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Mobile multimedia communication: a task- and user-centered approach to future systems development

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Mobile multimedia communication: a task- and user-centered approach to future systems development

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ABSTRACT

In the future, multimedia will also serve the interests of mobile users, thus extending the electronic superhighway to work situations that lack a wired infrastructure. Companies with mobile workers (e.g. in traffic and transport, field service engineering, emergency services) could substantially improve safety and efficiency with multimedia communications. However, communication media differ widely in terms of interaction and modalities. Therefore, choices have to be made between media, that suit the particular 'context of use'. It is hypothesized that the use of 'full' multi-media will not be suitable for every work situation. This article identifies the work situations in which full multimedia applications can be useful. From different sources the conclusion is drawn that interactive, multi-modal ('rich') media can best be applied to perform non-routine tasks. However, the empirical results have not shown improved task performance so far. A more task- and user-centered approach to communication is proposed in this article. This approach is primarily based on action theory.

1. THEORETICAL BACKGROUND

Too often communication systems are developed without full consideration of the work context in which they will be used. The results of such an approach may turn out to be catastrophic, as was shown by a project that involved the computerization of control room operations in two ambulance services, those of London and Manchester. The technology-driven approach failed, while the user-centered design approach was successful (Wastell & Cooper, 1996). In this paper the work and interaction model by Andriessen (1996) is used, which takes into account technological as well as user, task and organizational aspects (see Figure 1).

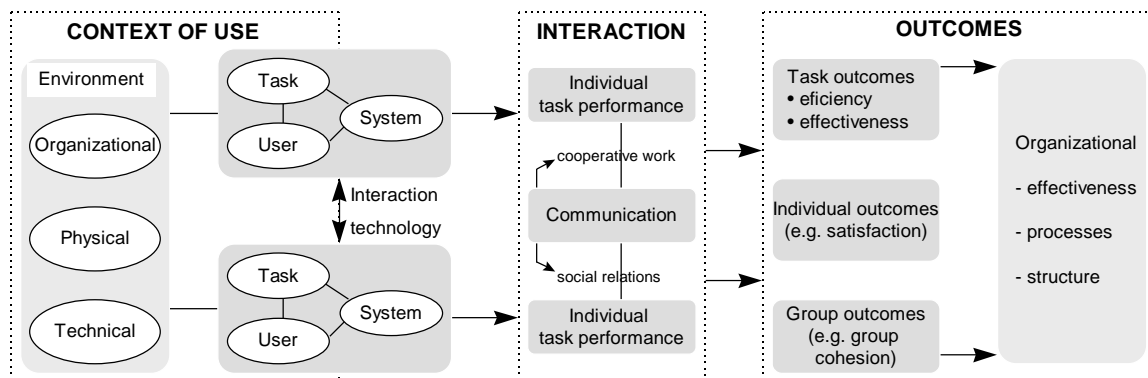


Figure 1 A model of work and interaction (Andriessen, 1996)

In this model, task performance and social interaction are determined by the degree of fit of the system in the 'context of use' (the organizational, physical and technical environment and the task and user characteristics). The specific interaction between the system and the users performing a task results in three types of outcomes: task (e.g. effectiveness, efficiency), individual (e.g. satisfaction) and group outcomes (e.g. cohesion). Furthermore, the interaction has impact on the organization as a whole, in terms of effectiveness, processes and structure.

2. PROBLEM DEFINITION AND METHOD

The choice for a particular media configuration must fit the particular 'context of use', supporting task performance and interaction in such a way that task, personal, group and organizational outcomes will be enhanced. Communication media differ widely in aspects like interaction and representational modalities. The use of interactive, multi-media (including video) communication will not be suitable for every work situation. On the basis of literature study and expert interviews we have tried to identify potentially useful applications of full mobile multimedia communication.

3. RESULTS

3.1 Media richness theory

In literature the concept of multimedia is unclear. In the first place, a medium is defined as a *way of communication*, e.g. E-mail, video-conferencing, telephone or face-to-face contact. Secondly, a medium is defined as *a way of presenting information*: text/ data, graphics, animation, images, still and moving video, sound/ speech. Instead of focussing on one definition of multimedia, the concept of 'media/ information richness' (Daft & Lengel, 1984) can be used to integrate the different definitions. Interactive, multi-modal ('expressive') media are called 'rich'.

According to Information Richness Theory, there is a match between the richness of media and the complexity of phenomena that are the subjects of communication through the medium. Simple phenomena can be handled via lean media, whereas complex or equivocal phenomena require rich media for effective communication (Rice, 1992). Rich media can be useful in unstructured work environments, in which information processing is less formalized and requires more improvisation. This conclusion is also supported by the practical experiences of experts from the scientific as well as practical fields of mobile communication, multimedia and telematics and transport.

3.2 Practice

As a result of the interviews with experts several potential areas of application for mobile multimedia communication were identified: fleet management, logistics, traffic control, surveillance and video-monitoring, emergency services (police, fire-brigade, ambulance services) and field service engineering. Incident- and accident management in the areas of emergency response - especially remote assistance in ambulance services - as well as remote support in service engineering were rated as most suitable for the interactive use of a combination of text/ data, audio and video communication. Text- and data-messages, as in Electronic Data Interchange, can be used to streamline the standard work processes. However, multimedia was seen as most suitable for non-standard work situations, *i.e.* when deviations from the normal procedures occur, which are difficult to put into words or into structured data or text-messages.

3.3. Limited effects

However, there is little evidence that rich media improve the *performance* of complex, non-routine tasks. Rich media rather support social activities, and may only be effective when the personal relationship is important for the task at hand (Gale,1990). This could be due to the limited functionality that has been given to video. Audio-visual communication is mainly used to substitute face-to-face contact by video-conferencing. The function of video in this case is to create context-awareness: to show the non-verbal context - gestures and facial expressions - of the spoken word (Van der Velden,1995). There are few examples of research into other possibilities of interactive video-communication. Much emphasis has been laid on rich media as a means to support interpersonal interaction and communication, as a goal in itself. However, within work domains like service engineering and incident management, criteria like the effectiveness, efficiency and safety of task performance are crucial. To identify useful applications of mobile multimedia communication, we need to model and design work and multimedia in a way that is more oriented towards these criteria.

3.4 An alternative approach

A starting point for a more task- and user-oriented approach to the development of interactive systems can be found in 'action theory' (Hacker,1986; Rasmussen,1983), a cognitive psychological framework of human work behavior and task performance, which considers people's behavior as goal-oriented. The theory has the advantage that it relates task complexity to user experiences and skills. Three levels of behavior regulation are distinguished: skill-, rule- and knowledge-based. At the skill- and rule-based levels no extensive information and explanation is needed, because skills and action procedures are available. But at the knowledge-based level it is not immediately clear how to solve a problem. We think multimedia communication will be most useful in supporting task performance at this level, at which knowledge falls short. This supports the idea that rich media are most suitable to solve unstructured problems (Rice,1992). At this higher intellectual or cognitive level system and/ or human support is important. Here, mobile multimedia communication can be used for collaborative task performance, offering remote assistance to local task performance. However, to support the effectiveness and efficiency of task performance in this situation, multimedia/ video communication should be considered as a means to show task-related information or video-as-data (Nardi et al., 1996). Rather than showing 'talking heads' through video-conferencing, the object of task performance (e.g. a machine or a patient) and the actions of the worker towards the object can be made visible via multimedia communication, e.g. to a remote expert.

4. DISCUSSION

To be of use for mobile workers, the future development of systems for multimedia communication should be more oriented towards supporting task performance, instead of communication as a goal in itself. At the application level a move from 'talking heads' video towards 'video-as-data' (Nardi et al.,1996) could be a step forward.

However, the question is how to proceed in developing systems for specific work settings. Here, the Action Facilitation Design Method (AFDM) (Arnold, in press), based on 'action theory', may have a guiding function in the whole development process. However, the user criteria the AFDM produces in terms of effectiveness and efficiency, are based on individual task performance and computer interaction. The AFDM needs to be elaborated towards the specifics of multimedia communication and co-operative work (as shown in Figure 1).

5. CONCLUSION

Enhancing work performance requires a more task- and user-oriented approach to the development of multimedia systems. To suit the specific 'context of use', choices must be made between media, defined in terms of ways of interaction and representational modalities. In this paper we tried to make clear that the so-called 'rich' media (highly interactive, multimodal media) can be useful for performing non-routine tasks. However, the focus on substituting interpersonal communication by electronic media, e.g. video-conferencing, has obstructed the effective use of multimedia applications. As an alternative we combined 'action theory' and the concept of 'video-as-data' (Nardi et al., 1996), as a first step in bridging the gap between multimedia communication and efficient and effective task performance in mobile work settings.

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