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Unions Future in the Online-World

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ABSTRACT

There are three main challenges for the unions in the online-world: 1. shaping working conditions for the ever increasing amounts of work with VDU’s and help to make it healthier, 2. using Information Technologies (IT) for their own purposes and 3. finding new forms of information, organization, solidarity and of action under the new conditions of world wide work with IT. This text is written mainly from a European viewpoint. Therefore this paper is not an answer for all worldwide questions and issues in particular for those of lesser developed countries.

1 Unions in past and future

In the middle of the 19th century workers in the rising capitalist industries were facing collective poverty without any insurance for illness, old age or loss of employment. They built up unions to organize collective activities to fight for minimum standards for the working class people.

Still today the main focus of unions is on the employees of larger companies, bargaining for higher wages, less working hours, insuring the success with contracts for industrial lines or undertakings.

In high-tech industries, using VDU’s as the main, often only working equipment, the conditions of life and work have changed radically in a very short period of time. Working at home with VDU’s - doing the job as a freelancer - small group project work in mobile offices, without any contact to unions - the branching out of more and more parts of big companies into small businesses and increasing multinational trusts on the other hand, are actually trends. International companies organize their work around the world and around the clock using Inter-Intranet solutions, satellites e.g., but the unions are mainly organized only nationally.

This development shows a big difference between unions history and challenges of working in the online-world. What are the main issues?

1.1 Making screen work healthier and caring for well-being

In addition to better wages and less working hours, the task of improving the working conditions belongs to the unions. The majority of the problems resulting from screen work are physical problems caused by continuous sitting and lack of movement, problems with sight caused by fixing the eyes on the screen, the lack of a quality work environment (insufficient light e.g.) and especially psychological strains resulting from high concentration, stress from time-pressure (long hours, quotas/deadlines e.g.) and other areas lacking in proper organization.

1.2 Legal rights and standards are available, unions must fight for realization

Since the beginning of the 90’s the European “Framework” Directive 89/391 for safety and health at work and the “VDU” Directive 90/270 have demanded a high legal standard for all member states in the European Community (EC). The conversion of these European Directives into national law occurred in all member states. Taking into account that associated states and all those who want to become a member of the EC have to adopt these rules, we can say that the level of legal rights and standards will cover nearly the whole of Europe.

With the international standard line ISO 9241 (taken over by EN 29241 in EC), extensive scientific findings are available. They state general protective aims like well being at work, participation of employees, examples for good and bad conditions during screen work (part 2), but they also handle specific questions like “software ergonomics” (part 10).

The following legal regulations are obligatory for the employer:

1. carrying out a risk assessment concerning all aspects of health and safety problems during screen work, in particular muscular/skeletal disorders, problems with sight and psychological strains,
2. taking measures to improve health and safety and in this case orienting himself with the current standards and state of the art methods and for example organizing breaks and medical eye-monitoring,
3. effective control and documentation of the whole process and the results.

Different surveys in Germany have shown, that in spite of valid laws and standards, more than 30% of all work places using VDU’s show considerable ergonomic weaknesses and more than 50% of the employees complain about time-pressure, and different health

3. www.iso.ch

problems concerning screen work. That means in practice a lot of work for union officials and members, work-councils, e.g. This work is not only necessary, but it’s profitable. In a capitalist society the employee can only sell his work when he is healthy, otherwise, nothing.

1.3 Realizing risk assessment
Many companies do not carry out any risk assessment at all and do not take any measures for improvement in the working conditions. The unions have to play a central role in forcing the employer to follow regulations and organize the pressure from all sides: the employees, their representatives, the government supervision e.g. The elimination of risks cannot take place without any risk assessment.

1.4 Minimizing psychological strains
Most companies, which have carried out a risk assessment, have only concentrated on purely technical issues (seat height, table size, viewing distance to the screen, glare on the screen, e.g.). These problems will remain important for proper health at work. But when assessing risks one also has to focus on lacks in: qualifying for the new technologies, communication, privacy and questions of risks through time-pressure and other forms of overload.

European unions, especially the technical union office in Brussels (TUTB)\(^1\), have often given advice on these problems. Some unions in Germany produced publications and information sheets for employees and their representatives\(^2\), considering stress resulting from screen work.

1.5 Participation of employees and their representatives
Risk assessment and planning measures often fit alone in the hand of technical or medical specialists for health and safety in the companies. Work councils are often not involved in the single steps. The employees and their working conditions are often seen as “objects” which are to be examined. In the rarest cases, the employees get the chance to participate in risk assessment and measuring. The same problem arises, if technical modifications are planned in the company. Employees and/or their representatives should be involved when aiming preventive measures. This is a demand of ISO 9241 part 2 and from the EC Directives but normally there is less participation organized by the employer.

In this field the unions have to play an important role, motivating members and works councils to use their legal rights of information and participation.

1.6 Unions can move the state of the art
With the TCO-Standard\(^3\) a Swedish union for “white collar” workers set a world-wide state of the art with demands and orders in the producing of VDU’s. If producers follow TCO (as most of them do), they guarantee elimination or minimizing of several health and environmental problems. This example shows a great potential of possibilities of union action, particularly in the field of prevention.

1.7 Unions have to care for working conditions, that are regulated the least
There are normally no special legal regulations and only a few company contracts about working conditions for new types of work, like online home-working with VDU, e.g. mobile-office working without a fixed workplace. Employees in newly founded small business high-tech undertakings normally don’t have any collective contracts.

This is a big challenge for the unions, as the number of people working under these conditions is increasing fast. The main problems are: How to get in contact with and organize very individual and mobile people and how to talk to people, who often don’t feel like a “normal” employees?

The crash of the financial market for new technologies in 2001 caused many problems in high-tech businesses. During this period the employees of “Pixel Park” founded a work-council supported by the Union “ver.di”, to have better legal rights against the employer and his rationalization ideas. The number of freelanced journalist’s, becoming member of a union, is moving up in Germany. These examples show a great potential for union work.

1.8 Privacy and participation in digital networking for employees as a union task
Information technologies offer gigantic possibilities to check the employees. While networking with IT, it can be precisely observed when and how someone is moving in electronic networks. Different surveys found out, that especially in the United States most employers control e-mail of their workers, often running special spy-programs.

In Spain a public discussion came up, when the Union CC.OO. sued a bank. The IT-administrator had installed an e-mail filter to avoid the communication between employees and their representatives and the unions. There are lot of public known examples for such cases in different Europe countries, presumably in the whole world.

The bad dream of Orwell’s “Big Brother” is a technical reality in the control of behaviour and working while using IT. The legal arrangements of privacy in Europe have a very high standard, but in everyday life in the workplace it is lacking.

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1. \(\text{http://www.etuc.org/tutb/uk/newsletter-no15.html}\)
2. \(\text{for example: www.igmetall.de/gesundheit/gesundheit_tipps}\)
3. \(\text{www.tco-info.com}\)
The Union Network International (UNI) started the campaign “Online Rights for Online Workers”\(^1\) having the following main demands:

- Free entrance for employees, unions and work-councils to email-systems and Inter-/Intranet services of the company.
- No electronic check of employees if using e-mail and online services.

There should only be two duties for the employees: no injuries of law or humanity, for example from sexual harassment or stigmatisations.

The UNI campaign forces guidelines in the companies to realize these tasks. In Germany the union “\(\text{ver.di}\)” picked up the idea with its own project, called “\(\text{On-ForTe}\)”\(^2\), combined with a call-centre for consultation with experts free of charge.

Another interesting approach in Germany is the involvement of “\(\text{ver.di}\)” in the evolution of the privacy audit “\(\text{quid}\)”\(^3\). Experts from unions, universities, economy and government privacy officers carried out a standard for good privacy in companies and businesses, not only for the employees but also for the employer.

Privacy and the development of personal rights is not only a formal legal order but an important necessity for a good working environment using IT, to avoid fear and stress.

### 1.9 Improve union work, new forms of solidarity and action in the online-world

Until the late 80’s many unions and their officials tried to keep out new technologies from the companies. The main reason was to prevent rationalization. In the unions themselves the implementation of IT took a very long time. The different chances: improving internal and external information politics, running data bases with important information for members and work councils e.g. had all been recognized very late.

The past several years show an increasing and pleasant offer, especially in the Internet and in using electronic newsletters. Some unions began to put out useful information about health and safety for screen work on their homepages. Some unions pushed public projects for health during screen work, for example “\(\text{ergo-online}\)”\(^4\) in Germany.

Several virtual union and worker actions happened in the past several years, for example:

- The fight of the employees from “Elf Exploitation Production” in Pau 1999 when they realized that more than 4000 colleagues will be laid off. They made the company IT-net insufficient, founded their own committee and organized their actions with their own homepage.
- When IBM (United States) wanted to eliminate their retiring-regulations, a flood of protest e-mails prevented this plan.
- Union members and members of work councils from the different film-theatres (UFA and Cinemaxx) in all of Germany, organized their struggle for collective contract mainly with a union supported homepage and mailing-list.
- More and more work-councils organize their information politics with own sites in the Intranet of companies.

The work-council of IBM-Germany started a campaign “my time is my life” supported by the metal workers union “\(\text{IGM}\)”.

The action started with an e-mail questionnaire about working time, well-being at work e.g. High-tech specialist’s poured their hearts out about the troubles of quotas, deadlines and other time pressures that were causing psychological strains, family problems e.g. Publications, exchange of experience by e-mail and meetings followed, organized by the union and work-council.

### 2 Conclusion

We don’t know whether the creatures in a far off high-tech-future, shown in science fiction films such as Star Trek, would need unions. It is a hard fact that there will be a strong demand for union activity as long as working with VDU’s takes place under the conditions of different forms of employment. Nevertheless: European and national campaigns of unions to improve screen work and the discussions about well-being at work are still in the beginning stages.

The European Directives for health and safety at the workplace are the most developed legal part of the “Social Europe”. For this to become reality, the unions have to adapt their organization and move up their engagement. There are promising approaches which have to be improved, just as the relationship of the new IT-working class to the unions. Adaptation and flexibility - charm words for the mainly younger employees in IT, can lead to health damage und social deformation if they are not accompanied by a balanced social dialogue, collective contracts and legal rights with minimum standards. This is the experience of Magda Müller, well known Professor at the University of Chico, USA, spoken out in a conference about the future of work. Looking at the social results of “Silicon Valley”, the alleged Garden of Eden of the IT-Industries, she has compared the situation with the gold-mining area in California\(^5\). We all know the results: a few rich people and a lot of poor outlaws, uprooted at the end of this period.

2. [www.onforte.de](http://www.onforte.de)
3. [www.quid.de](http://www.quid.de)
4. [www.ergo-online.de](http://www.ergo-online.de)
5. [www.baua.de/info/fachzeit/nga.pdf](http://www.baua.de/info/fachzeit/nga.pdf)
Functional Requirements for Knowledge Sharing Communities

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ABSTRACT

Human collaboration in distributed knowledge sharing groups depends on the functionality of information and communication technologies (ICT) to support performance. Since many of these dynamic environments are constrained by time limits, knowledge must be shared efficiently by adapting the level of information detail to the specific situation. This paper focuses on the process of knowledge and context sharing, with and without mediation by ICT. Both technology-rich and non-technology examples are discussed.

1 Introduction

Distributed interactive knowledge sharing communities are characterized by groups, with varied levels and types of expertise, interacting through technology mediated networks. Human collaboration in these task environments depends on the functionality of information and communication technologies (ICTs) to support system performance. These environments can range from that of a basic interaction at an information help desk to the complexity of a space vehicle mission control center. A complicating factor in each of these dynamic environments is the time constraints for synchronized and coordinated task performance. Therefore, knowledge must be shared efficiently, both limiting the amount of information presented to what can be processed within time constraints, and presenting information at a comparable level of complexity to match the expertise of the user.

As today’s work environments become more complex, more tasks are being done in groups. In fact, since very few jobs are done in complete isolation, individuals must be able to efficiently exchange information in order to accomplish their tasks. While most interaction takes place with face-to-face communication, new communication technologies are becoming a more common part of the work environment. ICT has become a prevalent form of communication between geographically and temporally distributed individuals.

1.1 Human Collaborative Work

People engaged in collaborative work can exchange information in a variety of ways depending on their particular situation. Individuals may meet face-to-face or communicate through a technology network. Technology mediated communication is represented by the IT usage link between the person and the ICT in Figure 1. There may actually be more than one type of technological interface that the person interacts with, such as a computer, a phone, voice mail, or videoconferencing equipment as shown by the various ICTs represented in the figure. These various ICTs represent different paths through which individuals communicate.

The chosen path not only changes what can be exchanged between the individuals, but each type of path is able to do a different type of task. For example, a phone will not only transmit the words that a person is using to communicate, but also the sound of their voice. The voice is then able to give para-verbal contextual cues to the words that are being communicated. A videoconference will not only transmit vocal para-verbal cues, but also body language. Computer messages, which generally only contain text, are essentially devoid of these types of contextual cues. Therefore, individuals have learned to provide indications of context through the use of additional symbols or emoticons. However, even with the specific deficiency of context within computer messages, it is nonetheless a very appropriate form of communication for large amounts of information, which may need to be referenced later, or the transmission of pictures, figures and documents.

Figure 1: Model of Human Collaboration

In a study of crews navigating a large vessel it was determined that information distribution and mutual awareness are the two most prominent functions involved in dynamic coordination of time critical work. Therefore it is essential that every crewmember is constantly aware of the “correct and updated ‘common picture’ of the ship’s performance, as well as each others actions” (Carstensen & Nielsen, 1997: 103). These functions are also crucial in other time-critical, dynamic systems such as air traffic control or a vehicle mission control center.

Knowing what paths exist, how to use them, and when they are open for use are all illustrations of “pathwork” (Caldwell, 2002). While pathwork describes identifying what communication path is appropriate and available for information exchange, taskwork is knowing what to
actually share. Taskwork, as illustrated by the dashed lines in Figure 1, describes the sharing of information and the context in which it is relevant. In all situations, either face-to-face or technology mediated, both information and situational context must be shared for knowledge to be synchronized. Social processes for effective sharing of understanding and maintenance of group function in the work context are also known as teamwork (Caldwell, 2002). While data can be transmitted within a physical path, expertise and situational meaning must be communicated through context sharing. Context sharing is not always directly available within the physical data path, and hence is shown as a separate interaction in Figure 1.

1.2 Information Requirements

To enhance the knowledge sharing between individuals, we must understand how we learn to recognize information requirements based on task needs, user characteristics, and situational constraints. Task needs are based on the type of information that must be shared, such as current system status or key points of interest. The user characteristics would include expertise levels, the level of interest (i.e. the desired depth of information), and the amount of time that they are willing to spend on acquiring the information. Situational constraints, on the other hand, incorporate information criticality, alternative sources of information and the total time available to complete the task. By recognizing the information requirements, knowledge sharing systems could be created to optimize the information exchange.

Previous research has investigated the circumstances in which a specific ICT is considered appropriate while considering factors such as task urgency, volume of information content, and distance between sender and receiver (Caldwell, 1999). Each technology medium has different features and abilities associated with it; therefore, a comparison must be made between the available options for a given situation. Rice and Shook (1990) have investigated how specific situational contexts affect how individuals will use voice mail systems in different task environments. Other literature has investigated the use of a digital voice communication system, known as DVIS, within NASA’s Mission Control Center. While DVIS is used to verbally communicate, it is much more than just a voice exchange medium, because it allows Flight Controllers to monitor multiple conversation loops at the same time (Patterson, et al., 1999). Other ICTs such as a phone, or teleconferencing do not have the same features and functional use of DVIS, which is what sets it apart for coordinating large amounts of information, between many individuals in a time-critical environment.

Time constraints are one of the most critical factors in a dynamic environment. When subject to time limitations, individuals must obtain the needed information as efficiently as possible. In order to respond to a deadline, Miller determined that one of three strategies is typically selected to handle excessive information or task requirements: filtering, omission, or acceleration (Maule & Hockey, 1993). However, in extreme time-critical situations even experts may focus on irrelevant information (Wickens & Hollands, 2000). Therefore, in order to reduce the cognitive demands on the operator, both the amount of information given to the operator and the complexity level of that information should be adapted to the specific situation and user characteristics.

2 National Park Study

A study was performed at a tourist information desk in a small, remote US National Park to examine a framework for addressing information access and exchange for users with a range of information needs. This study led to an examination of a distinct framework for addressing information access and exchange in time-critical task environments. It is not necessarily evident that a help desk is considered a time-critical environment; however each tourist may only be willing to devote a limited amount of time to gather the requested information, especially if they are part of a tour or are otherwise constrained by a schedule. If the park ranger is unable to provide the desired information in a time-relevant manner, the tourist will leave without gaining the requested information. This event can be considered a system failure.

In the National Park Study, visual context cues were used to determine how much information the tourist wanted, and the level of expertise the tourist had. These cues were present in both the environment and in the system user (the tourist), but were rarely directly present in the posed question. In order to determine what characterized a functional answer, the situational context had to be incorporated. This study, although performed in a low-technological environment, shows how real people interact in knowledge sharing tasks. This type of work can lay the groundwork for how critical functions should be implemented in a more complex, supervisory control environment and how to use ICT systems to improve knowledge sharing in distributed task performing groups.

3 Functionalities Within Communication Environments

So what are the advantages and disadvantages of different communication modes, and how can we optimize information exchange in each of these settings? Face-to-face communication is the most common and natural form for information exchange. This form of communication is generally the most information rich and has been considered desirable for situations when reaching consensus is more difficult, such as on a negotiation task (Hellingshead, et al., 1993; Rice & Shook, 1990). In face-to-face communication, both individuals have access to verbal, paraverbal and body language cues, as well as a shared environmental context during the exchange. More information can generally be exchanged in a given period of time and consensus is easier to reach in face-to-face communication than if technology...
mediated (Kiesler & Sproull, 1992; Hedlund, et al., 1998). Literature has also shown that accuracy in decision-making tasks is higher for face-to-face interactions, within the tested conditions (Hedlund, et al., 1998).

Technology mediation affects communication at two levels: the directly anticipated technical effects, and the indirect effects of behavior that is made possible by the new technology. Due to the inherent capabilities of ICT and differences in available context cues, certain social processes in these environments can have different forms. For example, member participation in an electronic discussion is more equally distributed, individuals are less likely to conform to social norms, and the effect of status on communication is reduced (Kiesler & Sproull, 1992; McGrath, 1990; Hedlund, et al., 1998).

Also, when communication takes place over a technological medium, it is possible to create an archival record of the interaction, such as a log file. Finally, ICT can facilitate the exchange of ideas without set temporal or physical boundaries.

Depending on the specific capabilities and interface design of the ICT, group members may be able to independently manipulate the level of spontaneity, synchrony, and archival permanence of group interactions. The tools available for communication among distributed groups remain in a state of rapid development and flux, limiting a comprehensive discussion of tool capabilities and limitations in particular social and task contexts. However, it is clear that this area of technology development will significantly influence our current and future understanding of what is possible for communication and task coordination by distributed groups.

4 References


The Lifecycle of Competencies in Media Industry

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ABSTRACT

The aim of this study is to examine how transition from analogue technology to digital technology at the production of radio and television programmes affects competencies and work-related well-being of the personnel working in media industry. The results indicate that along the technological change journalistic and editorial jobs become closer to each other. This means that new competencies are needed especially at merging interfaces of these two professions. It also seems that specialised competencies needed in particular phases of the work process change more than general competencies of the process. Technological change also affects work and well-being; work may become more convenient, precise, ergonomic and autonomous but also more abstract, unpredictable, stressing and lonely.

1 Introduction

Due to the development of ICT (Information and Communication Technology), job-descriptions and competency requirements have changed during the past decade in almost every business. In media industry, production and delivery of radio and television programmes are in transition from analogue to digital production and delivery. Technological changes have created new professions and changed competency requirements, whereas some of the existing competencies are no longer needed.

The aim of this study is to examine, how transition from analogue technology to digital technology at the production of radio programmes affects job-descriptions, competencies and work-related well-being of the personnel working in media industry.

The research questions are:

1. How does digitalisation of radio programme production change the job-descriptions of personnel?
2. How do competency requirements change with the transition from analogue to digital technology in radio production?
2.1 What kind of new competencies are required?
2.2 What kind of old competencies remain necessary?
3. How does the transition from analogue to digital technology affect work and the job-related well-being of the personnel working in radio production?

1.1 The impact of technological change on job-descriptions and competencies

In this study competency is not seen only as a quality of an individual or only as a quality of work but it is seen as something that worker uses in reality to accomplish the work (Ellström, 1997). Competency is also understood both as an input and as an output (Hoffmann, 1999). Competency as an input refers to such individual qualities as knowledge, skills and attitudes, which make it possible to perform the work. Competency as an output refers to observable performance or acting at work. Changes of competencies can be related to a model of competency lifecycle. The model assumes that professions have certain basic competencies that do not change much due to technological change. On the other hand there may be competencies that are technology-dependent and they are expected to change when technology changes. (Keil et al, 2001, 275.) New competencies are needed especially at crossing boundaries of professions. (Huhtanen, Immonen, Lindström & Lytyinen, 2000, 179; Keil et al, 2001, 275.)

According to Huovila (1998, 228) work in large media companies has traditionally been near to industrial work. By this he means that the radio programme production process has been organised through functions: journalists produce the text and sound editors are responsible for the technical realisation and broadcasting of the programme. Today digitalisation is changing the work process in the radio. In newspapers similar kind of shift from function based production to process based production occurred at the 1990s when newspapers adopted computer-based editorial systems. Now the same is occurring at the radio production due to Computer Aided Radio system that allows one with help of computers to complete the whole radio programme from writing the manuscripts to making effects and editing. (Kujala, Lahti & Tamminen, 1999, 212; Huovila, 1998, 228-230; Nukari & Ruohomaa, 1997, 122.)

Digital technology in the production of radio programmes is easier to use than analogue technology. This together with the rigorous financial situation has led to multi-professionalism and mixed job-descriptions. For example, journalists in the future will besides their content providing tasks both record and edit the programmes. What will happen to sound editors then? Will they work as journalists in the future? On the other hand, digital production requires, not only multi-professionalism, but also profound professional competencies on special areas. In the media industry this means that some professions disappear and a need for new education grows. (Teinilä-Šmid, 2000, 24.)
1.2 The impact of technological change on work and well-being

Technological change has been found to have various kinds of impacts on work and on the well-being of personnel. On one hand, increased use of information technology has been shown to have negative influences on work and well-being. For example, work becomes more lonely and isolated (Bradley, 2000; Kalimo, 2000). Overload of information boost by information and communication technology can induce stress (Kalimo, 2000). Also technical breakdowns can have a negative effect on well-being (Carayon-Sainfort, 1992, Lindström & Torstila, 1990; Palmini, 1994). Moreover, continuously evolving software enforces the need for continuous learning, which can lead to experiences of stress (Kalimo, 2000; Korunen, Zauhner & Weiss, 1997). On the other hand, technological change has also positive influences on work and well-being. Work may become more effective, interesting and challenging (Seppälä, 1995). Work can also become less dependent of space and time (Huhtanen & Leino, 1990; Pyörä, 2001). Moreover, working with ICT can offer new learning experiences, opportunities for developing competencies and new interesting tasks (Järvenpää & Eloranta, 2001).

2 Material and methods

The study was conducted in selected units of the Finnish National Broadcasting Company using the case study approach. Three units were selected as cases: one unit was from radio production and two from television production. The focus of this paper is on the first case, which is the speech programme department of the radio channel called ‘Ylen Ykkönen’.

Before the actual data collection researchers observed the production of radio programmes and the work of radio journalists, sound editors and announcers. Also expert interviews were conducted and organisational documents were studied in order to understand the production process beforehand. Data was collected using thematic interviews. A total of eleven employees were interviewed. Interviewed employees were journalists, sound editors and announcers. Themes of the interviews dealt with job-descriptions, changes in job-descriptions, competency requirements, changes in competency requirements and work related well-being during the technological change.

3 Results

The results related to changes in job-descriptions, changes in competencies as well as changes in work and well-being are presented independently.

3.1 The impact of technological change on job-descriptions

The results indicate that journalistic and editorial jobs seem to become closer to each other because of the digitalisation. It seems that in radio production, there were changes between the job-descriptions of journalists and sound editors, sound editors and announcers, sound editors and technical support staff and journalists and announcers. In this paper the focus is on the changes of job-descriptions between journalists and sound editors.

Journalists’ and sound editors’ job-descriptions in digital production have changed a lot due to a new computer based sound editing software. The software is easier to use than analogue editing equipment and therefore it is possible for journalists to edit the sound of their programmes. A part of the interviewed journalists mastered the whole production process by themselves from recording to editing, compiling and broadcasting the programme. Another group of the journalists worked still along the traditional job-descriptions concentrating only on producing the content for the programme. Third group of journalists had a job-description between these two groups. They produced the programme together with sound editors. In this case the recording was done either by the journalist him/herself or together with the sound editor in the studio. After that, the journalist could edit the sound partly but the final compiling of the programme was done with the sound editor.

3.2 The impact of technological change on competencies

Radio journalists’ and sound editors’ competencies were analysed and related to the work process, the production and delivery of radio programmes. This made it easier to understand the connections between the changes in job-descriptions and changes in competencies. Competencies were divided into two categories. The first category includes special competencies that are needed in particular phases of the production process and the second category consists of the general competencies that are needed throughout the production process.

Journalists’ special competencies were named “deciding the topic”, “getting acquainted with the subject”, “making interviews” and “delivering the programme”. Competencies, which were needed throughout the entire production process, were named as “basic knowledge competencies”, “interpersonal competencies” and “resource control competencies”. Substantial changes took place in the competency group “compiling the programme” because journalists began to edit their own programmes with the sound editing software. The whole way of thinking underlying the programme production also changed because text writing and sound editing were done with computers. Therefore journalists did not have to think the whole programme beforehand because they could mix the text writing and sound editing phases and sound editing also became non-linear. “Compiling the programme” includes also competencies that are no longer needed in digital production. Journalists do not have to, for example, handle concrete tapes and make tape maps in order to edit the material. New sound editing software also evolves continuously and competencies that are connected to old
softwares become partly obsolete. Secondly, the competency group “getting acquainted with the subject” changed due to Internet. Internet also made journalists more careful with the importance of source critique. Thirdly, digitalisation changed competency requirements involving the “recording competency” because journalists had to learn to record with digital audiotape recorders and minidisk recorders. Competency requirements will also change in the future due to versification. Versification changes competencies when journalists begin to make programmes for both the television and for other radio channels. Competencies are changed primarily within the basic knowledge competency, especially in the competency group “know-how of the media”.

Sound editors’ competencies related to the production process were named “recording”, “compiling the programme” and “mastering the broadcasting unit and online broadcasts”. Competencies, which were needed throughout the production process, were named as “listening”, “interpersonal competencies” and “developing the work”. New competency demands emerged in the competency groups “recording” and “compiling the programme”. Recording changed because sound editors had to learn to record the material into a computer. Recording includes also competencies that became obsolete, for example the handling of concrete tapes. “Compiling the programme” has changed due to new non-linear sound editing software. And because new sound editing software tools emerge constantly, competencies, which are connected to old softwares, become partly obsolete. It may also be in the future, that competencies connected to broadcasting the programme will change due to new digital broadcasting systems and announcers beginning to handle the broadcasting in stead of sound editors.

3.3 The impact of technological change on work and well-being

Technological change had both positive and negative effects on work and well-being. Digitalisation was viewed as a beneficial learning experience, but it also induced stress and insecurity. Negative feelings were experienced especially by inexperienced users of digital technologies and by employees whose job-description was narrowed by digitalisation. Digital technology brought about qualitative improvements in work. It enabled the versatile editing of large amounts of material. The work became more convenient, more precise and more ergonomic due to technological change. Against presumptions, work pace was not immediately speeded up because the learning of new digital tools took time. The breakdowns and insecure functioning of the new tools as well as the overload of information had negative effects on well-being. New working methods were considered to be difficult and personnel felt that the unreliable digital technology was controlling the working exceedingly. Continuous learning was experienced as interesting but at the same time it was seen as a stressor.

Moreover, with digitalisation work became more abstract, and the work process was more difficult to perceive as a whole.

Digitalisation changed job-descriptions, which also had positive and negative effects on work and well-being. Along with the changes in job-descriptions, the traditional types of co-operation among radio journalists, sound editors and announcers diminished and work became more autonomous, but also more lonely. On the other hand, new needs co-operation also emerged, as the unreliable technology required collective problem solving.

4 Conclusions

According to the results concerning job-descriptions in radio programme production, no totally new kinds of professions were emerged, and none of the old professions had totally disappeared. However, existing professions had been combined in new ways.

The results concerning competencies showed that competencies related to specific phases of the production process changed more than those needed throughout the production process. This corresponds with the theory of competency lifecycle. Competencies that are needed throughout the production process can be seen as basic competencies, which do not change much due to technological change. Competencies that are specific to particular phases in the production process are also more technology-dependent and they are expected to change when the technology changes. Also the assumption, that new competencies are needed especially at the merging boundaries of two professions, seems to be true according to this study.

The results concerning the impact of technological change on work and well-being corresponded largely with the theory background of the area. According to this case study, development of open communication, usability of computer aided and software tools, comprehensive training and new forms of co-operation should be taken into consideration when planning and implementing a technological change in an organisation.

5 References


Work @ Home: The Joy of Flex!? Alternating Telework as an Organisational Challenge

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1 Forms and penetration of telework
The increasing availability of modern information and communication technologies enables organizations to change their styles of operation and ways of cooperation. In this context different forms of telework are becoming more and more incident. To claim “The Joy of Flex” (Capowski 1996) is no longer a theoretical idea but an expectation that has to be proved in practice. According to results of the Eurobarometer survey conducted in November 2001 less than two per cent of the work force in Europe had experience with several kinds of regular telework, approximately three per cent with occasional one (Commission of the European Communities 2002: 12). Teleworking in Germany currently remains a phenomenon of peripheral importance. Nearly two per cent of the workforce (=540,000 employees) spent at least one full working day per week at home, usually linked with their employer via data communication (empirica 1999). Based on this study 2005 diffusion rates have been estimated. They range between five per cent of total labour force (in Spain), thirteen per cent (in Germany) and twenty-nine per cent in Finland. By all means telework is a complex and heterogeneous phenomenon (see Figure 1). Therefore precise distinctions are important when evaluating this kind of working.

2 Experiences with alternating telework
This paper is concerned with so-called alternating telework. In our study (for further details see Jäckel & Rövekamp 2001) employees who stay about two full days a week at home are referred to as alternating teleworkers. Furthermore these teleworkers are in salaried employment (only one employer) and use an online connection to companywide computer networks. Self-employed workers, occasional business travellers and mobile field staff were excluded. Details on participants are presented in Table 1.

Table 1: Demographic composition (Trier Study)

- sample size: n=277
- sex: women 68 %, men 32 %
- family status: 82 % married
- children: 76 % have at least 1 child at home
- age: 38 years (average)
- level of education: 37 % apprenticeship, 30 % university degree, 21% college of higher education, 9 % technician, 3 % other
- 48% official in charge, 32% expert, 14% staff function, 6% business management
- days per week at home: 3,1 (average)
- hours of work: 48 % full-time workers (approximately 20 hours per week at home), 52 % part-time workers (approximately 15 hours per week at home)
- use of personal computer at work: 4 hours and 45 minutes (average per day)
- telework experience: approximately 1 year
- job tenure: approximately 12 years

The organisation of work in modern societies is mainly based on a clear distinction between residential and working area. Therefore the decentralisation of work implies many organisational challenges for companies and employees. In fact, the relocation of the workplace is often perceived as an unusual change. Maitland (2000, with reference to a report in UK magazine Flexible Working) resumes: “Nevertheless, they began to feel their work identity was being challenged. Some went into the office when not required. Some found it difficult to cope with the blurring of boundaries between work and home. One felt it necessary to recreate his office at home, complete with flip-chart stand, photographs of his colleagues, and a name badge on his study door.” Objects of our study have been: reasons for participating in telework, working-time arrangements, organisation of family obligations, ways of balancing work and leisure. Beside this perspective integration of telework into traditional office environment (e.g. flow of information, tasks performed) is analysed too. Reflections on home-based telework have to consider employees’ expectations and preferences as well as restrictions and options. Adapting questions of Gutek

Figure 1: Forms of telework
(1983:163) one might ask: "What can technology do for you?" and "What can technology do to you?"

2.1 “Why Telework?”

According to Nilles (1999, p. 47) the introduction of telework arrangements is primarily influenced by four main factors: (1) office space savings, (2) productivity increases, (3) employee retention and recruitment as well as (4) good citizenship. Company programs are not only being introduced on the basis of these expectations alone. Setting up a pilot often is initiated by employees. Demand for telework can trigger a “bottom-up” process. Figure 2 illustrates motives for engaging in alternating telework for men and women.

Figure 2: Reasons for telework in % of respondents (Trier Study)

Our research suggests a wide range of motives. Anyhow, decisions can differ significantly between men and women (e.g. parental leave, offer from employer). Considerations may be affected by individual preferences, private circumstances (e.g. children) and/or work-related aspects (e.g. career, coordination). For female workers, especially those who switched to part-time employment, the participation in alternating telework may be characterised as a “career break with time limit” (e.g. taking care of (preschool) children). Legal regulations in Germany (till January 2001) did not allow to work more than 19 hours per week during parental leave. Therefore it is not surprising that presence in the office is reduced to a minimum. However, telework has the quality of a bridge to the labour market. After a certain period of time female teleworkers might give up work at home and return to office-based work. In contrast, the majority of full-time male workers chooses this mode of work to avoid commuting. They only switch the work location and usually stay about two days per week outside the office. Possibly, younger men and/or male executives anticipate disadvantages in getting ahead: an “out of sight, out of promotion” -situation (see Figure 3).

2.2 Temporal flexibility, coordination and communication

The benefit of temporal flexibility cannot be granted. Self-organisation and self-discipline favour a good work arrangement. Regulations and social factors (e.g. company demands, acceptance) may constrain temporal flexibility. For example, about 25% of the teleworkers have to work core hours at home, nearly 32% are obliged to regard contractual obligations and nearly 41% have to follow defined deadlines (“milestones”). Moreover, teleworkers coordinate their activities with office staff and must be attainable at certain times. The necessity and the amount of coordination are influenced by several factors (e.g. position, job characteristics, full-/part-time, organisational skills). To avoid “coordination problems” aptitude tests of jobs are a good prevention from possible conflicts. For example, it is more difficult to coordinate work with colleagues if tasks entail a high level of communication and a high extent of spontaneous conversation (e.g. involvement in networks). However, domestic life has its own rules and rhythms. Non-work and work has to be organised, teleworkers have to integrate different “time schedules” (e.g. kindergarten hours, business hours of spouse, family obligations, child care). The organisation of working time varies with the availability of human resources. Especially in cases where children are present this often means working at unusual times (e.g. in the evening, at the weekend) (see Figure 4).

Figure 3: Average days of work at home (Trier Study)

Thus demands of work (e.g. tasks performed, consultations) as well as private-familiar circumstances (e.g. children, age, attitude to telework) can affect time arrangements. In Figure 3 the average days of work stayed at home are compiled, differentiated for characteristics of teleworkers.

Figure 4: Organisation of working time at home in % of respondents (Trier Study)

For example, some female respondents work when their partners can look after the children, otherwise the assistance of a (paid) day mother is necessary. Therefore temporal flexibility is a matter of frames and situations. Referring to an economic perspective of time allocation (Becker 1978) these decisions can be interpreted as more or less “limited choices”. In addition, societal landmarks and industrial organisation of labour are constraints of equal importance. Alternating telework is still an unusual mode of work. Perception of social ac-
ceptance (resistance vs. support) and traditional time and leisure arrangements have an impact on how work is organized. Many leisure activities are conducted in groups (e.g. sport club) and take place in the evening or on the weekend. To work at “unsocial hours” implies an exclusion from social events. Nevertheless, the majority of teleworkers realises a growing potential of flexibility. Communication patterns change in the context of home-based work (see Figure 5).

Electronic supported communication (e.g. e-mail, telephone) increases significantly while formal meetings, especially informal conversation with colleagues, decrease. Typical opportunities (e.g. lunch, coffee break) occur less because of reduced presence at office. Consequently, working outside the central office requires one’s own initiative to be informed. It is important to keep efficient communication links. Furthermore a lack of media competence or “computer skills” leads to unexpected frustrations.

2.3 Family, private interests and work

The majority of teleworkers is satisfied with their new working-time arrangement. Nevertheless gender is an important factor. For example, women more frequently report a double load. Conflicting demands evoke difficulties to fulfill multiple roles (e.g. family and work requirements). In these cases telework possibly increases trouble or stress. On the other hand a lot of teleworkers (male and female) are more involved in family members’ lives (e.g. increased opportunities to spend more time with one’s family, availability in crucial moments). As a consequence work at home sometimes causes blurring lines between work and non-work. Especially teleworkers who often do their jobs in the evening hours (e.g. after 8 p.m.) report on difficulties to separate work and family obligations. Compared with the situation in the central office the majority of teleworkers reports an increased control over pacing and scheduling their tasks performed at home. Only a minority perceives a reduction of personal contacts outside home. With reference to the papers’ question “Work @ home: The Joy of Flex?” the following answer (based on results of the Trier Study) has to be given: “It depends!”

3 References


Implementation of an Intranet for Internal Communication Purposes

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ABSTRACT

A new intranet raises high control requirements in an organization. Besides the technical implementation, a strategic introduction is required in order to motivate employees for an intensive use of the intranet. The following presents approaches towards this goal.

1 Introduction

With the intranet, organization-wide communication is furnished with an adequate means for a dynamic, constantly changing labor world. As a relatively new instrument, it enhances internal communication with effective variations.

According to studies, within six months of their implementation, however, 60% of all intranet systems are no longer used by the employees. Besides technical shortcomings and faulty usability, the causes lie in organizational circumstances.

2 Effects on Internal Communication

The introduction of a new or strongly modified intranet implies, when exhausting all possibilities offered, a profound change in the internal communication structure of an organization (Kalmus, 1998). The intranet as a multimedia work, communications and information platform providing a large variety of services and applications, requires changes in the information and communication behavior of the employees.

In an organization-wide introduction of the intranet, the discrepancy between the subjective information demand and the objective information needs has to be reckoned with. A wide range of information supply and the partial conversion from push to pull technologies could entail gaps in the information flow as well as information overload for the employees. The task of internal communication consists now in a deliberate control of information demand and active participation of employees in the intranet.

3 Problems

A number of problems evolve in this context: Which accompanying internal communication measures are reasonable and necessary in order to support use and acceptance of a new or modified intranet with the employees? How can employees receive topic-relevant information on the contents of the new intranet? And how can employees’ preference structures referring to the usage of the intranet, be created, maintained and altered? Employees should be active, should participate in communication in the intranet, submit suggestions, provide ideas and knowledge. For most of the employees this is unusual.

4 Concept

We have developed a concept geared especially to the above-mentioned subjects, which comprises accompanying measures of internal communication in order to increase passive use of the intranet, but especially active use by the employees, e.g., participation in discussion forums. Internal as well as external PR measures and approaches from the external advertising research are key elements in this communication concept.

Special importance is placed on the networking of individual measures in order to achieve an as best as possible result and synergy effects at lowest possible costs. A further intention of this concept is the construction of an adequate positioning of the intranet within the scope of existing media in the organization and with regard to the organization culture and the organization’s overall concept.

If the organization’s guidelines, as a pendant set out in writing by the organization management, do not coincide with the existing organization culture, this can lead to interferences in the information, communication and knowledge transfer in the intranet, and the intended use of the intranet by employees can be impeded. If knowledge transfer, for example, is an important goal in regards to the intranet, organization culture should not be characterized by competitiveness. For the success of the measures, an explicit, company-specific situation analysis in the context of an employee survey, comprising questions regarding the employee’s information behavior, seems to be inevitable.

4.1 Target Groups

The employees of the organization present a heterogeneous group with the most diverging needs and motives. In order to enable an efficient approach, special target groups in view of the intranet, were compiled and appropriate measures suggested for these employees. The applications of a new intranet are to be evaluated considering the highly diverging degree of novelty regarding the individual employee. Many applications differ from their predecessors merely in graphic interface design or their prompting, correspond, however, in the
basic idea. Other applications could be completely new for some or all employees. The readiness to use innovations, differs interindividually to a high degree (Kotler & Bliemel, 1999). This aspect plays an important role in the measures for support of the implementation of a modified intranet.

Ideal-typically, following target groups were formed on this basis to be addressed separately:

- Opinion Leaders or Multipliers:
  - Innovators
  - Executives
  - Intranet Administrator
  - Staff Association
- External Journalists
- Staff Association
- Executives
- Non-Users or Rare Users
- New Employees (incl. Trainees and Apprentices)

### 4.2 Timing of Measures

In addition to special target-group-related actions taking different previous knowledge and requirements of individual employee groups into consideration, it is necessary to develop general communications measures which are attractive to all employees.

Besides the intranet, a multitude of alternatives for the information provision, internally as well as externally, are generally available for the employees. For problem tasks, many employees usually prefer traditional information means. The objective is that the individual employee recognizes the new intranet as an effective and efficient means and becomes a convinced user. The first step toward this is that the intranet ranks high in his/her Evoked-Set of information provision.

The point of time for the start of the first measures lies already before the organization-wide start of the intranet in order to achieve a high acceptance with the employees even before the new intranet is implemented. Quick acceptance is the goal so as to swiftly amortize the development costs accrued.

For a better understanding of temporal interrelations, measures undertaken in the target groups, which have a high temporal relevance for the concept, are categorized in four phases (here explained in the example “All Employees”):

- **Phase 1: Planning and Design Phase**
  
  It comprises the period between planning beginning and start of the intranet. In this phase, the first communicative measures for the steering of expectations by the employees regarding the new intranet start.
  
  Employees are to become aware that the available intranet is not definite, yet, and their participation plays an important role in its future success.

- **Phase 2: Introduction Phase**
  
  This phase comprises the first two months after the implementation of the new intranet. The perspicuous objective in this phase is to inform as many employees as possible, preferably all, on the usage possibilities and the contents of the new intranet.

- **Phase 3: Enhancement Phase**
  
  In this about four months-long phase, the actual positioning of the intranet in the organization’s information instruments begins. The intranet should be a continuously present theme in the organization during this phase in order to keep up and further constant use by the employees.

- **Phase 4: Intensifying of Image Building**
  
  The intranet reflects to a certain degree the existing organization culture. The focus in this phase lies on supporting it in accordance with the organization guidelines. Here in particular, image-building measures are necessary. Especially with regard to knowledge transfer via the intranet, this component plays a decisive role. The employees’ attitude toward the intranet can hamper the use of the intranet and, moreover, the placement of his knowledge.

### 5 Conclusion

Actions and communication measures should be conducted, in principle, over an extended period of time, i.e., a minimum of one year. If measures are implemented only during the introduction phase, there is a risk, on one hand, that not all employees are reached adequately and the “internal advertising pressure” is too low, and, on the other hand, the usage behavior of the employees should generally be monitored in an iterative procedure and corrected, if necessary.

The implementation of a new or modified intranet poses a complex task. The exhaustion of the numerous possibilities which the intranet as medium offers, may not be left to the arbitrary use by the employees but must be controlled through a communication strategy with accompanying measure.

### 6 References


Knowledge Management in Design Education

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ABSTRACT

Trends in economic globalisation have led to ever increasing competition and shortening of life cycles of products and services. According to Porter and others, only organisations which are focussed on ever increasing added value will survive competition. According to Reich (1989) the recipe for survival in the post-industrial information society is the creation of organisations which value learning, creativity and the ability to innovate. Institutions in higher art & design education are by nature organisations which value learning and creativity. Education and knowledge creation is the core business of these organisations. As such, it is quite remarkable how poorly developed the notion of knowledge management is at an institutional level. Although lecturers and educational staff put lots of energy at enabling knowledge creation and facilitating learning at a student level; very little organisations have developed a knowledge vision on how they can enable knowledge creation at an institutional level. Universities are faced with the same challenges as other organisations. The educational market is not any longer the exclusive field of classic universities.

Lifecycles of knowledge and information are decreasing. Especially in the field of digital media, the lifecycle of curricula are challenged by the speed at which knowledge deteriorates. In order to meet these challenges institutions in higher education need to install a knowledge vision on how they retain and promote the creation of knowledge on an institutional level. In the LEDA project, universities in the field of design education, work together to apply aspects of knowledge management at an institutional level, by re-engineering educational practices and the implementation of information-management technologies. This paper reflects on the way LEDA caters for the creation of knowledge (within the field of digital media education).

1 LEDA and its aims

LEDA (learning environments for the digital academy) is aimed at developing new educational practices and knowledge management systems to meet the challenges of education in the highly innovative field of design and digital media.

LEDA will build learning environments which are specifically designed to facilitate and promote the exchange of student acquired knowledge, skills and attitudes. Where most learning environments are developed from a very traditional educational point of view, the LEDA learning environments are aimed at the articulation of both formal and tacit knowledge.

The LEDA learning environments will be designed as a networked system that enables students to publish assets through intranet technology without prior technical knowledge. The LEDA technology will provide in fully configurable publication templates through which students can store and retrieve knowledge assets.

2 About Knowledge, Information and Data

In writing about knowledge management there is a clear need to describe the differences between knowledge, information and ‘raw’ data. This paper makes the distinction in which data are merely figures, information is meaningful data and knowledge can be understood as information which is part of a meaningful social context like a social group, a specific knowledge system or a culture (Weggeman, 2000). Following this definition, knowledge cannot exist outside an individual or a group. As a consequence of this approach, knowledge itself cannot be stored or transferred between individuals.

The only way knowledge can be exchanged is when knowledge is articulated into meaningful information. Articulation can be interpreted broader than just the codification of meaning into texts. Codification of meaning can occur by means of oral (speech, sounds, music), visual (body-movement, graphics) or even tactile codification.

Information in digital form can be stored and manipulated as data. The possibilities of manipulating, cross searching and storage of large data sets boosted the knowledge management hype. The LEDA research combines both pedagogical and technical research to design pedagogical approaches to the articulation of knowledge and technical solutions to facilitate information management. The model illustrates how the research in the LEDA projects is organized around the distinctions between knowledge, information and data. Pedagogical research in the LEDA project is targeted on the organisation of knowledge creation processes in research- or project-teams and in what way knowledge is articulated as information.
The technical research is oriented at the logistic facilitation of information storage, retrieval and manipulation of data as technical enablers of the knowledge creation process.

3 The knowledge creation process

“Learning is a process of creating knowledge” (Weick, 1991) The definition of learning in this way implies that knowledge is both the input of a learning process as well as the output of a learning process. Learning, seen as such a cyclic process involves three types of learning activities: ‘collection of information’, ‘processing & synthesising’ and ‘creation and evaluation’ (Renger, 2000).

In this cyclic approach, the first stage is ‘collection of information’. Information to be collected can range from ideas, research materials or individual outcomes of prior learning cycles. In this stage of the learning cycle, information is collected for processing.

In the second stage, ‘processing and synthesising’ information is ordered, structured, valued, interrelated and synthesised into new knowledge. For example, research material is being processed to support concept development, whether in the form of a research report or a structured data collection. It is a collection of activities with the purpose of the transition from raw data, rough ideas, brainstorm session outcomes etc. to concrete articulated ideas or solutions.

The creating aspect of learning is positioned in the third stage of the cycle, ‘creation and dissemination’. In this stage the results of processing & synthesis of information is synthesised into new created knowledge which can be articulated in various ways (such as articulated ideas, models, presentations or prototypes) By evaluating the newly created knowledge, the cycle can be re-entered to create solutions for new problems or refinements on existing knowledge.

3.1 Enabling the knowledge creation process

LEDA’s main purpose is to enable knowledge creation processes by using learning environments which facilitate the articulation and exchange of knowledge. In their publication “enabling knowledge creation” Krogh, Ichijo and Nonaka (2000) have defined key enablers which promote the knowledge creation process:

- Creating the Right Context
- Managing Conversations
- Globalising Local Knowledge

3.2 Creating the Right Context

Effective knowledge creation depends on an enabling context, which can foster ideas and facilitate the articulation, creation and evaluation of experiences and knowledge. As such the “whole process of knowledge creation requires the necessary context or “knowledge space”.

Knowledge creation can only happen through an organisational structure that reinforces enabling and is aligned with strategy. LEDA reflects these requirements by promoting knowledge articulation within the context of specific educational programs like project-based learning or the conduct of formal research at PhD level.

Creating a ‘right context’ is crucial to student-centred learning. Research into the facilitation of group projects that were carried out by students at the Utrecht School of the Arts showed that a critical factor to effective knowledge creation was the necessity for students to be physically concentrated in space. This sense of ‘nearness’ was crucial in stimulating the exchange of ideas, tacit knowledge and experiences, the provision of a stimulating social environment, and the generation of social pressure and a sense of mutual responsibility.

This ‘nearness’ was defined at first as a physical quality of the learning environment of students working in the same space, in terms of Euclidean distance. But students also extended their physical nearness to cyber-space using ICT tools as FTP, ICQ, email etc.

However, for co-operative learning to take place, more is needed than putting students together in space, whether it be physical, or in the case of LEDA, virtual. Students need to share a mutual frame of reference and structure which in LEDA are shared learning environments, shaped according to the pedagogical settings students are working in. LEDA will provide students with a work environment in which they can articulate their experiences and connect to intellectually related students or information.

3.3 Managing Conversations

“It is quite ironic that while executives and knowledge officers persist in focusing on expensive quantifiable databases and measurement tools one of the best means for sharing and creating knowledge already exist within their companies...Conversations” (Krogh, Ichijo, Nonaka, 2000). According to these authors good conversations are the cradle of social knowledge and the most important enabler of knowledge creation.

Educational facilitators in student-centred education do value the beneficial effects of conversation on knowledge creation processes. In coaching student groups educational facilitators often rely on conversations for the purpose of stimulating intellectual effort, promoting the articulating of progress and structuring the workflow. These Socratic dialogues stimulate students to articulate on the knowledge and learning experiences acquired and promote critical reflection. In the LEDA project the Socratic dialogue is translated to the digital domain.
The LEDA learning environments consist of pedagogical scripts which reflect the workflow a learning environment is meant to facilitate. These scripts consist of facilitating materials for the task at hand but more important, contain questions designed to promote the articulation and exchange of tacit knowledge. In designing these pedagogical scripts the dialogues are matched to the various motivations students can have in articulating their learning experiences, skills and knowledge: to comply to institutional requirements, to share knowledge as part of the communal learning process, to facilitate guidance and evaluation and/or to showcase their work.

One of the difficulties in designing pedagogical scripts to promote the articulation of knowledge in design education is to keep a good balance between articulation effort and killing the creative process by over-questioning students. A careful balance should be struck between registering crucial pieces of tacit knowledge while maintaining a good overview and representation of the entire design process.

3.4 Globalising Local Knowledge

As the labour market in the field of digital media design is becoming increasingly internationally oriented, co-operation between institutions of higher education becomes increasingly important. However, international differences in curricula and course contents pose significant limitations on the possibility to design and distribute courses on an international scale. The knowledge derived from experience, however, is highly fit for exchange because it is not directly related to the specific contents of curricula, while keeping its relevance for students in the same discipline, and even across disciplines. As stated in the paragraph about the nature of knowledge, knowledge itself can not be transferred as such. Articulation of knowledge into meaningful information however, can be stored and manipulated by means of technology.

When retrieved in the right learner’s context, mere data can acquire relevant meaning and become part of a knowledge creation process. The positive effects of the exchange of ‘knowledge’ assets depend entirely on the appropriateness of the data in the context of learner’s activity. The LEDA technical research is aimed at providing solutions to the effective exchange of information. This research is once again related to the concept of ‘nearness’ as put forward in paragraph 5.1.

Here the concept of nearness is looked at from a contextual point of view, where it is projected on a subject matter which could share relevance with subject matter. In order to globalise knowledge in the context of the LEDA learning environments “Nearness” can be defined as “the proximity value of information for knowledge (re)creation in terms of people working together and/or subject matter being relevant to people in a knowledge creation process”.

Metadata are used to describe and define the context knowledge is articulated in. As such information inherits meta-information about subject-area and usage contexts. Matching metadata at the level of pedagogical scripts provide in so-called ‘related topics, related issues, related persons’, listings of potentially meaningful data which can facilitate knowledge (re)creation.

4 Conclusion and discussion

In the previous sections notions about knowledge management were illustrated with research associated with the LEDA project. A research and development effort to put knowledge management to practice in the realm of student centred design education.

The paper emphasises the notion of enabling knowledge creation processes as important aspects of learning.

5 References

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ABSTRACT

“Successful and healthy work in Call Centres” is the motto of the CCall Project. Supported by the Federal Ministry of Labour and Social Affairs, CCall is managed by the Verwaltungs-Berufsgenossenschaft (VBG), the German institution for statutory accident insurance and prevention in the administration sector. It is conducted by partners from universities, governmental labour inspection, tripartite and trade union’s institutions - and call centres. Following the goal to find and point out practical solutions for Call Centres in order to have healthy and efficient employees, the last 1,5 years were used to make analyses of the present situation, to point out problem fields and to develop solutions and tools for practical use. An evaluation of the solutions is also part of the project. Ending in June 2002, CCall will offer a manual helping to realise good practice in Call Centers by means of optimising organisation of labour, human resources development, working environment and equipment.

1 The Project

The change of working life, especially in terms of globalisation of the labour market lead to a new kind of work mainly in the information- and communication sector. One of these new kinds of work are Call Centers. They are important interfaces between enterprises and customers. New kinds of work – this means also a new challenge for occupational safety and health.

Together with partners from universities, governmental labour inspection, tripartite and trade union’s institutions, business associations and Call Centers, CCall treats a variety of questions concerning physical and psychological loads for the employees of Call Centers.

The project is managed by the „Verwaltungs-Berufsgenossenschaft“ (VBG) with support of the research institutes BGAG and BIA of the „Central Association of the accident insurance in industry“(HVBG). The VBG is the German Institution for statutory accident insurance and prevention in the administration sector.

Results of the investigations, such as tools for practical use or reports over specific themes are continuously published.

By end of June 2002, the project will be terminated after a 2 years running time. The VBG will secure an integration of the project results and their further development in its preventional work.

2 The Concept

Besides the classic areas of industrial safety (Equipment, work environment) CCall focuses on the factors “organisation of work” and “employees” (see lower string in the above diagram). Aim is to find out the decisive factors for health and efficiency in a Call Center.

Bringing together equipment/Work environment on the one hand and work organisation/employees on the other will lead to a “good practice” Call Center. CCall intends to achieve this by developing and offering exemplary measures.

Areas with special importance for workability and employment are:

- Integration of handicapped people in Call Centers
- Voice problems of callcenter agents

3 Partners and Topics

In order to handle every aspect of healthy and efficient work in Call Centers, the project was conducted in cooperation with partners from science, associations and institutes. Within this group CCall investigates characteristic loads in the branch and develops solutions in line with standard usage.
The Partners are:

The main topics are:
- Economics
- Work Environment
- Software Ergonomics
- Voice
- Emotional load
- Personnel recruitment
- Qualification
- Organisation of work
- Health promotion
- Integration of Handicapped people

4 Structure of Results
For a user-friendly access to the outcome of the project, the results are structured as follows:

- **CCall Manual**: Problems will be pointed out, exemplary solutions will be given. The manual consists of different modules, each of them connected to a specific Call Center topic.
- **CCall tools**: CCall offers Instruments ready to use directly in everyday Call Center life such as software, Checklists or qualification programs.
- **CCall Reports**: Background information will be given on a scientific basis. The reports form a summary of the results of the respective project partners.

5 Activities and Results
CCall is designed as a continuously learning, flexible project. Results are given access directly to the public. Current project results are presented on the CCall homepage (www.ccall.de) and can be downloaded. A printed version of most results is also available.

During the runtime of CCall, enterprises, agents and other interested persons are continuously served with information by request. Contacting CCall is possible over all communication channels such as Telephone, Fax, email or letter.

Continuous consulting activities have been realised all through the running time of the Project. Congresses and workshops have been organized as well as presence at trade fairs.

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Working Conditions in CallCenters: Successfully and Healthy

Alfred BENNINGHOVEN

ABSTRACT:
Successful and healthy work is determined by many factors, which can be condensed into four main topics: Equipment (Software-ergonomics, Hardware-ergonomics, Office equipment), Work environment (acoustics, climate, office-design), Work organisation (working-tasks, workflow, work-structure) and Employees (resources, qualification, training).
The main problems in the field of working environment and equipment are:
• Climate: it is too warm or too cold, the air has an insufficient quality.
• Ergonomics: unhealthy postures often must be taken while working
• Acoustics: the noise level is often too high, the audibility is bad.
• Office-design: the workspace is often not sufficient.
• Light: it is too light or too dark, there is too much glare (blinding).

1 Introduction
Physical and chemical factors of the working surroundings as well as the workplace ergonomics represent essential basic conditions on the well-being and the capacity of employees in Call Centers.
Within the project CCall the BIA carried out exemplary examinations to acoustics (acoustics, sound propagation, Headsets), room climate (temperature and air movement, air humidity) and air quality as well as ergonomics in a row of Call Centers and in the laboratory.
As a result, CCall presents exemplary solutions by publishing manuals and reports.

2 Climate
Especially when talking a lot, the air quality has a big impact on the voice. Besides that, wellbeing and efficiency at work is affected to a big part by the climate conditions at the workplace.
Numerous investigations showed that the average air humidity is far too low (often less than 30% of relative humidity), especially during the heating periods. Measurements of CO₂ concentrations mostly showed high values (more than 1000 ppm). Apart from air loads caused by persons in the room, smell nuisance could also be stated by technical equipment. The latter also contribute to the deterioration of the climate situation by high heat emissions.
The most important results of the investigations are:
• Space air must be held at a minimum of 40% of relative humidity. Air humidifiers should be used if necessary (see CCall Tool "Auswahlhilfe für Luftbefeuchter").
• Technical equipment should be placed as far as possible from the working area.
• A constant ventilation of the workrooms has to be guaranteed; if necessary air-conditioners should be installed.

3 Ergonomics
Within the scope of the project posture and movement analyses have been executed in several Call Centers. It could be shown that there are quite a few differences between conventional office workplaces and Call Centers concerning the movement behavior.
Sitting over long periods with a partly one-sided and static demand of muscles and bones (locomotor system) is typically for Call Center work. Depending on the share of calls during a working period, e.g. the strength and duration of negative inclinations of the pelvis increases.
Besides that the investigations showed that an arrangement of the equipment (monitor, keyboard, document holder, etc) not corresponding to the working task could lead to unfavorable postures.
Interviews with Call Center employees on the basis of standardized questionnaires pointed out that most muscle skeleton complaints are settled in the neck and shoulder region as well as in the area of the lumbar vertebral column.

4 Acoustics
In this field the goal is to lower the noise load and at the same time not to isolate the agent. Especially when calling outbound, the possibility of communication between the agents may be useful.
Reverberation like reflection from walls, ceilings, windows and floors and too small level decrease in sound propagation result into high sound levels annoying the Call Center employees. Within the investigations relevant areas were identified by sound level measurements. Advice is given how to lower annoying sound by using sound absorbing materials on ceilings, walls and floors. To decrease reflections at windows for example, thin micro perforated, transparent foils can be used fixed in a distance of several centimetres in front of the windows.
Sound from neighbouring or opposite work places causes problems in intelligibility. This often results in a decrease of concentration and premature fatigue. Suitable screening devices improve communication and avoid untimely tiredness. The screening devices should be adjusted to the acoustic shielding as well as to the communication not only with the client but also with colleagues - where necessary.

Perception of annoying ambient sound is decreased also by special headphones. Employees using headphones should be involved in the selection of headphones. A good fitting to the user is important. The intelligibility between client and agent is improved by binaural constructions; but it may obstruct communication with colleagues.

5 Office Design

A sufficient offer of workplace area supports the Call Center agents at their daily work. Correctly dimensioned traffic routes help to structure the workflow and give enough place in case of emergency. Especially when moving into a new building good planning in advance is very important.

A space allocation that is too high can have negative effects e.g. on the concentration of the agents. People normally feel annoyed when sitting too near to their neighbors, furthermore this has negative influence on sound level and space climate.

The demands for office-setup areas are derived from EU directives as well as from national rules and are concretized by regulations and work standards.

According to their function, the setup area is divided into: work area, area for placing furniture, furniture function area, user’s area and traffic route areas. Thus an individual need of working area arises for the respective workplace.

6 Light

During the Call Center consultations inadequate lighting of room and workplace came across frequently. This was caused mainly by:

- Switching off of the room lighting because of glares and reflections of the space lights, e.g., on the screen surface.
- missing or inadequate workplace lighting.
- inadequate or not well balanced distributions of brightness.

It could be found out as well that the workroom was too much darkened by sun protection equipment on the window surfaces. As a result too little daylight could penetrate into the room.

For a proper room and workplace lighting it is highly recommended to elaborate an individual lighting concept. The system always has to be planned in accordance with the arrangement of working equipment such as table, chairs and displays. Among other things, correct colour appearance and sufficient density of light are to be planned for the room lighting as well as for the direct workplace lighting.

Sun protection systems are to be attached in the outside fassade. It has to be paid attention to the fact that systems are applied, which allow enough daylight to penetrate into the room areas. A sufficient visual contact outwardly has to be guaranteed as well.

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Demands on Call Centre Agents – Results and Solutions

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ABSTRACT

Call centres as an organisation form are determined by a high degree of differentiation. This is not only meant in terms of differentiation between in-house call centres, which are created as a part of already existing enterprises, and external service providers which have to cope with the free market.

Stress and strain for call handlers are strongly depending from the characteristics of the working tasks that have to be carried out. CCall has investigated the mental workloads in more than 60 call centres with more than 6000 call handlers. It was found that the determinants for healthy work in general were the heavy mental workload and especially the limited task variety. One significant indicator for healthy working condition is the proportion of call handling in relation to the working time.

By examples from practice the most important types of workloads in call centres will be presented. Proposals for effective solutions of good practice will be given.

1 Call Centre – New Organisations, New Problems

Call centres are new forms of organisation that have been built in order to optimise customer service. Call centres are marked by high growth rates and are considered as job engines. In Germany, the expected growth is to approximately 20% per year (Datamonitor, 2001). There are about 3500 call centres with over 250,000 employees.

However, near this pleasant economic development call centres are often criticised with regard to their working conditions. Recently a lot of work-scientific studies found a revival of taylorism in call centres because of limited task variety and job demands (e. g. Richter & Schulze, 2001; Metz, Rothe & Degener, 2001; CCall, 2001). So call handling seems to be a very poorly designed job with heavy workload (e. g. Smith & Sprigg, 2001). Employees spend a significant proportion of their working time in responding to calls on the telephone with limited physical activity and they are stressed by the automatic call distribution (ACD). The ACD controls when call handlers take calls and how many calls they take. As soon as the calls have been finished, the next call is automatically relayed to the handlers.

Furthermore call handling is multi-tasking. During responding a call the handler has to check the display screen and to deal with the order of the customer.

The aim of this presentation is to show results from the Ccall project in relation to the demands on the call handlers. Furthermore we give an example for good working practice in call centres and finally we will show some general guidelines for healthy call centre working.

2 Results from CCall

General mental workload potentials in call centres were determined and were compared to those from traditional working forms. Figure 1 shows that the mental workload potential in call centres lies much higher than in traditional working forms (CCall, 2001). The mental workload potential of call centres lies near the cut-off point that marks a shaping of an organisation as definitely necessary.

Figure 1: Mental workload potentials – comparison of new and traditional working forms

The problems in the single call centres are often the same: Here limited task varieties and job demands could be found.

The higher the amount of telephone time per shift, the more demands could be registered. As well it could be found that simple activities (e. g. information desk) show lower values in task and time varieties than complex activities (e. g. consulting).

High emotional workload can be found in call centres (Isic, Dormann & Zapf, 1999). Here the emotional dissonance plays a crucial role. The handlers emotions which correspond not necessarily to their real feelings during their job activity. Compared to a control group call centre employees show much higher values of emotional dissonance (Isic & Zapf, 2002).
Altogether the analyses show that call centre workplaces have high demands for the employees.

3 Example of good practice

It is not simple to determine criteria for a good-practice call centre. Also the organisation form call centre seems to be marked by approximately always the same problems, so that the question must be discussed after the general possibility to design working practice in call centres. In the following a call centre from Halle, Germany is presented in which CCall has found processes of good practice.

This call centre is an external service provider who treats only business to business orders. It possesses inbound as well as outbound areas. Furthermore it has an academy for further education as another enterprise area. In the enterprise there is no part-time employment. All call handlers work fulltime. Opening hours of the call centre is from 8am-8pm. During the last 12 months there was no turnover in the enterprise. The managing directors pay attention to a participative enterprise culture. The call handlers participate in a lot of areas in the enterprise. So they can choose, e.g., between different headsets.

The examinations in this call centre show no conspicuousness. No high mental workload is to be expected; decision and task variety are appropriate. Only the qualification requirements appear negative because the learned occupation is not used in this call centre. This represents no disadvantage in more exact analysis, because crucial new contents must be learned for the activity.

<table>
<thead>
<tr>
<th>Analysebereich</th>
<th>Kritischer Wert</th>
<th>negative Bewertung</th>
<th>Bewertung des Analysebereiches für b2b-CC</th>
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<tbody>
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<td>1</td>
<td>positiv</td>
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<td>Komplexität/Vielfalt</td>
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<td>4</td>
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</tr>
<tr>
<td>Qualifikationsanforder</td>
<td>≥ 1</td>
<td>1</td>
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In account to the results this call centre is a good-practice call centre. But it has to be considered that this is here a very new call centre, so that the exposition duration is low. A repetition measurement will clear whether the good mental workload values for a call centre could be held.

4 General guidelines for healthy call centre working

In the following some fundamental indications are given for healthy work in call centres. These indications have general character:

Mixed work: To mix call handling with back office activity reduces the proportion of call handling and leads to lower mental workload.

Promotion of education: To give a possibility for personal development and to make sure that the employees can handle the job tasks.
Maintaining breaks: To have a break is necessary for relaxation and promotes the performance on a long-term basis.

Here are some indications that correspond with healthy work:

- Make tasks more complex and more varied
- Enlarge decision making competencies
- Tasks have to be meaningful
- Avoid too high standardisation
- Reduce time of call handling

5 References


When the Voice Refuses to Smile – the Impact of CC-Work on the Voice

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ABSTRACT

Approximately one third of the labour force in industrialized societies rely on voice as their primary work tool (Vilkman 2000). Recent studies have shown a significant association between voice problems and vocally demanding jobs such as teaching, singing, acting and aerobics instruction. Call-center agents are working in a voice profession. They rely only on their voices as tools for communication. As Prof. Alfred Mehrabian found, only about 7 percent of the meaning of a message is communicated through verbal exchange. About 38 percent is transferred by the use of voice/tone. About 55 percent comes through nonverbal gesture, posture, facial expression, etc. Speaking “online” reduces the number and range of communication channels. The meaning of the “voice as the message” in telephony is even higher then in other communication situations. As a result a higher burden on call center agents’ voices is expected.

As a result of our research in the frame of “PASECCO — prevention of voice and breath disorders in call center organisations”, part of the Ccall Project, we found out that voice disorders among call center agents are accumulating. Previous studies in America indicate that telemarketers comprise 2.3 percent of the patient volume in a voice clinic but only 0.78 percent of the 1994 workforce, indicating that telemarketers are about three times more likely to seek help from a voice clinic compared to the average employees. On the first, the request of our survey lies on pinpointing specific work-related voice-risk factors in call center work and on second on the development of effective, sustainable and preventive voice training methods for voice professionals in order to submit a sparingly usage of voice and an efficient voice hygiene. Occupational voice disorders should be discussed like other occupational diseases and the prevention of voice disorders must be considered as a main task of occupational safety and health. First of all: people in voice and speech professions have a right for adequate vocational-training measurements focused on their primary work tool: the voice.

Call centers are an often and likely used tool in customer care. A lot of customers use this service in many ways: to be consulted via phone, to place an order or to reclaim in cases of dissatisfaction. Often, telephony in call centers is rather knowledge-intensive and the boundaries between pure informational service and straightforward processing are blurred. Employees have to be stress-resistant, well trained and customer oriented – and they have to possess very strainable voices. With no doubt, call center telephony with often eight hours customer contact per day must be called a voice profession – a profession that depends on the voice as the first and most important work tool.

Recent studies have shown a significant association between voice problems and vocally demanding jobs such as teaching, singing, acting and aerobics instruction (Jones, 2001). Previous studies in America indicate that telemarketers comprise 2.3 percent of the patient volume in a voice clinic but only 0.78 percent of the 1994 workforce, indicating that telemarketers are about three times more likely to seek help from a voice clinic compared to the average employees (Titze et al, 1997).

The primary risk factor in voice and speech professions is naturally the need for prolonged use of the voice – es-
especially when the speakers have never learned how to breath and speak in an appropriate and economical way. As Prof Alfred Mehrabian found out, only about 7 percent of the meaning of a message is communicated through verbal exchange. About 38 percent is transferred by the use of the voice / tone. About 55 percent comes through nonverbal — gesture, posture, facial expression, etc. (Mehrabian, 1972).

Speaking “online” reduces the number and range of communication channels. The meaning of the “voice as the message” in telephony is even higher then in other communication situations. As a result a higher burden on call center agent’s voices is expected. A basic training for professional speakers – obligate in the education of priests and teachers – should provide telephone workers with information and practical experiences on how to use their own voice appropriately. Surveys on other voice professions indicate, that the danger of suffering from voice disorders can be reduced when the speakers participate in speaking- and voice trainings.

The voice is a sensitive “organ”. It is indicator for the psychological condition of a human: the voice uncovers the mood of the speaker. Under permanent pressure or misuse it looses the resonance and in the worst case becomes dumb. When a voice disorder is given, the person in question can no longer continue its profession. This condition may be transitional, but can even end in a state of total invalidity concerning the field of professions having to do with speaking. On this account occupational voice disorders should be discussed like other occupational diseases and the prevention of voice disorders must be considered as a main task of occupational safety and health (Vilkman, 2000).

For call centers, investments in the voice health of their employees are a contribution towards efficient occupational safety and Health and will improve their service quality. Hoarse or throaty voices as a result from an unnatural (mostly too high-pitched) voice level, agents, who breath uneconomical and are catching their breath during the online-dialogue can not convince their customer, and – even worse – put across a negative image of the company they represent. The concept of prevention as a method for a better and sustainable voice health should by any means regard aspects of behaviour and working proportion prevention. It should aim on the speaking and intonation habits as well as influence the working environment and working organisation in a positive way.

For serious call center carriers ergonomically correct arrangements are a matter of course today. Especially the reduction of background noise and the moistening of the air are part of an voice-appropriate environment. But this is still not enough: call center Agents should have breaks regularly — even and especially when “the line burns”. They have to be skilled in order to speak their own language carried by a voluminate and economically acting voice without using hollow phrases, that have nothing to do with their natural use of speech.

The complete report on the topic “Voice in call center work” can be ordered as print-version from the VBG, or can be downloaded under the following addresses: www.ccall.de and www.pasecco.de.

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The Integration of Handicapped People in Call Centre Work – Results from the CCall Project

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ABSTRACT

Call centres offer good opportunities for the integration of handicapped people. While the employment ratio of handicapped persons lies generally with 3.7%, they are, with an employment rate of 2.12%, clearly under-represented in call centres. Therefore, the project CCall has started an integration measure that integrates handicapped people demand-oriented into call centres. The measure lasts 6 months and contains the mediation of theoretical knowledge and practical competence. Within the framework of training the participants can be recommended to their potential employers. A month before the end of the measure 70% of the participants are provided with labour.

1 Call centres as an employment chance for handicapped people

The integration of handicapped people in the labour market is a continuing aim. But with the change of work the integration ways also have to change. Until now integration consisted of long-term education measures, conveyor programs etc. With the increase in service activities and the amount of call centres in the working life the possibility of a fast integration of handicapped people is given. Using the specific resources of handicapped people it is now possible to create jobs of high quality. But call centres may not be respected as a “golden cow” of the integration of handicapped people. Nevertheless is a carefully choice of the potential of handicapped employees is as important as in other branches.

The aim of this presentation is to show data and facts from handicapped people working in German call centres. Furthermore an integration measure is presented which provides handicapped people with call centre work successfully.

2 Employment situation of handicapped people in Germany

In Germany handicapped people are concerned outstandingly high from unemployment. The rate of handicapped unemployed persons in the total number of unemployed persons was 3.9% in January 2002 (Bundesanstalt für Arbeit, 2002). The employment ratio of handicapped persons is declining since October 2000 (cf table 1; Bundesanstalt für Arbeit, 2001). Up to now more current numbers are not available. To stop this negative trend, the program “50,000 workplaces for handicapped persons” was initiated in 1999 by the Federal Ministry for Work and Social Affairs. With this program the number of unemployed handicapped persons should be decreased until 2003 from over 190,000 in 1999. After first successes the number stagnated for a while (January 2002) with approximately 167,000 un-employed handicapped persons (Bundesanstalt für Arbeit, 2002).

Figure 1: Employment ratio of handicapped people (1980-2000; Bundesanstalt für Arbeit, 2001)

3 Call centre — Potential employment for handicapped people

Why do call centres represent an employment chance for handicapped people?

- The demand profiles for call handlers can be fulfilled by people with impediments. They have to be communicative and creative, show learning readiness and have computer knowledge at their disposal.
- Working forms (like call centres) that are dominated by information technology differ from traditionally working forms by low physical activity. This aspect is positive for people who are physically handicapped. The operating elements of the call centres (telephone, keyboard etc.) can be installed with low technical and financial expenditure for the specific needs of the handicapped person.
- Call centres also offer a chance for people who are rather disadvantaged on account of a visible impediment in the normal public traffic. Also experiences with partially sighted call handlers are present.
- Call centres have a high need in qualified call handlers. In persons with impediments highly qualified applicants can be found. Handicapped people often handle with new media (like www) because of their impediment. This is coined particularly when immobility is present.
Call centres have a high need of motivated assistants. The employees are the capital of service providers. Call centres are extremely dependent on the commitment and the motivation of their working force. For handicapped people a particularly high professional motivation can be assumed. Nevertheless they also have to stand firm to a higher pressure like a non-handicapped employee.

4 Call centre survey – Handicapped people

To get an overview about the employment of handicapped people on the German call centre market, the CCall project made a call centres survey. N=412 call centres with altogether almost 60,000 employees participated in the nationwide study. Besides, quite small enterprises as well as the “global players” were considered to get an approximately representative picture of the employment of handicapped people in call centres. In contrast to general employment ratio of the handicapped people which was in 2000 in the range of 3.7%, the ratio registered in the survey was 2.12% which is much lower. 44.2% of the questioned call centres indicated to occupy handicapped agents. 55.8% have no handicapped office workers.

The experiences of call centres with handicapped employees are mainly good or very good (92.3%). Only 1% (n=2) of the human resource managers said they had bad experiences with handicapped assistants (cf. Figure 2).

Further results of the survey show that there is a strong need to support call centres managers in terms of informing them about the employment of handicapped agents and also in arranging employment for handicapped people in general. For more information on the survey: www.ccall.de.

5 CCall – Integration measure

CCall started an integration measure taking into account the results of the survey. The concept is shown in figure 3.

The experiences of call centres with handicapped employees are mainly good or very good (92.3%). Only 1% (n=2) of the human resource managers said they had bad experiences with handicapped assistants (cf. Figure 2).

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Figure 2: Experiences with handicapped call handlers

Figure 3: Concept of the CCall integration measure

At the beginning of the measure a network was created. This network consists of call centres, furniture manufacturers, hardware assemblers and other groups of interests. From these partners the measure was supported and was represented in the public. At the same moment suitable handicapped persons were selected and trained for the measure (“Reha-Pool”).

The measure consists of two parts. The first part lasts 3 months and provides fundamental knowledge for call handlers. In the second part the participants graduate from training and are recommended here for their later employers. A month before the end of the measure 70% of the participants are integrated into labour.

At this time further integration measures are started. Here different ways of the integration are tested. So the integration of 5 other handicapped people takes place directly in the enterprise. Here a two-month training phase takes place. After that the participants are put into a full temporary work relation.

6 References


Integration of Videoconferencing Technologies in Distributed Computer Cooperative Work; Preliminary Results from the Communicate-IT Project

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ABSTRACT

This paper reports the preliminary results from a study addressing the question of the requirement and mechanism related to the integration of video-mediated communication in the computer supported cooperation work (CSCW). This question is addressed in the specific context of the manufacturing industry. The method uses interviews as well as the simulation of tasks in experimental context. The results show the relevance of the videoconferencing means in distributed CSCW solutions.

1 Introduction

With the globalisation phenomenon and the increasing pressure for performance in manufacturing companies, the search for cost saving solutions and the rapid solving of production problems have become crucial. Using remote expertise to solve production problems is among the decisive challenges for current manufacturing companies. Videoconferencing and distributed Computer Supported Cooperation Work (CSCW) can be some possible way to succeed with these stakes. This paper report preliminary conclusions from a research project that was created by a consortium of researchers and industrial partners in order to:

(1) generate knowledge about the basic requirements of videoconferencing for business needs in the manufacturing sector, and (2) develop a prototype integrating videoconferencing in a CSCW setting.

The videoconferencing technologies have been improving for since 30 years now. One important aspect in this evolution is the uninterrupted scientific quest to improve the quality of sound and image and to limit delay. These questions remain important ones, even today with the dramatic progress seen over the last few years in network, compression, and end device technologies.

Despite this tremendous improvement, videoconferencing solutions often remain unused or little used where available. This situation suggests that users are missing some opportunities to benefit from distant collaboration.

The importance and the use of the visual channel in distant communication have been the subject of much research. As noted by Sellen (1992, p.49) “Video and audio technology have obvious potential for bringing people together at remote locations”. Despite this potential, the mediated communication differs from co-located face-to-face communication. This aspect of telecommunication has been the object of some research where, for example, conversational aspects in video-mediated communication (Sellen, 1992, 1995) were compared with face-to-face. Results from those studies show that the availability of the audio-visual channel, even with very good quality (O’Connal et al. 1993) does not guarantee conversational aspects similar to face-to-face conditions. The feeling of being distant and the lack of reciprocity are examples of characteristic that could explain this difference (Sellen, 1992). Evidence from this perspective drove the development of many prototypes aiming to recreate the communication conditions existing in co-located collaboration.

1.1 When Work is the Focus

Our project aims at bringing some answers to the crucial questions regarding basic requirements for the integration of videoconferencing capabilities in distributed CSCW solutions designed for the manufacturing sector. Moreover, this research includes the notion of task in its search of optimal solutions, which foster a real work oriented perspective. For example, we expect that the quality requirement for video-mediated communication could be different in the negotiation of initial goals for a important project than in the fine-tuning of a low-impact solution.

The orientation towards replications of face-to-face communication conditions may also have overshadowed some other important aspects, characteristics and requirements that have to be considered for supporting simultaneous communication in distant collaboration. As noted by Navarro (2001) in a review of the recent literature on the remote collaboration and the new communication technology, there are aspects that are more important than the actual sight of the other participant. The author suggests that sharing functional information is the fundamental factor for successful remote collaboration. This may explain the limited success of usual videoconferencing solutions to support collaboration in the manufacturing industry. It also puts forward the need for developing more integrated solutions, allowing adapted functional and social information to be exchanged by the remote collaborators.

Recent years have also shown a new important and significant interest in the cooperation and collaboration phenomenon under the specific context of its computerised support. This prolific field of CSCW is generating several theoretical, methodological and technical innovations. CSCW and videoconferencing offer a great potential benefit in integrative solutions.
1.2 Research purpose
One of the most important aims of our team is to recognize the great importance of the link between the real-world context and experimental environment. The composition of our team expresses this concern. The method used in this research also expressed this constant preoccupation.

2 Method
The first step of the project was to realise some semi-structured interviews with users of videoconferencing systems in the manufacturing industry. These interviews were designed to gather some relevant information on (1) the aspects related to collaboration and its relevant communication needs and (2) on the global aspect in which the real work is performed (immediate environment, interruptions, other responsibility, interfering tasks, broad goals...). The structure of the interview was inspired from the theoretical model presented by Lamonde and Montreuil (1995) in an article on the analysis of real work situations. This model, applied to mediated communication in collaboration contexts, enabled the consideration of a broader context and allowed to cover also some more general topics related to real work performed by the interviewees. The interviews were audio recorded in order to allow subsequent analysis.

The second step in our project will be to select and synthesise some specific tasks in order to use them in laboratory experiments. This synthesis requires qualitative analysis of the interviews realised in the previous step. The third step will be the experimental investigation of some variation of different communication parameter in the context of task simulation performed by the subjects. For example, the subjects are asked to perform some distributed CSCW sketching tasks supported by different communication solution (basic quality of communication aspects, support for communication management, etc.) The effects of these variations are measured in terms of process and output of the collaboration session. On the process level, conversational aspects and point of regard are considered. The work performed (action level) is also included in the analysis. The output indicators are related to specific and overall satisfaction.

The experimental setting and the test people are audio-video recorded while performing the experimental task, allowing a subsequent analysis of the integration modalities of the visual channel in the cooperation/collaboration. The audio-video channel is recorded in both sites. An aerial view of the desk is also recorded in order to observe what the participants use as support. The screen area is also recorded.

3 Preliminary results
The analysis of the interviews is ongoing but some evidence already raised. For example, sketching, pointing and referring to different types of documents are ubiquitous in real work situation as experienced by engineers in manufacturing industry. Such modules will therefore be included in the prototype. The need to keep some traces of the evolution in the project also appears as an important aspect.

The interviews also point out that the need for videoconferencing technologies exists but is accompanied by a more important and broader need for integrated distributed cooperation/collaboration technologies. The benefit of the joint audiovisual channel depends often on several basic characteristics of the cooperation context like culture, language skills of the participants and organizational or structural aspects.

The technological aspects are also important. Examples of such factors are privacy / security of the technology in use, standardisation, end point network capacity, accessibility and mobility of the system and overall quality of the communication.

Examples of important collaborative tasks in the manufacturing industry that could be address in the project are distant trouble shooting in complex process, planning the modification of a factory layout, new production planning etc.

It is still too early in the project to suggest integration mechanisms of the video channel in the collaboration process. Nonetheless, it appears at this point that the videoconferencing technologies are mainly used to show functional information. Social interaction between the participants has also been noticed.

4 Conclusion
The preliminary results are relevant and give interesting clues to address the integration of videoconferencing in distributed CSCW solutions. The video channel is used by the participants and brings important information in the distributed cooperation. Nevertheless, more empirical research are needed in order to achieve the optimisation of telecommunication technology in regard to specific distributed work in the manufacturing industry.

5 References
Time Delay Tolerance in Computer Supported Cooperative Work

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ABSTRACT

This paper focuses on finding appropriate time durations for information sharing delay to optimize the performance, workload and tolerance in CSCW, as well as how non-technological factors affect user’s delay tolerance. Three factors (gender, task type and difficulty level) were investigated by a mixed 2 X 2 X 2 factorial experimental design. MANOVA analysis indicates that task type (F (1, 28) = 121.87; P < 0.001) and difficulty level (F (1, 28) = 49.33; P < 0.001) have significant effects on user’s delay tolerance: the more difficult the task, the longer acceptable time delay (ATD); and user’s ATD in the calculation task is longer than the ATD in the search task. Task type and difficulty level also have a significant interaction effect (F (1, 28) = 11.02; P < 0.01). Two major strategies of estimating acceptable waiting duration were identified in this study: task simulation and mental counting. The findings suggest that users will adjust their delay tolerance based on the information of task type and difficulty level. To optimize the performance, workload and delay tolerance in CSCW, information regarding to take type, situation content, and difficulty level should be integrated and presented to users through Human-Computer Interface.

1 Introduction

In computer supported cooperative work (CSCW), users have to rely on information sharing (exchanging) within the group to accomplish cooperative tasks. CSCW is a special case of Human-Computer Interaction. A lot of researchers have been attracted to do research in this field in last two decades. However, delay effects and influencing factors in CSCW are still understudied areas. Previous studies (Billard & Pasquale, 1993) indicate that excessive delay of information sharing will deteriorate the quality of distributed decision making and cause emotional arousal (e.g. annoyance and anger); while working without any delay will lead to stress and increased mental workload to users. Newell (1990) also pointed out that human’s capacity of real-time information processing is limited. Therefore, an appropriate time delay in CSCW is necessary for the Human-Computer System to keep its optimal performance.

In order to determine the appropriate time delay, we have to resolve two fundamental issues: the mechanism of time perception in CSCW, and the factors affecting time perception. Unfortunately, there is no universal agreed mechanism in the literature for time perception. Some studies on time perception (Wang & Zhang, 1999; Brown, 1998) showed that the law of time perception would change over research paradigms and experiment tasks. However, only few researchers have started to systematically investigate the delay effects and influencing factors from human’s perspective. Caldwell and Paradkar (1995) reported that some non-technical factors such as the length of information, the degree of emergency, the sender-receiver distance and the frequency of use could significantly influence users tolerance of time delay. Based on previous studies, we proposed a hypothesis that task type and difficulty level can affect user’s tolerance of time delay in CSCW. The hypothesis was tested systematically by laboratory experiment. In addition to the major hypothesis, we also investigated the effects of individual difference such as gender and cognitive strategy in the same experiment.

2 Methodology

2.1 Experiment Design

Three factors (gender, task type and difficulty level) were investigated by a mixed 2 (male vs. female; between-group factor) X 2 (object search vs. budget calculation; within-group factor) X 2 (hard vs. easy; within-group factor) factorial experimental design.

2.2 Subject

Thirty subjects (15 male, 15 female) from China Agricultural University and two research assistants participated in this experiment. Each subject received $5 upon completing the whole experiment.

2.3 Apparatus

Two desktop computers running Windows 98 were connected to serve as a Local Computer Network (LAN). They were placed in two separated rooms. The CSCW simulation software was developed by the first author using Microsoft Visual Basic 5.0; it serves as the communication platform for two users to accomplish cooperative work via LAN.

2.4 Experiment Tasks

Two types of cooperation tasks, object search and budget calculation, were selected for experiment because they are basic activities in CSCW. A partner (one of two research assistants) was assigned to subject before experiment, and they were asked to complete a series of cooperation tasks.

In search tasks, the search target will be randomly selected by software. A list of search orders will be presented on subject’s computer screen. Meanwhile, 12 virtual rooms or houses will be presented on the partner’s computer screen (see Figure 1). In the easy level, there are only 12 rooms and each room contains 4 items; in the hard level, there will be 12 houses on the screen, each house has 4 rooms. Again, the search target is hidden in one of the rooms randomly. The subject can send a search order to the partner by clicking the corresponding button. Once the partner received the search order, he can open the corresponding room to search the target. If the target is found, the partner will send feedback to the subject. Otherwise, he will do nothing but wait for next search order from the subject. Therefore, the subject’s main job is to determine when to issue next search orders. The waiting duration between two successive search orders is defined as acceptable time delay (ATD).

**Figure 1: Sample CSCW Software Screens**

There are two difficult levels in the budget calculation tasks. In the easy level task, the subject was asked to help the partner to work out the total price for a computer system with 12 components. All the price information is available on the subject’s computer screen, and the partner only has 11 of them (one is missing randomly) as well as the subtotal price of them. Each time the subject only can send a piece of information to the partner. Once the partner received it, he will check if it is the missing one. If yes, then add the price into subtotal and send total price to the subject as soon as possible. Otherwise, just wait for next piece of information. The subject’s main job here is to determine when to send next piece of information. The waiting duration between two successive pieces of information is ATD. In the hard level task, they will work together on budget calculation for a batch order. The number of price parameters is reduced to 9, but the partner needs to calculate the product of a 6-7 digit number and a 1-2 digit number. All the calculations must be done with pencil and paper.

**2.5 Experiment Controls**

Since gender is a nested factor in the experiment design, there are only four treatments in the experiment: easy-level search, hard-level search, easy-level calculation and hard-level calculation. The subject must accomplish all four treatments in one experiment. In order to control practice effects and fatigue effects, we used Latin Square to balance the treatment order and took 5-minute break between two successive treatments. Each treatment contains one test task and six formal tasks. Before experiment, subjects will be oriented to the experiment setting and CSCW software. The each run of experiment will last 1.5 hours. In order to maintain stable performance, research assistants were not allowed to run two experiments successively. Watches and clocks are not allowed to use during experiment.

**2.6 Data Analysis**

The independent variables are gender, type of tasks and the difficult level of tasks, and the dependent variable is ATD, which is recorded by CSCW simulation software automatically. SPSS 8.0 software was used to conduct MANOVA and simple effect analysis in this study.

**3 Results**

**3.1 Acceptable Time Delay**

Table 1 shows that the ATD increases as the difficulty level increases in both task types; and the ATD in calculation task is larger than the ATD in search task at all difficulty levels.

**Table 1: ATD in Different Treatments**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search(easy)</td>
<td>4.2 (1.8)</td>
<td>4.6 (1.3)</td>
<td>4.4 (1.5)</td>
</tr>
<tr>
<td>Search(hard)</td>
<td>9.3 (4.5)</td>
<td>10.5 (6.2)</td>
<td>9.9 (5.3)</td>
</tr>
<tr>
<td>Calculation(easy)</td>
<td>15.7 (6.9)</td>
<td>14.8 (6.4)</td>
<td>15.3 (6.5)</td>
</tr>
<tr>
<td>Calculation(hard)</td>
<td>24.6 (11.3)</td>
<td>29.2 (11.2)</td>
<td>27.0 (11.3)</td>
</tr>
</tbody>
</table>

* ATD is measured in seconds. Corresponding SD is in the bracket.

MANOVA analysis indicated that the between-subject factor, gender had no significant effect (F (1, 28) = .67, P > .05). It also didn’t show any interaction effect with task type and difficulty level: gender X task type, F (1, 28) = .16, P > .05; gender X difficult level, F (1, 28) = 1.69, P > .05; gender X task type X difficult level, F (1, 28) = 1.57, P > .05. However, both task type and difficulty level showed significant main effects: task type, F (1, 28) = 121.87, P < .001; difficult level, F (1, 28) = 49.33, P < .001. We also found a significant interaction effect between them (F (1, 28) = 11.02, P < .001). Further simple effects analysis suggested that the simple effect of task type is significant at both difficulty levels: at easy level, F (1, 28) = 83.02, P < .001; at hard level, F (1, 28) = 83.02, P < .001. The difference of ATDs between tasks becomes larger as the difficulty level increases; and it becomes larger as the task was changed from search to calculation.

**3.2 Time Estimation Strategies**

In addition to the measurement of ATD, we also found three unique time estimation strategies in the experiment: strategy 1, task simulation (simulate the partner’s work in mind at normal speed and stop waiting when simulation is done); strategy 2, mental counting (count numbers in mind till a pre-set number is reached); strategy 3, intuitions (do nothing and stop waiting when she...
thinks she should). Table 2 shows the subject distribution in each strategy category.

Table 2: Distribution of Time Estimation Strategies

<table>
<thead>
<tr>
<th></th>
<th>Strategy 1</th>
<th>Strategy 2</th>
<th>Strategy 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Percent</td>
<td>N</td>
</tr>
<tr>
<td>Male</td>
<td>13</td>
<td>43.3%</td>
<td>2</td>
</tr>
<tr>
<td>Female</td>
<td>12</td>
<td>40.0%</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>83.3%</td>
<td>4</td>
</tr>
</tbody>
</table>

Both male and female have a similar strategy usage pattern. Two major strategies used by subjects were strategy 1(83.3%) and strategy 2(13.4%). Although we did not find significant difference between them using Mann-Whitney Test, we did find that the ATD estimated by task simulation was longer than the ATD estimated by mental counting in the high difficulty condition (see Figure 2).

4. Discussion

The results of this study strongly supported our hypothesis that task type and difficulty level can affect user’s tolerance of time delay in CSCW. People’s delay tolerance will increase as the difficulty level of task increases. People’s delay tolerance in the calculation tasks is also greater than the tolerance in the search tasks. That suggests that humans can automatically adjust their delay expectation based on task traits such as task type and difficulty level. So when designing interface for CSCW software, information regarding to task type, situation content, and difficulty level should be integrated and presented to users in order to optimize the performance, workload and delay tolerance.

Although the individual differences investigated in this study (gender and cognitive strategy) didn’t show significant influence on delay tolerance, we couldn’t ignore their existence. The variances of ATDs in the treatments (SD², see Table 1) also indicate that individual differences become larger and larger as the difficult level increases. Other researchers (Angrilli et al., 1997) also found that emotional arousal could affect human’s time perception. Thus, more variables should be investigated such as A-type personality.

The results of this study show that ATD and system performance can have significant effects on coordinated task performance in CSCW. This study expands the findings of other research demonstrating delay effects on coordination of supervisory control teams conducting vehicle navigation and control tasks (Caldwell and Everhart, 1998). Both system dynamics and group members’ cognitive skill affect team coordination, as is also seen in this study.

Task simulation is found as a major time estimation strategy in this experiment. It’s an important challenge to one of well-accepted time perception model, the attentional gateway model (Block and Zakay, 1997). The idea of internal pacemaker cannot explain this cognitive strategy at all. Therefore, more studies should be conducted for time perception in CSCW.

5. References


ABSTRACT

Teamwork is the customary type of labor organization used in the framework of Concurrent Engineering (CE). It requires a suitable design of the supporting software. Within the scope of an empirical study – which was actually meant to detect factors that could enhance effectiveness – guidelines for this software-design were derived. On a superordinated management level project contents and objectives as well as their temporal and logical context should be mapped with the help of a workflow system. On a more operational level in the team itself degrees of freedom regarding temporal and logical sequence of activities can be accepted. Nevertheless, a detailed planning concerning the contents of activities should take place with the assistance of groupware or database solutions.

1 Introduction

In order to reduce time-to-market, most car manufacturers and many of their suppliers fall back upon concepts for the integration and parallelization of the design of new products and the appendant manufacturing processes. A supporting organizational approach is team-based Concurrent Engineering (CE). “Concurrent Engineering is a systematic approach to integrated product development that emphasizes response to customer expectations and embodies team values of cooperation, trust and sharing in such manner that decision making proceeds with large intervals of parallel working by all life cycle perspectives early in the process, synchronized by comparatively brief exchanges to produce consensus.” (Cleetus, 1992)

Requirements for an “Effectiveness Model for CE-teams” can therefore be derived from the named CE-definition and from ergonomic demands concerning team organization (Hacker, 1998; Luczak, 1998):

• complexity of the work task
• crossfunctionality
• personnel desintegration
• change-caused pressure
• uncertainty
• parallelism and integration of activities
• goal-orientation
• predefinition of boundaries
• freedom from impairment
• promotion of personality growth
• social compatibility

The requirements mentioned occur more or less distinctly in the periphery of every CE-team. For this reason, they form the basis for a model-like description of CE teams and for the derived design guidelines. Thereby, they are automatically relevant for the supporting software that is used in the CE teams.

2 Model of Team Performance - CETEM

Taking into account the requirements mentioned above a three-level Concurrent Engineering Effectiveness Model (CETEM) has been developed in the scope of the SFB 361 which is being supported by the German National Research Foundation.

Figure 1: CETEM (adapted from Kabel, 2001)

Well-known three-level team models served as a basis for the chosen model structure (Hackman and Morris, 1975; Hackman, 1990; Gladstein, 1984). These models are being completed with the help of criteria which meet the named requirements for CE teams (Durst and Kabel, 2002). An operationalization through measurable and observable criteria follows subsequently.

The input variables describe the surrounding organization, the task and the individuals belonging to the team. The system variables can be divided into structural and procedural variables. Within the element “Team Process” variables with boundary, process or uncertainty reference are being operationalized. In this context

uncertainty of process UP and uncertainty of activities UA have to be emphasized.

\[
UP = \frac{\text{Number of Activities in Blobs}}{\text{Number of Activities}}
\]

Related to the structure of the business process a characteristic value is being defined which operationalizes activities with uncertain configurations. Thus, the drawing of a conclusion regarding the structural uncertainty of a process is possible. The implied activities can be found in so-called Blobs (Harel, 1987; cf. Figure 2).

\[
UA = \frac{\text{Number of uncertain Activities}}{\text{Number of Activities}}
\]

The project plan as well as the last team meeting – in which the detailed procedure for the subsequent interval has been fixed – serve as a basis for planning. Single activities can also take place unplanned, i.e. caused by external influences, malfunctions or lack of detailing. Such activities therefore generate uncertainty of activities.

Output variables can be subdivided into economic team “Performance” and “Psychosocial Outcomes”. Performance is being measured primarily by taking into account the ability to meet the classical three objectives of project management – costs, deadlines and quality. Apart from the degree of achievement of objectives in terms of effectiveness the quality of the use of available means in terms of efficiency is of interest. Psychosocial outcomes are being assessed separately with the help of the Job Characteristics Model (JCM; Hackman and Oldham, 1975) and the Instrument for the stress-oriented Analysis of Work (ISTA; Semmer et al., 1999).

3 Empirical Study

An empirical study consisting of ten teams and 67 measurements was being conducted in order to show a correlation between the described variables. Apart from qualitative discussions, quantitative statistical methods were being applied. Pearson’s r was used in order to point out the relationship between variables on an interval-scale-level whereas Spearman’s ρ got into action for variables on an ordinal-scale-level or variables that would not fit into a normal distribution. Normal distribution was tested with the help of the Kolmogorov-Smirnov-Test. (Bortz, 1999).

The correlation between uncertainty of process and meeting efficiency shows a statistical significance on a 1% alpha criterion level. A statistical significance on a 1% alpha criterion level can also be stated for the correlation between uncertainty of activities and freedom of stress (cf. ISTA). Finally, correlations between uncertainty of activities and effectiveness/level of achievement respectively meeting efficiency were found on 5%-alpha-criterion-level.

By means of a cluster analysis four team-states were unequivocally identified. These states can be arranged on a scale of effectiveness.

A comparison of the different clusters allows the conclusion that uncertainty of process apparently possesses a maximum and therefore needs to be limited. Too much structure seems to increase stress and endanger effectiveness, whereas too little structure lowers meeting efficiency. As a target figure effectiveness has priority compared to meeting efficiency and freedom of stress. For this reason, it appears to be plausible that process structures should not be fully determined on a team level (cf. Figure 3). A certain amount of uncertainty of process contains flexibility which team members use in order to heighten their level of achievement.

With a rise in the uncertainty of activities, effectiveness, meeting efficiency and freedom of stress are getting lower. Uncertainty of activities is caused by unplanned activities; i.e. a high planning quality improves the output of the team. Hence, it should be the main objective to avoid unplanned activities.

A conjoint analysis of the variables uncertainty of process and uncertainty of activities exposes a clear guideline for the management of a project. This recommendation has to be considered during the design process of software support. While the structure should be kept rather flexible, i.e. uncertainty of process should not be held at a minimum, uncertainty of activities should be avoided. Given this fact, most content-related activities on a team level should be planned in a detailed way at the beginning of a project, whereas the logical context of activities should be flexible and not fully defined.
4 Guidelines for the Design of the Supporting Software

The insights attained with the help of this empirical study and its statistical analysis regarding the correlation between the variables uncertainty of activities as well as uncertainty of process and the output variables influence the contents and the design of team-based and computer-supported tools, e.g. workflow and groupware systems. The study indicates that a high uncertainty of activities leads to lower outputs. Due to the fact that this correlation is probably linear, it must be the goal to reduce uncertainty of activities to a minimum. Hence, all activities should be planned in a detailed way on a content level. For instance, this can happen one week in advance. Uncertainty of process likewise influences the output variables but seems to have a maximum. That is why a detailed structural plan is not necessary on a team level. As consequences for process-supporting tools on a team level, it can be stated that activities should be rather easily available and planned thoroughly with the help of the given information. A representation of the process structure is not necessary – this is only useful and fully sufficient on a management level. This fact speaks against the use of inflexible and rigid project plans and workflow-systems on a team level. Workflow-systems are being successfully used on a management level for the planning of rough work packages and milestones (Grässler, 1999).

Given these results, the use of groupware-systems with rather open structures is sensible on a team level (Wolf et al. 2000). Such systems enable the team to work on a co-operative task within a defined amount of degrees of freedom. The boundaries are being fixed through the workflow-system on the management level. This is where clear demands are being set which can be met by the team in the framework of a decomposition task. On the individual level the lists of activities should be generated with the help of the available software. On the one hand they list activities according to dates with specifications of the technical solution, responsible person, deadline and level of achievement but on the other hand they do not determine the process structure. Interfaces between the different levels are being formed through activities with the aim of decomposition of goals and tasks and feedback of results in the sense of controlling. Through such activities the team level can influence the management level and vice versa. The system also documents and saves the data in a flawless manner even though the project might be already over. This enables future teams to use knowledge out of running or past projects for their own planning processes. By this means a prevention against critical incidents and misconductions becomes possible.

5 Conclusion

The results of the study show that an information and interface management based on an integrative software concept is needed in highly complex projects. A commonly used, priority-structured project information system seems to be useful. It should be based on a database that saves all the activities undertaken and all the relevant pieces of information.

On an individual level the single developer interacts with the system in order to plan his work with the help of lists of activities.

On a team level the team is being supported by groupware that maps cumulated lists of activities as well as network plans and thus supports the interactions of the different team members.

On a management level milestone plans serve the purpose to visualize a rough workflow and therefore manage the project as a whole.

6 References


Diffusion of Computer Supported Collaborative Work (CSCW) – an Information Systems Perspective

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ABSTRACT

CSCW did not diffuse as rapidly as most IS researchers envisioned two decades ago. We argue that this pertains firstly to a lack of understanding of group work from the systems designers point of view. Secondly researchers did not adress the process of introduction of CSCW systems in a manageable way for practice. We use the concept of implementation characteristics to derive some guidelines for a successful adoption of CSCW.

1 CSCW – what is it about?
1.1 Basic concepts and some examples

For a long time, ideas and applications of computer support for group work have been around – but not at hand in organizational reality. Diffusion (or rate of adoption) of these ideas has been poor in the last two decades. On the other hand – ideas that have been around and were touted dead, are still around: mainframe computers – today called servers. The difference between these two ideas is, that we are talking about a technical concept in the case of mainframe computers and about a socio-technical concept in the case of CSCW. This exerts considerable influence on the adoption process of CSCW applications.

After mainframe computers revolutionized the way how administrative tasks were performed, a new species of applications emerged on our desktops in the mid 70ies: office automation systems. These systems were single user applications and basically aimed to enhance personal productivity with digital spreadsheets, word processors and databases. Ten years later, the concept of group work became popular – researchers and practitioners discovered the group as a social system which might enhance business performance. So called “process gains” of group work were supposed to enhance productivity (Nunamaker; Dennis; Valach et al. 1991).

But office automation systems were not designed for groups and researchers and practitioners were wondering about the question how to improve group work with computers. The failure of office automation systems to support groups effectively and efficiently is based on a large difference in design requirements for such systems. Of course – technology was a limiting factor, but designers did not know how people work together in groups (Grudin 1991). Which are processes and conditions that constitute an effective and efficient socio-technical system? Some answers to these rather sociological questions have to be translated into design requirements for information systems engineers. We are talking about a class of applications and organizational concepts called computer supported collaborative work (CSCW), a term coined by Cashman and Grief during a Workshop at MIT in 1984 (Schlichter; Reichwald; Koch et al. 2001).

CSCW is a multidisciplinary field of research and application, which aims at the design of information systems that enhance temporarily and spatially independent group work. CSCW applications usually consist of features for information, communication, coordination and collaboration. CSCW applications are widely known through the dominant commercial software packages Lotus Notes™ and Microsoft Exchange™. A tool that has received significant interest from both practitioners and researchers is GroupSystems™ as a platform to support synchronous group work.

Today, an understanding of group work in order to design tools that allow the transformation of shared digital material is used by engineers as the main point of reference. The concept of shared digital material differentiates collaboration from communication by providing an explicit and shared point of reference (Schrage 1990). Collaborative problem solving in a distributed work setting, for example, is enabled by the digital representation of shared material and the provision of tools to transform this material.

1.2 CSCW applications as enablers of new ways of doing business

After one and a half decades of research and practice, CSCW applications are integrated in some organizational innovations which try to respond to changing market conditions and aspirations of employees. Telework aims at concepts to make work more flexible by technology enabled arrangements – nameley remote access to databases, communication channels and coop-
The diffusion of innovations approach in CSCW

Although CSCW is not a failure today, results are somewhat mixed (Orlikowski 1992a; Klein; Krcmar Schenk 2000). Of course - we know much more about the nature of group work and how it is affected by computer support, but most knowledge is gleaned from lab research and digital collaboration has not diffused as rapidly as researchers envisioned a decade ago. We believe mixed results in CSCW research and practice are mainly the result of a lack of knowledge about the process of introducing these systems as an innovation in a business context.

Rogers defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers 1995, 5). The organizational decision process to adopt an innovation constitutes diffusion and is the issue at hand for research and practice. According to Rogers, the innovation decision and therefore the speed of diffusion on the individual level is strongly influenced by the innovation characteristics (relative advantage, trialability, observability, compatibility, complexity). These characteristics are also important and have to be taken into account for CSCW success.

But another class of variables play an important role too, on which we will focus on the rest of this paper. If we shift the focus from the individual level to a group or organizational level, we have to deal with another level of complexity. Firstly, there is usually not one decision maker who decides about and uses the technology. That is, the communication process about the innovation is different since it has to address management and users. Secondly, innovations in organizations are embedded in a network of activities and dependencies. This aspect is especially important in CSCW projects, since the benefits of systems usage for the individual are tied to the usage of the group as a whole. An interesting perspective on that issue is provided by Leonard-Barton (1988a). She proposes a model of implementation characteristics. In that, not only the inherent characteristics of an innovation (as identified by Rogers) have to be considered but also implementation characteristics of an innovation. These characteristics set parameters for implementation strategies and influence the innovation response decisions, which can be acceptance, rejection or even sabotage.

Implementation characteristics are (1) transferability, (2) complexity and (3) divisibility.

(1) Transferability refers to the proof of feasability of a technology (preparedness) and "the degree to which a technologies operating principles (know how) and underlying scientific principles (know why) can be communicated to people other than its developers" (Communicability) (Leonard-Barton 1988a, 608). In recent years, CSCW applications have reached reasonable stability and reliability. On the other hand, the concept of shared digital material is not at all easy to communicate, and people usually need coaching on their way towards digital collaboration.

(2) Complexity from Leonard-Barton’s point of view is characterized by organizational span as the number of people affected by the introduction of an innovation and by organizational scope which “is determined by the number of different organizational subunits that must alter their output or input operations to accommodate an innovation” (Leonard-Barton 1988a, 612).

(3) Divisibility has two dimensions: modularization and individualization. Modularization is related to the technology and how it is possible to introduce single modules, each of which provides some benefit for the unit of adoption. Individualization is “the potential for beneficial use of a technology (...) independent of the innovation responses of others (...)” (Leonard-Barton 1988a, 613).

Some characteristics-variables identified by Leonard-Barton vary significantly dependent on size and scope of a CSCW project. On the other hand, transferability (particularly communicability) and divisibility seem to show stable patterns in CSCW projects. Communicability is relatively low, because people cannot anticipate effects and consequences for their everyday work without a hands on CSCW experience. The divisibility dimension is relatively low, too. Whereas modularization is in part feasible with most commercial groupware platforms, individualization of CSCW applications is a problem: The use of shared digital material for cooperation is not useful, if only a part of a group uses this material. That is, the beneficial use of technology is tied to the innovation response of others. The next section pre-
sent some guidelines for successful CSCW implementation.

3 Being a successful innovator - some issues in the adoption of CSCW

Given that CSCW projects are characterized by low communicability and relatively low divisibility, we suggest the following strategies, based on the assumption that implementation characteristics exert a significant influence on the diffusion of an innovation:

(1) Involvement of users - learn from and with users about their work processes and contexts. On this basis, provide training scenarios that include problemsolving with and without CSCW technology to make clear what the difference really is. Only if individual benefits are clear, one will achieve a critical mass of users.

(2) Enable mutual adaptation of technology and organization – (technological) innovations are more successful, if people are encouraged to modify the technology in question to their needs and organizational structures are flexible enough to respond to new usage patterns (Rogers 1995). The window of opportunity (Tyre and Orlikowski 1994) for these processes is relatively small. As Tyre and Orlikowski showed, most adaptive activities are performed in a 1-7 months period after implementation. Structural change occurs only, if management champions “an experiment, rather than a project with a highly certain outcome” (Leonard-Barton 1988a, 619).

(3) Focus on problems, not tools – successful CSCW applications start with a clear defined problem of people who are expected to used the technology. This rather obvious advice is often neglected in practice because of the pressure to achieve “quick wins” – often based on availability of technology and not the potential to solve problems.

(4) Focus on core business processes – CSCW applications aim to change behaviour. Changing behaviour needs practice, therefore a successful adoption of CSCW applications is achieved more easily if applications are embedded in core business processes.

4 References

A Cognitive Engineering Approach to Computer Supported Cooperative Design

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ABSTRACT

For the computer support of cooperative engineering design tasks, aspects of individual knowledge representation and team-based, collaborative work are described. In a cognitive engineering approach an analysis of empirical data in conjunction with the theories of shared mental models and awareness are used to derive implied requirements for cooperative design systems.

1 Introduction

Current product development processes can be characterized by their interdisciplinary team-based work organization. Regarding problem solving in design teams cooperative and coordinative aspects of simultaneous engineering become more important. The extensive intra-enterprise cooperation requires a comprehensive information technology network not only on the level of data exchange but also on the level of knowledge sharing between various departments according to competency-oriented labor partition. The following cognitive engineering approach tries to support computer mediated interdisciplinary design work by modeling and structuring product development on a knowledge-based level.

2 Knowledge representation for engineering design from a single user perspective

Starting point for a cognitive engineering approach to computer supported cooperative design are former studies in supporting a single designer’s work. Rasmussen (1986) described a two-dimensional reasoning space as a conceptual framework for human information processing. Functional properties of technical systems are represented by a means-ends abstraction hierarchy. This hierarchy describes bottom-up what components and functions can be used for, how they may serve higher level purposes, and, top-down, how these purposes can be implemented. Independently, and orthogonal to this functional dimension, various aggregation levels describe the whole-parts relationships of the system as a hierarchy of parts.

In all design process phases according to established design methodology (Pahl et al., 1996) the designer’s tasks can be assigned to different levels of abstraction in correlation to Rasmussen’s model of a functional abstraction hierarchy (Luczak et al., 2001). In the dimension of means-ends-relationships five abstraction levels can be separated:

1. The requirements list is a result of task definition and clarification to describe essential functional purposes and goals at the most abstract level.
2. The identification of functional interrelationships refers to the level of abstract function, where conversions of energy, material and signals are defined.
3. The description of standard functional relationships is the basis for principal solution variants.
4. To perform these generalized functions and working principles, physical effects and general material properties are used.
5. Results of final design in the construction interrelationship are all product defining data and related documents.

The designer’s mental model of the task can compatibly be represented in this framework and the structure can be used as a computer supported reasoning and navigation space. In an empirical case study (based on a design task derived from design methodology) this approach proved to meet the demands of working engineers. The results generally confirm the hypothesis that a comprehensive and unambiguous structure for knowledge representation in computer supported product development can help in design problem solving and decision making (Schmidt & Luczak, 2000; Schmidt et al., 2000).

3 Team-based product development

3.1 Empirical case study

The model of the design reasoning and navigation space has to be extended from the single user perspective to meet the requirements of team-based product development. To ensure the practical applicability of the concept in addition to design theory, empirical data were collected from a real product development scenario. This survey comprised structured interviews, participating observation of subtasks’ solutions and an extensive document analysis of the overall development project.

The project was modeled and graphically described using activity diagrams of the Unified Modeling Language (UML) (Rumbaugh et al., 1999). Specific elements for the aggregation and decomposition of activities as well as for the description of communication, coordination and cooperation (c3) processes were added. With regard to c3 modeling these extended UML activity dia-
grams were identified as suitable for task and information modeling (Killich et al., 1999; Foltz et al., 2001).

Altogether, 134 activities and 121 objects were applied to model the overall engineering design process of an electromechanical product. A detailed task analysis revealed the main problems and deficits in team-based communication, coordination and cooperation processes. This was used to derive requirements for computer supported cooperative design systems.

3.2 Analysis and requirements

Within the scope of teamwork a competency-oriented labor partition is roughly determined in the project planning phase. Besides the single designer mentioned above there are further engineers involved in the development process. Some of them have a similar professional qualification and work in comparable subtasks; others with different occupational skills and knowledge solve complementary problems. Orasanu and Salas (1993) characterize a ‘group’ by similar, possibly exchangeable members with homogeneous task-specific knowledge and skills; in contrast, ‘teams’ have different members concerning their professional qualification, their roles and their responsibilities as well as they are highly dependent from other team members to succeed a common goal (Orasanu and Salas, 1993; Kang et al., 1998). Consequently, a user group specific knowledge representation is required for cooperative design systems.

As a first step, appropriate abstraction hierarchies for other team members can be established comparable to the conceptual framework for the single design engineer. Instancing an electrical engineer’s hierarchy, the whole-part- and means-ends-relationships can comprise the representation of information on electrical components. Five levels of abstraction cover:

1. the requirements list about electronics representing the functional purpose,
2. the block diagram for the functional structure of signal processing on an abstract level,
3. the circuit diagram reflecting the generalized function of idealized electronic components,
4. the simulation model of electronic circuits, including the borders of physical function and time response of non-ideal, real components and
5. the physical form referring to components’ dimensions, the mounting diagram and the layout of the printed circuit board.

As a second example, when regarding a team member belonging to the marketing department, there is no correspondence to the physical function, but the means-ends-relationships can be defined according to the structure, that the respective higher abstraction level responds to ‘Why?’ and the respective lower level responds to ‘How?’ as described in paragraph 2.

Altogether, user group specific abstraction hierarchies for each member of the team enable task and qualification-specific views in the design system, different in respect to content, but using a comparable structure for modeling the reasoning space. This can be understood as a user-specific filter on the overall database.

Due to cooperative work and mutual dependencies, team members need to coordinate or ‘synchronize’ at particular points in time in terms of information exchange for other persons’ tasks. Intermediate or final results of individual tasks are interchanged at a kind of junction between individual abstraction hierarchies. From a cognitive engineering point of view this requires not only an access via data systems technology with notification and version management, but also a shared understanding in collaborative and the exchange partner’s individual tasks. E.g. a team member must estimate, whether or what kind of information is important for the cooperation partner. Otherwise data exchange can result in information overflow and problems to filter the relevant information, as the investigated product development scenario and Simon and Springer (1997) pointed out. Rouse et al. (1992) describe the high relevance of shared mental models for cooperative work and the related team knowledge about roles, relationships and mechanisms of team performance.

For users’ task coordination and as a context for a team members own activity, knowledge of what the other team members are doing at the same time or have done before is essential (also referred to as ‘awareness’; Dourish & Belotti, 1992). According to Greenberg et al. (1996) four types of awareness are distinguishable:

1. Informal awareness is fundamental knowledge about the general, temporal and spatial presence of cooperation partners.
2. Group-structural awareness refers to knowledge about roles and responsibilities of the other team members.
3. Social awareness stands for knowledge about attention paid by another person, her emotional state and her level of interest derived from the social context.
4. Workspace awareness comprises knowledge about other team members’ kind of interaction within a shared workspace.

As an implication for computer supported cooperative design systems, information about ‘who is participating in the design process’, ‘what are the other team members doing’ and ‘where are they working’, should be considered to ensure high awareness during synchronous collaborative work.

Especially the term of group-structural awareness is closely connected to the concept of shared mental models defined by Orasanu and Salas (1993), namely shared understanding of other members’ knowledge about functional principles, terms, language, methods, standards, roles and responsibilities.

Ye (1998) as well as Kraiger and Wenzel (1997) pointed out, that shared mental models can be measured and quantified. The significance of shared mental models for team performance could be proved empirically (Gar-
bis/Wærn, 1999; Kang et al., 1998). Also the weak point analysis of the investigated development process exposes cooperation problems if there is an insufficient shared mental model, estimated on basis of the involved persons’ qualification and know-how. This implicates cooperative design systems not only to offer common junctions between user group specific abstraction hierarchies, but also to support a shared mental model with the cooperation partner at these nodal points. For example, if team member A can look to a certain degree at member B’s reasoning space, A is enabled to set his own results in context to member B’s tasks. According to awareness aspects, attributes to describe the junction’s characteristics can be: involved persons, their roles and responsibilities referring to the cooperation object, the kind of exchanged data and its time slot, conditions for access (synchronous, asynchronous, limited access rights), quality and state of information.

4 Conclusion

In conclusion, a cognitive engineering approach to computer supported product development regarding the theories of awareness and shared mental models was presented. To meet the requirements of team-based engineering design, individual abstraction hierarchies and attributed junctions between them were used. It is planned to evaluate this approach using a software prototype.

5 Acknowledgements

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User-friendly Visualization of Object Versions and Archives in Collaborative Computer Work

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ABSTRACT

Data, states, events, information and knowledge are present in all production enterprises in a vast array of forms. There is a common trend for storage, administration and processing of these in a distributed and connected information system for collaborative computer work. Work objects and data in a shared computer application can be continually changed and modified by different users working simultaneously with this application. Due to the different versions and the history of a common working object it becomes more and more important to be aware of the various states of the object. Within a recently completed comparative investigation study at the “Laboratory for Human-Machine-Interaction” of the ifab-Institute, different ways of visualizing object versions and archives were evaluated. The investigation was based on different structured visualization forms.

1 Introduction

Work objects (for example a text document or a drawing of a new product) and data in a shared computer application can be continually changed and modified by different users working simultaneously with this application. Due to the different versions and the history of a common working object it becomes more and more important to be aware of the various states of the object. The version of an object is the explicit notation of a changing- or development level of this object. The following example should explain this in detail: within the shared development process of the design of a new product by different design engineers distributed over distant locations, different object versions (drawings) will be created and must be administrated by the computer application.

Moreover, the notification and visualization of different temporary modifications of an object, the so-called object history, is essential for the users in many application areas (e.g. CAD, CASE or CSCW). The object history can be realized with the use of time-orientated attributes for the transaction time, the so-called time marks. Object versions and their historical evolutions stored in archives are quite meaningful for engineering applications. The concept of object versions and archives presents new and comprehensive possibilities for cooperative computer work in distant working groups.

When using the construct of object versions and archives in shared work organizations importance must be attached to the user-friendly visualization of these attributes. A user-friendly design of object versions and archives requires an integration of human information processing aspects. The state of a work object must be visualized in a comprehensive, actual, process-orientated, perceptible, interpretable and user-friendly way in order to fulfil the ergonomic transparency requirement.

2 Design of the investigation of archives and versions of objects

2.1 Participants and methods of the investigation

The ifab-Institute of Human and Industrial Engineering at the University of Karlsruhe is occupied with the structured development and the cognitively-orientated experimental evaluation of human-computer interfaces in work environments. Within a recently completed comparative investigation study at the “Laboratory for Human-Machine-Interaction” of the ifab-Institute, different ways of visualizing object versions and archives were evaluated. Twenty test persons from several industry enterprises took part in this examination. In this way it could be verified to what degree the developed representation variations fulfilled the demand for industrial relevance.

In order to achieve the results, several evaluation techniques were used: eye mark registration, key stroke recording, video-taped observation of the test subjects and interview with checklists. The eye mark registration with a SMI Headmounted Eyetracking Device System (SMI 1999), for example, is very useful in finding out which spot on the interface the user is looking at, which type of information representation he prefers or, generally speaking, in which way the cognitive information processing is proceeding. In particular, key data give objective hints on aspects of a user-friendly visualization. Key stroke recording was used to examine interactions of the test subjects and to record e.g. the time the user needed to perform a specific task. Thus, this method was suitable for the analysis of the tactile actions of a user on the keyboard or mouse. Furthermore, other methods, such as video recordings of the test subject’s actions and structured interviews, were used to obtain subjective information.
2.2 Investigated variants of archives and versions of objects

The identification of components, their state of validity and time of transactions on them can be called upon for the representation and assessment of temporal aspects in object modelling (see Schreiber 1995; Saake et al 1997).

2.2.1 Identification of object versions:

Normally, as soon as an object is created for the first time, only one valid version of this object should be displayed to the user. If modifications to the object are carried out, the user must be made aware of the version sequence in such a way that the versions can be distinguished from one another and can be arranged according to their historical context.

2.2.2 State of validity of a version:

In the representation of data the user must know whether the object version is valid, outdated or invalid. The state of validity of a version generally changes with time.

2.2.3 Transaction date:

The transaction date (also called "time of registration") indicates when a specific version of the object was saved in the database. Fundamentally, the transaction date can neither changed retroactively, nor can it lie in the future.

Fundamentally different forms of visualization can be chosen for presenting object versions, the state of validity and the transaction date. In the choice of a representation variant, it is important that the user can locate the sought data quickly, securely as well as perceive and process it without error. Various characteristics such as form (e.g. fonts, pictograms, graphics), colour (e.g. red, yellow, green) and location (e.g. object proximity) can be used for the optical coding of object variants. Generally, the variants differ with respect to the coding of their position on the screen (fig. 1). The object attributes are usually visualized either in direct proximity to the object (e.g. version number directly beside the object name) or at a greater distance to it (e.g. version number in an information bar). The coding of version identification and transaction date were implemented numerically. According to this, a version is described clearly by a version number as well as a transaction date (date and time). Other forms of graphical visualization of these quantitative specifications, e.g. with symbols or diagrams, are, from an ergonomics point of view, not suitable (see DIN 66 234, part 5, 1988; Shneiderman 1998).

In comparison, qualitative statements about the state of validity can be represented by means of alphanumeric symbols, colours or pictographic symbols (see DIN 66 234, part 5, 1998). The state of validity of a version could assume the characteristic "current" (current version with the most recent date of transaction), "valid" (not the current version, some attributes however are still valid) or "invalid" (outdated version, attributes are no longer valid). An object can, according to this definition, posses one or more actual versions, one or more valid versions as well as one or more invalid versions. Three variants with alphanumeric symbols (current, valid, invalid), one colour coded 'traffic light'-representation (green denotes current, yellow denotes valid, red denotes invalid) and one abstract bar graph representation (full denotes current, half full denotes valid, empty denotes invalid) were examined for the representation of the state of validity. These three variants were, in one case, positioned directly beside the object, and in the other case, positioned at a distance (in the information bar).

<table>
<thead>
<tr>
<th>Component</th>
<th>Investigated variants</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of versions</td>
<td>letters, in direct or distant position to the object</td>
<td>version number: V1, V2, ...</td>
</tr>
<tr>
<td>State of validity</td>
<td>letters, traffic light visualization, filling beams visualization, each in direct or distant position to the object</td>
<td>[Traffic Light Visualization]</td>
</tr>
<tr>
<td>Transaction date</td>
<td>letters, in direct or distant position to the object</td>
<td>data entry time: 12.04.1998 / 13.31 h</td>
</tr>
</tbody>
</table>

Figure 1: Visualization of object versions and archives

Each test person was given a series of tasks including 21 tasks of identifying versions, validity states as well as times of transaction for various objects. In this test, the objects were instanced using condensed key figures from the areas of personnel, technology and organization (key figure system defined by Groth 1992). In different scenarios from order scheduling and operations planning the test persons were then required to process various of data archives aspects (e.g. identification of the oldest and still valid version of an object, identification of the instance with transaction data 13.11.97 etc.). Initially, the different variants were presented to the user separately. In a final scenario all variants were then integrated into the user interface in order to sort out the user’s preferred variant.

3 Results of the investigation

The questions posed were:

- Which spatial position is preferred for the representation of version number, transaction date or state of validity with respect to the representation position of the object?
- Which representation of the state of validity is preferred?
- Which strategy is used preferentially for searching historical data?

The assessment of the interviews and the eye movement registration showed that all test persons preferred the coding of the version number, transaction date and state of validity in direct proximity to the object. A representation of these attributes in the information bar...
(e.g. after the mouse pointer was moved over the object) was proven to be unsuitable; this form of coding led to a 25 % longer search time. Furthermore, it was observed that an indirect positioning of the temporal attributes increased the strain on the visual system due to more frequent glance changes, which is proven by the average eye path of 20800 mm with an indirect positioning, compared with 16700 mm with positioning in close proximity. Thus, the attributes for the representation of versions or archives should be placed relatively close to the object. For example, in a list representation of all objects, the version number should be aligned directly adjacent to the represented object.

The examination showed clear preferences for the representation of the state of validity. The use of colour coding (the traffic light representation in this examination) substantially improves the performance with respect to orientating, searching and discovering of the state of validity. A colour coding can be detected more quickly in a set of objects than other forms of coding, such as alphanumerical characters or abstract graphic representations (e.g. bar graphs). This advantage of colour coding is in part a result of the fact that colour signals can be discovered and differentiated well, even in the periphery of the fixation point.

The comparison of the identification durations of the sought objects (averaged for all test persons and tasks) resulted in 17 s for colour coding, 22 s for bar graph representation and 23 s for representation with written characters. Thus, invalid objects should be coded, for example, in red, either with red characters for the name in the object list or with an abstract colour labelling (e.g. a red circle beside the object name). However, it should be mentioned that the sole use of colour as a coding characteristic can not be recommended, for several reasons (e.g. colour weakness of user, monochrome screens). It should rather be supplemented with a further form of coding (e.g. alphanumerical signs).

During the survey of the test persons and the assessment of the eye mark registration it was discovered that various different strategies were used to solve the given tasks. It could thereby be differentiated between a structured approach to identifying the object’s historical data and an unstructured one. In a structured approach the presented set of objects is searched systematically for the wanted attribute. Test persons with unstructured approaches shift their gaze to randomly chosen objects in the hope of finding the right one in this manner.

### Table 1: Key data of the eye mark registration of object versions and histories

<table>
<thead>
<tr>
<th>Characteristic number</th>
<th>All test persons</th>
<th>Test persons with structured approach</th>
<th>Test persons with unstructured approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total processing time (in s)</td>
<td>383</td>
<td>366</td>
<td>409</td>
</tr>
<tr>
<td>Fixation rate (1/s)</td>
<td>4.4</td>
<td>3.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Average saccadic length (in mm)</td>
<td>27</td>
<td>35</td>
<td>18</td>
</tr>
<tr>
<td>Total view path (in mm)</td>
<td>40,191</td>
<td>37,904</td>
<td>42,477</td>
</tr>
</tbody>
</table>

The rate of fixation can be called upon in the description of glance behavior during task processing (Stowasser 2002). It has been shown that a much smaller fixation rate can be ascertained with those individuals who use a structured strategy (fig. 2). Glance transfers, so-called saccades, occur between two fixations. The average saccadic length was substantially longer when a structured approach was used than when an unstructured approach was used. This behavior can be explained by the fact that the test persons with a structured strategy let their eyes flow over the rows or columns. A visual information uptake can obviously not always be assumed with this "wandered" gaze so that the saccades between two fixations are longer. The eye path behaves differently: the more difficult the pattern of stimuli is to identify, the longer is the length of eye paths. Individuals with an unstructured approach should be directed by a structured arrangement of the objects on the screen and a correspondingly clear representation of the associated attributes.

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Support of Interorganizational Cooperation. VIA TeamUp - An Internet-Based Tool for Work Groups

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ABSTRACT

Interorganizational cooperation is gaining in importance. A computer support can essentially improve the communication and coordination of the involved partners. The technical and organizational realization of a CSCW-system for an interfirm cooperation has to deal with two or more independent organizational units. Hence, a software-tool has to take into account the different environmental and organizational conditions of the partners. The article describes the experiences and results of the development and implementation of a software-tool for a Small and Medium Sized Enterprise (SME) network in the German automotive supply chain industry. The tool called VIA-TeamUp enables the communication of experts as well as the coordination of discussion groups in order to make use of synergetic potentials.

1 Introduction

Automotive suppliers have to face new challenges. On the one hand, the economic relationship between car manufacturers and automotive suppliers has experienced major changes within the last years. The car manufacturers are outsourcing all operations, which are not belonging to their core competencies, e.g. marketing, design, engine development and manufacturing. Thus, the suppliers are required to develop and produce complete systems or modules instead of supplying just simple parts (Collins, 1996). On the other hand, the changing environmental conditions are leading to an increasing pressure according to time, quality and costs. Keywords like globalization, global competition, decreasing time to market etc. are becoming more and more crucial for these companies (Baur et al., 1999; Ehrig, 1999; Wildemann, 1992).

Most of the Small and Medium Sized Enterprises (SMEs) are not able to cope with these new challenges by themselves. Furthermore, the complexity of the development process and the production of whole systems or modules requires a close collaboration of different disciplines. Therefore, the strategic concept of cooperation, in-between the economic field of ‘make or buy’, is gaining in importance. ‘There is a large amount of partnering activity going on between suppliers in the form of alliances, acquisitions and mergers. Strategic alliances are by far the most common form of partnering’ (Automotive Consulting Group, 1996: 47).

2 Computer Supported Interorganizational Work

Cooperation always involves two or more organizational units. In terms of an interfirm cooperation two structural levels of work processes have to be taken into consideration: The level of industrial relations and organizations and the level of human relations and group work (Luczak, 1997: p.346). On the level of the industrial relations and organizations, the environmental and organizational conditions as well as the overall goal of the interfirm cooperation are defined. On the level of the human relations and group work, the cooperation is actually performed. A prerequisite for a cooperation on this level is an unhindered communication of the individuals (Piepenburg, 1991: 81). Another condition of cooperation is, that several activities of the organizational units have to be related to each other. Furthermore, ‘coordination is managing dependencies between activities’ (Malone & Crowston 1994). Hence, improving the communication and coordination of the individuals and their cooperation tasks is one major aspect to enable a convenient framework for interfirm cooperation.

Form and extent of an interorganizational cooperation can vary from a mere information or data sharing up to an organizational integration like a joint venture. The objectives of the cooperation activities are likewise numerous. Thus, it is very difficult for the management of a SME to decide on and set up a suitable cooperation strategy. Furthermore, a common approach to initiate, form and run an interorganizational cooperation is lacking. A lot of existing concepts, methods and tools according to a work system can be applied, though. The use of these approaches is often limited by the differences of the partners in technique, organization and personnel. Hence, existing approaches for communication and cooperation support have to be investigated and adapted, or elaborated, to specific cooperation conditions.

3 Communication and Coordination Support of an Enterprise Network

In 1994, ten SMEs of the German automotive supply chain industry decided to cooperate in order to meet the new requirements stemming back to the environmental changes described earlier. These competitors initiated common discussion groups to work on special topics and exchange experiences in sales, design, quality management and electronic data processing (EDP). One specialist of every company took place at regular meetings which were related to the respective expertise.
Thereby, the basis for an information exchange and a mutual learning process was established. More and more this cooperation has been extended, so that this network of automotive suppliers (called VIA) incorporates three joint ventures so far.

Even if the interorganizational cooperation was very successful, the effort to organize and stick together the several discussion groups was very high, because the members of each group work at different locations within a different organizational structure. For instance, making a simple agreement on a common appointment besides the regular meetings took a lot of time. Furthermore, problem solving processes out of the meetings were carried out bilaterally via email or telephone. Thus, the discussion of problems and the elaboration of the respective solutions had to be done repeatedly within a group. Therefore, VIA and the Institute of Industrial Engineering and Ergonomics (IAW) decided to ease the communication and coordination within the discussion groups. In several workshops with different discussion groups, a concept of a computer supported communication and coordination tool was elaborated. Accordingly, the software tool should support the management of the groups, the information exchange between the group members, visualize the organizational structure of the project teams, allow access from different locations and be accessible from different IT-platforms. Hence, the software called VIA TeamUp had been conceptualized, programmed and applied to the network.

VIA TeamUp is an internet-based application. Every registered user can access VIA TeamUp by using a usual internet browser and login with a personal account and password. VIA TeamUp consists of several areas. Every user can access the common area as well as the respective group area of the discussion group (according to the assigned rights), e.g. the sales area. In the common area information about the network itself is offered, whereas the other group areas consist of the seven modules document management of minutes of meeting, making appointments, team calendar, to-do list, project team news, discussion and group organization. The use of the respective modules had to be simple and feasible for an unpracticed computer user.

According to the assigned rights, in the first module document management of minutes of meeting the user can up- or download minutes of a meeting with associated information like date of the meeting, state of the minute (preliminary or agreed) and subject. In the module making appointments, the user can invite people to a meeting and suggest up to five different dates for the appointment. The invited people are going to be notified by an email and have to choose for every suggestion between the states “accept”, “accept under reserve” and “deny”. The inviting person can fix a date based on the result of the voting afterwards. In figure 1, an exemplary result of a vote of 20 group members is shown. The inviting person would probably choose the appointment on February 15th, 2002.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Accept</th>
<th>Accept under reserve</th>
<th>Deny</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-02-12</td>
<td>12:00PM</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>2002-02-12</td>
<td>16:00PM</td>
<td>4</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>2002-02-14</td>
<td>15:00PM</td>
<td>10</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>2002-02-15</td>
<td>15:00PM</td>
<td>15</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2002-02-16</td>
<td>15:00PM</td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 1: Exemplary Result of an Appointment Voting.

After fixing the appointment by the inviting person, this date is automatically entered in the team calendar where supplementary dates can also be filed. Furthermore, every invited person will be informed via email about the appointment. Thus, an arrangement of an appointment can be fixed for 20 persons within 2 days without any additional effort of the inviting person as shown in figure 2.

Figure 2: Time Dependent Arrangement of an Appointment.

The common to-do list comprises all group-related tasks that have been agreed on. The task possessor can change the percentage of completion as well as the state from "not started", "in process", "wait mode", "placed back" or "completed". The group members themselves demanded a visualization of overdue tasks to be implemented in Via Team Up in order to increase the commitment on commonly agreed tasks. In the project team news module the entitled persons can enter information which are relevant for all involved group members. In the discussion module, specific topics or questions can be discussed and answered by the group. Every group member has the possibility to enter a new discussion theme or to answer to a specific statement. Especially within the EDP area the discussion module was frequently used to solve specific problems. Thus it became obvious that a lot of problems had already been solved by partners within the network. In the group organization module every person who can...
access the group area is listed with his or her assigned rights. This organizational transparency is a crucial factor for the acceptance of a communication tool. Besides all modules, several cross-functions have been implemented. Accordingly, it is possible to subscribe to every module. By subscribing to a module a notification via email is served if a new entry is added to the module. Thus, the user can individually specify whether he wants to be kept up-to-date automatically or not. In order to apply to personal communication preferences, the subscriber can choose whether he or she wants to be informed immediately, every hour or once per day. Another cross-function is related to the group structural awareness. Every name entry in the system, e.g. in discussion groups or to-do lists, contains a business card which can be activated by clicking on the name. This business card comprises, in addition to the general information like telephone number and address, a photo of the respective persons (see figure 3). Thus the link between entered information and the face of the respective person is established. This is very important because the regular discussion meetings take place once a month, which is not enough for the group members to link faces to names and enterprises.

Figure 3: Business Card.

For an administrator of an interfirm cooperation tool it is very difficult to keep up-to-date all data of the groups and their members. Therefore, a decentralized administration concept has been implemented. Every group member is responsible for the administration of his or her personal data like telephone number and address. Additionally, for every area a group administrator is assigned, who can add or remove members from/to the group. Furthermore, the group administrator can change and remove all data entries of the area. The system administrator therefore can add new areas and administrate the Common Area as well as assign the group administrators.

4 Conclusion

A CSCW tool for communication and coordination support of an interfirm cooperation was presented. The elaborated and implemented software, called VIA TeamUp, has been widely accepted within the network because of its feasibility. Thus, VIA TeamUp has been used by the network of automotive suppliers for two years so far. By now Via Team Up consists of seven areas including one specific area for the managers of the SMEs. The network is growing and in January 2002 a new Joint Venture for the consulting service of the network called VIA Consult has been set up.

5 References


An Open Framework for Shared-Workspaces to Support Different Cooperation Tasks

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ABSTRACT

The development of a Web-based portal for the community of man-machine-interaction is the primary goal of the project MMI-Interaktiv. Scientists and other experts both in research and industry can use this portal for information retrieval, communication, support and help. The portal is funded by the DFN organization and addresses initially German-speaking people. According to these aspects the portal is extended with a shared workspace to meet the cooperative needs depending on different user groups. High usability is an important aspect of the implementation. Therefore, the design should be flexible and cover most of the requirements. To achieve these aims a “Shared Workspace Open Framework” called SWOF was developed. This framework can be adapted to several cooperation tasks and even to other problems.

1 Introduction

Today, cooperative work is a common practice in research and development. Therefore, it is typical for both teams of developers in industry and scientists of different research organizations to work together as a virtual and interdisciplinary team. The goal of the project MMI-Interaktiv is the development of a portal called “ergonauten.net” (see figure 1) that focuses on the scientists and experts of the community of man-machine-interfaces (MMI) needs. To build up the portal some already existing components are used: an online journal, psychological and ergonomic links, a list of upcoming conferences and a database of experts in ergonomics and industrial engineering (Bruder et al., 2001). These components are completed by a shared workspace that should be both flexible and easy to use (Kuenzer & Schmidt, 2002).

A Shared Workspace is a kind of a groupware system. Users share workspaces (e.g. for different projects) with each other or have their private ones (e.g. for personal documents). A shared workspace can contain different kinds of information such as documents, pictures, URL links to other Web pages, threaded discussions, information about other users and more. The contents of the workspaces are often arranged in a folder hierarchy based on structuring principles agreed upon by the members of a workspace (see Appelt, 1999).

The use of shared workspaces is becoming increasingly popular today (Appelt, 2001). Nevertheless, these systems have some problems and so the acceptance is often not very high. Caused by the technical restrictions given by the Internet protocols HTTP and HTML, the usability e.g. is usually not good. Nevertheless, the requirements of the users are not considered adequately.

2 Cooperative Work in the Web

Starting from these considerations a detailed analysis in terms of cooperative work was conducted. The goal of a study was to show, which aspects of information and communication processes and relations are important within the context of a cooperation platform like MMI-Interaktiv. For this, the style of existing cooperation relations as well as problems using the World Wide Web were focused (Leuchter et al., 2002).

The analysis results show that cooperation is an important part of the work of MMI scientists and experts (the target group of ergonauten.net). Cooperative work is done mostly “offline” so far. The web as a cooperation medium is not used frequently so far: only 5 percent of respondents use shared workspaces for their work and about 40 percent do not even know what a shared workspace is.

However, the study shows that there is a need for a better technical support of cooperative work. Caused by the large amount of cooperative activities the users see both a technical and a time benefit. Therefore the integration of a shared workspace to support the cooperative work is a critical factor for the acceptance of ergonauten.net.

Figure 1: Design Draft for ergonauten.net
3 Requirement Analysis
The criteria for electronic workspaces in figure 2 (Herel, 2000) form the basis for the requirement analysis.

Figure 2: Criteria for Shared Workspace

A survey should show how and to what extent people are using existing shared workspaces in their work. For this 28 persons were questioned. 18 of these interviewees belonged to the university field. Figure 3 shows the results for the main features for those interviewees having at least a medium skill in working with shared workspaces (altogether 15 interviewees, thereof 10 of the university field).

Furthermore the people who are involved in MMI were questioned for their requirement priorities according to the main features (figure 3). This information was used for a detailed requirement list, which forms the basis for the new shared workspace component of ergonauten.net.

4 Shared Workspace Open Framework (SWOF)
Many commercial and some free groupware solutions frequently integrate shared workspace functionality. Apart from using different concepts (e.g. virtual file system vs. rooms), they are mostly web-based. Normally users use several shared workspaces for different projects (particularly when cooperating with other companies). Therefore it is important to consider the effort for training with these systems.

In the most cases the usability of such solutions is not comparable to the usability of desktop applications. One reason for this is the limited technical possibilities of HTTP and HTML respectively. In addition many shared workspaces have a lot of functions, which the normal user doesn’t need. However, most users only know and use a small set of functions (Appelt, 2001) and this makes the usability often poor. Nevertheless, the set of functions a user really needs differs depending on the cooperation goals. Because of this it is not sufficient to reduce the amount of functions to increase usability.

As a possible solution to this a “Shared Workspace Open Framework” (SWOF) was conceptualized, which focuses on easy adaptation and extension of a shared workspace. Depending on the cooperation task only the required objects and functions are available. So this approach reduces complexity as well as the learning effort of the user:

• A lot of basic functions and object types are available using SWOF as an adequate shared workspace.
• Different use cases (e.g. engineering tasks or document creation) can be supported by adding adequate object types or removing functions that are not needed.

5 Architecture
The architecture of SWOF uses an application server and is based on Java Servlet Pages. The free available and widely used open source solution Tomcat has been chosen due to the fact that it is the JSP reference implementation. In order to derive an open architecture that can be easily extended, the Model-View-Controller (MVC) design pattern has been chosen (see figure 4).

• As model, basic object types for SWOF were implemented, which support the basic features like database persistence, presentation and modification. The object types were structured in a way that allows other developers to improve the existing framework to support new tasks. This is shown schematically in figure 5.
• The controller distributes user requests and forwards these to the referring objects and methods. If necessary, the controller can be extended too.
• The view component is responsible for the presentation in SWOF and can be tailored completely to support other layouts or user interfaces.

Figure 4: Model-View-Controller Design Pattern
6 SWOF and ergonauten.net
The primary goal for developing SWOF was to extend ergonauten.net with a shared workspace. To achieve a smooth integration for this purpose several new object classes were created. On the one hand the user’s habits have to be supported in a more natural way. Thus e.g. tailored workspaces are used such as
• Personal Archives: Allow the user to store information objects of interest in a hierarchical file system, like links to the portal or documents he or she found.
• Special Interest Groups: A workspace should emphasize the common interests of the members and increase their self-confidence. This is one possible way for user motivation (Kindsmueller et al., 2002).
• Project Spaces: Focus on solving a special project together with other users.
• Meeting Point: A central point for all users where threaded discussions about ”ergonauten.net” can be held. In addition, this area contains documentation to the portal.
These workspaces have a different layout and some relevant functions. Anyway, this approach makes it easier to distinguish between workspaces, e.g. to search for a Special Interest Group.
On the other hand, new object classes were created corresponding to the objects in the portal like categories and links to voting results etc. This enables users to store global objects in the Personal Archives.

7 Other Use Cases for SWOF
A major advantage of the SWOF framework is that it could be used in different cooperation cases without modifications. For cooperative engineering, some additional object types can support the engineers, e.g. by previewing CAD files. Additionally the SWOF framework can be used in non-cooperation scenarios, e.g. it can be used to develop an electronic quality management (QM) system. This can be done by implementing a new interface and new object types for agreements and processes. The history function is helpful to log the document modifications. The development of special views supports the quality managers by showing important information, e.g. responsibilities and audit agreements etc. (Oehme et al., 2002).

8 Acknowledgements
The German Research Network Organization (DFN-Verein) funds MMI-Interaktiv with support of the German Federal Ministry of Education and Research (BMBF) according to the field „Einsatz von Netzdiensten im wissenschaftlichen Informationswesen“.

9 References
Visual Interfaces to Coordinate Real-time Decision Making in Hierarchical Structures and Their Application to Fire Systems

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ABSTRACT

This paper deals with a design of visual interfaces for real-time decision making in hierarchical structures. Hierarchical structures are often adopted to control or manage large scale real-time systems, where the whole problem is divided into small portions of sub-problems which can be managed by each member. In this paper, real-time problem solving in hierarchical structures is analyzed first, and its process model is proposed. Then the visual interfaces are designed to support real-time decision making in hierarchical structures on the basis of the process model. The visual interfaces are applied to the management of the fire systems, and its results are evaluated.

1 Introduction

Here we focus on real-time problem solving in hierarchical structures, which is typically observed in control and operation of large scale systems such as fire systems or transportation systems. The structure of an organization should be suitably designed for the type of problem which might arise in it (Malone, 1987). In hierarchical structures, the whole problem is divided into small portions of sub-problems which are assigned to the members with suitable specialties. Each member deals with the assigned sub-problem according to his/her specialty and position. Hierarchical structures cause problems entirely different from those which are dealt with in the GDSS (Nunamaker, 1989) when they are used for real-time problem solving. We believe that special-purpose interfaces are necessary to cope with these problems.

2 Process Model for Problem Solving in Hierarchical Structures

The process of real-time problem solving in hierarchical structures is investigated. First of all, we interviewed fire people, and asked how they make decisions and how they change their decisions. Two important factors, that is, "intention" and "situation", were induced from the analysis of the interview. Both of them are defined as follows.

Intention: Intention is what the operator wants to do on his/her problem. Intention is composed of "target", which is the goal to be reached, and "strategy" which is the path to reach the target. It is very important that each operator understands intentions of other operators at different levels.

Situation: Situation is the state of the system or subsystem to be managed by the operator. The situation changes every moment, and it is important that the situation of the system is expressed for the operators to be understood intuitively and easily.

Operators at each level of hierarchy have their own intentions depending on the situation. In a two-layer model of hierarchy, the upper level manages the whole system and the lower levels manage each area. The intention at the upper level, which is composed of its target and strategy, is decided on the basis of the situation of the whole system. Then orders in perspective are sent to the lower levels based on the intention. At each lower level, intention is formed from the orders from the upper level and the situation in its area, and concrete operations are conducted based on its intention. The changes of the situations are caused by these operations at the lower levels, and in some cases the changes of intentions are caused as a result. This process continues until the problem is solved totally.

The proposed model was traced for the real problem solving process observed in the fire systems, and it was confirmed that the concepts of intention and situation were suitable to express the real-time problem solving process.

3 Design Concept of Visual Interfaces for Hierarchical Decision Making

Coordination between different levels in a hierarchical structure is very important in real-time problem solving. The following functions are proposed based on the process model in the previous section.

(a) Visualization of intention

Showing the intentions at other levels in concrete visible form is considered to be useful to enhance mutual understanding between operators. It will be useful for the lower situations. On the other hand, at the lower layer, fire people are trying to go to the fire points as fast as possible to extinguish lower level operators if they can see the intention of the upper level operator together with the issued orders concretely.
Situation is the current state of the system which is dealt with at some levels of hierarchy. It is considered to be useful for the operators to express the situation in the space defined by a small number of important indices. If the situation in each area is expressed by a few important indices, it will be useful for the operators at each level.

Another important function for the operators is to show the gap between intention and situation at each level. This gap shows the difference between the intended operation and its result, that is, the gap becomes zero if the operation works as he intends, and the gap becomes large if the operation does not work as he intends. Direct expression of this gap will be useful to detect the problem in the current situation and will give suggestions to the related operators.

The basic concept of our proposed interfaces is to visualize intention, situation and their gap in the same space as shown in Figure 1 and Figure 2, and to utilize them for the coordination in a hierarchical structure. (Details are shown in Koiso, 1999)


The proposed interfaces were implemented on the personal computer for the fire system management by JAVA language. Fire systems are usually composed of two or three layers. Here we suppose one upper layer (U) and two lower layers (L and R) as shown in Figure 3. At the upper layer, the total strategy for distribution of fire engines and fire people is decided by considering the whole fire. The following indices are picked up to express the situations.

Figure 1: Expression of intension and situation on the same plane (two indices case)

Figure 2: Expression of the gap between intention and situation (two indices case)

Figure 3: Hierarchical structure

(c) Visualization of the gap between intention and situation

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Figure 1: Expression of intension and situation on the same plane (two indices case)

Figure 2: Expression of the gap between intention and situation (two indices case)

Figure 3: Hierarchical structure

(1) Risk Index (RI)
RI shows how high the risk such as the danger of explosion etc. is. This value becomes large when the risk is high.

(2) Burning Index (BI)
BI shows how fast the fire is predicted to extend. If the fire is in wooden building area, the value is high. On the other hand, the value becomes low if the fire is in the fire-proof building area.

(3) Current Burning Area (CBA)
CBA shows the burning area currently. When the fire is extinguished, CBA becomes zero.

Figure 4 shows concrete interfaces of the proposed system. The interfaces were evaluated using a fire system simulator by giving various types of fires in the simulation area. The following results were obtained from the experiments.

The proposed interfaces are useful to reduce the time to extinguish all the fires in the hierarchical organization. Especially the interfaces are effective for the users who pay attention to index plane, however, the system is not
so effective for the users who pay attention to fire situation directly.
The results of the experiments showed that the coordinated interfaces are basically effective for hierarchical system management.

5 Conclusions
In this paper, we proposed visual interfaces for real-time decision making in hierarchical structure. A prototype system with GUI is developed on PC and the system is evaluated by the experiments. The results showed that the system is effective for fire management.

6 Acknowledgements
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7 References
Group Decision Support System for Emergent Situation Based on Communication and Work Flow Model

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ABSTRACT

It is very important to support decision making in emergency of large scale systems. This paper deals with group decision support system for emergent situations in a hierarchical management structure. Our system is based on the communication and workflow model which considers human related factors such as "competence", "duty", "responsibility" and "knowledge". A prototype system is developed based on the model, and the system is evaluated for a plant management example.

1 Introduction

It is frequently observed in the emergent situation that important information does not reach to an appropriate person or department in the organization because of the confusion after the emergency or in some case because of lack of knowledge on contact address. This phenomenon happens especially when the size of organization becomes large, and we believe it is very important to support communication in emergent situation for large scale systems.

Several types of communication models have been studied in the field of CSCW (Computer-Supported Cooperative Work) (Conklin & M.L.Begeman,1988) (Nakatan & Nishida,1992) (Winograd,1988) (Stefik et al.,1987). In this research, we first investigate in the important factors in emergent situations and propose a communication model in emergent situation which focuses on human related factors such as "competence", "duty", "responsibility" and "knowledge". Then a group decision support system is proposed based on the communication model and work flow model. Finally, a prototype system with GUI is developed and its evaluation results are discussed.

2 Analysis of Decision Making in Hierarchical Organization in Emergency

Recently, "commandware" is recognized to be very important in the field of crisis management (Kawata, 1995). "Commandware" is regarded as the chain of commands to manage emergent situations. Commandware is closely related to the structure of organization. Hierarchical structures are usually adopted for the large scale system such as fire department, police system, management system for large scale chemical plants, and so on. In the hierarchical structure, problem solving is conducted by mutual communication among the nodes in the hierarchy.

Here we interviewed to the people who manages large scale plants such as power plant etc. from the viewpoints of communication. Concretely, we asked what type of communications occurred, and what was the objective of the communication. By summarizing these data, we reached to the conclusions that many communications, which were observed in plant management, are caused by the following factors.

1. Who is the person that has competence to execute the operation?
2. Who is the person that must execute the operation?
3. Who is the person that takes responsibility for assuring some results on the emergent situation?
4. Who is the person that has knowledge on the current situation or on the actions to be taken?

We call the above factors "human related factors", and it is thought that they play a very important role in selecting proper actions in the judgement process. The human related factors are the causes of communications between each node in the hierarchy, and the destination or the quantity of the communication depends on the human related factors. Though little attention has been given to the communication caused by these factors so far, we recognized the importance of the human related factors through the analysis of the interviews to the fire department. In next section, communication model in emergency is discussed based on the human related factors.

3 A Communication Model in Emergent Situation

The following four types of communications generated at each node in the hierarchical organization are considered.

1. Communication generated by competence
   It is defined as the communication to get permission for executing some operation, since the person has no competence, that is, no right to execute the operation.

2. Communication generated by duty
   It is defined as the communication to contact to the other person who has the duty to execute some operation under a given situation, since current situation is considered to require the operation and the person has no duty of executing it.

3. Communication generated by responsibility
   When a person does not have the responsibility on some operation for assuring some results, it is defined
as the communication to contact to the other person who has the responsibility to execute it. Here responsibility means to assure the results by taking any means.

4 Communication generated by knowledge
It is defined as the communication to contact to the other person who knows the situation or the operation very well, since the person does not know it well.

Our communication model in emergent situations consists of the above four types of basic communications, and the model is composed of both "physical structure" of the large scale system and "human related factors" in it. Figure 1 shows concrete components of physical structure and human related factors. Physical structure is decided by the structure of artifacts. Physical structure is divided into four sub-structures as follows:

(a) Plant Structure (PS): PS shows names, location of each part.
(b) Sensor Structure (SS): SS shows sensor name, location, measurement and values.
(c) Actuator Structure (AS): AS shows actuator name, location and type of actuator.
(d) Trouble Operation Structure (TOS): TOS shows the relation between trouble situation, action to be taken and result of the action. Workflow data is included in this part, and a sequence of actions to be taken are presented depending on the situation.

These sub-structures are determined by the physical factors of the system, and it is independent of the human related factors. On the other hand, the human related factors are concerned with competence, duty, responsibility and knowledge. The factors are determined by the formation of organization, bylaw related to persons, each person’s knowledge and so on. The human related factors are expressed by the following five sub-structures:

(e) Organization Structure (OS): OS shows names of each person in the organization and location of hierarchal organization.
(f) Competence Structure (CS): CS indicates persons who can execute some actions to be taken.
(g) Duty Structure (DS): DS indicates persons who must execute some action to be taken in the trouble situaion.
(h) Responsibility Structure (RS): RS indicates persons who assure some results for the trouble situation.
(i) Knowledge Structure (KS): KS indicates persons who know the part of physical structure well.

Adding these structural data, the model has inference mechanism to predict "who has the competence on the operation?" "Who has the duty on the given troubled situation?" and so on. When some situation is given as an input, the person to be communicated is determined by the model on the basis of the physical structure and the human related factors. The details of the model are explained in Koiso & Nishida, 1998.

4 Prototype System
A prototype system is developed to support decision making in emergency based on the communication model and workflow model. Figure 2 shows an architecture of the prototype system. The system is composed of communication model part and workflow model part. The concrete function of the system is as follows.

The system gives advice on the persons to be communicated depending on the situation. (This part is based on the communication model.)

The system gives advice on the sequence of actions to be taken. (This part is based on the workflow model.)

Figure 1: Communication model
![Communication model](image1.png)

Figure 2: System Architecture
![System Architecture](image2.png)
generate advices on the persons to be communicated and actions to be taken exactly.

Figure 3: Output of the Prototype System

5 Conclusions
In this paper, we proposed a group decision support system based on the communication and workflow model in emergent situation. The system gives advice on the persons to be communicated and also on actions to be taken in emergency. A prototype system with GUI is developed on PC and it is confirmed that the system works well.

6 Acknowledgements
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7 References
The Importance of Remote Maintenance for Equipment Manufacturers Competitiveness and their Customer Satisfaction

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ABSTRACT

This paper presents Remote Maintenance Management (RMM) as an instrument to enable Portuguese equipment manufacturer companies to overcome international competitive weaknesses. The main issues in the national context of maintenance management are presented. General requirements for RMM systems are described, focusing on both functional and non-functional requirements. An approach to the design and implementation of RMM systems making use of state-of-the-art architectures and technologies is outlined. The paper concludes with the description of an industrial research project aiming at developing a RMM system according to the general requirements identified before.

1 Maintenance management in a national context

Today the equipment manufacturers seek to guarantee to their customers a product perfectly adapted to their present and future needs. A well-managed relationship with the customers allows equipment manufacturers to supply high quality services and products with continuous improvement. Therefore, in all stages of the product life cycle, namely product design and development, manufacturing, sales and after-sales services, customer’s requests during the equipment usage are taken into consideration. The integrated offer of products and services, covering the complete product life cycle allows the continuous monitoring of the product performance, customer satisfaction and market trends knowledge.

In the Portuguese context, equipment producers are experiencing difficulties to compete internationally. The lack of exporting tradition, the difficulty in passing an image of quality and the inability to support distributed structures, have been limiting the investment capability, hindering a competitive jump. With the number of industrial installations increasing, and the concerns with reliability and availability being more demanding, there is the need to increase the maintenance staff, to displace them more often and to spend more time servicing the clients. The inability of most of the supplier companies to cope with these requirements, result in a clear preference of the equipment clients for international equipment supplier companies that provide remote technical assistance and maintenance to their customers. Regarding the solution providers, there are mainly two areas where RMM concepts are applied: some IT companies provide remote technical assistance for a limited set of functions (version updating, bugs correction, etc.) and some automation companies provide tele-monitoring systems (based on SCADA applications) that provide some RM functions. In conclusion, there are very few solutions in the market that are adequate to satisfy in great part the requirements of industrial maintenance applications. This led us through the analysis, design and implementation of a RMM information system.

2 Remote maintenance management systems

Using a RMM has advantages both for the equipment manufacturers and the equipment users. The former realise a business opportunity by providing an integrated product and service package, while the latter get rid of an often overlooked but important support process.

From the point of view of the equipment manufacturers there are some obvious advantages in offering a RMM service: reduces the staff allocated to customer servicing in terms of maintenance, improves the overall quality of maintenance service (e.g. by decreasing time-to-service), makes easier the internationalisation of sales by reducing the need to displace temporary or permanent maintenance teams, improves the marketing image of the company.

2.1 General functional requirements

A RMM system should support a set of maintenance and technical assistance services to be carried out remotely by the equipment supplier companies. For that, this system must provide a set of functionalities to detect, diagnose and correct malfunctions or breakdowns remotely. This implies, of course, the remote access to...
The Importance of Remote Maintenance for Equipment Manufacturers Competitiveness and their Customer Satisfaction

Paula Alexandra SILVA (1) and António Lucas Soares (1,2)

The equipment controllers and data. As basic requirements, a RMM system should:
- monitor remotely of the equipment status,
- detect and diagnose malfunctions and breakdowns,
- store breakdown, malfunction and repair data,
- notify maintenance managers,
- visualise the status of the monitoring components
- visualise maintenance state variables
- control the equipment remotely,
- remotely access to the equipment technical data,
- extract and visualise performance indicators regarding interventions and maintenance costs,
- assist technically in the of equipment problems.

Additionally, RMM services must enable the co-ordination with local maintenance activities. RMM cannot cover all the maintenance needs, but it should support complementary actions performed on-site by the company technicians.

2.2 General non-functional requirements
The success of a RMM system depends a great deal on the efficiency in monitoring, create and communicate correct maintenance data where and when it is necessary. Also crucial is the ability of being reconfigurable in a flexible way in order to respond to the change in the equipment itself and its characteristics. More specifically, in addition to the functional requirements enumerated above, a RMM system should:
- provide high levels of availability,
- adopt the simplicity and usability of a web based system,
- be easily integrated with legacy systems,
- be used by a number of users without a noticeable performance degradation
- assure trusted enterprise transactions,
- be scalable to assure a smooth evolution with more demanding requirements,
- enable localised and isolated changes to the system,
- be able to be distributed across multiple platforms in a network

To conclude, it must be known that there are a few more considerations for a RMM system to be comprehensively designed: there are different contracts for different clients, clients can be in very different locations, maintenance staff can also be in different locations, the equipment to maintain evolves rapidly, and the clients are more and more demanding.

3 Architectures and technologies to support RMM
To design and implement an information system that fully implements the above requirements, it is necessary to make use of state-of-the-art architectures. Multi-tier architectures and distributed objects technologies enable to separate user interfaces from business rules and data management. They also enable a system to be built around a component structure that makes it easier to evolve through the updating or creation of components. These architectures are based on standards such as the Common Object Request Broker Architecture (CORBA) or the Enterprise Java Beans Architecture (J2EE) (see figure 1).

The project STEPE aims to design and implement a RMM system for critical equipment. The main goals are:
- to provide a set of services for technical assistance and maintenance that can be performed remotely by equipment manufacturing companies to their clients
- to support local maintenance management either by internal staff or by the service provider.

This way the STEPE system provides three solutions: remote maintenance, external maintenance management and internal maintenance management.

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Figure 1: Generic three-tier architecture to implement RMM systems (source: java.sun.com)

The main functionalities of this system are: static data management, intervention management, alarms management, tools management, stock management, monitoring and tele-maintenance, technical support, staff management, document management, training and evaluation.

The STEPE system was built around the technologies enumerated above. More specifically, object-orientation was implemented through the use of the Java language that provides platform independence either. The design

Figure 2: Architecture of the first STEPE prototype
was based on the Unified Modelling Language and the implementation was based on open-source software. After testing some development environments, the J2EE architecture was chosen because of its support to multi-tier and distribution (Avedal et al., 2001). The planning of the project considered the development in parallel of two prototypes: the global system prototype and the monitoring and tele-maintenance module. These where implemented in a pilot company where it was possible to evaluate the expectations of the customer regarding tele-maintenance, validate the system functionalities, refine the monitoring infra-structure, define the operating methods.

4 Conclusion

A first prototype of this system was configured for a company that produces automated transport systems for the textile industry. The distributed system was installed in both the producer and in one of its clients. The prototype architecture is shown in figure 2. Both software and hardware problems are being identified, diagnosed and solved without the physical displacement of maintenance staff to the client premises. With this approach, the client is fully satisfied with the availability of the equipment. Furthermore, the equipment supplier, besides obvious costs reduction in the performance of maintenance services, also improves its image to this and other clients.

RMM proved to be a valuable instrument in implementing an integrated product/service strategy. Today’s information systems architectures enable the construction of cost-effective distributed applications that answer comprehensively to the requirements of RMM. Nevertheless, there stills a lot to do in terms of optimizing the systems architecture to be more easily and flexibly adaptable to the different situations that can arise. From an organizational perspective, there is the need to redefine maintenance management business processes (Silva, 1997) in order to fully take advantage of these systems. On-going research work in these areas is still being done at INESC-Porto.

5 References


Virtual Workplaces for Supervision of Manufacturing Systems

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ABSTRACT

The application of new information and communication technologies in manufacturing gives companies the possibility to create value-added services in the usage phase, for example through remote operations or virtual facility management. In this regard a communication platform for a digital factory was developed to make diagnoses of the machine, changes of programs or process optimizations possible in less time by using an integrated control system, visualization and surveillance. The precise reproduction of the production system in a virtual world makes it possible to analyze and optimize all influences on the real production in that virtual world or virtual workplaces. Especially the integration of virtual reality applications to provide 3D visualizations of machines operations leads to a higher level of immersion for the user.

1 Introduction

During the last few years the technical development has been widely changed by new information and communication technologies. These changes have, however, not yet been adopted for manufacturing technologies in a larger scale because users are not prepared to take risks due to the high investments required. Yet in the field of manufacturing technology there is a high potential for extra added values during the product life cycle, too.

2 Value added services in the product life cycle

A possible method to evaluate these idle potentials economically is the method of life cycle management [1]. It shows the costs and benefits of the product’s whole life cycle and makes a better identification of the life cycle profit and its key influences possible.

Figure 1: Costs and benefits in the product life cycle

As seen in Figure 1 the phase of product usage has the highest influence on the life cycle profit. Within this phase the product’s economic success or failure is determined. Therefore, production should aim at improving the added value especially in this usage phase by establishing of so called value added services.

Nonetheless, these value added services are possible in any phase of the product life cycle, starting from planning and making concepts, including the manufacturing and service processes as well as the phases of usage and finally recycling or disposal. Often new technologies are used in order to achieve better results in less time through process knowledge and process transparency and to make a more flexible and especially ubiquitous provision of knowledge and work possible (e.g. e-service, Tele-operations). With these developments it is possible to realize flexible structures and high process control, because “the only thing that is certain for the future is that nothing is certain” [2].

3 Change drivers for the production

Based on this thesis, which has by now been commonly accepted [3, 4, 5], the structures of future production companies will gravely differ from today’s production structures. One main characteristic of these future production structures will be its higher versatility, which makes it possible to react to changing market requirements faster or even proactive. These versatile production structures do not put their focus on the “computer-guided unpeopled factory” as it was the aim in the eighties, but try to establish a factory structure which works in the outer levels of the technological limitations and in which the human being is the central element in the continuous adaptation of factory structures because of their unique abilities in terms of association and creativity.

Based on a Delphi-Study [6], there seem to be two main change drivers in production technology at the moment:

On the one hand the ergonomic representation and security of planning will increase by establishing “virtual production worlds”, which are based on detailed reproductions of the real production systems on the computer.

It is possible to test all measures for the real production in the virtual production world first and apply the results
to the real production world only if the results are successful.
The global interactive relationships between manufacturer and user of production systems enable the manufacturer to receive information - with the agreement of the user - about the actual status of the production systems, independent of where in the world they are located.

4 Process control and virtual technologies

However, these change drivers demand a detailed knowledge of the technical and technological processes in a production system. One has to know the relevant process parameters and their influences to model a manufacturing process or to operate it with a remote control system.

In reference to these demands of process information the developments in sensor technology are very important (see Fig. 2). Today it is possible to make measurements in situ, i.e. directly within the process, which provide online information for simulation or knowledge bases to allow a closed loop control of manufacturing processes in order to achieve a zero-waste production [7,8]. Sensor data can be presented to the user with assistance of computer graphics taking into account ergonomic aspects.

But sensors can only measure the process parameters, they cannot show the correlations between the parameters. Therefore a detailed model of the manufacturing process has to be developed based on the real processes. This model displays the behavior of the input and the corresponding parameters truthfully.

Based on a process model it is feasible to calculate and show the results of a manufacturing step before it is carried out. Figure 3 demonstrates the model for such a “virtual manufacturing”. It is possible, for example, to analyze the technological processes on the computer just before starting-up the real production in order to get experience of the process parameters and to optimize their settings.

Considering the empirical law of learning, learning effects may be achieved in the early stages of the planning and development process by using virtual workplaces. This leads to less problems in the start-up and therefore to less costs and a decreased starting up time (see Fig. 4). Furthermore, the planning reliability increases because of the possibilities of visualization and simulation.

5 The digital company of the future

In order to find new approaches and methods in the fields of the change drivers mentioned above, the Institute of Industrial Manufacturing and Management (IFF) together with the Fraunhofer Institute for Manufacturing Engineering and Automation (IPA) developed a platform for the control, visualization and surveillance of a manufacturing cell. The project, which was financed by the German Ministry of Education and Research or BMBF, was presented within the Global Dialogue “Sci-
ence and Technology - Thinking the Future” during the word exhibition EXPO 2000 in Hannover.

As mentioned above, from the first idea to the realization, a multitude of influences and limiting conditions have an impact on the planning of production systems and they are, in addition, changing rapidly during the planning. Because of this the intention for the “communication platform digital factory” is the integrated representation and connection of the planning and development process to support the communication between human being and machine (human-machine interface) and the persons concerned in planning (human-human interface).

Spoken on an abstract layer it is necessary to provide a complete connection between distributed real and virtual objects (machines) of a manufacturing system on the basis of a bi-directional interactive information flow.

Based on this bi-directional interactive information flow, changes of the real object show off immediately at the virtual model and vice versa.

In order to demonstrate these ideas a “workplace of the future” was developed. With the help of this workplace it was possible for experts to supervise the real manufacturing process and to interact with a machining cell over long distance in a virtual world, which was connected to a real world. It was also possible to observe the alterations in the virtual model and to monitor process parameters of the real machine operations. So the manufacturing process was not simulated, but the changes during the real process were visualized.

6 The structure of the workplace

As shown in figure 6, the structure of this workplace basically consists of the virtual working place and the real dislocated process and the communication system to connect both sub-systems.

In developing the workplace’s structure the aim was to provide the user with all information that an attendant located directly at the machine would receive - and if possible even more. Therefore not only an interface to the control system of the manufacturing cell was established but also microphones and video-cameras to make audio-visual surveillance available. The interface to the machine’s control system made it possible to extract the actual axe values and even extra values like axe currents, forces or temperatures. Additional sensors, for example for measuring the quality parameters, could have also been integrated.

Telephone lines were used instead of the internet in order to provide constant transmission rates and security against wrongful access, but by using TCP/IP as transfer protocol the system could operate via internet as well. The communication was bi-directional to send the update information for the visualizations in one direction and the user inputs to control the machine in the other direction.

All the information from the machine was thus bundled in a “cockpit” e.g. virtual workplace. It consisted of three screens on which the user could watch the machine’s working status. One screen showed the view of the two video-cameras inside and outside the machine to provide an image of the real machine.

Figure 5: The structure of the workplace

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display, for often the user cannot see the real milling tool since the coolant floods the whole work piece. In contrast to that all details can be seen exactly in the virtual model.

7 Conclusion and outlook

It can be expected that “virtual technologies” will gain an increasing importance for the working in future networked manufacturing. It is possible to work remote in virtual workplaces, which are online with real processes at any place in the world. Integrated platforms for control, high-end visualization by virtual reality and surveillance provide possibilities to make program changes, machine diagnoses or process optimizations in a very short time and online. Furthermore the planning reliability is increased because all data and information of the real production system can be analyzed and optimized in the virtual world. Remote operations or virtual facility management will provide additional potentials for added value in a product’s life cycle.

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Ergonomic Evaluation with Human Models in Virtual Environments

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ABSTRACT

Ergonomic evaluation with human models is a beneficial approach in Virtual Engineering. However the customary way of working, i.e., using two-dimensional screen representations and pointing devices, together with a lack of standardized procedures, leads to some drawbacks concerning reliability, efficiency and related expenses. Within the SAFEGUARD project an explorative study was conducted in order to test a normative method of evaluating driver workplaces by human models in a stereoscopic projection room with three-dimensional interaction devices and speech control. The tests showed clear benefits compared to the customary method. But there are still further improvements required including in particular the optimisation of the interaction control loops. Furthermore it seems useful to integrate an electronic checklist and user support system into the virtual environment.

1 Introduction

Ergonomic quality has become a crucial issue for the success of many products in various markets or market segments, respectively. In parallel competition leads to an increasing speed in product development cycles, while costs have to be kept to a minimum.

These challenges are tackled by the Virtual Engineering approach. It aims at the creation and evaluation of virtual prototypes at early stages of the design process in order to eliminate design errors before they will cause high consequential costs and costly delays. Such approaches are also applied in the field of ergonomics. Ergonomic models - more precisely anthropometrical human models - such as JACK, SAFEWORK, RAMSIS and ANTHROPOS (e.g. Kraus et al., 1997; Krueger et al., 1997) are in use to perform three-dimensional anthropometrical evaluation and design tasks for mobile and stationary workstations. One of the main fields of application is the vehicle industry using human models particularly to design the packaging of the vehicle or the cabin, respectively (Figure 1).

2 Problem

The state of the art for those applications of human models is characterized by the use of graphics workstations with one or more screens. The tools used for the anthropometrical analysis are implemented as supplements to various CAD systems ready to be used by the CAD designer. This way of implementation leads to a number of shortcomings and barriers to a wider spread application of such tools:

• The use of the tools requires both human factors knowledge and CAD skills. This combination is not frequently found on the labor market.
• A special training and a certain amount of experience is needed to be able to work with a particular human model. Human models cannot be operated intuitively.
• Performing a three-dimensional analyses by using two-dimensional displays is difficult and leads frequently to perspective errors.
• Furthermore positioning and animating the human model correctly in the virtual environment is a time-consuming task.

Finally the procedures of ergonomic evaluation of a workplace - as applied in practice - are neither well defined nor well documented or standardized. This is the reason for evaluation results being poorly reproducible, incomparable and thus being not fully reliable.

3 Method

Firstly the use of Virtual Environments which provide a stereoscopic view of both the system and the human model seems a promising solution for the mentioned three-dimensional perception problem. Secondly direct manipulation of the human model’s limbs by a three-di-
dimensional “drag-and-drop” control can be expected to reduce training requirements and to lower the barriers to efficient use considerably. Thirdly a normative method for performing ergonomic analyses has to be used to solve the reliability problem.

All components for this approach have been provided during the recent few years. Virtual ANTHROPOS is the implementation of the ANTHOPOS human model for use in stereoscopic and 3D interactive virtual environments (Rössler et al. 1997, Deisinger et al., 2000). It is a general-purpose fully three-dimensional human model with an anthropometrical database allowing for modeling a variety of humans with respect to gender, nationality, body height, and proportions based on data of several international anthropometrical surveys. It provides analysis capabilities for anthropometrical fit, reach, vision, and postural workload.

VirtualANTHROPOS can be used with a stereoscopic projection wall or, even better, with a projection room. PC-based Virtual Reality systems (Bues et al. 2001) will more and more allow for affordable Virtual Environment solutions in Virtual Engineering.

The interaction technology includes head-tacking which is required to create the correct stereoscopic view. Furthermore two tracked flying joysticks (Figure 3) are used to position the reference points and contact points of the human model in a natural and intuitive way by three-dimensional drag-and-drop related to the model geometry to be evaluated. Speech recognition is used as well to enhance the interaction capabilities and to reduce the requirement of complex model operations to a minimum, e.g. by allowing to select even hidden body parts for manipulation with the pointing devices.

A normative method for evaluation with human models as well as with real persons is described by Dangelmaier et al. (1995) and Dangelmaier (2001). It defines how to use a human model in the context of an evaluation task within the iterative design process. It addresses all the required steps for a comprehensive analysis providing a checklist for the users. By means of that it both facilitates the usability for non-expert users and a well-defined procedure to improve reproducibility. The suggested procedures are not only suited for the evaluation of a merely virtual environment but can also be applied in (mixed) mock-ups and prototype vehicles.

Concerning the representation of the checklist it is preferable to have it integrated into the stereoscopic virtual environment instead of memorizing it or using a paper checklist. The former is undesirable due to oblivescence, the latter is inconvenient (see situation in Figure 2).

A further technical issue is the time lag in the control loop which includes the operator, the spatial tracking of the interaction devices, the position computation of the environmental and human model, and the rendering
process of the images. This delay makes the use of the system more difficult and requires some training. On the other hand the spatial drag-and-drop mechanism together with speech control is very easily comprehensible, easy to memorize, and easy to “automate” in terms of behavioral patterns and also quick to perform. This may reduce the initial training required considerably compared to the customary method. There is also some indication (Dangelmaier, 2001, p. 123) that it might be possible to reduce the required time for an anthropometrical analysis of a driver’s place by up to 66%. The stereoscopic view turned out to be helpful in better understanding the spatial situation. The possibility to control the view point and viewing direction intuitively by head and body movements also facilitates usability compared to work with normal CAD workstations. This is in particular the case when the spatial situation is complex and cannot be shown in one single planar view.

5 Conclusions
It is concluded that the explorative study encourages further research and development work related to the integration of human models in virtual environments and the use of checklist / user support systems. However the latter systems shall be an integrative part of the Virtual Environment. Technical deficiencies such as time lags in the control loop and imprecise tracking should be minimized, e. g. by using optical tracking systems and optimized hardware/software systems.

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7 References
Emerging Issues in the Productive Use of Virtual Environments

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ABSTRACT

Work within immersive virtual environments (VE) achieves enriched functionality and interaction by the increasing performance of today’s computer and visualization technology. The range of available input and output media in VE is still growing with the objective to enhance usability, visual or audible quality and provide an improved sense of presence. Although there have been different approaches, some of the fundamental questions in the field of Virtual Reality still are unresolved. This paper gives an overview over some of the emerging issues in immersive virtual environments from our point of view and shows some trends for the near future.

1 Introduction

In the last ten years, the topic Virtual Reality (VR) evolved dramatically. In the early years it was generally based on head mounted displays (HMD) or head coupled displays (HCD). The most popular interaction devices have been the data gloves, and the whole system was driven by expensive graphics workstations. A few years later, immersive projection systems more and more replaced the helmets. New, easy to use input devices have been developed and used successfully. In the last couple of years VR systems may even be based on low cost commodity computer-hardware. This leads to a broader user base with a wide range of application fields, requiring development of new functionalities and extended possibilities for interaction.

2 Graphical User Interfaces

The different immersive virtual environments, such as head-mounted displays, immersive desks, projection walls and Cave-like projection rooms have been advanced by VR-related research facilities rapidly. But after all, one thing has not become reality yet: A standardized graphical user interface like the mouse and window paradigm that we find on all platforms in desktop computing. An interface that allows people to take over control immediately in a new Virtual Reality application or a yet unknown site without any training. The working groups usually define their own standards on graphical user interfaces and modify their input devices, according to their special needs or even design them from scratch. The different application tasks the teams had to perform, led to the development of different interaction methods. For the future end-user of Virtual Environments a set of common, standardized input paradigms or at least recommendations would be desirable. If there were a de facto standard like the window and mouse based interaction in VR, getting productive would be much faster and easier. In program SFB374 ‘Development and Testing of innovative Products - Rapid Prototyping’ (SFB374, 2002), we are researching on an application platform to provide an integrated user interface for a set of arbitrary functional modules that can be loaded on demand from inside the VE. This would be a first step in change of paradigms towards considering the VR system as a kind of visual Operating System, while until now it more or less is an engine for the content of single applications.

3 Configurations of Virtual Environments

Use of HMD- and HCD-Systems, popular in the early years of VE, turned out to be uncomfortable in the long-term use. Besides the weight on user’s neck there is annoying wiring connected to the helmet and the air tends to get muggy. Furthermore those systems lack visual reference of the users’ bodies. In the stereoscopic approach these are single-user systems, where further users must be content with a two-dimensional sight of the scene on control monitors. Appearance of immersive projection systems solved much of these problems. Wearing shutter or polarization filter glasses is much more comfortable than wearing helmets. Perspectives in projection systems still are calculated for the head-tracked user, whereas further users, standing nearby the tracked user experience a sufficient accuracy of the shown perspectives. The visibility of the physical users’ bodies in back-projection based VE provide a useful dimensional reference to estimate size and distance proportions of the 3D scene. A range of different setups for projection systems has been established, starting at immersive desks, employing one or two screens and projection walls with one or more upright screens or even a projected floor. Projection rooms offer four to six back-projected walls in the form of a cube. Another approach are front-projected systems, based on curved screens, where the sight is no longer disturbed by visible edges of adjoining screen walls. Those systems mostly consist of a broad vertical screen, sometimes accompanied by a projected floor. To get a wider angle of sight, a complete projected sphere is
imaginable, which would be hard to realize for various reasons.

General drawback of front-projected systems is the visibility of the projectors, which have to be installed on the user side of the screen. Regarding the special requirements of Augmented Reality, numerous partners from Industry and research are investigating new approaches in the field of tracking, visualization and applications in the research project ARVIKA (ARVIKA, 2002).

4 Use of commodity hardware in VE

Since the early days of Virtual Reality, expensive and specialized graphics workstations had been necessary to drive Virtual Environments, starting from HMDs up to immersive multi-screen projection systems. Nowadays the performance of commodity PC Hardware more or less caught up with the specialized workstations, at least when combined in clusters. Currently commodity PCs are still lacking the flexible multiprocessor capabilities and special features of the graphics hardware like genlock signals for shutter glasses or extensive hardware support for antialiasing. Nevertheless PC technology currently is rapidly gaining a foothold at VE in research and industry, now affordable even for mid-sized and small companies. While single graphics workstations are mostly configured to drive the VE as a whole, PCs are working in Clusters with each machine driving one single perspective on one projection screen only. In spring 2000 we have been one of the first sites to port our VR system Lightning from Silicon Graphics’ IRIX to the Linux platform. We set up a PC-based one-wall system for passive stereo projection with Nvidia’s GeForce graphics cards initially. Instead of shutter technology linear polarized filters at the projectors’ objectives and at the glasses have been employed, for one eye in horizontal, for the other one in vertical direction. Head tracking of the user is realized by the position-only tracking system Dynasight. In May 2001 we advanced the development to a cluster of 12 PCs driving our new six-wall projection room HyPi6. Here we currently use PCs with AMD Athlon Processor running at 1200MHz and NVidia’s GeForce series graphics cards. Each PC supplies one perspective on one wall here. Currently, a lot of Linux based VR systems have been put to use by other VR research sites as well.

5 Tracking Technology

The use of tracking technology is a general prerequisite for human computer interaction in immersive virtual environments. On one hand, the location and orientation of the user’s head respectively eyes must be known to the graphics system to show correct perspectives for each eye on every projection screen. On the other hand, the user’s interaction with the immersive environment is based on position and orientation tracking of the input device as well. A lot of tracking systems are available on the market, but this technology still is in state of development, far from being mature. Currently the electromagnetic principle is the most popular tracking technology used for this purpose. The advantage of magnetic tracking is its flexibility. It’s able to operate through fabric or acrylic screens and the sensors are tiny enough to integrate them in nearly arbitrary tools. But the magnetic fields are subject to heavy static and dynamic spatial distortion, caused by reflections on metallic surfaces or interferences with other magnetic fields. The conse-

Figure 1: a) Immersive desk, one diagonal screen, b) immersive desk, two orthogonal screens, c) projection wall, one upright screen, d) projection room, five screens

Figure 2: Six wall projection room HyPi6 of the IAO, driven alternatively by a SGI Onyx 3400 or a Linux Cluster of 12 PCs with opened door screen
sequence is a discrepancy between the real position of the sensor and its virtual representation, and jiggling perspectives. The dynamic part of the distortion can be filtered, the static part nowadays often gets calibrated (Kindratenko, 2000). Beyond magnetic there are acoustic tracking systems available, based on measurement of sonic run time values. To measure position and orientation, the tracking sensor here has to consist of three spatial distributed microphones, which can turn out to be too unhandy for certain installation situations. The technology is subject to acoustic reflections and back-ground noise in the Virtual Environment.

Another approach is optical tracking by the use of cameras. Instead of active sensors, reflecting targets are fixed to the input devices and the users head, glasses or HMD. Evaluation of an infrared tracking system in our CAVEEE showed excellent behavior in aspects of accuracy and latency. The drawback of such systems is the required undisturbed line of sight between cameras and targets. If the direct line of sight between one or more cameras and targets gets interrupted in work process, the accuracy of tracking decreases or the system intermits completely. In a six wall projection room, optical tracking cannot be used, because either the cameras would restrict the sight to the screens, or holes in the screens would be required, to mount the cameras behind. Some systems combine different physical principles like ultrasonic and inertial sensing technology. Häfner has developed a wireless input device, based on a combination of optical tracking and radio transmitted button events. Another wireless input device, deploying acceleration measurement and a gyroscope instead of optical tracking is in development, too (Häfner, 2002). In daily practical use of VE a wide range of requirements for the future tracking system shows up. Beyond high accuracy and low latency the system should work across screen materials with no need for a direct line of sight and no susceptibility for sound reflexions. The sensors, if required at all, should be tiny and stable and offer wireless operation.

6 Input devices for immersive use

One of the key features of large-scale Virtual Environments is the direct interaction, that allows grabbing the 3D models with the input device and handling it in a natural manner in six degrees of freedom. In the early years of Virtual Reality, tracked data gloves have been used a lot to interact immersively. Soon turned out that the complex process of measuring the fingers flexing and spreading angles to enable grasping objects is not required for most tasks in daily use of VE. Furthermore the data gloves are uncomfortable to wear, put on and put off, particularly when the user is additionally working on a keyboard at the desktop outside the VE. For this reason we developed range of simple and handy input devices. a) shows a basic version with three buttons. A magnetic tracking sensor is integrated in the housing. We utilize this device since two years in nearly all fields of application, for ambidextrous interaction we work with two of them. Nevertheless we advanced this concept by different variants, either to obtain better overall ergonomics or to enhance usability for certain tasks. b) to d) show three new concept variants, partly specialized for the immersive modeling application. They have been produced using a Rapid-Prototyping machine and evaluated in user tests. The concept called ‘Spoon’ is based on the pen metaphor with enhanced operation angles for the users wrist, when the typical movements of immersive modeling are performed. In this field of application it is particularly important to supply a defined point of operation. The Mike or the OmniControl cannot provide an operating point that is such clearly defined by the form of the device. The OmniControl is a general further development of the Mike, providing two rings that are worn on index and middle finger. The user doesn’t have to hold the input device actively, it keeps in its position autonomously. In future besides discrete function buttons we will investigate the use of continuous working sliders at the input device as well. Especially for navigational tasks a slider could provide the amount of speed while the orientation of the device prescribes the direction of the movement.

Figure 3: Developing input devices for VE:

| a) ‘Mike’ for general use, |
| b) ‘Spoon’ for modelling app., |
| c) ‘StyleBall’ for modelling, |
| d) ‘OmniControl’ for general use |

7 Integration of external applications

One of the greatest challenges in VR development is the integration of external applications. Access to knowledge bases like PDM and ERP systems as well as CAD or CAX applications are strongly requested from industrial users today. The major CAD system companies currently extend their CAD Products by VR capabilities, to provide access to at least a subset of the drawing functionalities available on desktop from inside the VE. Internally the systems are working on the undiminished precision of the geometric model representations (Rantzau et al, 2001). We developed an integration module for our VR system lightning that shows a virtual Windows% or Unix X11 desktop from within the Virtual Environment, fed by real PCs or Unix Workstations, reach-
able on Ethernet. When the connection is established, its desktop with all opened windows is visualized in the VR application on a floating and moveable plane, the mouse is controlled by a selection ray and keyboard entries can be done on a huge virtual keyboard. shows a remote Windows’ desktop, with a Pro/Engineer CAD system running, where changes to the CAD model can be done right from the VE. The whole functionalities of all installed applications on the connected PCs are available from the VE. These include full Internet, Email and knowledgeware access as well as document readers or streaming video.

Figure 4: CAD system Integration with a virtual Windows™ desktop in the HyPI6

8 Extended input devices

Users experience the requirement for alternative input paradigms to solve particular problems. Beyond sketching or annotating additional information about the visualized 3D contents, the integrated functionalities as described in chapter could be controlled. From practical use we learned, that the task of text input with the classical VR input devices, utilizing select rays and virtual keyboards, is slow and uncomfortable. Hence supplementary equipment like 2D touch pads, wireless keyboards or PDAs can be useful for simple interaction, whereas for more complex tasks we utilize a touch screen notebook with wireless network connection and additional appliance to provide its freehand use in the VE. The latter case is a way to control not just the running application, but the VR system as a whole. Unfortunately such devices can only be employed at projection based VEs where the line of sight is not limited, but not at HMDs or HCDs.

9 Conclusion

Up to now expensive VR systems have more or less been reserved for research and large-scale industry. With the drop in prizes by the use of commodity PC hardware and other components, VE more and more becomes an interesting tool for medium-sized companies. So a new dimension in the spread of VR installations will emerge, the fields of application will further expand and hopefully a lot of new approaches and ideas will arise from the broader user base. There still is a lot of work to do. There still exist a lot of functionalities and tools on desktop, which would be valuable in Virtual Environments too. There has to be done conceptual work on input paradigms as well as implementatory effort, to say nothing of an unification of VR software systems themself. But all this is part of the process, the technology of VE requires growing up from its laboratory existence to a valuable tool with essential usability for the daily productive use in industry.

10 References


Evaluating Task Performance in Immersive Virtual Environments

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ABSTRACT

Is performance of tasks better in fully immersive virtual environment as opposed to partially immersive? This experiment is an attempt to evaluate task performance in 3D virtual environments at three complexity levels. Subjects performed the tasks in two experimental conditions: partially-immersive VE of a desktop and fully immersive VE of a cave. The order of task presentation was counterbalanced across subjects and conditions. The ANOVA was performed on the data. The results showed significant differences between virtual environments and complexity of tasks in the time taken to complete the tasks, as well as in the accuracy of performing the tasks. There is, however, no correlation between perceived subjective immersion and presence. But subjects felt disoriented while performing the tasks, suggesting the experience of virtual presence.

1 Introduction

Effective design of virtual environments (VE) requires a means of assessing human performance efficiency in virtual worlds (Stanney, et al., 1998; Khalid & Helander, 2000). Nash et al. (2000) reviewed the literature related to presence and performance within VEs. Factors contributing to human performance in VEs include the navigational complexity of the VE, the degree of immersion and presence provided by the virtual world, and the users’ performance on benchmark tests. If individuals cannot effectively navigate in VEs, then their ability to perform required tasks will be severely limited. This study is an extension of the UniCaVE project (Khalid, Teh & Fong, 2000). It is aimed at evaluating the benefits of presence on task performance in 3D virtual environments.

Immersion is a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences (Witmer & Singer, 1998). Therefore, virtual presence is a normal awareness phenomenon that requires directed attention and is based in the interaction between sensory stimulation, environmental factors that encourage involvement and enable immersion, and internal tendencies to become involved. Clearly, involvement depends on the degree of significance or meaning that the individual attaches to the stimuli, activities or events. Both involvement and immersion are necessary for experiencing virtual presence.

Slater et al. (1996) compared task performance with respect to immersive and non-immersive participation and interaction in a VE. Subjects observed a sequence of events played out in relation to a complex geometrical structure in the VE, and their task involved the reproduction of moves on a real world equivalent of that structure. The aim was to assess their understanding of geometric structure when they are immersed in and interact with a VE compared to the use of conventional workstations. That is whether skills or knowledge gained in a VE can be successfully transferred to the real world.

Our study compared the performance of tasks at three levels of complexity without transfer to the real world. The difficulty of the task itself that requires a lot of attentional resources and motivation may affect virtual presence. We hypothesize that performance will differ significantly between different virtual environments for different task levels.

The independent variables in this experiment are VE system type (desktop and cave systems) and task complexity (low, moderate and high task difficulty and navigation), while the dependent measures are time on task measured in seconds, number of correct responses to object recognition and judgement, and degree of subjective virtual presence.

2 Method

2.1 Subjects

About eight subjects (4 males and 4 females) with mean age of 24 years participated in this experiment. All have had at least a year of computer experience.

2.2 Immersive virtual environments

The virtual environments were manipulated in terms of degree of immersion. The desktop virtual environment generates a partially immersive VE, while a four-wall
Evaluating Task Performance in Immersive Virtual Environments

Halimahtun M. KHALID (1) and Choo Chiaw Ting (2)

2.3 Tasks and measures

Subjects were given three tasks to perform in the two conditions. The tasks were designed to provide varying degrees of involvement and virtual presence. The first task involved simple object recognition of chemistry molecules, the second task required detection of virtual objects, while the third task involved object judgement and estimation, as shown in figures 1, 2 and 3, respectively. Each task required different degrees of navigation in the virtual world with little navigation for task 1, moderate navigation for task 2 and greater navigation for task 3. For these tasks, performance was measured on the basis of correct responses to questions posed to subjects and the time taken to complete the tasks. These questions are expected to induce a feeling of involvement in relation to the complexity of the task. In addition a subjective questionnaire on measures of perceived immersion (15 items) and subjective presence (21 items) was administered to subjects. Subjective presence was measured in relation to factors such as control, sensory, distraction and involvement (Witmer & Singer, 1998).

2.4 Procedure and data analysis

Subjects were first briefed on the experiment. They were then trained on the first VE system followed by the performance of three tasks. The time taken to complete each task was recorded using a stopwatch. Subjects answered 5 questions per task concerning the virtual scene. They completed the presence questionnaire and were given a rest pause of about 15 minutes before being trained on the second system. Likewise, subjects performed the same three tasks but with a different set of questions. At the end of the second session, they completed another set of the presence questionnaire. Items in the questionnaire were randomised to control test-taking attitude. The order of presentation of conditions and tasks was counterbalanced across subjects. The data were analysed using oneway ANOVA and Pearson correlation.
3 Results

Tables 1 and 2 summarised the results. Table 1 showed mean performance in the desktop system, while Table 2 for the cave system. The one-way ANOVA performed on the data showed highly significant effects of VE system on time on task, F (1,7) = 9.17, p<0.02, but not for accuracy of task performance (F(1,7) = 1.34, n.s.). There is also highly significant effects of task type on time on task, F(2,7) = 22.64, p<0.001, and accuracy of task performance, F(2,7) = 8.40, p = 0.005. A pairwise comparison indicated that task 1 (mean = 146 secs) differed significantly from task 2 (mean = 341 secs) and from task 3 (mean = 481 secs) in terms of time on task. Task 1 (mean = 3.8) also differed significantly from task 2 (mean = 2.8) in terms of accuracy of object recognition, but did not differ significantly from task 3 (mean = 3.3).

The mean rating for immersion on a 5-point scale is 3.33. The mean rating for subjective presence in the desktop and cave system is 2.99 and 3.01, respectively, see Tables 1 and 2. However, there is no significant correlation between perceived subjective immersion and presence for both systems.

4 Discussion

This experiment has shown that task performance in the desktop system was better than that in the cave despite the larger field of view in the cave to support object detection and spatial navigation. One possible reason is the usability of the input device. The 3D tracking device, an absolute controller, is more difficult to manipulate compared to the conventional mouse, a relative controller. McGee et al. (1997) claimed that greater user experience with input devices such as the mouse could reduce performance time. This was confirmed by subjects who needed more practice and training in order to use the tracking device effectively. Another reason relates to user experience with the VE systems. As this is the first time that subjects were in a cave, the tendency to explore the virtual world increased the time on task for some subjects who were curious about the technology.

Table 1: Mean task performance and subjective presence in desktop VE

<table>
<thead>
<tr>
<th>Subject</th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Subjective Presence Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time on task (sec)</td>
<td>Correct responses</td>
<td>Time on task (sec)</td>
<td>Correct responses</td>
<td>Time on task (sec)</td>
</tr>
<tr>
<td>1</td>
<td>132</td>
<td>1</td>
<td>329</td>
<td>2</td>
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<td>103</td>
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<td>7</td>
<td>60</td>
<td>3</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>120</td>
<td>4</td>
<td>380</td>
<td>2</td>
</tr>
<tr>
<td>Mean</td>
<td>157.38</td>
<td>3.75</td>
<td>293.50</td>
<td>2.50</td>
</tr>
</tbody>
</table>

Table 2: Mean task performance and subjective presence in cave VE

<table>
<thead>
<tr>
<th>Subject</th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Subjective Presence Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time on task (sec)</td>
<td>Correct responses</td>
<td>Time on task (sec)</td>
<td>Correct responses</td>
<td>Time on task (sec)</td>
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<td>3</td>
<td>744</td>
<td>3</td>
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<td>59</td>
<td>4</td>
<td>480</td>
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<tr>
<td>8</td>
<td>120</td>
<td>5</td>
<td>350</td>
<td>4</td>
</tr>
<tr>
<td>Mean</td>
<td>134.13</td>
<td>3.88</td>
<td>389.25</td>
<td>3.13</td>
</tr>
</tbody>
</table>
The difficulty of the task affected task performance. Task 1 that involved simple object recognition of chemistry molecules, with little navigation, was proven to be easy than Task 2 that involved object recognition of desktop objects but with greater navigability. Task 3 that required estimation of object size and increased navigation was viewed as the most difficult. Since the more complex tasks required greater attentional resources and motivation, the time spent on the task also increased, thereby inducing greater virtual presence (e.g. Witmer & Singer, 1998). Due to disorientation effects experienced in the cave, the longer time on task in the VE could decrease virtual presence as well (e.g. Stanney et al., 1998). About 63% of the subjects experienced disorientation in the cave system while performing the task. Others experienced cybersickness (13%), loss in virtual space (38%) and confusion (38%). The eyeglass was found to be cumbersome and heavy to use which may have reduced further virtual presence. As a result, subjects’ ratings of perceived presence did not reflect they were immersed in a virtual environment.

5 Conclusion
Clearly, optimal performance of tasks in virtual environments requires better design of the user interface in the VE systems and input device. Given that there is no relationship between perceived immersion and subjective presence, it can be said that task complexity played a greater role in determining involvement and virtual presence. Both VE systems appear to create similar inclusive, surrounding and vivid environment despite the fact that the cave provides a larger field of view than the desktop system.

6 Acknowledgement
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7 References


Supporting Concurrent Engineering in Conceptual Product Design Using Virtual Environment

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ABSTRACT

Integrating virtual environment within a collaborative system may support conceptual design. This study investigates the utility of employing a shared virtual environment in concurrent engineering. Two collaborative systems were compared and the results showed that a multiparticipant system with free-for-all communication is more effective than turn-taking alone. The virtual environment was found to be limited in its applicability although it enabled active design communication.

1 Introduction

In concurrent engineering (CE), product designers collaborate with representatives from manufacturing, marketing, sales, and engineering divisions to jointly decide upon the optimal product design. To support CE in collaborative work situations, multiparticipant, distributed, virtual reality systems are emerging as a new class of tools. Examples include: the COVEN system (Normand, 1999), DCEE (Maxfield et al., 1998), DIVE and MASSIVE (Benford et al., 1995) and VCODE system (Khalid, 2000).

In a collaborative environment, CE team members interact by sharing common information and reaching agreements. Members bring their own personal viewpoints to the integrated vision of the product design process. Functional, aesthetic, environmental and life-cycle issues are each characterised by different viewpoints, goals and constraints that have to be balanced with appropriate tradeoffs (e.g. Maxfield et al., 1998). To support the CE team in conceptual design, a system for distributed collaboration that enables evaluation of product design problems in a network-oriented design environment is required. A shared virtual environment allows the team to discuss design problems synchronously in real-time. Design issues in developing shared virtual environments are therefore important (Amselem, 1995; Khalid & Helander, 2000).

A major purpose of using virtual collaborative systems is to have meaningful interactions with members of the CE team. Such interaction richness can be achieved when barriers of space, time and media/document formats are overcome. This includes the ability to talk, see, write and draw in both synchronous and asynchronous manner, access to relevant information, archiving of interactions for future review, and debate of issues on a global basis.

Evidently, it is still hard for people to work together through their computers because of the artificial constraints of technology, inadequate interface design, and the poor integration of conventional software with groupware. Human-machine interaction could be enhanced further by having collaborative systems naturally adapt to their users. Such user interfaces take into consideration user experience and seek to reduce user frustration during an interaction.

2 Objectives

This paper addresses the issue of integrating a virtual environment with Web-based collaborative tools and customer needs data to support conceptual product design. The aim is to determine the utility of using virtual environment in concurrent engineering. Another aim of the study is to understand how design teams discuss and communicate their design solutions concerning Information, Communication and Entertainment Devices (ICED) to other team members using the collaborative systems.

3 Method

3.1 Subjects

Two distributed concurrent engineering teams from local car manufacturing companies in Malaysia participated in the study (henceforth referred as Team A and Team B). Each team comprised 5 designers and engineers.

3.2 Systems

Two collaborative systems, termed VCODE, were configured comprising an integrated desktop video conferencing system with collaborative multimedia and Web-based VRML (virtual reality modeling language) environment. The first system (System A) enables free-for-all discussion, while the second (System B) allows discussion by turn-taking only, as determined and coordinated by a project leader.

The virtual environment (VE) shown in Figure 1 comprised two alternative layouts of four electronic ICE devices to be integrated in the instrument panel of future cars. Besides the VE, each of the VCODE system comprised an audio-video conferencing facility, text chat, and whiteboard. A summary of customer needs for the in-car electronic devices was also provided to support...
design communication. Figure 2 illustrates the collaborative interface for the VCODE system.

Figure 1: VE prototype

Figure 2: Collaborative interface

3.3 Tasks
The teams were required to perform four tasks in two sessions, namely: to identify trade-offs in design and negotiate, to negotiate trade-offs and propose conceptual design, to discuss configuration layout of ICE devices in the virtual environment, and to negotiate design details by pointing to features on a whiteboard.

3.4 Procedures
Each task was performed for 15 minutes using both VCODE systems. Subjects performed the tasks ‘remotely’ although they were located in the same physical space. The environment simulated the open plan layout of their real physical workspaces.

The subjects’ site behavior was recorded via a camcorder while the collaborative behaviour, including verbal communication, screen information and social processes, was recorded directly into a videocassette recorder. A usability questionnaire was given at the end of each session to measure system effectiveness and usability of the system with respect to supporting concurrent engineering activities.

3.5 Data analysis
In order to understand the communication processes among the CE team members involved in the study, the video was analysed for speech content. Also, the questionnaire data were analysed using a 2 x 2 way ANOVA.

4 Results and Discussion

4.1 Verbal protocol analysis
Subjects’ verbal protocols from the video were used to develop a taxonomy of design communication based on Speech Act theory, as shown in Table 1. An analysis of each subjects’ speech acts indicated that the VCODE systems encouraged active design communication.

Table 1: Design communication

<table>
<thead>
<tr>
<th>Speech Act</th>
<th>System A</th>
<th>System B</th>
</tr>
</thead>
<tbody>
<tr>
<td>establish contact</td>
<td>identify customer needs</td>
<td></td>
</tr>
<tr>
<td>prompt team to participate</td>
<td>clarify functional requirements</td>
<td></td>
</tr>
<tr>
<td>chat socially</td>
<td>propose design parameters</td>
<td></td>
</tr>
<tr>
<td>give instructions for task</td>
<td>make confirmation</td>
<td></td>
</tr>
<tr>
<td>discuss design goals</td>
<td>disagree</td>
<td></td>
</tr>
<tr>
<td>discuss design details</td>
<td>request for information</td>
<td></td>
</tr>
<tr>
<td>discuss design trade-offs</td>
<td>seek help</td>
<td></td>
</tr>
</tbody>
</table>

4.2 System performance
The systems supported performance of design tasks significantly, in particular identifying design trade-offs (F (1,1) =5.59, p<0.05). The ANOVA tests on subjects’ ratings of the systems showed significant differences between the teams in user experience as well as system preferences. System A allows better interaction and support over System B. There is also a significant difference between teams in terms of system effectiveness in supporting conceptual design discussion, F (1,1)= 4.50, p<0.05. Team B feels that they can accomplish the task using the systems. The same team also finds collaborating on the net is helpful in design (F (1,1)= 14.00, p<0.01). System A, which enables free-for-all discussion, is greatly favoured over System B (F (1,1) =38.12, p<0.001). This is because each member feels free to discuss without having to wait for his/her turn as induced by System B. This feeling of ‘autonomy’ and freedom in system use is crucial in enhancing design creativity.

Additionally, the collaborative system was viewed as fun to use although there were technological constraints that impeded useful interaction, F (1,1) = 8.23, p<0.05. Team B preferred System A although their typical collaborative culture seems to prioritise turn-taking which is enabled by System B. Also, this was the first time the team had used the collaborative system, therefore the experience itself in using a new technology and...
the awkwardness of collaborating electronically may have induced the feeling of fun.
The use of virtual environment was found to be beneficial in supporting design communication. Team A, in particular, liked using the virtual environment together with the customer needs data.

4.3 Virtual environment

From the study, it was shown that the VE was limited in its applicability as it only allowed the team to discuss two possible ICED configurations. On the basis of subjective feedback, the VE prototype was improved as shown in Figure 3. Unlike the first prototype, this improved version has a pop-up menu of ICED icons representing nine best designs of each device type. The designs were selected from a ranking of 12 ICED designs in the customer needs survey. In this hybrid system, a CE team could select different options and configurations in conceptual design. The prototype was tested in a post-hoc session, and was found to be extremely useful.

4.4 Implications for design

The results in general indicated that design of collaborative interfaces should consider user experience and support team requirements in terms of: free-for-all communication, provide a sense of social engagement, enable user control, being robust and forgiving, allow physical or sensory interactions and flexible to use. Furthermore, the user interface required better organization of windows as subjects found the screens to be too cluttered with the virtual world, customer needs data, whiteboard, text chat and video images (see Figure 2). Conclusion

Although the virtual environment was found to be limited in its use, it did provide a means for a CE team to discuss design conceptually. Integrating the VE within a collaborative system supports design communication as gauged from the speech acts of the team. An improved menu-driven user interface comprising virtual prototypes may help to enhance further VCODE system performance.

5 Acknowledgements

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6 References

Virtual Communities - A Virtual Session on Virtual Conferences

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ABSTRACT

Virtual communities supported by computers and communication facilities have existed for about two decades. Virtual meetings around the world became technically feasible once there was a sufficient number of satellites to relay data communication, and became commonplace at companies that could afford computer-mediated communication (CMC). Today, technological advances, coupled with social changes, mean that virtual communities can be useful to many people. The goal of this session is to demonstrate how virtual communities can be established and kept going using inexpensive technical means. The meeting will be held during a scientific conference on worldwide distributed work, by presenters who have organized and run at least one virtual event. It will itself be a virtual event, with contributions from Philadelphia in the west to Hong Kong in the east and South Africa in the south. The physical auditorium will be present in Berchtesgaden, a small town in the south of Germany; virtual participants may be anywhere.

1 Introduction

Human networks have existed throughout history in various forms, such as clubs, sects, brotherhoods, guilds, gangs, and political parties. Forming such networks required sharing the same physical space, at least for a certain time. This meant members of a network needed common space to develop social mores, but not always for the entire lifespan of that network. When some members of a network had to leave the common space (clubhouse, city, country, etc.) but were able to maintain the links to the community it started becoming "virtual." The community was held together by common interests and not by common space alone. However, the members of such a community needed to meet from time to time to refresh their ties. The Inns of Court in London are an excellent example of forming networks in a common space. The Inns of Court are voluntary societies, unchartered and unincorporated. Hence, their early history is obscure. Since their inception in the Middle Ages, they have been devoted to the technical study of English law, rather than Roman law, as was taught in the universities. The ties created by this common interest were supported by common space, such as libraries that could be used by students as well as attorneys. The main common space, “The Temple,” a series of buildings associated with the legal profession, lies between Fleet Street and the Embankment in the City of London. When the members had to leave to work somewhere else in the vast empire, they became members of a virtual community held together by ships, mail, and later telegraphy. Yet such means by themselves would not be sufficient to form a true community.

With the advent of videoconferencing during the late 1970’s, it was believed that people who had never seen each other would be able to communicate using technical networks. The experience of less than a decade was sufficient to demonstrate that the intensity of such communications would not suffice to form communities. However, they could support existing human networks to a certain degree.

The 1990’s witnessed the birth of a new era in communication technologies with two outstanding characteristics: versatility and richness. While in 1985 the most modern communication technology available to the German public, Teletex (not to be mistaken for Teletext), was able to send plain text if typed in portrait format but failed if it attempted to transfer a table in landscape format, modern computers may transmit any data that can be digitized, including text, sound, pictures, and movies. Will they enable us to form virtual communities by establishing ties between people who have never shared common space at any time?

2 Why a virtual meeting at a “real” conference?

2.1 Parallel universes in a universe, or the people of my town

Long before I studied telecommunication engineering, I was interested in the relationships of people who lived in small groups far away from their “mainland.” The place I was born into was full of such people. My town was part of a city, and the people there called it “our village” although in consideration of the size of its population one could call it a “city.” Just walking down the road from our house, I might greet some Belarusians who had fled Lenin’s revolution long before I was born; buy something from a Greek whose ancestors had lived in what was once the most powerful empire east of Rome, Byzantium; and perhaps go fishing with a Jew, a descendant of the Sephardim who had arrived about 500 years earlier. Being the capital of two of the longest lasting empires in history, for a total of 1400 years, the city had attracted people from all over the
world. So did our village. Finally, WWII had brought even more people because it was one of the few places in Europe without war. “My” people were proud of ruling this place, but even they had their origins somewhere else. For the city’s first two millennia, other people had lived there.

The relationships between the people in my town looked very much like the links Ted Nelson, the creator of the Xanadu Project, draws between sets of documents. The name Xanadu comes from a magical place in Coleridge’s poem “The Ballad of Kublai Khan.” The project led to the hypertext structure of the Web (Nelson coined the term “hypertext”), but Nelson is deeply concerned because the links in the Web are one-way and may break (and the user then receives the code “404 Not found on this server!”). His model establishes non-breaking two-way links.

Would it be possible to link groups of people to parallel “universes,” like Ted Nelson tries to accomplish, with literature and documents? While planning this virtual meeting, I found many indications on the Web that this could work much better than we can imagine. In less than a week, I was able to find a vast variety of virtual events and communities that could never exist in physical space — anything between one real person joining communities without being restricted by time or space and persons remotely controlling the body of a single human being (“Fractal Flesh” by Stelarc, 2). As a result, my answer was “Yes! We should try it!”

2.2 Some people have gone, but they are still here

All of those people I had in mind while talking of my town were living in an old city. They belonged to the same big community and to a smaller part of it, our village. At the same time, they were also part of various other networks. Today, many of them live far away, and try to maintain ties to their place of origin. They also would like to see that their children develop some relationship to their parents’ world. This was little more than a dream when a telephone call home cost a day’s wages; and chatting over a phone line cannot show the children the blue ocean. This situation has changed fundamentally through versatile technical means that offer communication through different channels for reasonable costs.

Today’s technologies offer advantages that may even be more important than financial benefits. For example, the simple fact that people may use their e-mail addresses anywhere enables other members of all communities to stay in contact regardless of where they are. This is important, because we do not “call home” to just a place, but to a person at a given time.

This session was planned to demonstrate how creating virtual communities could work using inexpensive technologies. I think there is no need to show that expensive equipment works because more than half of the world population was born after worldwide television production had already become a reality. Some companies started working with videoconferences two decades ago and don’t need a demonstration of the past. They may, however, be surprised that someone in a bush camp can comment on a lecture given in a small town in Germany by somebody who is actually in Singapore, or even decide to join the lecture without getting up from her or his chair.

2.3 Means for being active anytime and anywhere

For most WWDU 2002 sessions, methods suitable for face-to-face meetings suffice. During the virtual sessions, we will use these techniques for those present in the conference room, while others will join the meeting using other methods. The presentations during the session require that all participants be available at the same time, but not necessarily present in the same location. Presenters and other participants may be anywhere.

Some presentations discuss virtual events not requiring synchronicity, and of course not being present at a certain location. Thus, the participants may be anytime and anywhere. Each means used for events, from face-to-
face meetings to activities anytime and anywhere, has specific features, but also specific disadvantages. A short representation of such means is given in Figure 3.

The WWDU 2002 virtual meetings will be “same time — same place” and “same time — another place” but will also introduce others, “another time....” An example is text-e, the first entirely virtual symposium dedicated to investigating the impact of the Web on reading, writing, and the diffusion of knowledge. The (asynchronous) symposium took place from October 2001 to March 2002.

3 Short notes on the presentations

3.1 Time schedule

Virtual meetings of the type “same time ....” require special considerations because there is no “same time” across the world. This fact has both positive and negative effects for WWW (World Wide Work). While the positive effects, e.g., always performing a given task at the time of the day when workers are available or most efficient, will be discussed in other sessions of WWDU 2002, the virtual session should avoid the negative. Unfortunately, for presenters in Hong Kong and the USA and participants in Germany there is no common time window. Therefore, we had to divide the presentations into an afternoon session (May 22, afternoon at 11° east) and a morning session (May 23, afternoon at 102° east).

Remote participants will be able to join the session most conveniently in the time zone GMT ± 3h (4). Others need to consider the time zone for the conference venue (GMT +1h).

3.2 Presentations of the afternoon session

All presentations of this virtual session are reports about virtual events by persons who have organized or run them. Both local and remote participants can judge after this experience whether or not the goals of such events are achievable.

For a Human Science of the Internet: The Case of www.text-e.org
(Gloria Origgi, University of Bologna)

Text-e was the first entirely virtual symposium on the impact of new technologies on reading, writing, and the diffusion of knowledge. The project was a complex synergy between a group of researchers in human science (myself and the other associates of the euro-edu association, www.euro-edu.com), a French institution (the Bibliothèque Publique d’Information of the Centre Pompidou, www.bpi.fr), and a Franco-American start-up (GiantChair, www.giantchair.com). A reconstruction of the main phases of the project (content design, website design, etc.) and an analysis of the statistics of access will be provided. Text-e is an experience and a model of interactive research in human science. A more general framework for a human science of the Internet will be presented.

Convergent Interests and Divergent Perspectives: The Marketplace of Ideas and Knowledge-Sharing in a New Media Environment
(Linda Greenwood, Dominique Monolescu, Gail Gallo, and Katia Lima, Temple University, Philadelphia, USA)

New media technologies present unique opportunities for knowledge sharing, discussion, and collaboration across national and international boundaries. The Internet has evolved from a text-based, asynchronous mode...
of communication into a communication experience that allows for a more personal, interactive environment. Research has shown that these types of environments foster greater gains in knowledge and provide a collaborative atmosphere in which ideas are more readily exchanged. With this in mind, the director and staff of Temple University’s Online Learning Program organized and implemented a virtual conference that would involve individuals from various communities in a discussion of issues pertaining to intellectual property in the digital age.

In the spring of 2001, the virtual conference “Intellectual Property and Digital Information in Higher Education: Problems and Solutions” brought together a diverse group of scholars, administrators, and jurists into discussion about intellectual property. The authors of this paper propose that most participants might not have been as inclined to participate in a face-to-face conference with such a broad range of perspectives as they would be to participate in a virtual conference where they are allowed a certain degree of anonymity. Indeed, several responses to a post-conference questionnaire indicated that the diversity of perspectives was what was most valuable to many of the participants. Conference participants came from throughout the United States, as well as the United Kingdom and Canada.

In addition to a variety of content and perspectives, conference organizers also wanted to offer participants diversity in the channels of communication and access to information. Multiple platforms were employed in an effort to allow flexible information-gathering and knowledge-sharing. Live chat sessions and asynchronous discussion boards were scheduled during the two weeks. Participants had access to content via downloadable conference papers and live slide presentations. AOL Instant Messaging was also employed with the objective of adding another, less formal, dimension to the virtual conference experience.

Virtual Conferencing as a Tool for the Social and Economic Development of Communities

(David Wortley, Mass Mitec-Creative Collaborative Communications, Market Harborough, England)

The Information Age is creating many challenges and opportunities for global society. Paradoxically, the same technologies which offer unrivalled opportunities for mankind to communicate, collaborate and build a rich, equitable and sustainable future, could also create a divided world in which individual self-interest might lead to the destruction of the human race.

Virtual conferencing is a technology which offers great hope for the development of social and economic wealth within communities, helping to address some of the less desirable aspects of globalisation by creating an environment in which people can work together to mutual benefit, strengthening the bonds of stable and fruitful relationships.

The Harborough Community Learning Network project in the UK is a pioneering scheme to explore how HP’s Virtual Classroom technology might be used to create a virtual community centre in which all sectors of the Harborough community can learn, work and socialise. The concept behind the project regards a physical community as an organisation whose common feature is the area in which the citizens live. The social and economic wealth of a district will increasingly depend on the degree to which the local population is empowered and motivated to shape its own social and economic future. Virtual conferencing using HP’s Virtual Classroom will create a shared space, and this, coupled with the development of a networked infrastructure linking the rural villages to a town hub, will provide an environment to stimulate enterprise and collaborative working across all sectors.

The success of the project will not only depend on the reliability, accessibility and ease of use of the virtual conferencing technology, but also on a coherent, innovative and well-supported campaign to stimulate entrepreneurial uses for the virtual space for business meetings, community education, social gatherings and a whole spectrum of other activities.

HP’s Virtual Classroom allows presenters across the globe to share their ideas and knowledge within anyone who can access the internet in a highly interactive way through the use of polling questions, text questions, chat, electronic surveys and “web tours”. The Harborough Community Learning Network truly brings the combined power of multimedia, networking and collaboration technologies to harness the human potential which exists in any community.

CybErg 2002 - Ergonomics for Human and Community Development

(Andrew Thatcher, University of the Witwatersrand, South Africa)

The CybErg 2002 conference is one of a series of “virtual” international ergonomics conferences first conceptualized by Dr Leon Straker of Curtin University of Technology in Australia, and successfully held for the first time in 1996 and again in 1999. The CybErg 2002 conference is the next international conference in a series of international conferences that have received widespread acclaim in the international ergonomics arena.

The CybErg conference series is based on the principle of internationalizing ergonomics knowledge and increasing the quality of ergonomics discussion by making conference attendance easier, quicker, and far cheaper than face-to-face conferences. It is easy to see how an international Web-based conference can drastically reduce travel-related costs. Such a virtual conference also enables discussions and knowledge to be immediately accessible around the world at the click of a mouse.

The organizers are most excited about being invited to convene and host CybErg 2002 from Africa. As a result of the previous CybErg conferences, organized under the auspices of the International Ergonomics Associa-
tion (IEA), the conference already boasts an internation-
al standing in the scientific field, with particularly strong
links to people and associations in Australasia, the
Americas, Europe, and Southeast Asia. It is therefore
quite significant, given the aims of internationalizing er-
gonomics, that the Core Organizing Committee for Cy-
bErg 2002 will be from South Africa, at the tip of the world’s
most economically impoverished continent. (See also full paper by the author in the proceedings)

**CyberLux – An Internet-Based Medium and Conference on Light and Humans**
(Ahmet Çakir, ERGONOMIC Institute, Berlin)

*A Deo lux nostrae* — “*Our light comes from God.*” This ancient belief gives an impression of the importance
of light and vision for all life on earth. Yet few ergono-
mists are interested in lighting. Surprisingly, architects
in many countries also neglect lighting-related issues.
There may be many reasons for this situation, but one
of the most important could lie in the lack of exchange
of knowledge between disciplines. CyberLux aims to
help remove barriers between them.

CyberLux is a cross between a virtual conference in
two languages (English and German) and a knowledge
accumulator where “knowledge” means creating links
to the places where useful information may be
found. Following the rationale that most existing
knowledge does not deserve this name because it is
unknown to most people, CyberLux sorts sources of
information on light and filters them for more conve-
nient access. Where new knowledge seems to be ap-
propriate, papers are published, e.g., on the relations-
ships between ergonomics, lighting technology, and
medical research.

CyberLux comprises five forums that accept submis-
sions of new articles or comments on existing papers.
There are parallel forums in English and German. Each
forum is guided by a Convenor who is responsible for
the papers but not for the comments. Participation is
free. Users need to register only if they want to write
comments.

**Call Center Agent Network — A Virtual Conference for Call Center Agents**
(Bernhard Raestrup, Eckart Menzler-Trott, Hannes
Oberlindober, change U – Die Innovationswerkstatt,
Bochum, Germany)

Call Center Agent Network is a website for people
who work in call centers, organized and run by former
colleagues. The initiators of this network are primarily
interested in creating ties between call center agents
worldwide, enabling them to exchange information on
their specific type of work, and involving call center
customers in the discussion. They will run a three-day
parallel virtual conference of which part will be report-
ed in the WWDU virtual session.

The topic call center fits into the wide scope of
WWDU 2002 for various reasons:

- The work of call center agents is distributed world-
  wide
- The tasks of those organizing and running call cen-
  ters may be distributed worldwide
- Those who conduct research need a global view
- The future prospects of work for call center agents
  in a given country may be influenced by the situa-
  tion in other countries

With the presenters being former call center agents
and the remote participants calling (hopefully) from real
call center workplaces we hope to realize a unique ex-
xperience. (See also full paper by the author in the pro-
ceedings)

### 3.3 Presentations of the morning session

Unlike the first session, the session on May 23 will be
coordinated from Universiti Malaysia Sarawak in
Borneo. This is part of the intended demonstration of
worldwide cooperation. The topics of the session will
be presented from Sarawak; Navi Mumbai, India; Sin-
gapore; and Hong Kong.

**A Constructivist-based Virtual Training Environment for Novice Car Drivers**
(Chen Chwen Jen, Eve CHEONG Chung Sze, See TOH
Kok Keong and TAY Choon Yong, Universiti Malaysia
Sarawak)

This contribution reports the implementation of a web-
based three-dimensional virtual environment training
system for novice car drivers. Generally, this system
aims to train people learning to drive in cognitive as-
pects so that they will better understand the meaning
of various highway codes and on-the-road regulations.
This is done by providing a more realistic representation
of the road scenario through a virtual environment and
by designing the system based on constructivist learn-
ing principles. It is hoped that this system could be used
as a supplementary training system to help beginning
drivers perform better on their written driving test, and
subsequently in their real-world driving performance.
(See also full paper by the authors in the proceedings)

**Electronic Catalog for Online Product Customization**
(Jianxin JIAO and Mitchell M. Tseng, Nanyang Techno-
logical University, Singapore; Hong Kong University of
Science & Technology)

This topic discusses an indispensable electronic aid for
distributed work. The versatile electronic catalog is
used to support product presentation, search, and clas-
sification, served as interfaces to other market services
such as advertising, marketing, sales, distribution and
channels, as well as used as an alternative retailing ven-
u.

The status of electronic catalogs is reviewed in the con-
text of online product customization. Technical chal-
enges and fundamental issues underlying electronic
catalogs are discussed. An approach to developing elec-
tronic catalogs is outlined based on the product family
architecture. (See also full paper by the authors in the proceedings)

**A Grammar Tool for Sentence Generation and Cross-Language Communication**

*(PVS Rao, Tata Infotech Ltd., Vashi, Navi Mumbai, India)*

Communication across language barriers is an important need in the multilingual context of India. With low literacy levels, individuals in developing countries generally have reasonable language competence (understanding language) but face difficulties with respect to language performance (constructing grammatically correct — and therefore unambiguous — sentences). This presentation describes a grammar tool which can be a literacy aid as well as a facilitator of cross-language communication at the national level (for multilingual countries) and at the global level. It enables a user to generate:

- Fairly complex sentences in a language that he is barely familiar with, and
- Equivalent sentences in a second language with which the user need not be familiar with

The user can incrementally convey the intended concept underlying the sentence to the machine in a non-sentential form. This is internally represented as a structure that is not language-specific. This structure can be converted (using appropriate grammar rules) into sentences of a language.

The tool can be used in two modes:

- As an aid for sentence generation in real life or
- As a training tool for gaining competence, either in the first language of the user or in a second language

**4 References**


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Figure 5: Possible communication between presenters during the sessions (other participants may be anywhere). Some potential links have been left out in order not to obscure the picture.
CybErg’2002: Ergonomics for Human and Community Development

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ABSTRACT

This paper introduces a series of web-based ergonomic conferences known as CybErg, the international cyberspace conferences on ergonomics. The WWW holds a great deal of appeal in hosting an international conference, allowing conferences to be cheaper and more accessible to many people worldwide. A web-based conference allows conference delegates to participate at an international conference without leaving their own offices and without the cost of physically travelling to a face-to-face conference. A web-based conference therefore has a greater chance at internationalising the dissemination of knowledge and dialogue. This paper discusses the advantages of a web-based academic conference on ergonomics by introducing the CybErg series and CybErg’2002. The paper makes suggestions on how the problems of past CybErg conferences will be addressed by the next in the series, CybErg’2002. CybErg’2002 is to be organised from South Africa and is endorsed by the International Ergonomics Association (IEA).

1 Introduction

It can be demonstrated that the WWW is a suitable venue for an international academic conference. In fact, the initial aims of the WWW are closely aligned with the aims of scientific discourse, to introduce a common protocol to allow all machines to seamlessly communicate with one another (Berners-Lee et al., 1994). This means that information anywhere on the WWW can be accessed from any point in the WWW domain. In addition, the WWW allows the full capabilities of multimedia technology to be incorporated into the world-wide knowledge resources. Couple this multimedia capability with the stated aims of the WWW to facilitate collaboration between people in remote locations, and the WWW appears to be the ideal venue for academics to meet and discuss issues of mutual concern.

A web-based conference is any conference where the primary medium of presentation and interaction is the WWW. There are a large number of web-based conferences both of an academic and of a business nature to be found on the WWW. The conference formats found on the WWW are quite varied, from simple discussion forums (operating as nothing more than simple bulletin boards), to graphic-intensive “virtual” conferences that simulate everything from the registration foyer to the presentation hall. Some web-based conferences have even taken the text-based presentation medium a step further and experimented with multimedia presentations including the use of video and sound clips of keynote speakers and other presenters. There are even instances of conferences that have attempted (albeit not with widespread success) graphic Multiple User Domains (MUD’s) to create highly interactive conference experiences. These MUD’s allow a number of participants to interact with one another in an online graphic environment.

2 The CybErg series

The CybErg series has a special part to play in our understanding of web-based conferencing. Since it is a conference on ergonomics, this allows ergonomists to both participate in, and reflect on, the conference process. The role of the ergonomist in the reflection process is to compare the design, functioning and efficacy of a web-based conference to more traditional discussion media (i.e. face-to-face discussions). Once this has been done, the ergonomist is better placed to use ergonomics knowledge to design better web-based conferences. In this context, CybErg aims to investigate the ability of virtual WWW conferences to disseminate research results and to stimulate quality academic debate. Also, since the CybErg conferences are technologically simple, the aim is to allow more people from around the world to participate without alienating them through technological sophistication.

The CybErg conferences are held every three years to coincide with the closing date for submissions to the triennial International Ergonomics Association Congress. Two CybErg conferences have been held previously, in 1996 and 1999. The stated aims for each of the CybErg conferences have remained the same (Straker et al, 1996; Straker et al, 1999). Firstly, to increase the quality of academic papers and the quality of academic discussion by allowing more time to read papers and more time for the discussion of these papers (hence the conference is active for one month). Secondly, reducing the costs of travelling (such as airfares, accommodation, and subsistence) by negating the need to travel. This would be particularly beneficial to academics from developing countries, where there is a poor rate of currency exchange. Finally, accessing a wider range of participants (through the reduction of travel expenses) and reduce the bias towards predominantly west European and North American delegates found at most international face-to-face conferences.
CybErg is designed around the primary programme of face-to-face conferences to communicate and disseminate knowledge. The format of the conference is similar to that found at many face-to-face conferences. At the core, CybErg conferences are based on peer-reviewed abstracts, where quality abstracts are selected for presentation as papers. At the CybErg conference site, the presentation has been primarily in text and static image format. This “low-tech” presentation format is aimed at facilitating a greater number of participants, especially from less technologically developed parts of the World.

The full papers (similar in length and appearance to journal articles) are “presented” for the duration of the conference (lasting one month), and delegates are invited to read the papers and ask questions or make comments by means of an asynchronous text-based bulletin board. Presenters are encouraged to respond to questions and comments. The one-month time period for the conference allows for more in depth discussions than what found at face-to-face conferences. The number of papers depends of course, on the number of quality submissions and the range of topics being covered. In addition to the academic paper discussions there are also general academic and social discussion areas, allowing delegates to communicate and discuss more than just the content of the academic papers. The proceedings are produced on CD-Rom and sent to all registered delegates before the conference is active to enable delegates to read papers without having to rely on slow WWW connections. However, in order to make comments, ask questions and participate in discussions, delegates must be connected to the CybErg website.

3 Past CybErg conferences

The production of the proceedings on a CD-Rom necessitated the introduction of a minimal registration fee of US$75 (the first conference in 1996 was free, but with no CD-Rom proceedings). This, in turn may have led to fewer delegates (a reduction from 1078 in 1996 to 146 in 1999). However, it is possible that by introducing a small cost, delegates were more interested in getting something valuable out of the 1999 conference. It was still evident though, that the majority of the presenters at both the previous conferences were from western European and North American backgrounds. For example, there were only two papers from Africa (both from South Africa), three from Brazil and one from Mexico (representing south and central America), and a handful of papers from Malaysia, China (Hong Kong), Japan and India at CybErg’99. However, the percentage representation of delegates at CybErg’96 and CybErg’99 shows a slightly different picture. While CybErg’96 was dominated by delegates from Europe and North America, CybErg’99 shows a considerable increase in the percentage of delegates from South America and Asia. Even though there is a wide diversity of representation in the delegates, this does not necessarily indicate a diversity of active participation in the discussion and debate interactions. In fact, with a few minor exceptions, much of the discussion was still dominated by English-speaking, western-oriented delegates.

4 Technology and virtual conferences

One of the reasons for the dominance of European and North American delegates at previous CybErg conferences has been the unequal global distribution of technological resources. In a survey of industrially developed countries, income, educational attainment, urbanisation, type of industries and language spoken had an impact on the degree of Internet penetration. Those countries that were English-speaking, high average incomes, high educational attainment and a high degree of their population in an urbanised environment, had the highest rates of Internet penetration (OECD, 2001). In addition, countries with dominant industries in the transportation, forestry, construction and agriculture sectors demonstrated poor Internet penetration (OECD, 2001). Even though this survey was conducted in industrially developed countries, it is quite easy to see that the factors that predict low Internet penetration are the same factors that describe typical industrially developing countries (IDC’s).

Taking this information to the CybErg situation, there are a number of possible reasons for the lack of participation and involvement. At an obvious level, it is possible that there are language barriers that prevent many people from developing nations from submitting abstracts and from actively participating in discussions and debates. However, one might say that the same is true for many of the western European countries and from other industrially developed non English-speaking nations around the world (such as Japan). The fact still remains though, that these countries have the educational resources to actively ensure that their citizens have a basic command of conversational English. The same cannot be said of most countries in Africa, eastern Europe, and central and southern America.

A second reason, which is perhaps more disturbing given the nature of virtual conferences and the stated aims of the conference, is one of access to technology. It is most evident that the majority of people who have access to the WWW are from the USA. Nua Internet Surveys’ (2000) estimates of the number of people connected to the Internet indicate a dismal situation for Africa, the Middle East and Latin America. The developing countries of the world simply do not have the same access to information technology and the WWW as countries such as the USA, Great Britain, Germany, Japan or Australia. Even in South Africa, with the highest Internet penetration rate in Africa, only 4.15% of the South African population has access to the WWW. This is in sharp contrast to other developed countries in the world (contrasted with a penetration rate of 60% of the population in the USA).

Without some form of concerted intervention virtual conferences will not be able to increase accessibility
and diversity of views, except through developed countries. Naturally, this will lead to increased domination by western European and North American academics and theorists. This poses a challenge not only to future CybErg conferences, but also to all virtual conferences that are attempting to access a wider population of participants.

5 Towards CybErg’2002

Since the CybErg conferences in 1996 and 1999 achieved the first two aims of the conference, there is no need to change the structure, format and content of the CybErg’2002 conference. The conference secretariat moves to the University of the Witwatersrand, Johannesburg and an International Scientific Advisory Committee has been set up that consists largely of senior ergonomists from industrially developing countries. The main aim of the CybErg’2002 conference is therefore to attract quality participation particularly from Africa and Latin America. Limited translation facilities are available to allow non-English speakers to have their conference papers translated into English.

Based on an analysis of CybErg’99 it has been suggested that CybErg’2002 experiments with synchronous discussions using “real-time” discussion facilities (Thatcher et al, 2001). The Conference Secretariat will explore the feasibility of setting up a limited number of synchronous sessions. The timing of these sessions will be critically important if this experiment is to prove successful. It will be impossible to find a time that is mutually convenient to all delegates from around the world, but it is possible to define a broad time period that is less inconvenient.

Finally, on the subject of computer facilities, there will not be any form of equality in access to technology without a substantial amount of money being invested in information technology infrastructure and basic computing facilities. It is not the job of the CybErg’2002 committee to see that enough funds can be raised to redress the imbalance in all industrially developing countries. The OECD’s (2001) recommendations suggest that this would be a multibillion-dollar effort far beyond the scope of an academic conference. The role of the CybErg conferences will be to keep the format and technological innovation to a minimum in order to allow access to communities that are less technologically sophisticated. It is also hoped that we can link up with local, face-to-face conferences that are taking place concurrently with the CybErg’2002 conference. Thus, a small number of public access terminals will allow more people to be exposed to the conference without needing personal computer and Internet facilities.

CybErg’2002 will be active from 15 September to 15 October 2002. We have already received a great deal of interest from industrially developing countries. The extended abstracts (that are currently being peer-reviewed by internationally recognised ergonomists) from industrially developing countries (including countries in Africa, South America and Asia) have substantially increased from previous CybErg conferences. We would therefore like to invite people to register and participate in the third CybErg conference, “Ergonomics for Human and Community Development”. More information can be obtained from the conference website at: http://cyberg.wits.ac.za/

6 References


Call Center Agent Network – A Strategy against “Cubicalization”: A Virtual Community for Call-Center Workers in the Information Industry

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ABSTRACT

The call-center industry creates jobs with similar working conditions and a similar workload all over the world. The jobs of the call-center agents are highly dependent on technological, economic, and strategic international developments. In contrast to this situation, call-center research and call-center policies in most countries are conducted only on the national level. Yet there is a need to transfer information, knowledge, and strategy in an international context. Congresses on call-center agents’ working conditions are held without the participation of the agents. Call-center agents sell their voice and their mind at work: It’s not their voice on the line – it’s the voice of the company they are working for. As a result of these facts, Call Center Agent Network was started in October 2001 as an international communication and information platform. The Network is a no-budget project, so we were forced to run the web site very economically. The virtual conference is an experiment to share information about working conditions in call centers worldwide and to start an international networking project for call-center workers.

1 Introduction: Call Center Agent Network

Call Center Agent Network is intended as an international web community for call-center agents (http://www.callcenteragent.net). Responsible for this project are Bernhard Raestrup, Eckart Menzler-Trott and Hannes Oberlindober. We are former call-center agents and work now as advisers and researchers for and about call centers. The web community was started in October 2001, because there did not exist a central and international communication and information platform for call-center agents on the Web.

2 Why do call-center agents need an international communication and information platform?

Photographs of call centers show agents working in long rows or at their individual workplaces. This is a splendid situation for a job whose material is communication. The call-center agents are integrated into a global communication network with phone calls, bits and bytes transported around the world. Yet in most call centers, the agents are the only subjects who are not asked to communicate with each other: They are separated communication workers. In tribute to the cubicles that separate direct communication in a lot of call centers, let us call this situation “cubicalization” of information work.

Call Center Agent Network is an answer to cubicalization. It intends to create a global network of call-center agents.

2.1 Call centers depend on global developments

Work in call centers depends on the international labor market, on the international economy, and very often on the organizational strategies of companies operating internationally. Many job cuts in the last year were a result of one or more of these three factors. The agent in his cubicle is part of major strategic decisions – keeping or losing his job very often depends on these factors.

The crash of the “new economy” and the economic effects of September 11 cost thousands of call-center jobs in Germany and some tens of thousands in the USA. The closure of software-support lines is a direct result of the weak hardware and software market. The closure of telebanking hotlines is a consequence of international bank strategies; 65,000 call center jobs in the UK are at risk during the next decade, due to the international labor market – these jobs could go to India.

2.2 Standardized call-center work has globalized workload

Research on working conditions, health, and safety in call centers usually has a national focus. However, call centers worldwide have similar working conditions and problems. The organization of call center work is based on the factory model with repetitive tasks and standardized workplaces. The basic workloads are similar. Worldwide there are reports about stress in call centers, high talking levels, close supervision, and low freedom of decision-making (Bagnara (2000), 22). Most problem-solving strategies of management in call centers are technologically driven – there is a lack of orientation on the human resources in call centers.

There are many national differences – wages, national law, general social conditions, regional economically differences, and so on. Yet the standardized working experience and the comparable problems form a basis for international communication among call-center agents – the basic problems are the same in Canada, Australia, India, or France. This is the basis for an international
community of call-center agents to discuss problems and to share best-practice solutions.

Figure 1: Global working conditions in call centers

2.3 Agents have no voice of their own

Agents have no voice of their own. They sell their voice and their thoughts to a call center to fulfill the work that machines cannot process yet. There are many call-center conferences, there is a lot of literature about call centers, and there are many web sites offering information about call centers. But one group of people is conspicuously absent from this discussion – the agents themselves.

In the process of the international division of labor, the agents must even deny their cultural identity. Arundhati Roy describes this as imperialism in the mind and soul of agents in India, Malaysia, and other countries (Roy 2001, p 83ff.). Call-center training for call centers with US contractors in India includes language and cultural training – sometimes even soap operas are part of the training programs. This dramatic cultural impact of mondialisation is the focus of the GERM Group (2002).

2.4 Agents need new means of participation

Call-center agents need new ways of participation. They cannot strike. Only one click is needed to direct the phone calls to another call center. They are a new “cyber-proletariat” on the communication line, who have similar problems as workers on the production line. However, they have completely different jobs and a different social background from assembly-line workers – and they do not have any traditionally grown infrastructures to care for them.

Traditional trade union strategies are no solution for most of the agents’ problems. New strategies must be developed and a new cultural approach is needed. Campaigns can be one answer, the call center as a weapon itself another answer. We need new concepts for participation and new strategies to push through the call-center agents’ rights – and this must be discussed in an international context.

2.5 Conclusion

Two trends are important for the future working conditions of call-center workers: flexibility and networking. Flexibility as a part of call-center agents’ lifestyle is a result of the high-risk, flexible industry (Sennett 1998). Networking is important because agents need more specified information and communication to be able to react as subjects and groups at their work and to the whole call center industry. The international access to information and communication (Rifkin 2000) among and with call-center agents is also important for trade unions and researches to change the working conditions in call centers. Call Center Agent Network is one possible solution to these problems.

3 Our goals and experiences

Call Center Agent Network is a no-budget project. It is sponsored by the social and political research institute, change U (http://www.change-u.de).

Call Center Agent Network was started to share information and to start communication among call-center agents with a national and international focus. It provides daily news about the situation in the call-center business worldwide; in the German section there are essays and comments on call centers. A virtual library collects international documents about call centers – a special section provides documents about working conditions in different call centers around the world. There are many features for response and communication including forums, chats, comments, etc.

After half a year, we have finished the first step – to establish the web page. The next step will be getting international partners caring about national parts of the network. We are collecting experiences with this virtual community to find common solutions to establish international virtual communities for working people. We are optimizing Call Center Agent Network on the basic of the results of our experiences.

3.1 Conditions of virtual call-center agent communities – first results

One of the goals is to get experiences in social-work-related communities on the Web – especially for and with call-center agents.

Call-center agents appear to be “non-communicators” on the Web. This might seem surprising, because they are seen as very communicative people.

a) Call-center agents are indeed communicative people. But communication via voice and telephone (talking) and communication via keyboard and Internet (writing) are two very different ways to communicate. Workers in a very restricted communication situation at work face difficulties in starting to communicate with one another. My thesis: Call-center agents prefer to communicate in “real” communities (pubs, parties, cinema, university, family, etc.) rather than in virtual communities. There is one exception: hardware and software helpdesk agents. They need Internet-based newsgroup information and discussion for their work (searching for new drivers, solving hardware mysteries, etc.).

b) Traditional trade-union theories argue that part-time workers have less identification with their job, because they have different orientations in their lives (family, university, etc.). This has consequences for all web-based communities for call-center agents: Why visit a call-cen-
Call Center Agent Network – A Strategy against “Cubicalization”: A Virtual Community for Call-Center Workers in the Information Industry

Bernhard RAESTRUP

Call Center Agent Network – A Strategy against “Cubicalization”: A Virtual Community for Call-Center Workers in the Information Industry

4 Virtual conference for call-center agents

The virtual conference for call-center agents was planned because a “real” conference for agents is difficult to finance. The virtual conference will be held on the homepage of Call Center Agent Network. We use basic Internet technologies – chat, forum, news articles – no web conferencing or anything else which needs high technological standards or special software plug-ins.

Our virtual conference will be held parallel to the "real" conference in Berchtesgaden. We prefer to use asynchronous technologies because of the different time zones and the need for and opportunities for special concepts for virtual conferences.

Our virtual conference will be held under the topic “Working Conditions in Call Centers.” The conference will be divided between different workshops. We try to get experts and agents from different countries and continents to care for the workshops. The actual topics (April 2002):

Workshop 1: Voice Load in Call Centers
Workshop 2: Health and Safety in Call Centers
Workshop 3: Trade Unions and Innovative Strategies in Call Centers
Workshop 4: Call Center – A Chance for Handicapped Workers?
Workshop 5: Call Center and Globalization - Country Reports
Workshop 6: Standardization as Amelioration of Human Communication
Workshop 7: In the beginning was the word. Call Center Communication and Religion
Workshop 8: Virtual Worker’s Networks

One week before the beginning of the conference, the papers must be handed in. Each workshop will be monitored by one expert.

More information at: http://www.callcenteragent.net

5 References

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A Constructivist-Based Virtual Training Environment for Novice Car Driver

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ABSTRACT
This paper reports the implementation of a web-based three-dimensional virtual environment training system for novice car drivers. Generally, this system aims to train these novice drivers from the cognitive aspects so that they will better understand the meaning of various highway codes and on-the-road regulations. This is done by providing a more realistic representation of the road scenario through virtual environment and designing the system based on the constructivist learning principles. It is hopefully that this system could be used as a supplementary training material to help the novice car drivers to perform better in their paper-based driving test and subsequently in their real-world driving performance.

1 Introduction
Road accident is one of the major causes of death in Malaysia. Statistics released by the Road Transport Department (RTD) of Malaysia shows that the number of road accidents has been increasing since the last 10 years. In the year 2000, for instance, a total of 250,429 road accidents were reported with the death toll of 6,029 and 44,165 injuries (Jabatan Pengangkutan Jalan Malaysia, 2001). RTD has always envisioned in producing competent drivers. Among the measures taken is to introduce a more stringent driving test procedure. Currently, a candidate has to go through 4 test components in order to be eligible for the competent driving license. These components include (i) theory test (oral or written), (ii) attending a 6-hour practical lesson, (iii) practical test, and (iv) road test.

Component (i), which is the theory test, consists of 50 multiple-choice questions. This test is basically text-based with some images showing Highway Code or two-dimensional plan view of various road scenarios. Generally, these questions aim to test the candidate’s ability to distinguish different Highway Code and his/her understanding of on-the-road regulations. However, we observed that there exist a few limitations on the current paper-based theory test to effectively evaluate a candidate. Highway Code is tested individually and not incorporated into the real road scenario. This encourages rote learning of the code without fully comprehending the real usage of each code. In addition, the utilization of two-dimensional representation of the road scenario is unrealistic. It increases the candidate’s cognitive load by demanding him/her to mentally construct the three-dimensional road scenario from the two-dimensional plan. Indeed, this task entails the knowledge of isometric, parallel and perspective projections, elevations, materials, dimensioning and so on. The fact that different people have different spatial ability raises the ambiguity on the validity and ability of these two-dimensional plans to accurately test the candidate’s understanding as it involves another level of abstraction that is unnecessary when facing a real driving condition.

2 Aims
This project aims to design and develop an affordable web-based virtual environment training system that will serve as a supplementary training material to the current driving course. Generally, this desktop-based training system is meant to improve the comprehension of the Highway Code by simulating the use of it in the real context within the virtual environment. It also aims to better prepare the candidate for the theory test, especially in practicing his/her cognitive ability to construct the three-dimensional road scenario from the two-dimensional plan. This will hopefully reduce errors that may be made due to the candidate’s poor spatial ability.

The use of an interactive virtual environment system such as this allows the user to control and interact directly with objects within the virtual world. Such control and interaction, together with free exploration, provide a greater sense of empowerment. As pointed out by Bricken (1990), one surprising result from virtual reality research is that subjects have a strong positive emotional reaction. They feel free and empowered, in which empowerment is a factor that contributes to motivation. Moreover, it also offers flexibility for repetition and
self-pacing. The integration of this virtual environment on the web also enables us to manipulate the benefits offered by both virtual environment and web technologies.

3 Methodology

The scope of the training system was identified after a thorough discussion with an officer of the RTD. This training system was then designed based on the principles of constructivism, a current educational thinking that believe that a person can learn more effectively by constructing their knowledge through learning-by-doing. Winn (1993), Bricken (1990), and Chen & Teh (2000) are among others who have pointed out how the various capabilities of the virtual environment technology could support the principles of constructivism.

Figure 2: Model for designing constructivist learning environments (Adapted from: Jonassen, 1997)

Referring to Figure 2, which shows the model for designing constructivist learning environments as proposed by Jonassen (1997), this model consists of a problem, project, question, or case that learners attempt to solve or resolve with various support systems, such as related cases, information resources, cognitive tools, conversation or collaboration tools, and social or contextual support systems.

Heuristic evaluation, which is performed by usability experts, identifies potential usability problems by comparing the existing user interface to usability principles or guidelines. Results from heuristic evaluation are subsequently used to remedy obvious and critical usability problems (Gabbard et al., 1999).

Thus, to improve the usability of the system, heuristic evaluation had first been applied on the paper and pencil storyboard and then on the first system prototype.

4 Results and Discussions

4.1 System Design

In this constructivist training system, problems were described and represented in the three-dimensional virtual environments to resemble the various real world road scenarios. Learner was then allowed to manipulate the problem space by exploring and navigating through the virtual environment. This training system consisted of 3 different stages with increasing difficulty. The various situations that had been incorporated into each stage were summarized in Table 1.

Table 1: a summary of the various road situations that had been incorporated into each stage of the training system

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Situation</th>
<th>Appropriate Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Learner drives at 50km/hr along the right lane.</td>
<td>Learner should move to the left lane and give way to other vehicles to overtake.</td>
<td></td>
</tr>
<tr>
<td>2. Learner was tested whether he or she will overtake other vehicles on a double-line road.</td>
<td>Learner should keep following the front vehicle.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 2</th>
<th>Situation</th>
<th>Appropriate Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Learner is supposed to enter a main road by turning to the right, where there were many vehicles on the main road.</td>
<td>Learner should stop to give priority to those vehicles on the main road.</td>
<td></td>
</tr>
<tr>
<td>2. A car from the opposite lane would like to turn into a junction, which was in front and next to your car.</td>
<td>Learner has priority in this situation and should keep on moving.</td>
<td></td>
</tr>
<tr>
<td>3. Learner entered a roundabout and was required to turn into the third junction of the roundabout.</td>
<td>Learner should use the right lane of the roundabout.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 3</th>
<th>Situation</th>
<th>Appropriate Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Learner’s car was initially moving on the right lane and he or she had to turn into a junction, which was on the left.</td>
<td>Learner should move to the left lane before reaching the junction and then turn into it.</td>
<td></td>
</tr>
<tr>
<td>2. Learner was tested on his or her reaction when facing a zebra crossing.</td>
<td>Learner should give priority to pedestrians who want to cross at the zebra crossing.</td>
<td></td>
</tr>
<tr>
<td>3. Learner was supposed to turn into a junction to the right and there is a car coming from the opposite direction on the other lane.</td>
<td>Learner should stop and wait until the car from the opposite direction moved away from the junction.</td>
<td></td>
</tr>
<tr>
<td>4. Learner was tested on his or her reaction towards emergency scenario.</td>
<td>Learner should always alert when driving.</td>
<td></td>
</tr>
<tr>
<td>5. Learner’s car is moving towards a half-closed road due to a construction work.</td>
<td>Learner should stop his or her car and wait until the opposite lane is clear before moving onto that lane.</td>
<td></td>
</tr>
</tbody>
</table>
This complied with the scaffolding strategy that stresses the importance of gradually adjusting the difficulty of task. Besides, two-dimensional plan of the whole road scenario for each stage and two-dimensional plan showing the current location of the learner’s car were used to serve as cognitive tools to assist the learner in manipulating the problem.

Coaching strategy was also employed by providing frequent feedback to the learner’s action. These feedback may provide hints and helps, such as reminding learner of parts of the task he or she may overlook, directing learner to particular aspects of the tasks, or provide feedback that not only informs the learner about the effectiveness and accuracy of their performance but also analyses their actions and thinking.

A demonstration of the proper reaction for each situation was also incorporated if ‘Show Me’ button on the web page is clicked. This is in line with the modeling strategy, which according to Jonassen (1997) is the most commonly used instructional strategy in constructivist learning environments.

The two figures 3-6 below showed a few screenshots of the various road situations that have been incorporated into system after being improved based on the feedback obtained through the heuristic evaluation.

5 Conclusions

At the time this paper is written, an evaluation study to investigate the effectiveness of this training system is still in progress. This evaluation involves two groups of subjects where both groups need to attend a 6-hour practical lesson conducted by a qualified driving instructor. After the lesson, both groups will do their revision based on paper-based materials while only one of the groups will be given opportunity to use the training system. A written test, which is based on the theory test set by RTD will be given at the end of this session and the performance of these two groups will be compared to reveal the effect of this training system, if available.

6 References


Electronic Catalog for Online Product Customization

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ABSTRACT  
The status quo of electronic catalogs is reviewed in the context of online product customization. Technical challenges and fundamental issues underlying electronic catalogs are discussed. An approach to developing electronic catalogs is outlined based on the product family architecture.

1 Introduction  
As one of important pillars of online product customization, an electronic catalog serves as an interactive interface to online customers. Segev et al. (1995) describe the electronic catalog as a virtual gateway to a company through which customers obtain product information, place orders, and access customer support. The electronic catalog is used to support product presentation, search and classification, served as interfaces to other market services such as advertising, marketing, sales, distribution and channels, as well as an alternative retailing venue.

Electronic catalogs have their origin in hardcopy printouts of product information (i.e., paper-based catalogs). Though convenient for home shopping, traditional hardcopy catalogs are expensive to produce and difficult to maintain complete and up-to-date. Compared with their hardcopy counterparts, electronic catalogs can be potentially integrated with other functions and services, such as access to product information and direct communication between suppliers and customers. Electronic catalogs are online and permanently up-to-date, and enable integration of content (e.g., access to product information) and direct communication between suppliers and customers (Stanoevska-Slabeva and Schmid, 2000). The most important characteristic of electronic catalogs lies in that they can be potentially integrated with other functions of the company and of its business partners, such as synchronization with product databases, communication with suppliers’ ordering systems, and electronic payments of customer orders (Segev et al. 1995). Like other e-commerce applications, electronic catalogs are still in their infancy. An electronic catalog is not an electronic replica of a hardcopy catalog. Rather, it involves characteristics of both the technology and related business practices. A common problem of current online sales is that searching for products on the Internet is always a cumbersome process. A major reason that makes finding the right products difficult is due to unstructured product information and overloaded sites with no navigation support (Stanoevska-Slabeva and Schmid, 2000). Instead of direct translation of the usage and representation patterns of hardcopy catalogs to the Internet, a comprehensive approach is necessary to organize and deliver product information, which enables customized and structured retrieval of information as well as navigation support.

In addition, prevailing solutions to online marketing of products usually focus on the ordering process and skip the negotiation process by providing only a direct link to a shopping basket. Under the online sales paradigm, electronic catalogs must support online configuration of products, resulting in large data volumes related to combinations of subassemblies and parts as well as configuration constraints. This raises the pressure on the managing capability of electronic catalogs. Furthermore, customization leads to a wide variety of configured products, in which a wide range of combinations of product features and design parameters may yield millions of variants for a single product. The traditional approach to variant handling is to treat every variant as a separate product by specifying a unique Bill-of-Materials (BOM) for each variant. This works with a low number of variants but not when customers are granted a high degree of freedom for specifying products. Design and maintenance of such a large number of complex data structures with minimum data redundancy are difficult, if not impossible. Therefore, it is necessary to understand the implication of variety and to be able to deal with a large number of variants effectively.

2 Research Issues  
From the above observations, this Section identifies fundamental issues underlying electronic catalogs and accordingly discusses key techniques of constructing electronic catalogs for customization.

2.1 Generic Representation of Variety  
To understand variety and its impact on product differentiation, Jiao and Tseng (1999a) introduce a generic variety structure. As illustrated in Figure 1, there are three elements: Product structure, Variety parameters, and...
Configuration constraints. As far as variant handling is concerned, the rationale for the generic variety structure lies in the recognition of the origin and propagation of variety. Three levels of variation can be indicated, i.e., at the structure, variety parameter and instance levels. Different variation levels have different variety implications. Accordingly, a generic representation can be introduced to represent variety with minimum data redundancy.

2.2 Product Family Architecture

Instead of a direct translation from hardcopy catalogs, good electronic catalogs should be built upon a thorough understanding of the coherence of product information. This research extends our previous work on the product family architecture (PFA) for mass customization (Tseng and Jiao, 1996). PFA is the conceptual structure and overall logical organization of generating a family of products, which provide a generic umbrella to capture and utilize commonality, within which each new product instantiated and extends so as to anchor future designs to a common product line structure. The rationale of such a PFA lies in not only unburdening the knowledge base from keeping variant forms of the same solution, but also with modeling the design process of a class of products that can widely variegate designs based on individual customization requirements within a coherent framework.

2.3 Product Configuration Model

To deal with variety resulting from customization, online sales can employ a strategy of product configuration by managing a large number of variants as a PFA. The utilization of PFA requires a systematic sales-delivery process and modeling of the configuration process. Instead of explicitly defining a set of product variants in a product family, PFA implies a configuration model that contains all information on the possibilities of adapting the product to customer needs. The configuration model involves two stages: preparation and application (Figure 2).

The task of the preparation stage is the construction of PFA, which represents product knowledge needed in the sales-delivery process. It defines the generic product model and classification (assortment) of products and component parts by means of modules, variety parameters, and constraints. During the application stage, PFA is applied to product configuration. It creates a specific product instance or variant based on the generic model. This configuration solution can be represented as a product specification, a sales order, or a part list or a BOM. In this sense, PFA-based product configuration becomes the derivation of product variants through instantiating the generic product structure according to customer-specified variety parameters.

2.4 Rapid RFQ Processing

Mass customization involves a large variety of configured products. It is difficult, if not impossible, for sales to process RFQs with the traditional practice, which often treats every RFQ as being unique and handled individually. In addition, online sales requires rapid and real-time response to RFQs. More specifically, it is demanding for rapid estimation of product costs and delivery dates. Under the umbrella of PFA, we develop a rapid, pragmatic and accurate (RPA) approach to cost and lead-time estimation (Jiao and Tseng, 1999b). The approach excels in unifying the estimation of both cost and lead-time. The idea is based on the technique of standard time estimation.

Instead of reliance on detailed design information and manufacturing knowledge, the RPA approach aims at a rapid estimation without developing detailed process plans. Considering that a large majority of products follow a finite set of process routings, the RPA approach first extracts these standard routings generic to all the products according to historical production documents. Every standard routing is associated with a set of design characteristics that can be employed to determine the possible standard routings applied to manufacturing a given product. These characteristics are referred to as Cost-related Design Features (CDFs) and are treated as indexes to infer a “dummy process plan” for rapid cost and time estimation. Usually CDFs can be determined from a schematic in an early stage of design, such as the case of configuration design.
2.5 Early Supplier Involvement

Online mass customization implies an advantage over traditional supply chain intermediaries, that is, the direct interaction between customers and suppliers for every single transaction, which involves coordination about the customer-specific product design. The costs rising from customization consist largely of information costs resulting from the transfer of individual configurations to manufacturing, the increased complexity in production planning and control, the coordination of external suppliers involved in individual assembly, and individual distributions of customer-specific products. Electronic linkages enable companies to re-engineer supply chain relationships fundamentally in reducing transaction costs through electronic handling of orders, invoices, and payments. These will facilitate reduced inventory requirements and vendor managed inventory programs. In particular, online product configuration results in an increasing number of supplier-customer relationships and an increasing use of supplier parts. Design-stage sourcing, if accomplished properly, is particularly effective at the downstream assembly-to-order stage of order fulfillment. Therefore, the involvement of suppliers in online product configuration becomes an important issue for web-based sales support. Furthermore, suppliers should be involved earlier than they must be actually involved. During online configuration, decisions regarding supplier parts, such as make or buy decisions, bid preparation, and supplier selection, must be determined while real-time interaction with customers, marketing personnel, and designers. Traditionally, however, suppliers are often involved offline after design is over.

2.6 Workflow Management

With online mass customization, product development is collaborative, involving multi-disciplinary functions and heterogeneous tools. Teamwork is essential through seamless tool integration and better coordination of human activities. Workflow management is important in collaborative product development. To prevent inconsistency and reduce redundant activities, engineers must collaborate effectively and project activities must be well coordinated. However, the navigating flow of present Web browsers, by going backwards or forwards or jumping to specific web pages, does not conform to the flow of the work involved in the design project. Therefore, it is important to develop a workflow navigator for capturing both the process (workflow) and the results of decision-making from Web-based design tools together with human users. Initially, intended or planned Web-based design tools are logically arranged into a project network according to their dependencies. This initial network will act as a guide for collaborative work, e.g. when a specific design tool is activated or terminated, whether several design tools can perform their activities simultaneously or sequentially, etc. Huang et al. (2000) present an agent-based approach.

3 Summary

Electronic catalogs imply such technical challenges as how to organize unstructured product information, how to provide navigation support to online product customization, how to deal with variety explosion, and how to facilitate electronic ordering. Accordingly, key research issues include product family architecture, configuration modeling and workflow management, generic variety representation, rapid RFQ and early supply involvement.

4 References

A Grammar Tool for Sentence Generation and Cross-Language Communication

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ABSTRACT
This paper describes a grammar tool that can be a literacy aid as well as a facilitator of cross-language communication at the national level (for multilingual countries) and at the global level. It enables a user to generate:

a) fairly complex sentences in a language that he is barely familiar with, and
b) equivalent sentences in a second language with which the user need not even be familiar with.

He can incrementally convey the intended ‘concept’ (underlying the sentence) to the machine in a non-sentential form. This is internally represented as a structure that is not language-specific. This structure can be converted (using appropriate grammar rules) into sentences of a language.

The tool can be used in two modes:
a) as an aid for sentence generation in real life or
b) as a training tool for gaining competence, either in the first language of the user or in a second language.

1 Introduction
Communication across language barriers is a common need for global communication as well as in the multilingual context of India. Literacy levels being low, individuals in developing countries generally have reasonable language competence (understanding language) but face difficulties with respect to language performance (constructing grammatically correct - and therefore unambiguous - sentences). In many instances, such persons need to generate text in languages that they do not know. The present paper describes an attempt to devise a flexible tool aimed at such situations and has the following objectives.

1) Enable a non-native speaker of English to generate sentences with fairly complex grammatical structures.
2) Permit a user to generate sentences in his own (source) language, as well as construct equivalent sentences in a second (target) language.
3) Function as a grammar training tool which can be used for practice in constructing and manipulating sentences: start with a basic, simple sentence, add phrases and clauses, convert it from active to passive voice, assertive to interrogative, etc. Such practice would be a valuable learning experience. Provide grammar training not in just one language but also in a second language in parallel.
4) Broadly speaking, the design is based on concepts of Recursive Transition Network and more closely, Augmented Transition Network formalisms for grammars of Natural Languages (Terry Winograd). (The method of implementation, however, is significantly different from the one suggested in the cited reference.) It also incorporates some aspects of transformational grammars.
5) It provides for several of the more commonly used constructs in English (P.C. Wren & H. Martin) and Hindi (Kamta Prasad Guru). However, the implementation does not impose any limitations on the types of sentences that can be potentially generated using the method.

2 Broad Features
To use the tool, the user merely selects the basic key words (subject, verb and object) that his sentence has to contain. It allows him to select the tense of the verb, or the voice (active/passive) of the sentence. It permits him to expand the sentence by inserting modifiers such as adjectives, adverbs, phrases or clauses. Realizing these changes may require fairly complex modifications to the structure of the sentence. How ever, the user is not burdened with unnecessary detail regarding how this is done.

3 Overall Approach
3.1 General remarks
It is due to limitations of the medium of communication (speech or written text), that the human is constrained to express his concepts, which are richly structured, in the form of linear strings of words. Grammar can be visualized as a means of converting a structured concept into a sentence and back. (Humans, by virtue of their linguistic ability - knowledge of grammar - do this effortlessly and without awareness, when they speak or write and listen or read.). The sentence generation tool described here permits the user to overcome his grammar handicap by providing him a means of non-sentential, step by step communication of his concept to the system. It then takes on the task of converting this into sentential form.
3.2 Generation of simple sentences

A user, to communicate a concept, starts with the words for a basic structure, which we may call the ‘root’ frame.

Each of these words has attributes associated with it (such as number, gender and tense) (see Figure 1). Some attributes are fixed (e.g. case of a noun in the object position). Others are multi-valued. While the values of some of these can be changed independently, some are dependent variables. These dependencies themselves are language specific. In English, for instance, the verb ‘agrees’ with the subject in number and person. In Hindi, this agreement extends even to gender. The user can change the values of any of the independent attributes, the values of all the attributes that depend on it change automatically, like cells containing equations in an Excel sheet. For instance, if he changes the number attribute of the subject from singular to plural, ‘boy’ changes to ‘boys’ and the verb ‘plays’ changes to ‘play’. In the grammar trainer mode, the user is expected to know the names and values of attributes and can change them via drop box options. In the sentence generator application, the user does not have this burden; all sentence variants are displayed and the user merely chooses the desired one.

Changing to passive voice or interrogative form is straightforward: apply the appropriate transformational rules for word order and attribute values.

3.3 Adding to the Structure: Words, phrases and clauses

The system permits the user to insert modifiers (words, phrases and clauses) to any noun or verb; the corresponding root frame appears on pressing an appropriate button near the word for which the modifier is desired. The concerned words are either entered or chosen from a drop box. If the words boy - wear hat - are entered as a modifier to the subject boy, it is first converted into an appropriate sentence (boy was wearing cap) and then converted into a clause, giving the final sentence:

*Boy who was wearing cap plays football*

Word and phrase modifiers can be inserted for any of these words, e.g. to make the sentence

*Boy who was wearing green cap plays football in school.*

ladka jo hari topi pahan raha tha, school me football khelta hai

3.4 Conversion into another language

The strategy used is to dynamically construct the syntactic structure of the sentence through user interaction and then to derive the sentence from that. This structure, not being language specific, can easily be converted into a sentence in any other language (for which grammar rules exist within the system).

This has been demonstrated for English and Hindi and works very well despite the significant differences between the two languages, with respect to both word order and attribute dependency rules.

3.5 Current status

The sentence generator tool has been implemented in two versions:

(a) A grammar trainer version for language learners.

(b) A direct use version for users with minimal language competence.

Both versions have different user interfaces, but essentially the same internal structure.

The current status of the system is indicated in Table 1

Table 1: Current extent of implementation in English and Hindi

<table>
<thead>
<tr>
<th>Sentence types implemented</th>
<th>Present</th>
<th>Past</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice</td>
<td>S</td>
<td>N</td>
<td>I</td>
</tr>
<tr>
<td>Active Indefinite</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Active Continuous</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Active Perfect</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Active Per-Cont</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Passive Indefinite</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Passive Continuous</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Passive Perfect</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

S: Simple N: Negative I: Interrogative

E: English B: English & Hindi

4 Discussion and Conclusions

Given the limited literacy and increasing importance of cross language communication in today’s global village, writing support tools would be of great help. This paper describes such a tool.
The aim is not to implement an exhaustive system that takes care of all the idiosyncrasies of the host and target languages, but an inexpensive, practical, simple tool that gives good value for money. Also, no claim is made with respect to any radically novel concept or approach to sentence generation.

This is essentially a modest system that generates expansions, transformations and combinations of simple ‘kernel’ sentences. It incorporates the present NLP technology to provide a writing support and grammar training tool, which is usable in a host language (in which the user has competence but not performance) as well as one or more target languages (where he has neither, to any significant degree).

It is a grammar tool and does not address semantics related problems in cross-language sentence generation. For instance, it cannot handle word sense disambiguation or translating sentences like ‘no one said yes’ into a second language. This however does not detract from its utility as a transactional sentence generator, grammar trainer and ‘translator’ for day to day real world use and practice. Also, there does not seem to be any conceptual difficulty in taking care of some aspects of semantics by associating even semantic tags with the words.

It can be seen that the tool permits the construction of sentences of significant complexity and covering many of the constructs of grammar. The simplicity of approach and implementation make it easy to implement such systems in inexpensive hand held devices for use by students or during travel.

5 References


Peter W. Culicover (1976), Syntax, Academic Press.


Kamta Prasad Guru, Hindi Vyakaran, Nagari Pracharini Sabha, Varanasi, pp 22 - 50