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WEB-SUPPORTED PRODUCT CONCEPT DEVELOPMENT

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Abstract

Web-based activities are becoming more and more common. Telephoning free of charge over the Internet (IP – Internet Protocol) has become much used within a short period of time. In a similar way videoconferences can be held in an inexpensive way over the Internet. Equally, radio and TV broadcasting over Internet will become more and more common.

It should be possible to use inexpensive web-based support both during the creation of a new product concept and during the following product development. However, two types of dilemma exist: the mental problem and technological problems. In tests in late 2004 and early 2005 we have found that mentally related problems seem to be the most difficult ones to overcome as most people found it of outmost importance to meet in person to be creative. We have also experienced that the technology still is not good enough for combined IP-based meetings. However, the latter is a technology problem that seems easier to be solved.

We have experienced that using web-based support can be beneficial in many ways. We believe that in the future the web will be used even in the creative process to bring forward product concepts. As it offers global cooperation without expensive and time consuming travelling, it is of great interest to innovative enterprises.

Keywords: CPD, concept development, Internet, IP technology, product development

1. Background

The term "Collaborative Product Development" (CPD) emerged during the 1990s (e.g. [1]) to describe a concept of "work around the clock", virtually speaking following the sun around the globe. Thus, when a development team had finished its work for the day, it sent its work further to a second team being 8 hours behind the first team. When that team had finished its work after 8 hours, it sent in turn its work further to a third team being 8 hours behind the second team. When that team had finished its work for the day, it should send the work further to the first team. Running a product development project in this way was thought of to be very time-efficient – theoretically. However, limited tests (e.g. [2]) showed great problems getting acceptable results out of CPD, even for simple development projects.

Despite the disappointing results, globally acting enterprises are determined to find (even unusual) ways to overcome these problems. General Motors e.g. has formed a global network of universities in what is called the PACE project (www.pacepartners.org) of which one important aim is to encourage CPD projects.

An obvious benefit from distributing workgroups around the world is the increased sharing possibility of software licenses. Thus, when Ford acquired Volvo Car, the total number of software licenses didn't increase since the USA, Europe and Japan are suitably separated in time [3].

Within standard CPD descriptions, product development is done in a sequential way with information attached to each package of work (mostly CAD files). The next team can use this information as input and can continue the work. CPD is also regarded as a possibility to shorten the Engineering design process. As Engineering design is partly artistic and heuristic, it is, however, difficult to transfer the so-far-existing or still vague ideas in a written and consistent form so that the next team can continue the work without ambiguity. One approach to overcome these difficulties and to improve the outcome of CPD is to use IP communication by phone and video, at least for a certain period of time, where both teams have to overlap.

At the 5th workshop on Integrated Product Development (IPD) held in Magdeburg in September 2004, it was decided to investigate whether IPD students from different universities in Europe could create product concepts by purely using the Internet (no personal meetings) under the leadership of a project leader, who was supposed to participate from still another place in Europe. Initially it was decided that Halmstad University in Sweden and Magdeburg University in Germany should take part in the project after which other universities should join when experiences had been gained. Halmstad University was to give the problem to solve. This paper tells about our findings of this investigation so far.

Communication over the Internet is a much-researched subject. There is e.g. the problem of designing the software for voice and video transfer [4], [5], and to interface with the system [6]. Experimenters have tried different arrangement of components of wearable computers in order to create so-called tele-presence [7]. Tele learning is an important subject as there is a need for distributed educational opportunities [8]. There is videoconferencing [9] and a wish for mobility [10], which puts out demand for positioning [11], and to create ad hoc networks [12]. There is also a wish for immersion and enrichment of experience with multimedia [13], [14].

It seems that so-called e-meetings and videoconferences so far only have used video to create a sense of presence. For good communication these systems have to rely on high quality audio channels [5], [15]. Design activities, however, are different in nature from learning or sharing information. Because being of highly interactive nature, they are also more demanding activities than e.g. tele-participation in sports events or immersing oneself in multimedia presentations.

2. Purpose

Our focus of interest has been to investigate to what extent low cost web collaboration and low cost video, voice and file transfer solutions using the Internet could efficiently enable creative collaborative product development when team members are geographically dispersed.

3. Approach and methods

This paper describes a CPD project where the researchers have an insider as well as an outsider perspective on the project [15].

The idea was to set up a concept development team of three students from Halmstad University and three students from Magdeburg University, under the leadership of a project leader, who was a PhD student in Magdeburg. The teams should develop a product concept on a problem that had been solved earlier by student groups in a regular product development course at Halmstad University. No personal meetings should take place, as all communication

should happen over the Internet. The teams should have three weeks from project start to the presentation of their results. The process was to be observed by the authors.

The problem to be solved was that packages of wash powder are difficult to handle for people with reduced body functions due to impairment like e.g. a stroke or rheumatoid arthritis. A new solution was needed that should

1. be easy to open with only one hand and
2. not break or open by itself if it falls from a table on a hard floor.

This problem has already been investigated at the University of Halmstad using traditional methods. In a similar way, the student teams in the pilot test should develop a product concept together, "meeting" each other only over the web. For the project work, a web portal should be used, which in turn could also be entered over a home page set up for the test project to offer to other participating universities participating at the IPD workshop to follow the project.

3.1.Mental problems

Having set up the home page and connected the web portal to it, the next step was the setting up of the two student teams in Germany and Sweden. A preparation meeting was held in January 2005 in Magdeburg.

In the discussions, the PhD student, who was expected to be the project leader, showed to be very sceptical about the whole idea as he was convinced that it is not possible to develop new concepts if the team members do not meet in person “to sit together”[1]. Additionally, because of the actual winter semester in Germany, the possible student members were tied up in lectures and other work[2]. The same situation happened when Delft Technical University in the Netherlands was asked to recruit the students. Therefore, the project could not be conducted in the planned way.

Instead, one of the authors, Lars Holmdahl, was asked to be project leader. Having installed the project leader and in order to minimise technical problems occurring with the new IP technology, the authors agreed that the first tests should be conducted in Sweden after which it should be easier to conduct the additional tests that would include students from Sweden and other countries.

3.2.Technology issues

By the end of 2004, the number of worldwide broadband subscribers exceeded 150 millions, with a 50% annual increase. There are 14 – 25 broadband lines per 100 inhabitants in the top ten countries (www.point-topic.com). Therefore IP (Internet Protocol) rapidly offers an increasing possibility to communicate, for example by video, voice and file transfer, and to broadcast over the Internet. This is a cost-effective way to communicate, which in turn means that small companies, clusters of small enterprises, and virtual companies can afford to use distance communication en masse.

As an example, IP telephone market leader Skype (www.skype.com) has got more than 29 millions of registered users since its start in 2003 (actually, the number of users increases by 0,15 million per day). At any single time there are more than 2 million users on-line. This can, in effect, lead to the creation of the first true worldwide telephone book.

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[1] His standpoint was "taking a beer and being together is important for the creative process".

[2] The different teaching times throughout Europe have caused quite a lot of problems when establishing international IPD student project teams.

There are three main types of solutions available:

- **Web collaboration** - The simultaneous viewing and modification of a shared document or computer application.
- **Videoconferencing** - The use of digital video transmission systems to communicate between sites using video and voice. Digital video transmission systems typically consist of camera, codec[3], network access equipment, video and audio system.
- **Webconferencing** - A term that describes the industry forming around the creation of virtual events. This industry is a convergence of technology developed to provide cost-effective interactive communication channels for individuals and businesses.

By searching the Internet we found 152 vendors providing web collaboration (40), video-conferencing (54) and webconferencing solutions (104).

To test IP-based cost effective videoconferences, webcams were bought in January 2005. One *iVisit Plus* and two free *iVisit Lite* licenses were acquired from iVisit (www.ivisit.com). The annual cost for the *iVisit Plus* license is $40, that is about 1% of the cost for a high-end solution. For each license there is one channel each for video, voice, and file transfer.

Mid January 2005 the authors Ottosson and Holmdahl and a third person started a conference. Holmdahl was sitting in his home in Göteborg while the two other test persons were sitting in an office in central Göteborg about 4 meters from each other not in a Face-to-Face (F2F) position.

Video, chat, and file transfer were working well, but we experienced problems with the voice channel (apparently the software did not allocate enough bandwidth for this channel). By switching to Skype for voice communication, we also had flawless voice transfer (20–20,000 Hz as compared to 300-3,000 Hz for normal telephone communication) and could start testing how to use cameras and software for dialogues and brainstorming.

3.3.Functional set up

Often when a group comes together for discussions or creative work (talking, making quick sketches and quick calculations), members sit close to each other around a table face to face, where items to be discussed can be viewed. Almost always a whiteboard hangs on the wall at the short end of the table and often there are provisions for hanging drawings, pictures, and diagrams on the walls. In a video conference/web collaboration setting we wanted to recreate – as far as possible – this familiar way of working. This was realised by a set-up, as shown in figure 1, in which an (although weak) illusion is created that the two groups are sitting at each end of a table. The projected picture on the wall in figure 1 can be the other group, for instance for introductory presentations, or a special object to be viewed by the groups. It can also be a digital whiteboard where all participants can draw and write on the same surface using the mouse or special pen and digitiser tablet.

The difference compared to "classical" videoconferencing is the multitude of communication channels and the available collaborative software. Only the number of computers and broadband connections limits the number of channels for video, voice, and file transfer.

The operator of the computer connected to the video projector controls the content of the projection. It is fully possible for each participant to have his own computer, webcam, etc,

[3] Codec is the short form for compressor/decompressor, i.e. any technology for compressing and decompressing data. Codecs can be implemented in software, in hardware, or in a combination of both. Some popular codecs for computer video include MPEG, Indeo, and Cinepak.

and freely to choose what windows to be open, what channels to monitor, with whom to chat, to talk to, etc.

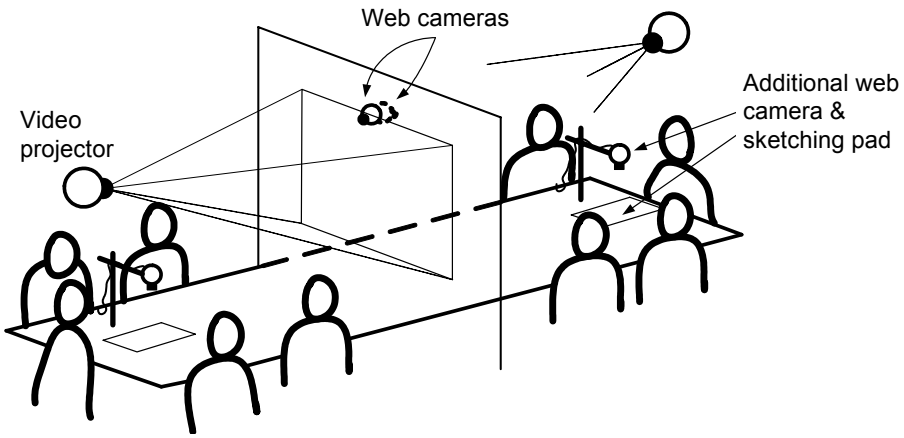

Figure 1: Even though the two groups are sitting thousands of kilometres apart (symbolised by the wall in the middle of the table) the web cameras and the projected pictures, by the imaginary window between the groups, create a feeling of collaboration

The principle set-up of the solution that we found to be useful for dialogues and brainstorming is shown in figure 2. Depending on the set-up of the router/firewall, several licences can be operated on the same IP number. This means that additional cameras can be added as is shown for project group 2 in figure 2.

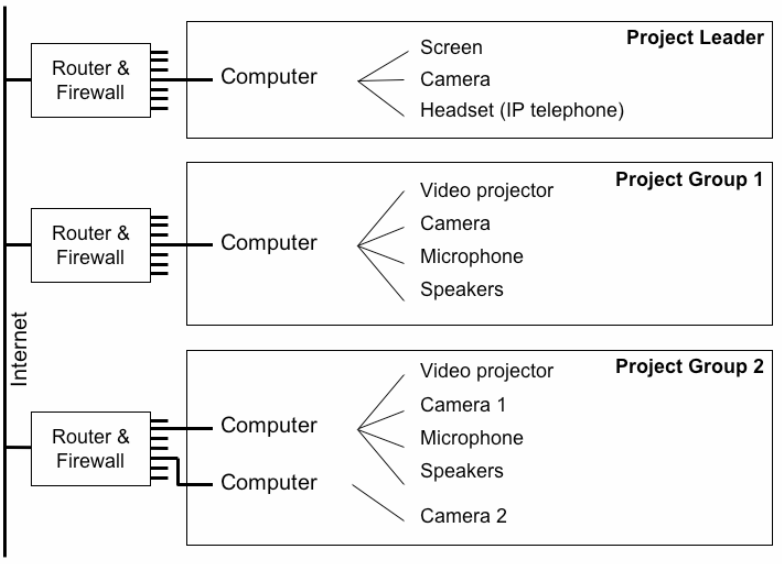

Figure 2: A functional set up when two groups of three people are sitting together and the project leader is sitting at a third place. In this example project group 2 has an additional web camera attached to a second computer as shown in figure 3

It is possible to use only one web camera and move the camera, showing a person or the whole group and a piece of paper on which a sketch is made. However, it is more convenient to have additional web cameras, each dedicated for a certain purpose. We quickly found that it is most convenient to have web cameras positioned so as to capture paper and pencil sketches

as they are made, exactly as when sitting together in a real life situation. This retains the important coupling between brain, hand, and visual impression during creative concept development [16]. For this purpose there are many simple ways to arrange an additional web camera, see figure 3.

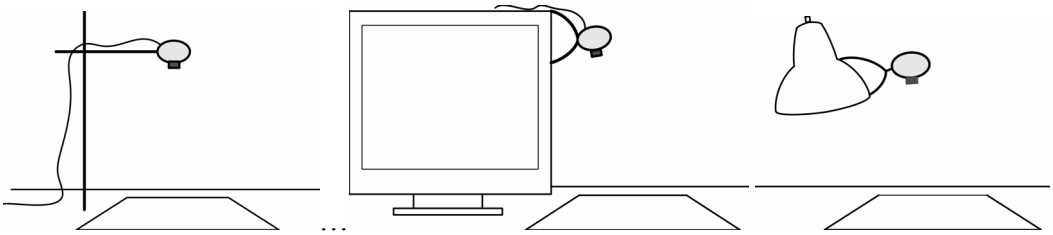

Figure 3: Simple ways for arranging a web camera, so as to capture paper and pencil sketches

In product development there are many instances when visual information is important. There are, to name a few, the check of first shot specimens, reverse engineering of designs of a competitor, and the inspection of tested parts. In all these cases a high quality video image is very important if we intend to substitute regular meetings with videoconferences.

Figure 4 shows an example of the screen set-up used during an actual videoconference session. In this example we see two of the participants, some video conference "house holding" windows and the share window put on top of a Microsoft Paint window containing a drawing of a belt tensioner which is commented upon. Thereby the drawing was made visible to the other party.

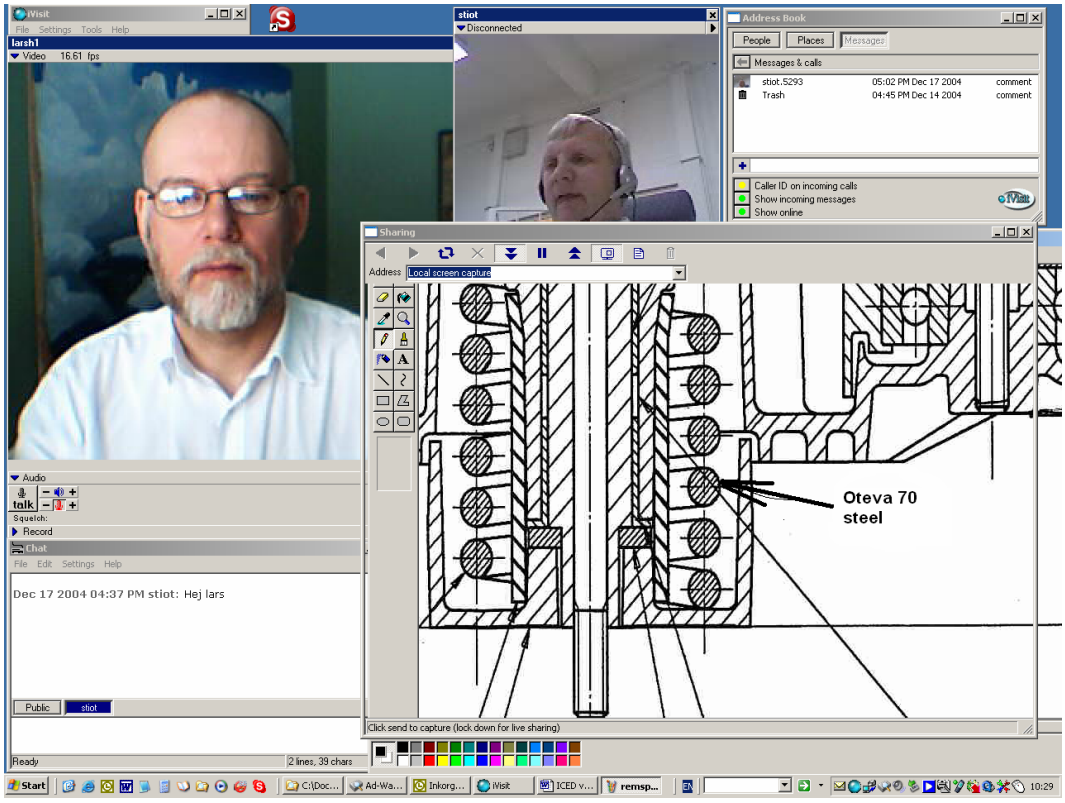

Figure 4: An example of a computer screen used during the test videoconference session

The total investment for the arrangement for the set-up shown in figure 1 (except for computers, video projectors and Internet connection) was less than 500 Euros.

4. Results

The whole test session showed that it is possible to be creative, even under the given circumstances. Not surprisingly the quality of the video image is important as concept development in new product development relies heavily on making sketches and jotting down ideas using symbols [17]. There is also a need for sharing images of prototypes and models. In the later case a high video frame rate is important for the correct representation of movements.

In the dialogues we found solutions of how to arrange cameras etc. to make dialogues and brainstorming on distance using IP technology.

The planning and conducting of the test have clearly shown that IP technology can be used for dialogues and brainstorming sessions when people are sitting distributed. The purpose to find cheap ways for small companies using the web was also satisfied in the test.

5. Discussion

Many researchers have experienced as a difficult task the implementation of new tools and methods on how to perform product development and its management. The explanations of why enterprises take a distant position towards new research findings have been discussed among researchers as well as among practitioners [18] and the arguments have varied with research approach, size of company, organisation etc. A well-known argument heard from companies is that the outside research perspective provides the researchers with “outside information” meaning information known and obvious to anyone. In order to get hold of the “unspoken and silent" knowledge often needed to be able to understand a task/problem in a proper way, and to create useful and valuable solutions to the practitioner, a totally different research approach is needed [19].

Product development projects, especially new product development projects (often with tight time schedules due to short life cycles and financial reasons) demand effective global communication and rather fast decision making. Therefore it should be of industrial interest, especially for international companies with many subsidiaries and partners abroad as well as for virtual companies, to introduce new tools and methods based on Information and Communication Technology (ICT) for supporting the creative part of the development process. As many employees today have access to own and other personal computers and laptops connected to web servers (see figure 5) and as web cameras are inexpensive, there are possibilities to have short daily videoconferences, virtually at no cost and regardless of where one happens to be [5]. So far, the research has provided us with another picture [1] based on a situation when the new web based possibilities did not exist.

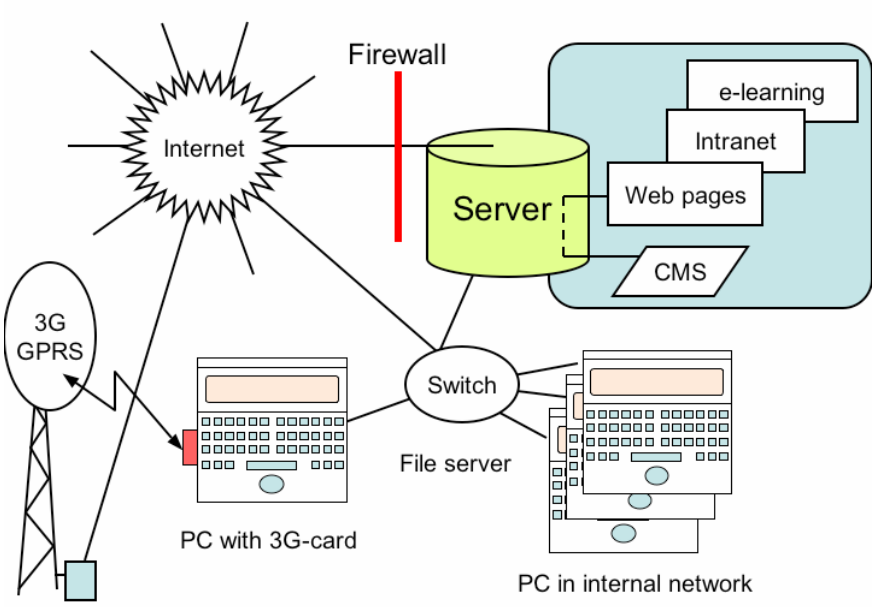

Figure 5: The web system offers a possibility to work from any computer sharing information [8]

Young people at European universities are familiar with computers, the use of web-based services, and communication tools. However, due to various difficulties, it was only possible to set up a student group in Sweden, but not in Germany. For instance, the attitude of the potential German project leader towards conducting an innovative product concept development without personal meetings was negative. This "mental dilemma" was an example of how unfamiliar ways of handling things make people feel insecure and doubtful.

In the limited test we found that it was possible to make brain storming. Solving the technical problems we got in a way quite similar to what our experiences are when people are actually together. Our test did not grasp cultural and language problems that theoretically can be an additional problem to handle working "around the clock". Thus we think that the traditional rules of thumb on what is needed for a group to be creative (geographical collocation, sitting in an office, etc) must be re-judged. The fast development of the web technology has opened new possibilities, even when it comes to innovative product concept development and the work to finish the development of a new product.

The way of working that we have tested should offer new opportunities to make CPD more functional even though it means that people on different continents have to attend meetings over the web at off-time hours. It also offers possibilities to involve experts without time-consuming travel to bring them together. As often is the case when new ways of working are tested, few people initially want to take part if the learned behaviour is threatened. Only when an outer pressure is put on change, resistant people accept changes. With the globalisation that takes part in a rapid speed, methods as the tested will be needed in a near future. Hence, a new thrilling field for research therefore surely has opened not the least to bring in small companies on the scene.

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