NETMEETING: A TOOL FOR COLLABORATIVE SIMULATION MODELLING

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Abstract: Effective collaboration in simulation modelling is possibly one of the key factors in the success of a simulation project. Computer Supported Cooperative Work is a research field that has investigated this in other domains. This field has led to the technological development of software, or groupware, to facilitate group working. This paper investigates the appropriateness of groupware in simulation modelling by introducing Microsoft's NetMeeting, an exemplar of this technology. This groupware is discussed in terms of simulation modelling activities. A short survey of expert opinion is also presented to evaluate the usefulness of this technology. The survey shows that application sharing is clearly perceived to be the most useful feature of NetMeeting.

Keywords: Simulation Modelling, Groupware, Computer Supported Cooperative Working.

1 INTRODUCTION

This paper serves several purposes. Firstly, it is intended to highlight the need for effective cooperative work in simulation modelling. Secondly, it is intended to introduce the reader to a research and development field that focuses on this area (Computer Supported Cooperative Work and Groupware). Thirdly and finally, it is intended to demonstrate to the simulation community a useful software tool that can be used to support cooperative work (NetMeeting).

This work comes partly from the EPSRC Technology Programme Network *GROUPSIM*. This programme is dedicated to investigating strategies and infrastructures that can support collaboration in simulation modelling. It attempts to draw three possibly complementary areas together: simulation modelling, computer supported cooperative work and groupware, and networked simulation. This paper will review the first and second of these areas (a short discussion of simulation modelling is included in this paper for completeness). Networked simulation collectively addresses the use of many computers to enhance simulation modelling and includes distributed (interactive) simulation, parallel and distributed simulation, and web-based simulation. This topic that will be considered with respect to the others in future work. For now let us consider the importance of effective cooperation in simulation modelling.

Within the simulation modelling community (but not necessarily the wider communities involved in the support of decision making) the techniques involved in simulation modelling have been used in decision support systems to analyse aspects of organisational processes for around forty years [Law and Kelton, 1999; Pidd, 1998; Robinson 1994]. Robinson and Pidd [1998] have studied some factors that play a key role in the success of a simulation project. Providers of simulation expertise (simulation consultants) and their customers were interviewed. Analysis of these interviews revealed three common factors related to aspects of cooperation related to success. These were "*there will be regular communication between the provider and customer,*" "*regular meetings will be held between the customer and the provider,*" and "*the project will be a team effort.*" These are catagorised as *Communication and Interaction* (frequency, clarity and appropriateness of communication and interaction with those involved in the

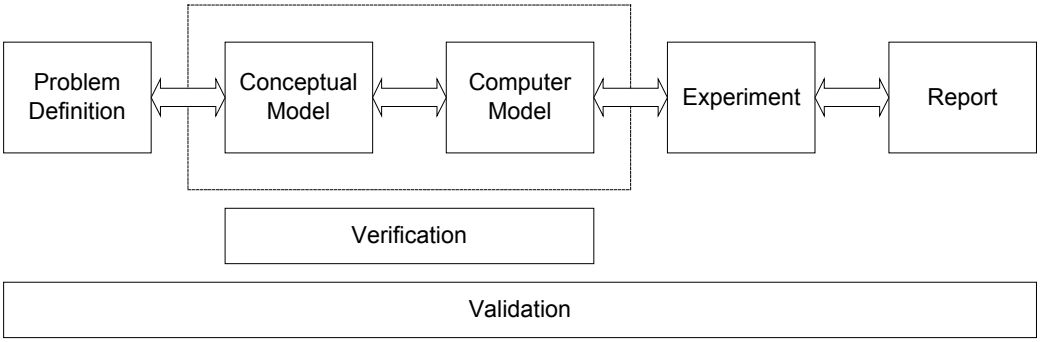

Figure 1: Simple Simulation Modelling Project

simulation project). A factor in a successful simulation project is therefore dependent on frequent meetings between customers and providers in the process of simulation modelling. These might involve the development of valid conceptual and computer models of an organisational process, the experimentation with that model, the reporting of results, and the decision making based the results.

Computer Supported Cooperative Work (CSCW) is the field that studies means to help people work effectively together. One of the major innovations in information technology that has resulted from this field is groupware. These cooperative applications help people work together in the same room or over large distances, at the same time or at different times. Applications range from electronic mail to general purpose enterprise client-server systems composed of integrated multimedia document management [Orfali et al., 1996; Poltrock and Grudin, 1998]. The market leaders in this field are Office/Exchange (Microsoft), Lotus Notes/Domino (IBM), and Groupwise (Novell) [News.com, 1999]. Some groupware systems can be extremely cheap (free!) or extremely expensive with consultancy being responsible for over two thirds of the costs [Field, 1996]. Adoption of groupware is usually justified by cost saving and a need to use contemporary systems. It is estimated that the groupware document management and workflow software market will represent a market of over $7 billion by 2003 [Dataquest, 1999].

There is, unfortunately, little evidence that the benefits of groupware have been taken up by the simulation community. This is possibly due to critical mass and a lack of general knowledge about the field (as simulation consultants quite rightly tend to spend their time in the tasks that reap immediate rewards!) This paper attempts to make a step down the path towards the introduction of groupware. The paper is structured as followed. Section 2 reviews some of the basic issues in the process of simulation. Section 3 reviews computer supported cooperative work and groupware. Section 4 introduces Microsoft's NetMeeting as an example of groupware and discusses some possible uses this software. Section 5 presents some results of demonstrating NetMeeting to a section of the simulation community. Section 6 concludes the paper with a short discussion of on-going work.

2 SIMULATION MODELLING

This section serves as a short introduction to simulation (in the role of analysis) and may be omitted if the reader is familiar with the field. More detail can be found in Law and Kelton [1999]; Macredie et al. [1999]; Pidd [1998]; and Robinson [1994]. Figure 1 shows a simple simulation project. A simulation project is usually initiated as result of a need to analyse a real world problem with a view to decision making (planning a new factory, studying various strategies for improving the efficiency of a manufacturing system, studying the implications of different evacuation strategies during an emergency, etc.) in a system that cannot be studied directly due to cost or danger. The project usually begins by defining the problem in as much detail as possible and identifying personnel to perform the study (experts in simulation, system stakeholders). The next step is to form a conceptual model of the physical system in which the problem exists. Diagrammatic techniques are typically used (activity cycle diagrams, event graphs, flow

		Time		
		Same	Different but predictable	Different but unpredictable
Place	Same	Meeting facilitation	Work shifts	Team rooms
	Different but predictable	*-conferencing	Electronic mail	Collaborative writing
	Different but unpredictable	Interactive multicast seminars	Computer bulletin boards	Workflow

Figure 2: 3x3 Map of Groupware Options (Grudin and Poltrock 1997)

charts, block diagrams, etc.). Consideration must also be given to how time advances in the system (time stepped, next event, continuous), to whether or not system activities take deterministic or stochastic time, and to how the system changes state (discretely, continuously, or both). Once there is agreement by the involved parties that the conceptual model is an adequate representation of the physical system (validation), it is translated into a computer model, which is then tested (verified) to determine if it conforms to the computer model (although with modern simulation environments the conceptual and computer modelling are often merged). The computer model is then combined with experimental data to attempt to discover more about the problem under investigation. Validation is carried out at all stages of the simulation project to ensure that the various models used do not deviate from the physical system being studied. Statistical analysis of experimental results can either result in recommendations as to how to solve the real world problem, or in further refinement of the problem (as more is discovered about the real world system).

A major theme in simulation is the interaction between consultant and clients. In virtually all steps of a simulation project there must be close and effective communication between the modeller and the stakeholders. Without this many errors may enter the project (imagine attempting validation without interaction with the client group). Frequent meetings of simulationists and clients can lead to extended project times and high cost due to, for example, difficulties in scheduling and the need to travel over long distances.

The next section introduces CSCW and groupware, and gives some examples of the type of groupware applications that exist. This is followed by a discussion of Microsoft's NetMeeting (a type of groupware *net conferencing*) and some results from analysis of its use.

3 CSCW AND GROUPWARE

Computer Supported Cooperative Work (CSCW) is a multidisciplinary field that appeared in the early 1980's as a response to the failure of Information Technology to properly support the needs of people working in groups and organisations [Grudin, 1994]. The field studies the development and use of computer-based methods to support work that is shared amongst individuals who may not be co-located. The field gave rise to groupware, "*computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment* [Ellis et al., 1991]" or "… *software that supports the creation, flow, and tracking of non-structured information in direct support of collaborative group activity* [Orfali et al., 1996]." There are many aspects to CSCW research ranging from the technological (computer support) to the sociological (cooperative work). Some consider CSCW as focusing on the sociological aspects of IT support for group working, while others argue that groupware stresses the technological aspects of the same [Grudin, 1994]. As evidenced by papers in the major CSCW conferences (CSCW, ECSCW, and CHI) the balance between sociological and technological research appears to have shifted in favor of technology in the early-1990's as groupware applications began to achieve market penetration (e.g. Lotus Notes). Most of the primary foundational work is dated prior to this time [Whitaker, 1996]. See Baecker [1993]; Grief [1988]; and Johansen [1988] for major examples of this work.

The Internet, the World Wide Web, desktop computing, office information systems, and local area networks have made possible many groupware applications, some of which are in daily (hourly!) use. Email, for example, is often cited as successful groupware as it allows the exchange of electronic documents and promotes information flow and coordination [Sproull and Kiesler, 1991]. Similar points can be made about other group communication facilitation technologies such as the various forms of computer-, tele-, video-, and net-conferencing [Grudin and Palen, 1995]. Information can also be shared using task-specific common media, or whiteboard variants (Ellis et al. [1991] and Whitaker [1996] cite many of these). Many companies and universities have rooms dedicated to remote conferencing that use a combination of technologies to effect communication. Groupware taxonomies have been suggested for the classification of applications and products [Johansen, 1991; Grudin and Poltrock, 1994; 1997; and Ellis et al., 1991]. Figure 2 shows a time and space taxonomy suggested by Grudin and Poltrock [1994; 1997]. This indicates possible groupware applications that are useful for tasks involving different types of meetings. Generally speaking, think of a situation at work. Many of us are, for example, used to meeting clients at the same time and in the same place. In this instance meeting facilitation technologies are useful. One company reserves a room in which the walls are whiteboards. In order to discuss the development of a business process, stakeholders are encouraged to draw their perception of their own processes. As the meeting continues, the stakeholders swap position and modify any processes they disagree with. The purpose of the meeting is discover the overall perceptions (and misperceptions) of those involved in the overall business process. This is also appropriate for meetings that take place between parties who meet at different but predictable times in the same place (work shifts) and for those who meet at different but unpredictable times in the same place (drop in team rooms) and may be replaced by a computer-based whiteboard. Alternatively, for example, in those situations where we wish to collaborate with others where we do not know where they will be, but can predict to a certain extent (i.e. by email address), we can use email to conduct business. The framework is useful in that it offers different ideas as to when a particular technology may be used. This is especially true as the simulation consultant faces many working situations when some or all of these situations may occur.

Grudin and Poltrock also offer a useful framework that considers groupware from the basic supporting themes of collaboration. These include technologies that support *communication*, those that support *information sharing*, and those that support *coordination*. Communication technologies include electronic mail (a technology that should be familiar to most), real time computer-, tele-, video-, and net-conferencing, and multicast audio and video (used to support, for example, internet-based concerts and presentations). Information sharing technologies can be split into shared information spaces that allow synchronous or asynchronous access. The major representative of synchronous shared information spaces is the whiteboard (see next section for an example). Asynchronous shared information spaces include computer bulletin boards and threaded discussion groups (netnews, etc.), document management systems that provide for the creation and reuse of documents as well as the control of access, concurrency, and versioning. Finally, coordination technologies include calendars and schedulers and workflow management systems such as Lotus Notes and SAP.

With this variety of technologies in mind, Microsoft's NetMeeting is now presented.

4 NETMEETING

Net-conferencing is a same time/different but predicable place groupware application. In other words it requires two or more parties to be logged on simultaneously to communicate remotely. It effectively performs the collaborative function of conferencing two or more parties working together on a particular task via the internet. Microsoft's NetMeeting is an excellent example of this. The product is reported (principally in Microsoft's press) as being used for applications such as remote training, collaborative design, augmenting existing software applications, virtual team support, accessibility, user support and many other situations where the emphasis is on reducing travel costs and saving time. It provides net-conferencing with other forms of groupware in one integrated package. These are text chat, whiteboard, file transfer, and application sharing. The package does not

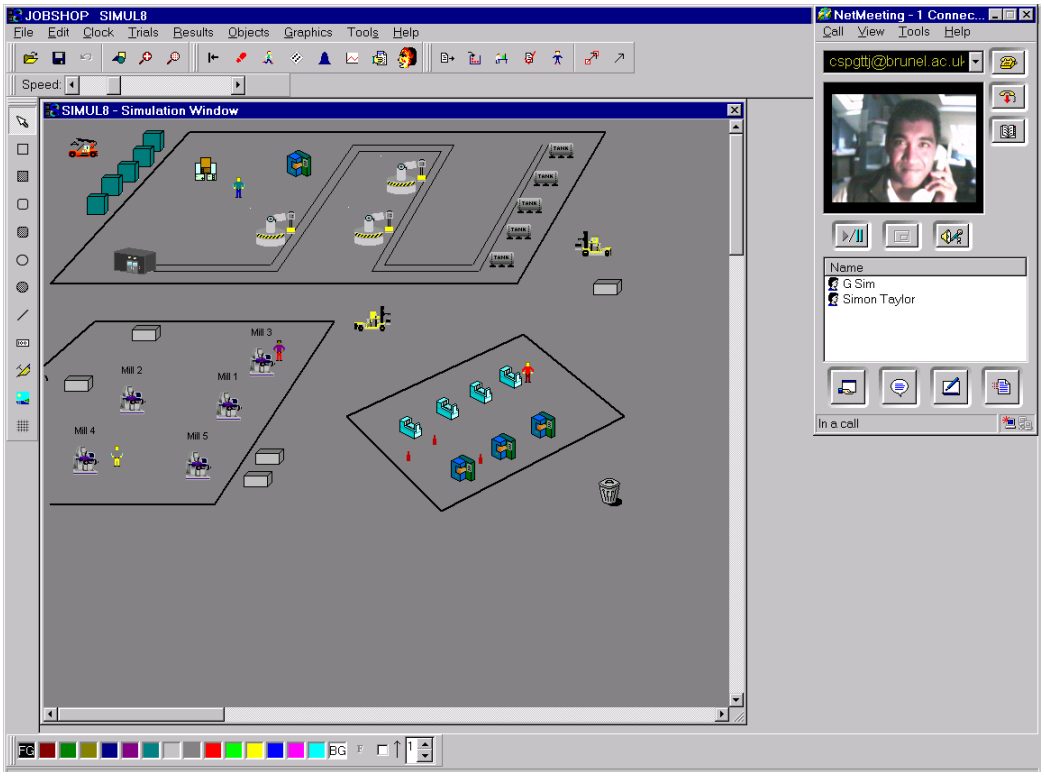

Figure 3: NetMeeting and Simulation Software

support (at the time of writing) multi-point audio and video. This is not too limiting as (arguably) the ability to see another's image is of limited utility, and multi-point audio can be achieved via a conferencing call using a normal telephone system. NetMeeting works acceptably on a laptop connected to the internet via a normal modem (faster communications are preferable for ease of use).

NetMeeting is fairly simple to set up and is guided via an install wizard. Once running, one user must "host" the meeting. This is performed by selecting one of many directory ILS servers that support NetMeeting (such as those provided by Microsoft; some companies have their own within a intranet). If a public directory server is used, to prevent unwelcome attention, it is imperative that the host registers him or herself with the option "Do not list my name in the directory" checked. If not, the host's name will appear with all other users listed on the directory server making it possible for anyone to be connected to the host (with unfortunate and quite unexpected consequences!) Private meetings are usually conducted by passing the host's name to all participants privately (via email for example). Connecting to a host is a simple matter of typing in the host's address and "placing a call."

Figure 3 shows an example screen shot of NetMeeting. The front end of the package is in the top left hand corner of the screen. It consists of a title bar displaying the status of the call (in this example there are two people in the call – this is shown by "1 Connection"). The address of the host is shown below the option bar and below that is the video image of the host (NetMeeting can only connect two participants by video). To the right of this are three icons that place a call, hang up a call, and list the participants of the directory sever. Below the video window are three buttons that alternatively control the video image, place a local video image within the remote video image window, and control the audio settings. Below that are the names of the meeting participants. Finally, the four buttons at the bottom of the NetMeeting window invoke the four integrated groupware applications. These are (from left to right) application sharing, text chat, whiteboard, and file transfer. The larger part of the screen shot is taken by a simulation application (in this case the simulation program is Visual Thinking International's Simul8 with a

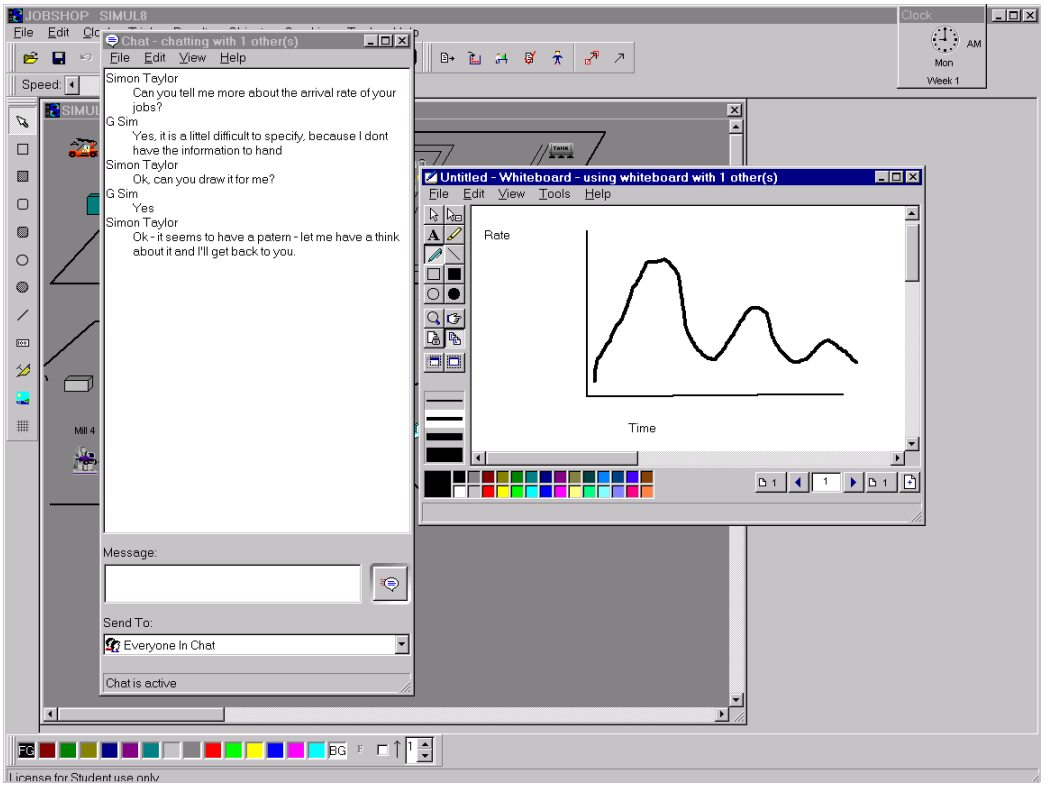

Figure 4: Text Chat and Whiteboard

simple job shop taken from the packages model library).

In figure 4 the NetMeeting window has been minimised to clear space. The figure shows the text chat and whiteboard applications. The text chat is useful for two reasons. If there is no realistic means of connecting participants together via a conference call, then a useful alternative is to connect via the text chat. This can be troublesome as, particularly for longer exchanges, to use the text chat a participant must type in his or her contribution to the chat session in the message box and then hit return to send it to one or more participants (the application provides the functionality for "side conversations"). Users can become impatient for those of us who are slow typists (sometimes the impression is given that the text chat session has crashed). On the plus side, text chat presents the opportunity for the development of many-way documentation and agreement, something that is perhaps difficult to attain via an exchange of emails (consider the problems of decision making with many users by email!) Text chat also provides security encryption and the ability to save a chat session as a permanent record of the meeting. The whiteboard application is useful as a multi-user "flip chart"; users connected to the NetMeeting session can access the whiteboard as and how they wish. The rather fictitious example is a conversation between consultant and client where the consultant is attempting to get a feel for how jobs arrive in the client's factory. The whiteboard (similar in look and feel to Microsoft's Paint) shows the client's first attempt to describe how the rate of job arrival varies over time. One could see the remote conversation continuing by the consultant showing the user how the distribution could be translated into a valid representation in the model.

Another application is File Transfer. This appears in a similar form to text chat; a menu of participants lists allows the user to choose to transfer a file to another single participant or to the entire complement of participants. The ability to transfer files between users is similar to attaching a file to an email. The integration of this application into NetMeeting is useful as it reduces the number of different applications that a user must select during a conferencing session. The ability to transfer files to all participants in the meeting is also useful as one

can ensure that at the end of a meeting all participants can receive a copy of the same file (possibly reducing another source of confusion and error). In terms of simulation, a consultant can make sure that all clients have the same copy of the data, model, etc. if necessary.

The final, and possibly most powerful feature of this package is the Application Sharing feature. This allows a participant in a NetMeeting session to share any application running on his or her computer. For example, a simulation package can be "shared" by selecting Application Sharing and selecting the simulation package from a list of running applications that NetMeeting can find on that participant's computer. Once the package has been shared, all participants receive an image of the package as if it were running locally on their computer (the simulation package show in figures 3 and 4 is actually running on the computer of the other participant in the conferencing session). Each participant can see the shared package and the results of any manipulation performed by the owner of the package. For example, the owner may communicate to the other participants (by text chat for example) that s/he is going to run the model to demonstrate how a part of the model works to the other participants. The owner runs the model as normal and the other participants will see the model animation as if the package were running on their own computer (with the caveat of communication speed). If one of the participants wanted to point out a model feature, or indeed stop the model and change some aspect of the model, the participant could request control from the owner. If control is granted, then all participants will see the mouse arrow annotated with the ID of the participant. The participant is then in *direct* control of the package running on the remote machine of the owner and may modify the model as they wish.

5 EVALUATION

Rather than assuming that all features of NetMeeting were useful, a short survey was conducted to elicit opinion on the usefulness of each of the groupware features. Three principal approaches were considered. The first was to send out a general questionnaire to simulation modellers via various email address lists. The second was to set up an interactive demonstration via the web and support this with a questionnaire. The third was to contact interested parties, demonstrate the NetMeeting groupware, and then follow up with a questionnaire.

Of the three approaches, the final one was chosen. The first was not considered as the author felt that the simulation community had received too many emailed questionnaires over the preceding months and did not want to add another. The second was discounted on grounds of development time. The third was selected as it allowed the author to present a "standard" demonstration of NetMeeting and to answer any outstanding questions. The questionnaire was then given to be filled in at the user's convenience.

The demonstration was given at nine different sites to approximately seventy subjects (one site involved a workshop led by the Simulation Study Group of the UK Operational Research Society). Eleven returns were made from users in industry, defense, and academia. This is relatively poor and indicates an error in the evaluation method (i.e. the questionnaire should have been filled in at the time of visit rather than after). The results are presented here therefore as an indication rather than exhaustive evidence.

The demonstration took the form of an example collaboration between two users (the demonstration site and a PhD student at Brunel). A laptop with NetMeeting was connect via a standard modem to a global ILS server. Each of the groupware features were demonstrated in turn with application sharing left for last. The application was loaded at Brunel and local and remote interaction were demonstrated. The communication mechanism used was telephone (mobile) rather than the audio feature of NetMeeting. This was due to feedback when audio was placed on external speakers (necessary for the demonstration). The evaluation of audio was therefore on the basis of telephone (in two cases conference calls). The most unpredictable element of the exercise was making the modem connection as various methods were used each time to find a working phone point. The video was shown – the image was quite jerky and it was pointed out that this was smooth if a network connected to the internet was used.

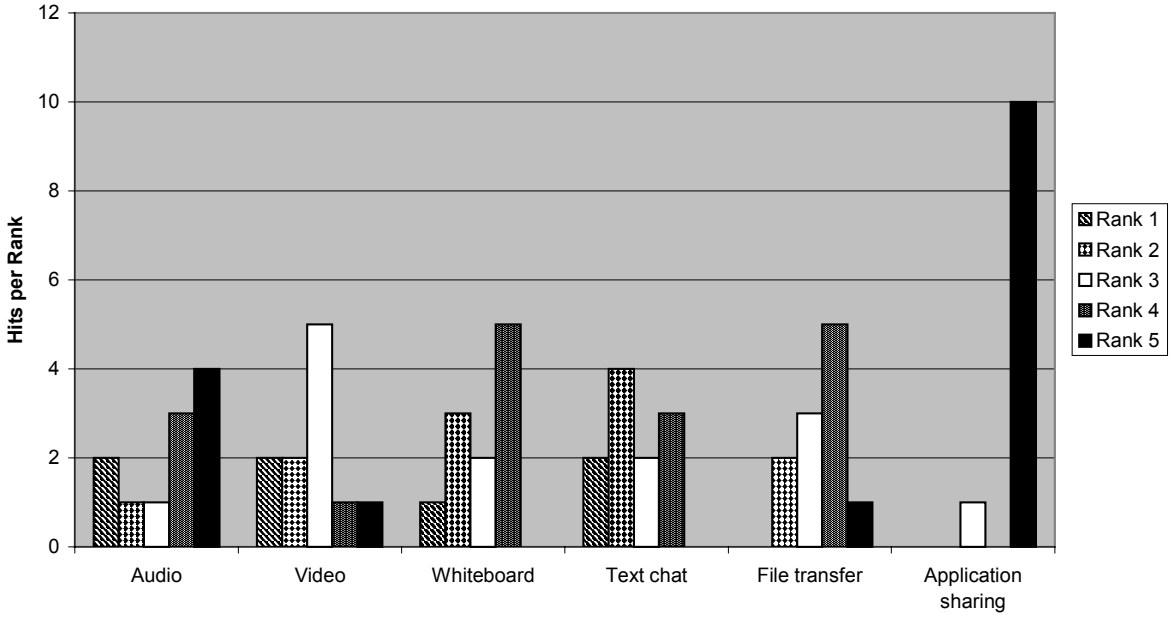

Figure 5: NetMeeting Feature by Rank

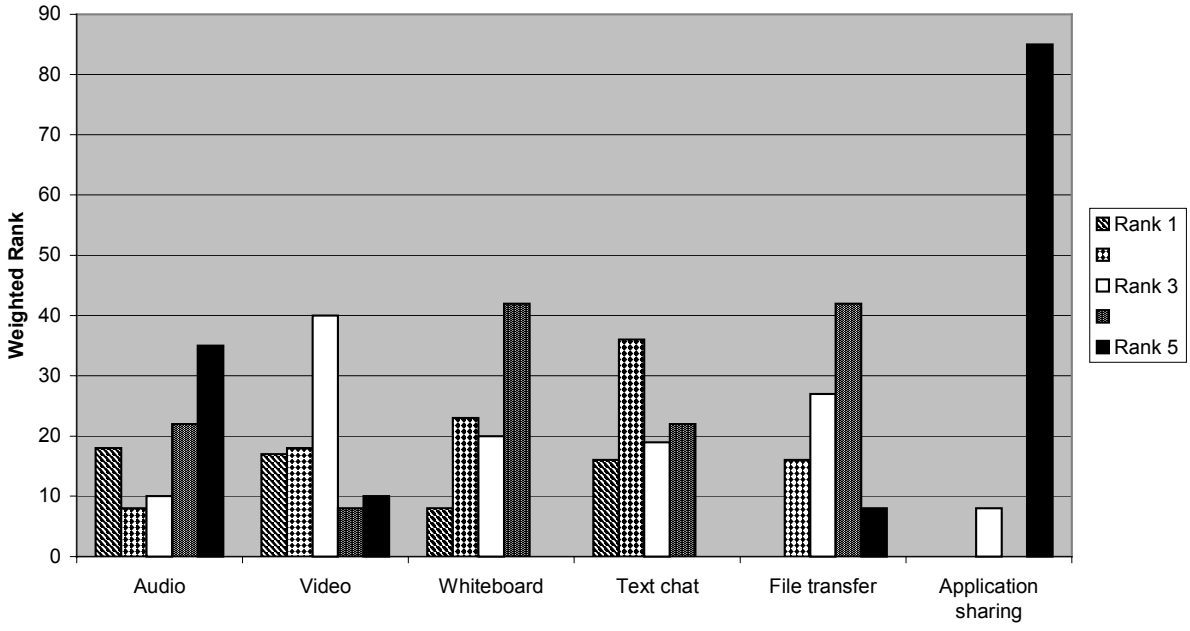

Figure 6: NetMeeting Feature by Weighted Rank

Figures 5 and 6 show the results from the evaluation. Each user was asked to rate the features on interpreted usability on a scale of 1-5. Each was also asked to weight their expertise of simulation modelling and computer technology. Hindsight suggests that the 1-5 scale should have been broader (to present a wider range of options) and that expertise should have been evaluated against other factors rather than just a number. Figure 7 shows the raw data while figure 8 shows the weighted data by expertise.

Both graphs show similar results. Relatively speaking, audio shows favorable results. Video performed moderately. Whiteboard performed well. Text chat performed poorly. File transfer also returned well. However, without doubt, application sharing performed the best. Although the cross-section of the simulation modelling community was small, the indication from this experiment is extremely clear. Whatever groupware features a technology such as NetMeeting has to offer, the ability to share applications over distance is an outstanding feature.

6 CONCLUSIONS

This paper has introduced on-going work in collaborative simulation modelling. This has taken the form of introductory material on simulation modelling and CSCW and groupware. An example of groupware was presented and results from a short survey were discussed. It is hoped that readers of this paper take the time to investigate NetMeeting for themselves as it appears that there is a perception that application sharing is extremely useful in simulation modelling. This work will continue over the next few years as it is a topic under investigation by the GROUPSIM Network.

Another part of the GROUPSIM work is an investigation of the relevance of Networked Simulation to commercial simulation modelling tools and techniques (another form of collaboration; machine to machine rather than user to user). This complex issue will be the focus of a panel discussion at UKSIM 2001.

For more information on the GROUPSIM Network, see www.brunel.ac.uk/~csstsjt.

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BIOGRAPHY

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