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Using Group Support Systems to Facilitate the Research Process

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ABSTRACT

Group Support Systems (GSS) and their effects on group processes and outcomes have been an object of intense study over the past ten years. The purpose of this paper is to take a different perspective with respect to GSS research. Rather than discussing research about GSS, we will discuss the capabilities of GSS tools to support the process of doing research. A model of the steps involved in the research process is discussed and specific suggestions for the application of GSS tools are mapped to these research steps. GSS can provide a variety of benefits to researchers, including basic meeting support for multiple researchers in developing elements of the research project, electronically recording data from subjects, performing data analysis, and integrating information and data across the entire research process.

1.0 Introduction

As researchers in the field of Information Systems (IS) we tend to focus on applying computer tools to individual, group, or organizational tasks. Research into one particular set of tools, Group Support Systems (GSS), has concentrated on the effects of supporting such group tasks as idea generation [5,10], planning [7,18], decision making [3,12], and negotiation [1,15]. Generally, the research has found evidence that GSS can have an important impact on these tasks.

The purpose of this paper is to suggest applications of GSS tools to a different set of tasks--those of the researcher. The suggestions in this paper for applying GSS tools to research tasks are principally intended to enhance our efficiency and effectiveness as researchers. However, a secondary purpose is to help promote the adoption and diffusion of GSS within the university setting. In an influential early paper on GSS, Huber [14] reasoned that, "there may be a critical frequency of [GSS] use that must be attained in order for the system to survive in any given organizational environment" (p. 198). He suggests that GSS must support a range of tasks and capabilities to attain a critical frequency of use. Thus, to become firmly established in the university setting, GSS must be able to support research, teaching and administrative tasks.

Over the last five years we have been engaged in GSS use, training and research. In this paper we have drawn upon our use of GSS tools, as well as additional ideas as to how these tools could be used, to support the research process. We will start with a generic model of the research process, then relate possible GSS applications to each step in the model. Next, potential benefits are summarized and two case scenarios described. Finally, we will discuss how GSS could be used to bring together researchers from different universities, disciplines, and ultimately to include increased practitioner participation in the research process.

2.0 Research Model

There are many books and models available which describe the steps in the research process. We have selected a model developed by Jenkins [16], which includes a sequence of eight steps, from the initial idea through dissemination/publication. This process is by no means a simple sequence of steps from the beginning to the end. As researchers ourselves, we experience the process as dynamic, even volatile. At times we progress from step to step in an orderly manner, at other times we are working on many steps simultaneously. Likewise, Jenkins stipulates that this research process "does not exist in a vacuum." The researcher will be influenced by a number of outside factors related to the paradigms of

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his/her field and beyond. While this model does not include all the potential intricacies of the research process, it does provide a concrete basis for our discussion on the application of GSS tools to the research process.

The first step in Jenkins' model is generating **ideas** for the research project. This is frequently an unstructured process, involving the inputs of other researchers who often provide ideas for future research in their work. Once an initial concept has been formed, a **library search** is used to determine what research has been conducted in the selected area.

The result of many ideas and much searching leads the researcher to refining a **research topic**. Without a clear research objective, including research questions and hypotheses, it becomes increasingly difficult to proceed through each subsequent step in the research process. Once a research objective has been developed, the next step is to select the most appropriate **research strategy** or methodology to obtain the research objective. There are many factors that must be evaluated and alternatives considered in order for the selection of an appropriate strategy.

The research strategy will lead to developing the **experimental design** and the necessary experimental (or quasi-experimental) procedures and measurement instruments. Once methods and procedures have been selected and established, **data collection** can commence. While we often focus much of our attention on this step of the research process, there is obviously much preliminary work to be done.

Once the data is collected, **data analysis** can begin. This process involves applying the appropriate statistical technique(s), both quantitative and/or qualitative, and interpreting the results. The final step in the research process is to **publish results** of the research.

3.0 Group Support Systems

In this section we will discuss the characteristics of GSS tools which facilitate the research process. We will also overview the toolkits from two commonly available GSS, GroupSystems (from Ventana Corporation) and VisionQuest (from Collaborative Technologies Corporation). While there are other products, these are the most widely available to universities, as well as commercially, and represent the current state of the art in GSS design. Further, for us to provide concrete examples of our experience we must limit the scope of the paper by excluding other products. Throughout the remainder of this paper we will reference GroupSystems tools with a "(GS)" and VisionQuest tools with a "(VQ)." (While these tools have been called Group Decision Support Systems (GDSS), or Collaborative Work Support Systems (CWS), we choose the name GSS, the emerging name for such tools.)

3.1 Characteristics of GSS Which Facilitate Research Use

The GSS technology usually includes multiple microcomputers operating on a local area network, running special group-oriented software. The computers can be in the same room to support face to face interaction, in which case a public screen is added to display and edit information during supplementary verbal discussions. Alternatively (or in addition), the computers can be in different rooms to support dispersed, and possibly asynchronous, interaction. The dispersed setting supports collaboration that may take place "anytime or anywhere," overcoming many practical barriers to collaboration. Either arrangement allows researchers (or subjects) to take advantage of the GSS software, while working alone or in groups.

Current GSS are designed around a toolbox approach which provides a great deal of flexibility. The idea of a toolbox is that a number of software modules or tools are included which may be used independently (e.g., for a simple brainstorming activity) or linked together to accomplish an integrated, multi-activity process. Linkages are accomplished by using the output from one tool as the input to another tool (e.g., passing the list of ideas generated in a brainstorming session to an evaluation tool where the ideas may be rank-ordered). The versatility of GSS for new applications is derived from this tool independence and the ability to use the output of any tool as the input to most any other tool. When each tool is used, all transactions are recorded in one or more data files to print or load into other GSS tools. Additionally, GSS may include logging functions to capture individual and group actions.

The capabilities of GSS tools may be enhanced by integrating them with non-GSS software. The ability to import/export ASCII format files allows various types of software to be integrated with the GSS. For example, whereas GSS tools focus attention on agenda-driven, outcome-oriented interactions, integrating E-Mail adds a relatively unstructured media for less strictly defined communications. Additional integration with other software packages could provide increased GSS functionality. Examples of such software include: statistical packages to provide specialized analysis and graphical routines; word processors or desktop publishers which feature distinctive report formatting capabilities; and database management systems which help store, organize and retrieve large amounts of captured data.

3.2 Generic Activities Supported by GSS Tools

GSS tools are often categorized by the type of generic activity they support. Three general categories include Generating, Organizing, and Evaluating ideas, concepts, and judgments [2]. Although usually applied to generic meeting processes, these also may represent generic research processes. Each step in the research process may involve one or all of these activities, and hence the application of GSS tools.

Each of the generic activities may involve tools used directly by the researcher(s) or the subjects. That is, a generate tool could be used by researchers to develop questions for a survey, and also used by the subjects to generate responses to the questions. Looking across the entire research process, the subjects will use tools in the Data Capture step, while researchers may potentially use GSS throughout the entire research process.

4.0 Application of GSS Tools in the Research Process

It is our contention that innovative applications of GSS tools throughout the research process can make our work more efficient and effective. In regards to addressing multiple research-related objectives, GSS tools can be viewed as filling four general roles:

1) Research Object: Up to now, the IS field has mainly focused on using GSS as an object of research, i.e., as an independent variable.

2) Research Development Tool: A majority of the sample applications we discuss involve using GSS tools to develop research projects. For example, using GSS in the traditional meeting support sense to facilitate the group dynamics involved when multiple researchers are collaborating. A quick perusal of most IS journals or conference proceedings will reinforce the collaborative nature of our field since most articles/papers have two or more authors.

3) Research Implementation Tool: GSS can be used for implementing research in the data capture and analysis activities, involving both quantitative and qualitative data.

4) Research Environment: GSS can be used as an environment with which to study the various phenomena by isolating certain group characteristics/processes that would otherwise be unattainable without such support. This especially pertains to group dynamics phenomena, such as groupthink, feedback, and consensus development.

The following paragraphs include examples of how these tools have been, or could be, applied to the research process. For some steps there are many applications and ideas, for others the current state of GSS tools do not yet afford many opportunities of support. Subsequently, we also present two example scenarios of studies in which we used multiple GSS tools to support various steps of the research process.

The first step in the research process is generating **ideas** for developing research projects. It is important to make a distinction between generating ideas, as a step in the research process, and the generic idea generation activity. This research step may also include organizing and evaluating ideas.

Both individually and collectively, we have used many of these tools for numerous research-related brainstorming sessions to generate ideas for: research areas/topics, questions/hypotheses, methodologies, variables, tasks, survey questions, subjects, etc.

Idea generation is one of the most common applications of GSS, and there are several tools which can be used in different ways to support the idea generation process. Different GSS tools essentially provide alternative means of

structuring the generation process. For example, if the goal of the idea generation session is to generate as many ideas on a single topic, then idea generation tools such as Brainwriting (VQ) or Electronic Brainstorming (GS) will enable the group members to accumulate a "pool" of ideas (e.g., generating ideas for potential tasks to be used in a given study). This pool may need to be further refined using a categorization tool, such as Compactor (VQ) or Idea Organizer (GS). However, other idea generation tools such as CommentCards (VQ), Compactor (VQ), Idea Organization (GS), or Topic Commenter (GS), which allow entering responses directly into categories, may be more productive when the initial task is more clearly defined (e.g., generating survey questions for several specific factors in a given study). In general, when using any of these tools we have found the sessions to be most productive when the group has a clearly defined outcome/goal for the session and follows Osborn's [19] basic brainstorming instructions (which promote idea generation and defer evaluation).

Once ideas have been generated, and placed into categories if necessary, some evaluation and selection of ideas is often necessary. There are different ways in which GSS tools can support this evaluation. One set of tools can be used to rank or rate the ideas (or categories). Possible tools include Ranking (VQ), Rating (VQ), or Vote (GS), or Alternative Evaluator (GS) or Score and Allocate (VQ) for a multicriteria evaluation. These latter tools support applying criteria to the alternatives and assigning weights to the criteria (e.g., to evaluate alternative research questions, criteria such as potential contribution, feasibility, cost, subject availability could be used).

The generation of ideas is for some individuals one of the more difficult steps in the research process. One way to increase the number of ideas is to increase the number of people generating ideas. However, idea generation research has shown that groups tend to be quite dysfunctional [9]. GSS generate tools have been shown to enable groups to overcome many of these dysfunctional behaviors [7,12,13,18], and therefore should enable researchers to be more productive in this step and subsequent steps of the research process.

Applications of GSS tools are limited in their support for the **library research** process. However, we have successfully used GSS tools for identifying sources of relevant information (e.g., books, journals, potential reference disciplines), as well as generating a list of people who are actively engaged in an area of research. Other technologies are also available to support this process, such as bibliographic data bases and on-line retrieval systems which allow on-site or even remote access to library materials. Currently, data from these systems may be downloaded into an ASCII file. This file could further be passed to a GSS categorization tool, such as Compactor (VQ) or Idea Organization (GS), for researchers to organize references into categories. Likewise, this file could be loaded into an individual word processor or group writing tool, such as Group Writer (GS), for jointly developing the research report. While traditional joint writing ventures may tend to be more linear in nature, tools such as those discussed in this paper may enable collaboration in a more parallel process.

Idea generation tools can support developing alternative **research topics**. As indicated earlier, it is extremely important to generate a clear, unambiguous statement of the focus for any study. One tool which would be quite useful is Policy Formulation (GS). This tool allows several people to iteratively develop and refine a topic statement. This could be particularly useful for research projects involving multiple participants or dissertation committees. This tool could also be used for other key statements such as research questions and hypotheses.

Idea generation tools could also be used to generate alternative **research strategies.** There are many factors to evaluate in the selection of a research strategy, such as appropriateness, feasibility, or risk involved in conducting the study. A multicriteria decision making tool, such as Alternative Evaluator (GS) or Scoring (VQ), could help evaluate strategies based on these factors.

In our experience, these first four steps often occur concurrently. As described later (in the first scenario) a tool such as Comment Cards (VQ) or Topic Commenter (GS) could support work on all four steps at once, compressing the time involved in laying the initial foundation of a project. This enables researchers to not only work in parallel, but also enables them to address several of the steps in the research process in a parallel manner.

Again, idea generation tools may be used to develop different **experimental designs** and related materials. Tools such as CommentCards (VQ), Compactor (VQ), Idea Organization (GS), or Topic Commenter (GS), which allow participants to assign their ideas or comments to specific topics/categories, enable researchers to set up categories for generating alternative methodologies, different designs, risk, potential subjects, and other problems or concerns. Additionally, these tools could support the development of survey questions, experimental procedures and instructions.

While we tend to think about doing research on GSS, we can easily use many of the GSS tools to **capture data** for other research topics. In Section 4.0 we indicated that GSS can help implement the planned research. The generic design of GSS tools permits them to be applied to a wide variety of research methodologies for studying both group and individual level phenomena. GSS tools have direct applications to opinion research, group feedback analysis, focus groups, critical success factors, and assessment methodologies, to cite only a few examples.

Many different GSS tools have been successfully used to collect data for wide variety of studies. For example, Fellers, et al. [9] elicited critical success factors and rankings from knowledge engineers involved in designing, developing and managing expert systems. Davis, et al. [6] used a GSS for a group of practitioners and academics to develop and prioritize top IS issues of the nineties. In both cases, generate tools were used to elicit ideas, then evaluate tools were applied to capture numeric judgments to weight the relative importance of these ideas.

GSS facilitate the capture of both qualitative as well as quantitative data. Quantitative data may be captured in a variety of formats, such as ranking, rating, point allocation, subgroup selection, or multi-criteria rating. Generally these tools are used by participants working independently, after which their judgments may be pooled and the results shown. Immediate presentation of group level results also may be used as feedback to the group preceding another evaluation round or other activities. This iterative method may be useful for studying such group dynamics issues as groupthink or other group influence phenomena.

Regarding qualitative data capture, the variety of idea generation tools, as well as electronic survey tools that include open-ended responses, provide different ways to gather responses from subjects. Most commonly, a generate tool is used to facilitate an interaction between participants, permitting people to work off of one another's ideas, gaining a creative synergy. However, it is also possible to facilitate independent work when individual levels alone are the object of study. For example, the Idea Organization (GS) tool allows the facilitator (or researcher) to selectively retrieve ideas from participants; or the Topic Commenter (GS) tool could be set up with a separate topic folder provided for each participant. In Brainwriting (VQ), separate agenda items (or entire meetings) could be set up for each participant. Where more constricted or focused responses are sought (as in open-ended survey questions), an electronic questionnaire tool, such as Questionnaire (GS), may be used. Thus it is possible to use the GSS as an alternative to paper and pencil means of capturing individual reactions, question responses, protocols, and so forth. Fellers, et al. [11], who experimentally compared electronic to paper and pencil survey responses, found that the content of responses captured electronically did not significantly differ from paper and pencil responses. Also, subjects tended to provide more information responding to electronic survey questions.

In Section 4.0, it was noted that there were four general roles for applying GSS in the research process: as a research object, a research development tool, an implementation tool, and/or as a research environment. Data capture applications address the first, third and fourth roles. As an object of study, data regarding how GSS is used may be captured through the transaction logging capabilities. (A log file is simply a recording of the separate entries made by each participant, often including time stamps and the specific key pressed.) GSS tools, especially the generate and evaluate tools, may facilitate directly capturing quantitative and qualitative data. Finally, the GSS may be applied as an environment in which certain phenomena, especially relating to group dynamics, can be studied (e.g., through the use of automated, real-time feedback mechanisms or the effects of different types of information sources on group decision making quality). For example, McLeod, et al. [17] used a GSS to provide real-time feedback to specific

individuals, during a meeting, without interrupting the other members of the group.

Regarding the **analysis** of quantitative data, the group may directly apply the evaluation tools to produce standard outputs, which may be used by the group as well as the researcher. Averages, ranges, voting distributions and even concordance statistics are available as standard output from certain tools. Generally, however, more advanced statistical analysis requires reformatting (via special programming or manual reentry) of the standard outputs into files which can be compatibly loaded into a statistical package. Similarly, the GroupSystems individual log files provide a rich source of data which must be reformatted for further analysis.

We have found that GSS tools can provide substantial value added for analyzing qualitative data, particularly the task of assigning textual responses to nominal categories based on their content or meaning. This task is normally quite time consuming and presents interpretation and transcription problems. Also, to accomplish this with an acceptable degree of rigor requires eliciting and summarizing the views of multiple judges. We have used the Issue Organization (GS) tool on a number of occasions to significantly streamline this task (the Compactor (VQ) tool may be similarly applied). Either independent judges or the participants themselves individually review each idea in a list and move it into a category. (An initial set of categories is usually supplied by the researcher, drawn from the discussion or theoretical frameworks.) The standard output from the Compactor (VQ) tool merges the separate classifications and reports the percentage of judges who placed each idea into each category. (To do this with the Issue Organization (GS) requires a special programming routine.) The percentages are easily translated into frequency counts from which a concordance statistic [20] for inter-rater reliability can be directly computed. Categorizing may be done iteratively to develop consensus between judges.

One of the traditional bottlenecks with preparing any collaborative work for **publication** is the actual writing process. GSS tools such as CommentCards (VQ), Group Outlining (GS), and Topic Commenter (GS) can be used to support the joint development of outlines; while such tools as Group Dictionary (GS) and Group Writing (GS) can also be used to support the collaboration required in this step. Electronic outputs generated at any point in the research process can be moved directly into the final document. These outputs can also be loaded into word processors or desktop publishing system to support the writing process. The use of GSS tools, either stand-alone or with other tools, could enable researchers to be more efficient in the writing process.

4.1 Benefits from GSS Support of the Research Process

GSS may provide four major types of benefits to the research process. The most obvious benefits are related to meeting support. GSS can support the interactions of multiple researchers just as it supports other group task interactions. Likewise, meeting support benefits can also apply to individuals and groups of subjects who are providing information directly pertinent to the research, such as with focus groups. Evidence for these benefits can be drawn from the expanding base of GSS-supported meeting research. This research indicates that GSS tools have allowed groups to generate more ideas [10,12], make higher quality decisions [12,22], participate with greater equality [13,22], and with higher participant satisfaction [7,18]. The rationale for this improved performance is based on the fact that GSS tools provide groups with anonymity, simultaneous participation, process structuring, electronic recording and display of information, and extended data processing capabilities [2].

A second set of benefits relate to electronically recording data from subjects. Having subjects directly enter data (e.g, survey responses, communications, judgments) into the GSS eliminates transcription costs and potential interpretation errors. It also drastically cuts the turnaround time from data capture to analysis. This can make it possible to feed back analysis results to the subjects or researchers in real time. We can look forward to more dynamic research studies in the future, where researchers utilize real time analysis to respond to ongoing behavioral contingencies.

A third set of benefits involves the application of GSS tools for data analysis. Quantitative GSS

evaluation tools can be used by researchers (e.g., aggregating the evaluations of multiple observers). Additionally, GSS organize tools have been very useful in the analysis of qualitative data.

A final benefit is the efficiency derived from integrating information and data in a compatible electronic form (e.g,, ASCII format) across the entire research process. The advantages are especially evident when assembling the final report from pieces developed during different steps of the project.

In conclusion, we reiterate that these benefits are relevant to the research process, in any discipline. Whereas GSS have primarily been used to study the effects of this technology on groups, this paper has attempted to underscore the value GSS may add to how research is performed. To better illustrate the research applications of GSS, we will briefly describe two scenarios from our own experience.

4.2 Scenarios

What follows is an example of how we applied GSS tools to support the steps of the research process for a particular experiment. Since we often learn much by reflecting on our previous experiences, we have also included in this example ways which we could have additionally applied GSS tools to support the research process, if we knew then what we know now.

Various GSS applications were(/could have been) used in a research project comparing response bias effects of electronic versus paper (and pencil) surveys [11]. The biasing concern arose just prior to the start of a major GSS dissertation experiment [10]. There was concern that if mixed paper and electronic surveys were used in different treatments, that some media biasing effect could confound the findings. The researchers needed to address this question rapidly and effectively so as not to jeopardize the main study findings. A GSS (GroupSystems), and an electronic survey tool developed at Indiana University, were involved.

The media biasing concerns prompted the three researchers to meet using the GSS. The Topic Commenter (GS) tool was set up with categories for defining the potential problem, statements of the research question, references to related research, and methods of studying potential bias. The GSS made it possible to interact efficiently, exchanging ideas while recording the points for further refinement. We entered ideas into these categories for approximately one and one half hours. Next, the entries for each category in turn were displayed on the public screen to focus our verbal discussion while one person edited the text. A consensus to add a survey to the dissertation experiment was quickly reached. The survey would elicit subject attitudes toward the electronic survey tool media. Half of the subjects would complete the survey in paper form, and half in electronic form, to compare the responses for differences.

The Electronic Brainstorming (GS) tool was set up to generate questions for the survey instrument. After generating the questions, they were pulled into the ranking tool and quickly prioritized by each researcher. The aggregated rankings highlighted areas of agreement and disagreement which helped focus our verbal discussion. Based on this discussion, twelve questions were selected. The Electronic Brainstorming output was edited on the public screen using a text processor. Then this text was transferred to a desktop publisher to create the final paper instrument, and to the electronic instrument. Subjects then completed the survey via the electronic or paper instrument.

Both closed (numeric response) and open (text response) questions were included on the survey. The numeric paper survey responses were manually entered into the SPSS-X Data Entry software, while the paper text responses were typed into a text file. Responses from those who used the electronic survey tool were downloaded (using the tool features) into two files: one for numeric and the other for textual responses. Both numeric files were uploaded into SPSS-X for statistical analysis of differences based on media type and other factors (e.g., typing ability). The text responses were uploaded into the Issue Organization (GS) tool, where the three researchers independently categorized the responses into 27 subcategories within five major categories reflecting positive or negative orientation. A special program at Indiana University compared the categorizations, computing a simple inter-rater reliability. Responses placed in categories by only one of the three judges were removed from the list to leave a file of representative comments for each category.

The initial draft of the final paper [could have been] developed using Topic Commenter (GS) to facilitate building a single document with inputs from multiple authors. The categories corresponded to sections of the paper. Each author concentrated on a couple of sections, also adding notes to others' sections as they came to mind. This GSS [could have been] tool made available over a period of time to accommodate conflicting schedules. The Topic Commenter draft [could have been] uploaded into a word processor as a single version, and edited by each author in turn until it reached its final form.

In a second scenario, a variety of the above applications were also used in a study on expert systems development [9]. The idea for this study was the result of a Electronic Brainstorming (GS) session of IRMIS (Institute for Research into the Management of Information Systems, at Indiana University) researchers and affiliated practitioners. The participants generated ideas on potential research issues, then placed these issues into categories using Issue Organization (GS), finally using Vote (GS) to identify the most important research issue.

The first step in the actual study utilized Electronic Brainstorming (GS) to support the generation of critical success factors (CSF) for the expert systems development process by 13 knowledge engineers. The participants generated nearly 150 factors in 70 minutes. They then went on to categorize the factors into categories of their own choosing, using Issue Organization (GS). Finally, Vote (GS) was used to generate a straw vote to provide an initial ranking of the categories they had created. In a later step the researchers combined the output from the electronically-supported session with that of a subsequent discussion. Issue Organization (GS) was used to determine the final critical factors categories. Each participant was then sent a CSF questionnaire asking them to rank order CSF for expert systems development four key areas.

5.0 Linkages with Researchers and Practitioners

So far we have shown example uses of GSS tools for supporting individual and multiple researchers working on research projects. However, there is no need to restrict GSS usage to specific projects. In the Jenkins' model there are several levels or layers which go beyond the individual researcher or research program to reach out to others working in the same area (Jenkins uses the term paradigm), same field, or beyond to those working in related areas (e.g., for GSS researchers these areas would include such disciplines as management and communication). There are many ways GSS can be used to support this larger research infrastructure which exists at most universities. For example, GSS tools could be used to support a university-wide research committee generating ideas on how the university could better support research or deciding which researchers are to receive funding for competitive grants. As mentioned in the Introduction, it is important that GSS tools are not only utilized in specific research projects, but are also applied to support a wide range of academic and administrative needs.

However, we should not limit our focus to just IS researchers or academia, rather we should also envision linkages to practitioners in industry (such as via advisory board). The GSS is one means of providing the linking mechanism. It is becoming increasingly important to include greater participation by practitioners in the IS research process--not just as subjects but as participants--contributing their ideas, support, and direction. Currently, this would most likely involve the participants coming to the discussion where the GSS is currently available. As the ability for any time/any place interaction increases, the GSS may be capable of bringing the people to the discussion, wherever it may be, regardless of geographic and temporal boundaries.

One example was a gathering of numerous GSS researchers and interested practitioners at a demonstration of GSS tools (GroupSystems and SAMM) at the International Conference on Information Systems (ICIS) at Minneapolis in 1988. The participants were not only able to experience the systems, but also used some of the tools to generate ideas on such topics as key research issues, potential research topics, and possible collaboration. Another similar example include the SIM gathering in Georgia for an IS critical issues study [6].

Expanding these linkages will require that researchers share their ideas, techniques and special software developments with one another regarding how to apply GSS to the research process, as we have attempted to do in this

paper. Support is also needed from GSS product developers to provide special research tools (e.g., full-feature electronic survey instruments, comprehensive logging facilities, real-time monitoring facilities).

6.0 Limitations and Barriers to Advancement

This paper has provided a number of suggestions for the use of GSS tools to improve both the effectiveness and efficiency of the research process. While this potential does exist, there are many potential barriers to advancement in this area. One common barrier is the cost factors involved in setting up and utilizing a GSS as this technology is not yet affordable by all universities. Additionally, the expertise to set up and run a GSS is also not yet widespread. Once a GSS facility is available, the demand for such a facility and those trained to run it may outstrip the available resources. This may create tensions as conflicting priorities vie for limited resources.

As with any new technology there are a number of potential problems that can exist as a result of its use, or misuse, and GSS is no exception. While a detailed analysis of these factors is beyond the scope of this paper, a few comments are necessary. As with any new technology there can a resistance to its introduction, use, or imposition upon an individual, group or organization. While there are many advantages espoused for GSS use, there will undoubtedly be new social, organizational and ethical problems that emerge from GSS use. As researchers it is our responsibility to be alert to such developments and ensure that GSS tools are not misused or abused.

7.0 Concluding Comments

The primary outcome of this paper was to explore means of making our work more efficient and effective by the use of GSS tools to support the research process. We have noted that there were four general roles GSS may play in the research process: 1) as a research object, 2) as a research development tool, 3) as a research implementation tool, and/or 4) to create a research environment. GSS tools can provide a variety of benefits to researchers, including basic meeting support for multiple researchers in developing elements of the research project, electronically recording data from subjects, performing data analysis, and integrating information and data across the entire research process.

Many universities currently have access to GSS given vender efforts to encourage research and testing of this new technology. One purpose of this paper was to broaden the horizon of potential GSS applications in a university setting. Viewing GSS as a tool for improving the efficiency and effectiveness of doing research--whether or not technology is itself under the microscope--can help gain wider acceptance for supporting investments and interdisciplinary involvement in the technology. That is, research applications could help GSS usage reach the critical frequency for successful adoption suggested by Huber [14].

We have provided a model of the IS research process and have mapped specific GSS tools to this model, along with a discussion of how these tools can be applied. While our discussion is by no means inclusive, we have attempted to provide an overview of the main ways in which we have applied, or could apply, GSS tools to support the research process. Additionally, we have mentioned other tools or technologies which can be used to support those engaged in the research process. While we have presented our discussion from the viewpoint of those engaged in IS research, there is obviously no reason to restrict the application of these tools to IS researchers only. In fact, providing GSS tools to our colleagues to assist them in the research process should enable us to not only provide a service for them, but also provide a means of creating potential linkages for collaborative work. Our ultimate goal is to make us all better at the work we do--and with this goal in mind we hope that this is a very practical paper for all who are engaged in the research process.

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