Improving Inter-personnel Communication Using the MRD's Desktop Conferencing and Multimedia Messaging Facilities

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Sammendrag/Abstract:

The Middle Road Demonstrator (MRD) is a system for communication support within cooperative work settings. The MRD is one of three demonstrator systems developed within the framework of ESPRIT Project 6155 - EuroCODE: CSCW Open Development Environment. The system was designed and evaluated in cooperation with a pilot group from the Department of Radiology at Rikshospitalet.

The MRD supports cooperative work by allowing users to share applications independent of time and space. The MRD supports both synchronous and asynchronous communication modalities. In both of these modalities, the MRD provides communication facilities based upon a "show, point and talk" functional profile.

The MRD's synchronous communication modality is realized through it's desktop conferencing facility, while it's asynchronous modality is realized through a multimedia messaging facility called the Snapshot Composer. These two facilities are thoroughly integrated with one another, and presented through a homogenous, task-oriented user-interface.

Radiologists within the pilot group identified a number of application areas for the MRD. They also stated that the MRD could help make certain processes involving inter-personnel communication more effective.This paper briefly describes the MRD's functionality. Thereafter, screen images depicting the MRD in use are presented. Lastly, the pilot group's evaluation of the system is summarized.

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Table of Contents

1 Introduction

The Middle Road Demonstrator (MRD) is a system for communication support within cooperative work settings [9]. The MRD is one of three demonstrator systems developed within the framework of ESPRIT Project 6155 - EuroCODE: CSCW Open Development Environment [5]. The system was designed and evaluated in cooperation with a pilot group from the Department of Radiology at Rikshospitalet [3, 2, 10, 8].

The MRD supports cooperative work by allowing users to share applications independent of time and space. The MRD supports both synchronous and asynchronous communication modalities [12]. In both of these modalities, the MRD provides communication facilities based upon a "show, point and talk" functional profile.

The MRD's synchronous communication modality is realized through it's desktop conferencing facility, while it's asynchronous modality is realized through a multimedia messaging facility called the Snapshot Composer. These two facilities are thoroughly integrated with one another, and presented through a homogenous, task-oriented user-interface [6].

Radiologists within the pilot group identified a number of application areas for the MRD. They also stated that the MRD could help make certain processes involving inter-personnel communication more effective. This paper briefly describes the MRD's functionality. Thereafter, screen images depicting the MRD in use are presented. Lastly, the pilot group's evaluation of the system is summarized.

2 The MRD

The MRD has been designed to fit into cooperative work processes as unobtrusively as possible. Within such processes, there arise settings and situations in which a person needs to, or is obliged or requested to, communicate with another person. It is at these moments that the MRD is used to support the initiation and reception of communication contacts.

With regard to communication contacts between persons, at least two contextual dimensions can be distinguished:

- whether the communicative interaction transpires in real-time or not (i.e., *synchronous* vs. *asynchronous* contact); and,
- whether an individual is the one *initiating* a communication contact, or *receiving* such a contact.

The interaction of these two dimensions creates four communication contexts; these are illustrated in figure 1(a). Within a cooperative work setting, this figure depicts how these communication contexts are experienced from the individual's point-of-view, rather than that of the group as a whole.

Figure 1(b) depicts how the design of the MRD's top-level interface directly reflects the four communication contexts illustrated in figure 1(a).

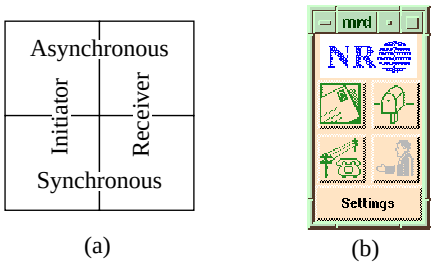

Figure 1 : *Communication contexts within cooperative work settings: (a) as experienced from the individual's point-of-view; and, (b) as reflected within the MRD's top-level interface.*

2.1 The MRD and communication support

2.1.1 Synchronous contact: desktop conferencing

The MRD's desktop conferencing support is primarily intended for situations in which persons need to discuss task-related material(s) "right at that moment". It provides for application sharing, telepointing and multi-party audio conversations via the data network. The application sharing and telepointing mechanisms are implemented within EuroCODE's Global Window Toolkit [1]. The conference audio facility is implemented within EuroCODE's Digitized Sound Toolkit [7].

All of the MRD's desktop conferencing facilities are orchestrated by the EuroCODE conferencing architecture, implemented within EuroCODE's Conference Toolkit [13]. The conferencing architecture enables a uniform means for coordinating of a number of conferencing applications. It also offers a well-defined interface through which it is possible to integrate third-party applications.

Many systems exist today which offer desktop conferencing as a kind of communication support. Use of the MRD's desktop conferencing facility is depicted later in the paper.

2.1.2 Asynchronous contact: multimedia messaging

The MRD's multimedia messaging support is primarily intended for less time-critical situations in which persons need to exchange and/or pose questions about task-related material(s). Multimedia messaging can also be effectively used when someone is not available for a real-time conference.

Like the MRD's desktop conferencing facility, the Snapshot Composer also provides show, point and talk functionality — though without the feedback characteristics inherent in real-time communication. When composing a multimedia message, these facilities allow one to:

- create a "snapshot" (i.e., a set of selected documents, images, etc.) to be sent to and viewed by others (document/image selection is done by simply pointing at the documents and clicking upon them);

- place simple annotation marks (e.g., arrows) atop[1] the documents within a snapshot; and,
- include an audio and/or text message along with the snapshot and annotations.

The simple text editor, annotation and snapshot mechanisms are implemented within EuroCODE's Snapshot Composer Toolkit. The simple audio recorder/player is implemented within EuroCODE's Digitized Sound Toolkit [7]. Use of the MRD is depicted later.

3 Use of the MRD

This section briefly depicts scenario-based use of the MRD. The scenarios were originally presented in an early MRD design document [10]. The scenarios illustrate how the MRD supports, through a homogenous user-interface [6], the communication and cooperation needs between doctors at Rikshospitalet. These scenarios are two of several identified by the pilot group during the MRD's requirement acquisition and early design phases. They were developed using scenario-based design principles described in [4].

3.1 Scenario 1: use of desktop conferencing

The first scenario depicts a situation in which a pediatrician (Dr. Peter) has encountered a sudden need to have a brief consultation with a pediatric radiologist (Dr. Eigil); this scenario is just one instance of the kinds of situations involving unplanned, spontaneous consultations amongst doctors. Using the MRD's desktop conferencing facility, the doctors in the scenario are able to simultaneously view the patient's image(s) and discuss the case in real-time. Use of the MRD's telepointing facility allows the doctors to electronically point within the images such that each of them can see the other's marker. The MRD's conferencing facility allows for conferences having more than two persons, such that group involvement is possible. Figure 2 depicts use of the MRD's conferencing facility.

3.2 Scenario 2: use of multimedia messaging

The second scenario depicts a situation in which a pediatric radiologist (Dr. Eigil) needs to receive some advice from a neuroradiologist (Dr. Larsen). The communication requirements in the second scenario are not unlike the first. In the second scenario, however, the neuroradiologist is not immediately available. Using the MRD's multimedia messaging facility, the Snapshot Composer, the pediatric radiologist assembles together documents related to the nature of the desired consultation. These documents, along with annotation marks, text and voice messages, are then sent to the neuroradiologist. Just prior to sending the message, Dr. Eigil's screen appears as shown in figure 3.

1) Note: these annotations do not in any way become written into a document's contents. They appear atop a document, but a different logical layer is used to present them on the computer screen.

3.2.1 Reception of messages

When a user receives a multimedia message, the MRD's "mailbox" button (upper-right) turns yellow. By clicking on the mailbox button, the Snapshot Composer's `receive` window opens, see figure 4.

In the `receive` window panel, the messages are listed. The listing specifies the date, sender and subject for each message; unread messages are marked as "NEW". By selecting (i.e., single-clicking upon) a message in the listing, a logical representation of that message's contents is presented just above the panel. As in the Snapshot Composer's `send` window, this representation is provided as a set of icons which reflect the kinds of information elements within the message.

Dr. Larsen sees the new message from Dr. Eigil which asks for a quick reply. When the multimedia message is fully opened, Dr. Larsen's screen appears as shown in figure 3, *except for two differences*: (1) Dr. Larsen has a `receive` window instead of a `send` window; and, (2) the "annotation-viewer" application (`makeannot`) is running on her workstation instead of the "annotation-creation" application (`asyncannot`).

4 Evaluation Results

The design, testing and evaluation periods of the MRD were carried out as iterative processes. This chapter primarily addresses the results obtained in the latter phase of the MRD evaluation. In this phase, the evaluation concentrated upon obtaining feedback concerning functionality and user-interface design for the MRD's desktop conferencing and multimedia messaging facilities. This evaluation phase also sought to obtain indications as to where and when communication systems such as the MRD could be useful for the radiologists at Rikshospitalet — the pilot group — as well as for other working groups at Rikshospitalet.

In seeking to explore these issues, three questions were used to keep the MRD testing and evaluation sessions in focus. One question concerned the usability of the MRD; the other two, the system's usefulness:

Q1.Is the MRD easy to work with?

Q2.Can the MRD system make work more efficient at the Department of Radiology?

Q3.Are there other application areas where MRD-like systems can be useful?

4.1 Application Areas for the MRD

This section combines responses received from the pilot group concerning questions Q2 and Q3. In regard to Q3, however, all of the application areas identified involve the Department of Radiology in one capacity or another. The pilot group did not speculate as to the potential usefulness of MRD-like systems for other working groups at Rikshospitalet.

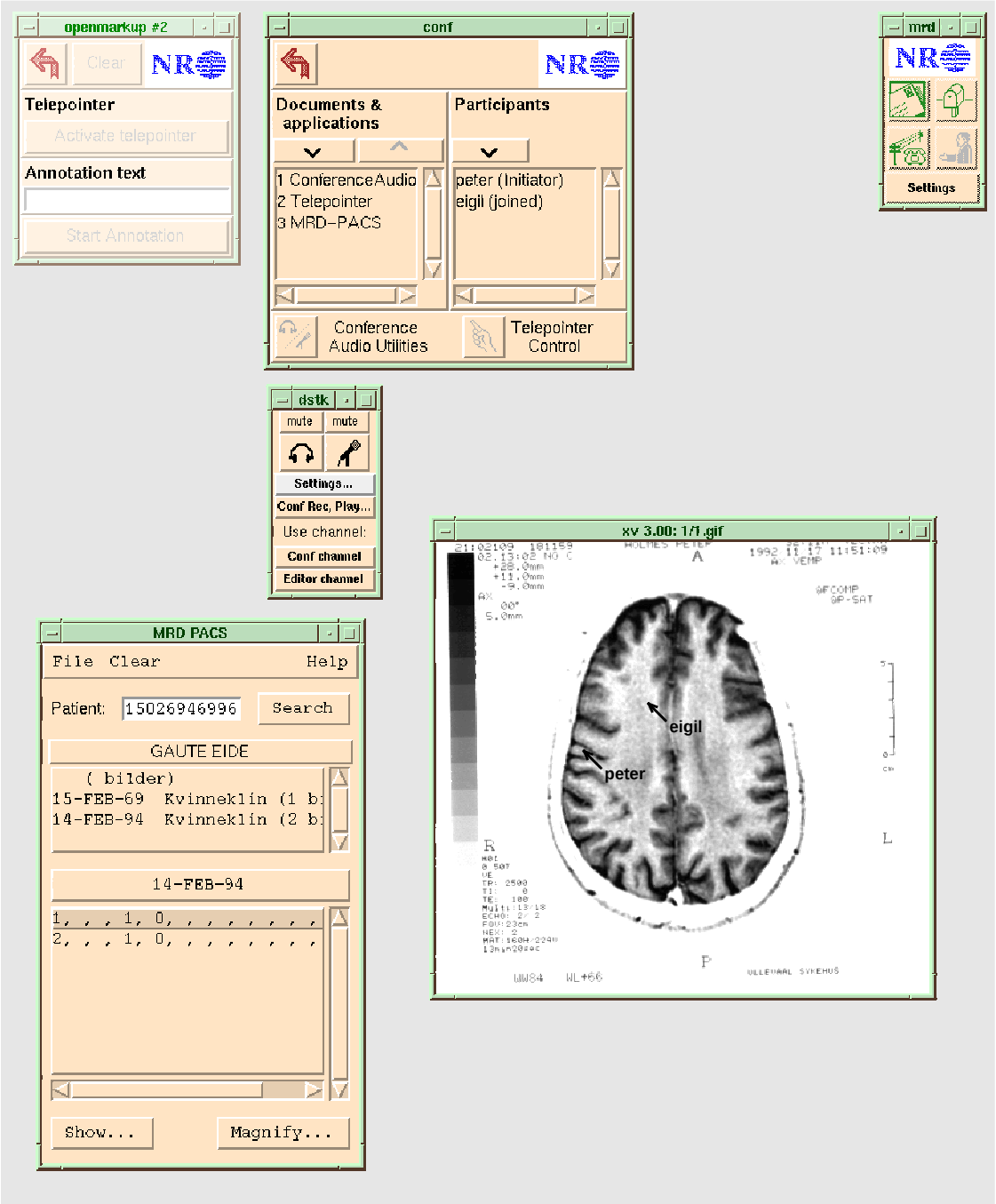

Figure 2 : *The MRD supports real-time communication while keeping users' favorite applications in focus.*
From left-to-right, descending:
a) the telepointer application (`openmarkup` window)
b) the Conference Manager (`conf` window), for adding/removing applications and participants
c) the top-level MRD window
d) the conference audio application (`dstk` window)
e) a typical image, including the conference participant's telepointers (labelled by name).
f) MRD-PACS, an in-house application which was integrated with the pilot group's digital image archive during the evaluation period

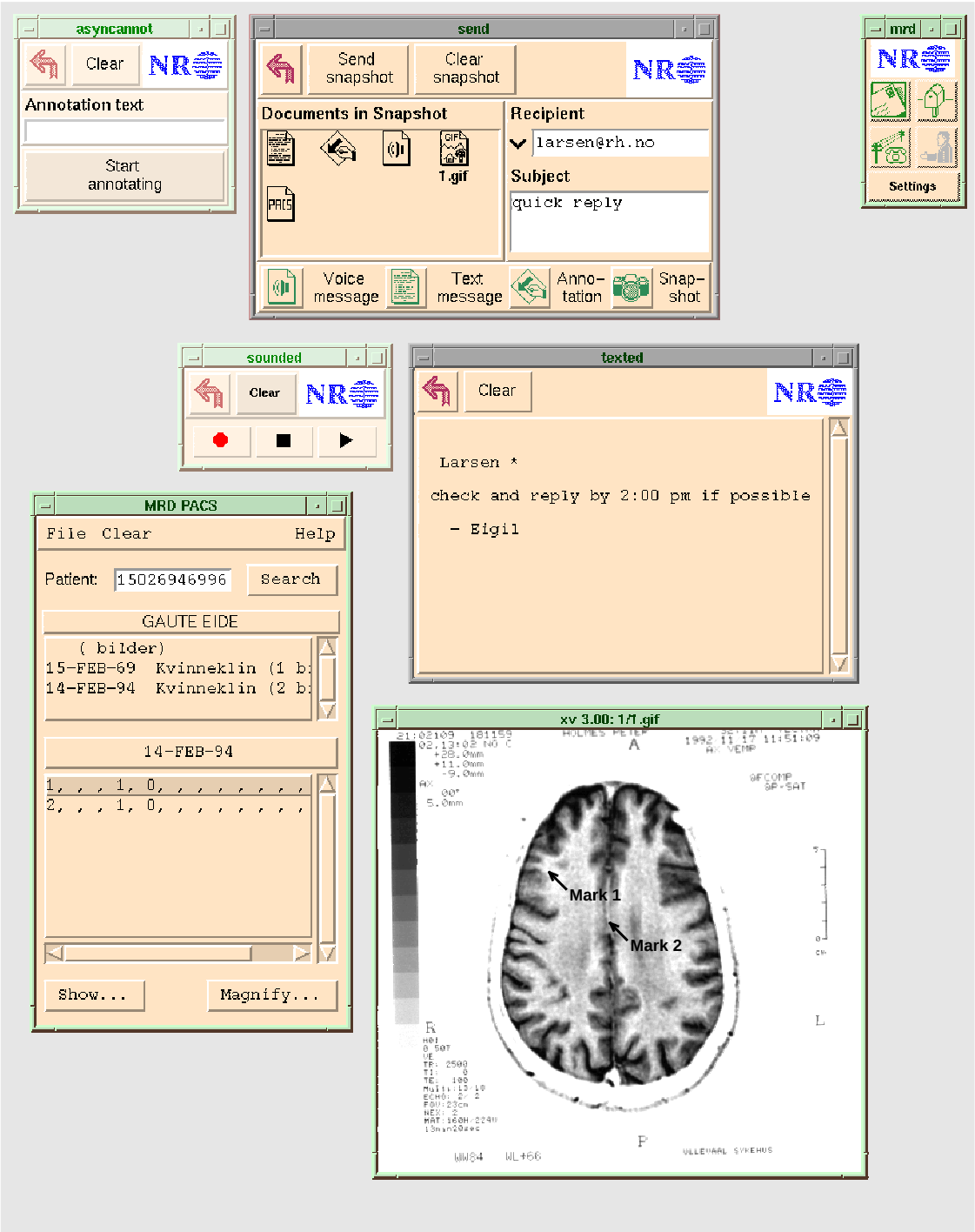

Figure 3 : *A multimedia message created using the MRD's Snapshot Composer. From left-to-right, descending:*
a) the "annotation-creation" application (`asyncannot` window)
b) the Snapshot Composer's `send` window, for composing multimedia messages
c) the top-level MRD window
d) a simple audio recorder/player application (`sounded` window)
e) a simple text editor application (`texted` window)
f) MRD-PACS, an in-house application which was integrated with the pilot group's digital image archive during the evaluation period
g) a typical image, including simple annotations (labelled as "mark1" and "mark2")

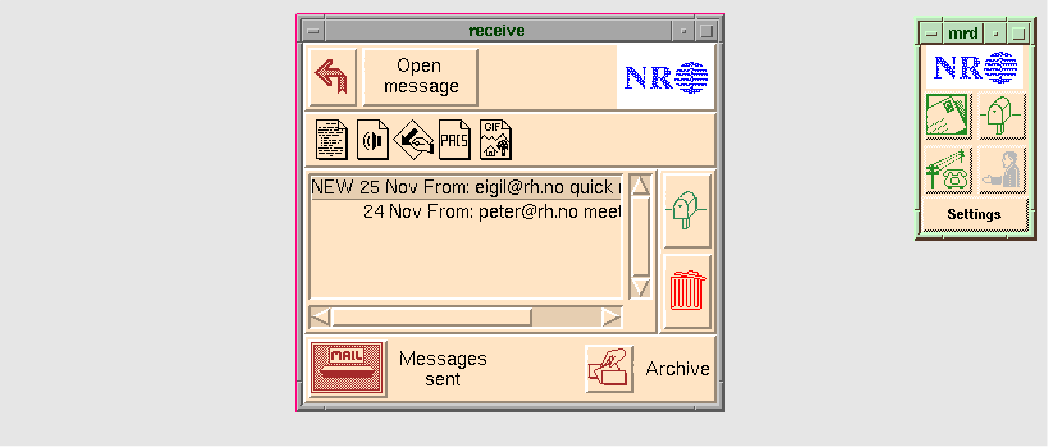

Figure 4 : *The Snapshot Composer's* `receive` *window.*

The pilot group identified several different application areas for the MRD during the testing and evaluation periods. Some of the application areas were earlier identified and presented as scenarios during the functional design specification phase [10]. For the sake of completeness, all of the identified areas explicitly mentioned are presented below. The first five mentioned are *intra*-hospital application areas, while the sixth concerns all of the first five application areas in an *inter*-hospital communication setting:

- Ordinary consultations
- Consultation during surgery
- Morning demonstrations
- Remote supervision of radiographers
- Education
- Inter-hospital communication

Currently, clinicians at Rikshospitalet must either walk to the radiology department, or use the telephone, in order to consult a radiologist. Through use of the MRD's Snapshot Composer, clinicians and radiologists could have the option to formulate their consultation requests as multimedia messages, including images, annotations, text and/or audio as necessary. If situations called for it, users would also have the possibility of reaching radiologists for real-time consultations.

In some situations, surgeons need to consult with a radiologist during surgery. The pilot group considered that the MRD would be very useful in these kinds of situations, especially due to the critical nature and time pressures which often exist at such times.

The pediatric radiologists at Rikshospitalet demonstrate the examinations of children with heart diseases to the heart surgeons; this transpires in a building different than that in which the pediatric radiology department is located. The pediatric radiologist in the pilot group meant that it was possible to use the MRD in order to carry out the usually brief, but remotely situated morning demonstrations for the heart surgeons. For the radiologists at Rikshospitalet, this possibility would be especially important on days in which there is only one pediatric radiologist on duty.

Another application area identified by the pilot group involved the remote supervision and guidance of radiographers during the digital image acquisition phase of certain radiological examinations. This application area is especially important since the pediatric radiology department has the policy that images of children must be checked and approved by a radiologist while the patient is still at the radiological department.

The last application area identified by the pilot group was within medical education. More and more, the teaching situation at Rikshospitalet has become based upon problem solving using case material from real patients. This pedagogical approach creates a need for supervision by the teacher, as well as encouraging cooperation between the students. The kinds of communication needs which arise within different teacher↔student↔ student groupings can be addressed using the MRD's synchronous and asynchronous communication facilities.

The pilot group meant that it is important to introduce MRD-like communication technology at this educational level. Allowing the students to become familiar with the kinds of communication support available *now* gives them the opportunity to create expectations and requirements about their future work environment.

The final application area concerns hospital↔hospital communication. The pilot group stressed that should they have new means by which to communicate with partners outside the hospital — both synchronously and asynchronously — the benefits of the MRD would be much greater. All of the five application areas mentioned above could be application areas for the MRD, within an inter-hospital communication setting.

4.2 Potential Consequences of MRD Use

The discussion above has focused upon application areas for the MRD; for some of those areas, the manner and/or degree to which the MRD would increase effectivity was also discussed. During the final evaluation phase, several other issues were also addressed. These issues concerned expectations about the potential consequences of using the MRD within the Department of Radiology. Some of these issues addressed were: (1) quality; (2) security; (3) cost - benefit: organizational; and, (4) cost - benefit: economical.

The radiologists in the pilot group meant that the MRD could help increase the quality of their services. In particular, the radiologists felt that the MRD would help enable them to carry out their daily plans, since there would likely be fewer interruptions during their days. At the same time, they would be available for real-time consultations in acute medical situations. In this regard, it is crucial that the MRD support both synchronous and asynchronous communication.

The radiologists in the pilot group meant that the MRD system could help increase security. In particular, the MRD enhances a PACS system with added functionality such that spontaneous communication requests — requests involving messages about images — can be sent directly to the receiver, without involving the need to physically transport the image hardcopies.

One radiologist in the pilot group meant that the clinicians will achieve the greatest benefit from the MRD, while the radiologists' work-load will increase. The reason for this is that the radiologist will be more accessible for the clinicians. Still, there exist many factors of uncertainty with respect to this issue. One of those factors concerns how the PACS system

is used within the hospital. Since a PACS system can make it easier for clinicians to access radiographic images, it may also decrease the need for consultations with radiologists. Another factor concerns how PACS and MRD technology are organizationally implemented.

Producing a cost - benefit analysis regarding the economic side of MRD use was considered an extremely complex issue. There exist innumerable factors that can be brought into any such analysis, and the question becomes thereafter one of scope. One perspective which developed during the evaluation period was this: should the MRD make work-processes more time-efficient within the department, and should this savings increase patient throughput within the department, one could then argue that the MRD helps promote "more health per dollar" within the community.

5 Conclusions

With it's mechanisms for real-time application sharing, telepointing and conference audio, the MRD's desktop conferencing facility helps eliminate barriers normally associated with geographically-distributed cooperative efforts. The MRD's Snapshot Composer also helps eliminate barriers; in this case, barriers primarily associated with temporal distribution. This multimedia messaging facility provides the equivalent of a desktop conference, except for the real-time feedback. In both of it's communication modalities, the MRD allows: (1) work within applications to be shared; (2) pointers to be used for directing attention; and, (3) questions to be asked and answered orally.

Radiologists within the pilot group identified a number of application areas for the MRD. They also stated that the MRD could help make certain processes involving inter-personnel communication more effective. In regard to PACS systems and communication needs originating both inside and outside of radiology departments, it is believed that the MRD can make significant contributions towards making a number of work processes more effective.

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