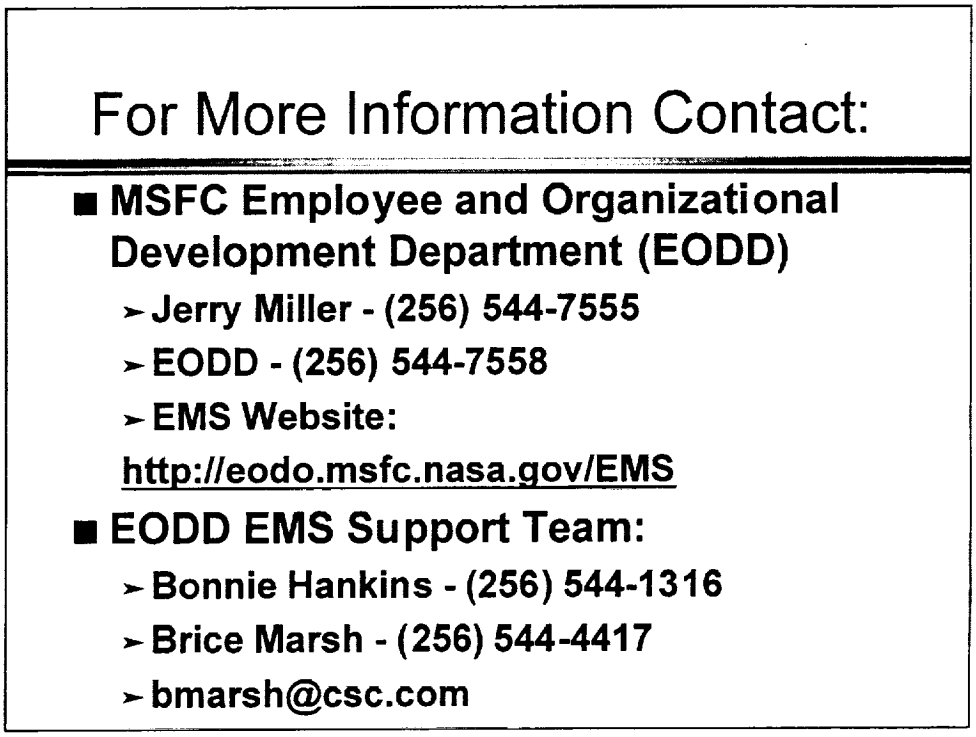
Brice Marsh (256) 544-4417 - Brice.marsh@msfc.nasa.gov



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The document contains the proceedings of the Workshop on Advanced Group Support Systems and Facilities held at NASA Langley Research Center, Hampton, Virginia, July 19–20, 1999. The workshop was jointly sponsored by the University of Virginia Center for Advanced Computational Technology and NASA. Workshop attendees came from NASA, other government agencies, industry, and universities. The objectives of the workshop were to assess the status of advanced group support systems and to identify the potential of these systems for use in future collaborative distributed design and synthesis environments. The presentations covered the current status and effectiveness of different group support systems.

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