Proceedings Conference on Architectural Research and Information Technology. Nordic Association for Architectural Research. Arkitektskolen i Aarhus April 27.-29, 2001. (pp. 103-112)

EXPERIENCES FROM USING INTERNET BASED COLLABORATION

Per Christiansson

Dept of Building Technology and Structural Engineering,
Aalborg University, Denmark
http://it.civil.auc.dk

ABSTRACT:
The paper summarises experiences from the last decade of using Information and Communication Technology (ICT) tools for collaboration over local networks and Internet. An overview is given over how the collaboration tools have developed and which functions they can support during Internet supported collaboration. The collaboration can take place at the same or different places and at the same or different times in more or less virtual environments. Experiences are gained from research and education and from collaboration with industry. Views are also presented on which direction we can expect future development of ICT based tools to support collaboration and knowledge sharing in a building process context.

KEYWORDS: virtual reality, collaborative work, ICT tools, design, virtual reality, intelligent buildings, knowledge transfer.

1 INTRODUCTION

Information and Communication Technology (ICT) has during the last decades been used to improve collaboration between persons located in the same or distributed locations. This is achieved through improvements of both *human computer interaction* (HCI) and *information handling* such as use of digital application models and lately meta information containers. In this paper we focus on the communication aspects. Let us first mention to typical (historical) cases where ICT support for collaboration and information mediation was used

- two or more persons using a telephones
- two or more persons using (displaying) the same information on computer screens

These principle cases can of course be combined on more complex levels such as using video communication and using application sharing. In the latter case we introduce a new concept namely remote manipulation of computer stored information. By introducing intelligence into the collaboration systems and advanced multimedia communication facilities like virtual reality (VR) and mixed reality (Billinghurst & Kato, 1999) we also start to create a new (virtual) collaboration room (virtual workspace) with properties unlike those we are familiar with.

Virtual Worlspace Definition: From (Christiansson et.al, 2001);
"The Virtual Workspace, VW, is actually the new design room designed to fit new and existing design routines. VW may well be a mixed reality environment. The VW will host all design partners from project start with different access and visibility (for persons and groups) in space and time to the project, and will promote building up shared values in projects. The VW thus acts as a communication space with project information support in adapted appearances. VW gives access to general and specific ICT-tools "

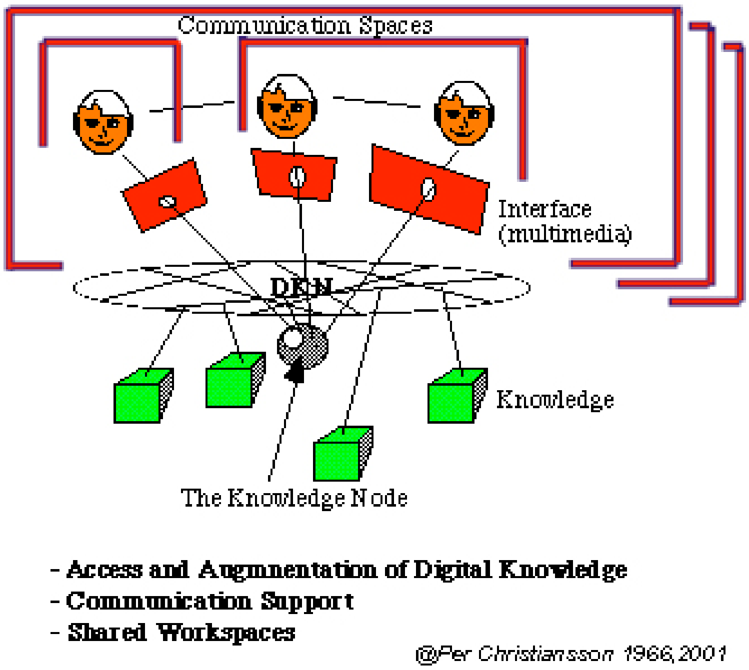

Figure 1 Information and communication tools (ICT) support communication between persons in defined spaces.

Due to introduction of ICT we must define some basic parameters to describe the collaboration in existing and not yet defined environments. See also figure 1 and figure 2.

- *Participants*; number of, type (persons, agents and avatars i.e. 'an incarnation in human form' according to Merriam Webster). See also (Christiansson et.al., 1996);
- *Collaboration subject*; design and knowledge transfer support such as analyses, synthesis, simulations, decisions, model annotations, reviews, planning, co-ordination, evaluation, purchase, learning;
- *Form of interaction*; e.g. presentation, design, brainstorm, negotiation, consultation, discussion, decisions, documentation, sketching;
- *Communication content* to support interaction; e.g. speech, sound, images, music, video, whisper, body language, 3D objects, control information;
- *Meeting spaces* and room definitions; physical, virtual, static, dynamic, mobile and combinations. (Intra personal workspaces, personal work spaces, team work spaces, linked spaces or one common space for all collaborators, spaces for personal and team annotations of models, etc.);
- *Time*; synchronous and asynchronous meetings, time stamped activities;
- *Collaboration artifacts*
  communication channels e.g. displays, glasses, haptic devices, positioning devices (Haptics is the science of applying touch (tactile) sensation and control to interaction with computer applications. http://whatis.techtarget.com/)
  control and access mechanisms (function and form of ICT tools for search, navigation, time browsing, annotation, information storing and access, space connection and overlap, x-ray and see through, model and application sharing and handling etc.),
  user *applications* and *information containers* (e.g. Cad, databases, data warehouses, simulation programs, planning programs, external resources).

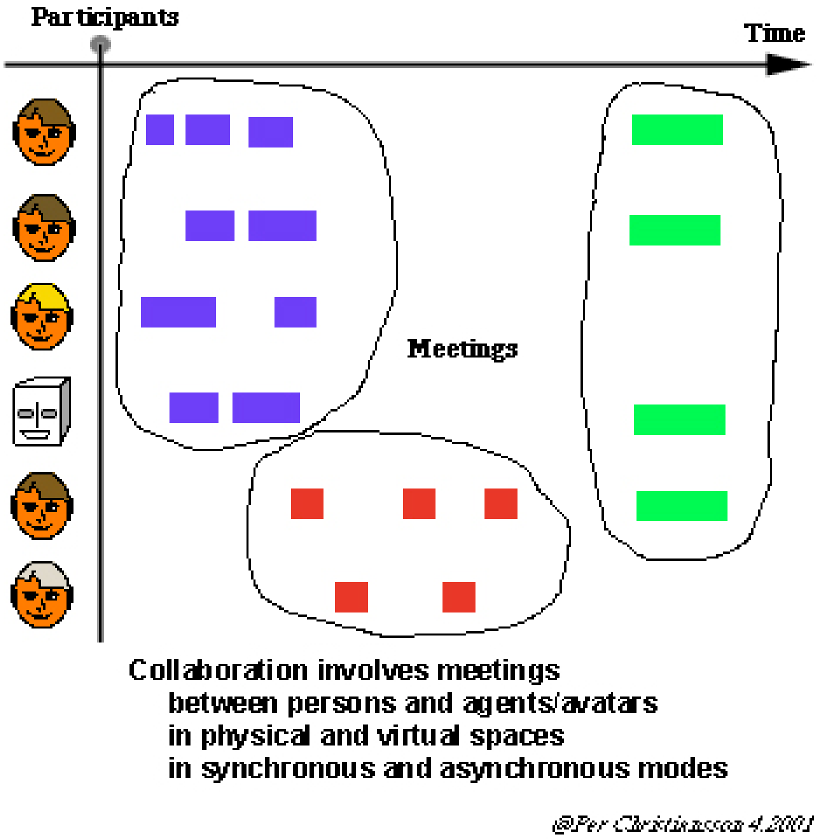

Figure 2 Purpose, outcome and possibly documentation should be defined for different type of meetings with respect to participants, time constraints and meeting environment.

Through ICT introduction we phase new challenges and possibilities for creative design of enhanced collaboration environments;

- How can we visualise *mobile personal room* for other meeting participants ?
- To what degree should we use *mixed reality* in collaboration?
- How can personal or project *agents* assist us in synchronous and asynchronous communication?
- What *new worlds* with until now unfamiliar properties can we create (e.g. real time space overlay, controlled communication spaces, responsive and intelligent artefacts)?
- What are the relations between *collaborators and their placement* in the mixed reality work space (e.g. possible optional placements, space connections, sketching in a common volume)?
- How can *contexts* and *collaboration tools* easily be changed causing shifts in operation modes with completely new functions (e.g. move my eyes to another place or person, anti gravity tools, many users handling the same tool in parallel, tools for personal or team views to work space, tools to hand over a complete environment/context)?
- How can *virtual products* be handled (e.g. hand over objects, see through products, life cycle studies, time property access, and simulations)?
- How can we define *control mechanisms* for opening and closing communication channels?
- What properties would we like to assign new types of (distributed) *information containers* and documents?

2 THE FIRST STEP

In December 1968 Douglas Engelbart demonstrated the first networked remote collaboration with video communication and remote control. See figure 3.

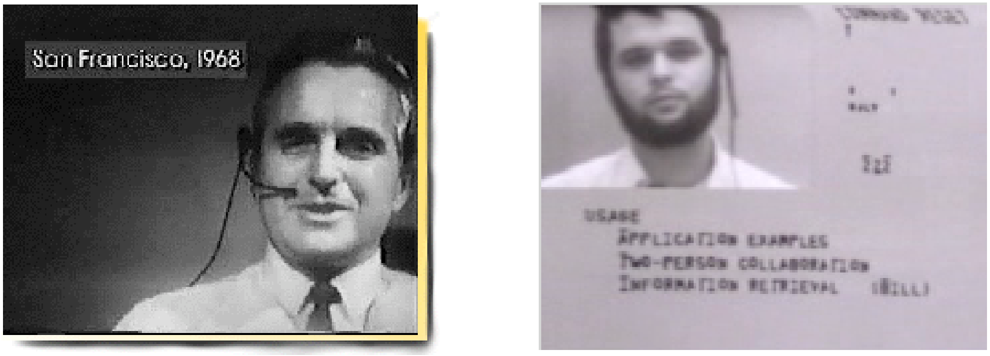

Figure 3 Doug Engelbart 1968 demonstrates distant collaboration over the net with document sharing and video communication. From http://vodreal.stanford.edu/engel/17engel200.ram. Vigraphical Sketch. Douglas C. Engelbart. Bootstrap Institute.

(from http://sloan.stanford.edu/MouseSite/1968Demo.html)
"On December 9, 1968, Douglas C. Engelbart and the group of 17 researchers working with him in the Augmentation Research Center at Stanford Research Institute in Menlo Park, CA, presented a 90-minute live public demonstration of the online system, NLS, they had been working on since 1962……….This was the public debut of the computer mouse. But the mouse was only one of many innovations demonstrated that day, including hypertext, object addressing and dynamic file linking, as well as shared-screen collaboration involving two persons at different sites communicating over a network with audio and video interface."

3 ICT COLLABORATION TOOLS

In research connections my research group started to use groupware for Information and Communication Technology (ICT) supported collaboration at the end of the 1980s in local area networks and later on the Internet. We started to use *email* 1986 (there were 2386 email servers at that time compared to millions now). Around 1990 we started to use *CuSeeMe* from Cornell University, Itacha USA, and could establish remote video and text chat communication over the Internet between many participants e.g. with colleagues at University of Virginia Charlottesville USA. The central server was a so-called reflector for multi-casting on a SUN workstation. The Mac computers we used were equipped with special video frame-grabber cards. White Pine Software 1993 released a whiteboard extension to CuSeeMe. See also figure 4.

About the same time 1990 we started to use application sharing (through remote screen control, WYSIWIS (What You See Is What I See) and file transfer with the *Timbuktu* program from Farallon, *Aspects* (Aspects, 1990) from Group Technologies for joint editing of drawings, word processor documents and bitmaps, *MacEuclid* from University of Colorado Boulder (Bernard Bernstein) for creating, editing and analysing reasoned arguments, see also (Modin et.al., 1994) and (Modin, 1995), *First Class* from Softarc (a so called BBS/Billboard system for structured email discussions). The programs used the AppleTalk network and later (around 1993) the Internet. 1994 KBS-Media Lab launched their web site to support easy information access over the Internet. See also http://it.civil.auc.dk. Figure 5 shows an example of industry research co-operation in ICT supported collaboration.

 

Figure 4 Left; Experimental set-up at KBS-Media Lab, Lund University, 1991, with video communication and screen sharing using Timbuktu from Farallon. Right; A hypermedia workstation developed 1988 at KBS-Media Lab, Lund University with video display of images and films stored on video disk integrated with the hypertext based program HyperCard from Apple computer. (Christiansson 1989) and (Christiansson, 1991).

Figure 5   In the COOCOM project (Cooperation and Communication in the Building Process), 1993, industry participants (SKANSKA, FFNS Architects, and LKF facility managers) performed local and distributed ICT supported collaboration (local joint document editing, remote screen sharing using ISDN connection with support group at SKANSKA, and structured discussions). Walk-throughs of the design object were also available using the Virtus Walk-through system. (Modin, 1995)

During European Academic Software Award (EASA) 1994 in Heidelberg a student group presented an application sharing software for the PC Windows platform. After that Microsoft launced the *NetMeeting* system enabling net based application sharing, chat, and a common whiteboard as well as one-to-one video communication between workstations. Figure 6 shows daily and natural use of collaborative systems

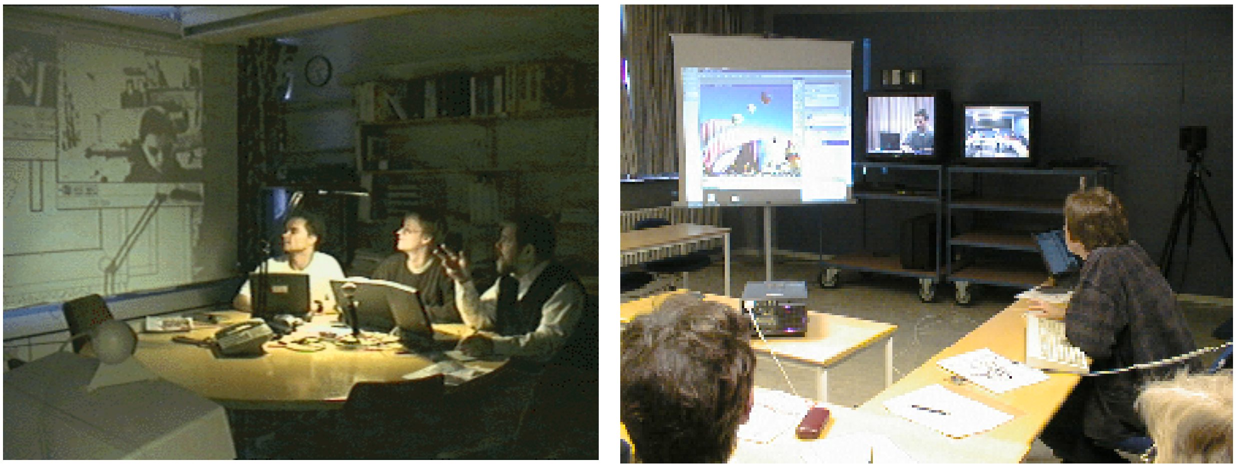

Figure 6 Left; Distributed collaborative work in regular use at the KBS-media Lab, Lund University, 1995. Right; Remote lecture and application sharing between Aalborg and Lund Universities 1999 in teacher/secretary course (parallel ISDN based video communication and Internet based application sharing) *http://it.civil.auc.dk/it/education/secretary_teacher_1/lecture_5.html*

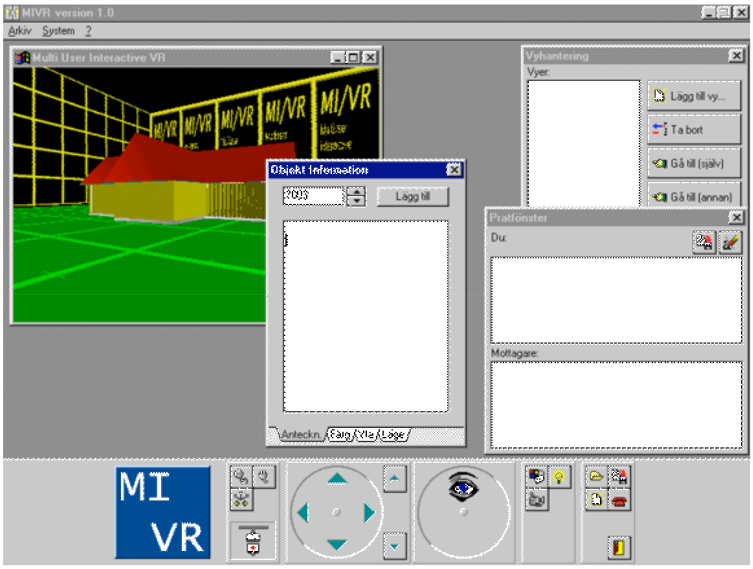

Figure 7 Low cost virtual reality environment for synchronous and asynchronous work on building models. From (Lindemann ,1996).

The latest 5 years it has been possible to install free NEWS group type server software for structured discussions (e.g. WWWBoard, http://worldwidemart.com/scripts/) and document handling (e.g. Basic Support for Cooperative Work - BSCW, http://bscw.gmd.de/about.html) and today we find a range of server and peer-to-peer based groupware. Recently we have tried out the peer-to-peer beta software release of the interesting Groove system (created by the Lotus Notes pioneer Ray Ozzie), http://www.groove.net. The promising system is used to create secure project spaces on the Internet with information containers and simple planning and communication resources.

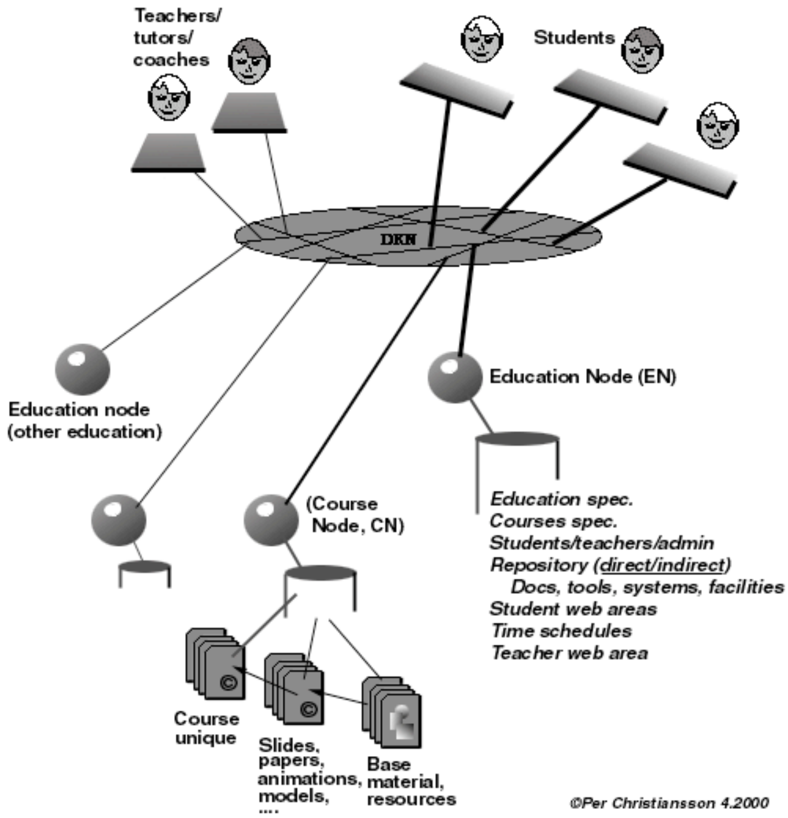

Figure 8. There is a storage, responsibility, update, and efficiency conflict between shared course information such as administrative data ('who-is-on', 'who accessed what', links between course material) accessed through a course node (EN) and teachers locally produced learning material (CN). From (Christiansson, 2000a).

The interest for creating Virtual Reality (VR) environments increased after the introduction of the CAVE (a recursive acronym for CAVE Automatic Virtual Environment) virtual reality system in 1992 at the University of Illinois at Chicago (see also http://www.evl.uic.edu/anstey/THING/aw_article.html). In order to provide a low cost VR environment a peer-to peer PC windows based system was developed at KBS-media Lab at Lund University (Lindemann, 1996). See figure 7. The system enabled synchronous or asynchronous manipulation of and navigation in 3D building models. Avatars in the model view represented the participants, guided tours could be stored and objects manipulated and annotated (yellow stickers on objects) for information to visitors. The system showed that low cost high quality 3D collaboration system could be implemented and useful.

The underlying models of our building applications support collaboration in the distributed environments. We will in the future see much more focus on how to structure and physically and logically handle distributed information containers and application models. Common use of geometric 3D kernels such as Parasolid (http://www.ugs.com/products/parasolid//) and Acis (http://www.spatial.com/) ease geometric model integration. See also Cadalyst http://www.cadonline.com/features/0500kernel/index.htm.

Internet distributed databases and meta-data handling are though still in its infancy. Figure 8 indicates some of the problems when you build distributed information containers and communication support in learning environments. (Christiansson, 2000a).

From (Billinghurst & Kato, 1999)
"Current CSCW interfaces often introduce seams and discontinuities into the collaborative workspace". They mention *Functional Seams*: Discontinuities between different functional workspaces, forcing the user to change modes of operation, and *Cognitive Seams*: Discontinuities between existing and new work practices, forcing the user to learn new ways of working.

Groupware shall though be regarded as a *complement* to personal meetings in physical rooms.

4 EXPERIENCES FROM USING COLLABORATION TOOLS

We have during 10 years collected experiences on Computer Supported Collaborative Work (CSCW) in joint industry research and distributed learning. Some of the findings are, see also (Modin, 1995) and (Christiansson, 2000a),

- Important to plan the *collaborative work on documents* with regard to choice of *atomic level* at different work stages to avoid re-examining whole documents/chapters;
- Establish *versioning routines* for documents and program source codes;
- Establish routines for long term back-up and *document maintenance* (both physical and logical);
- If you base your work on using digital information *containers they must be easily accessible* both physically (near to Internet/intranet access points via wireless connection or fixed points) and logically (network domain access);
- Permanent *wall display* units in meeting and lecture rooms are of great advantage;
- Be aware that most people are *not familiar* with paperless way of working;
- Provide easy *instructions for use of communication tools* (remote and local control of cameras in video conferencing, setting up of desk-top groupware);
- Distant *video/sound connection* over Internet, e.g. over a CuSeeMe reflector is only adequate using very low image update;
- Very good *social connections* may be achieved through remote connections though wishes for better eye and body language contact is reported;
- *Shared applications* work very well both for collaborative production work and creative sketching;
- Possibilities to continuously *document the decision/collaboration process* should be better;
- *Creative work* often requires physical round table contact.

5 THE FUTURE

More and more advanced and also affordable virtual environments are designed and tried out now. In addition the surrounding physical rooms get more intelligent and responsive. We have for almost 20 years been talking about *intelligent buildings* (IBI) and Smart Houses. Today they are becoming feasible reality due to standardized intelligent networking, sensors and actuators solutions. The IBI will provide service to building users, operation and maintenance and especially in the collaboration context support virtual rooms with dynamic properties, context sensitivity and high adaptability, built in memories, communication and integrity support, and new innovative types of services. This paper will not dive further into intelligent and responsive buildings. For further reading see also (Christiansson, 2000b).

Concerning *immersive environments.* From the National Tele-Immersion Initiative http://www.advanced.org/tele-immersion/introduction.html.

"Tele-Immersion (National Tele-immersion Initiative - NTII) will enable users at geographically distributed sites to collaborate in real time in a shared, simulated environment as if they were in the same physical room. It is the ultimate synthesis of networking and media technologies to enhance collaborative environments.

In a tele-immersive environment computers recognize the presence and movements of individuals and objects, track those individuals and images, and then permit them to be projected in realistic, multiple, geographically distributed immersive environments on stereo-immersive surfaces. This requires sampling and resynthesis of the physical environment as well as the users' faces and bodies, which is a new challenge that will move the range of emerging technologies, …….This future type of solutions will provide access to many persons to be collaborate as if they were in the same room handling e.g. objects to each other. The ICT to sense a remote place and re-render in real time involves problems within computer graphics, vision, and networking that can only partially solved today. The possible applications are on the other hand unlimited and the environments will be cheaper and more transparent to the user after 10 years of devlopment". See also (Raskar et.al. 1998), (Ditlea, 2001) and Rajat Arya, Tele-immersion, http://www.cis.upenn.edu/~sequence/teleim1.html

Concerning *augmented environments*. From 'Occlusion in Collaborative Augmented Environments' http://www.cg.tuwien.ac.at/research/vr/occlusion/ (Virtual Environemnt Group, Graz University of Technology, Austria. Project started 1996). See also figure 9.

"One of the main advantages of using an augmented environment for collaboration as opposed to an immersive setup is the direct interaction of participants in reality. While the collaborators in an immersive setup always have to rely on more or less satisfying representations of each other, ranging from disembodied hands or heads to complete bodies visualized in plausible poses, users of an augmented scenario always are able to directly see each other and the interface devices they are using. This combination of reality and virtuality leads to the problem of correct occlusion between real and virtual objects, which of course does not exist in an immersive environment." See also figure 9.

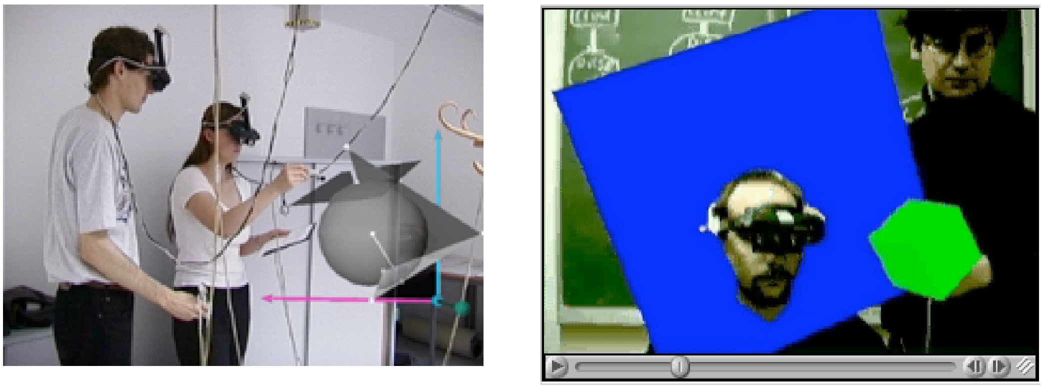

Figure 9 Left; " A tutor and student are working together in Construct3D. Both are constructively solving an example from vector analysis." from http://www.cg.tuwien.ac.at/research/vr/studierstube/construct3d/. Right; 'Virtual object intersecting real head' http://www.cg.tuwien.ac.at/research/vr/occlusion/headmove.mov

In the EU IST-project 'Distributed Virtual Workspace for enhancing Communication within the Construction Industry - DIVERCITY' engineers, architects, builders, researchers, and ICT developers participate (Christiansson et.al., 2001). The objective of the project is to produce a prototype virtual workspace that will enable client briefing, design review and construction simulation to be visualised and manipulated, and to produce a set of VR tools that aid the construction design and planning process. See also figure 10. The project is halfway today (15 months) and the participating industry have expressed a great need and interest for this type of systems.

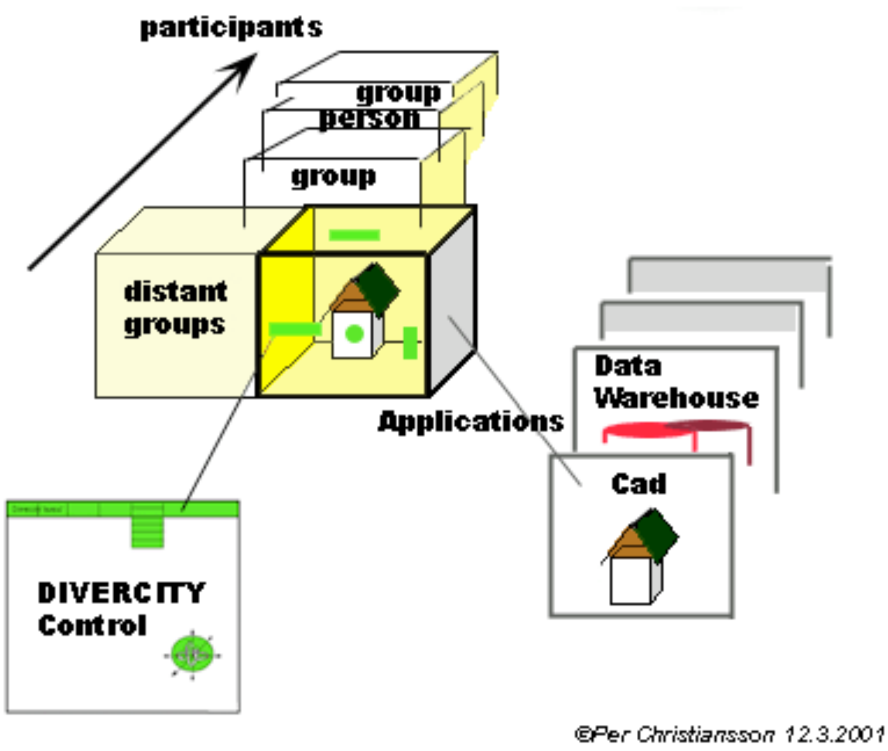

Figure10 Principal Virtual Worlspace (VW) layout with 'dimensions' and 'artefacts'. The design object is the Virtual Building (VB). From the DIVERCITY procject (Christiansson et.al. 2001)

6 REFERENCES

Aspects, 1990, The First Simultaneous Conference Software for the Macintosh, *Group Technologies,* Arlington Virginia USA (328 pp.)

Billinghurst, M. and Kato, H., 1999, Collaborative Mixed Reality. In *Proceedings of International Symposium on Mixed Reality (ISMR '99).* Mixed Reality--Merging Real and Virtual Worlds, pp. 261-284. http://www.hitl.washington.edu/publications/r-98-36/

Christiansson P, Svidt K, Jens Ove Skjærbæk J O, Aaholm R, 2001, User requirements modelling in design of collaborative virtual reality design systems. *Construction Information Technology, INTERNATIONAL CONFERENCE IT in Construction in Africa*, 30 May – 1 June 2001, Mpumalanga, South Africa (12 pp.) (Accepted paper)

Christiansson P, 2000a, IT in Distributed Open Learning Environments. *Construction Information Technology 2000 - Taking the Construction Industry into the 21st century', (ed. G. Gudnason) Icelandic Building Research Institute.* ISBN 9979-9174-3-1. Reykjavik, Iceland in June 26-30 , 2000. (pp. 197-208). http://it.civil.auc.dk/it/reports/r_iceland_6_2000.pdf

Christiansson P, 2000b, Knowledge Representations and Information Flow in the Intelligent Building. *Proceedings of he Eighth International Conference on Computing in Civil and Building Engineering. ICCCBE-VIII 2000 (eds: Fruchter R, Pena-Mora F, Roddis K)*, ISBN 0-7844-0513-1. American Society of Civil Engineers, Reston, Virginia, USA. (Stanford University, USA. August 14-17, 2000). (pp. 604-611)
http://it.civil.auc.dk/it/reports/r_stanford_8_2000.pdf

Christiansson P, Lagerstedt R, Engborg U, 1996, User Models in Search and Navigation Systems on the Internet. *AEC Applications of the Internet AEC Systems Anaheim* June 17-20. (7 pp)
http://it.civil.auc.dk/it/reports/delphi/aec96/aec96.html

Christiansson P, 1993, Advanced Material and Vendor Information system - AMVI. *Automation in Construction , Vol 2, nb 2, , July,1993,* Elsevier Science Publishers B.V. (pp 109-121).

Christiansson P, 1991, The KBS-Media Project. *European course of the COMETT II program in 'New tools for the city, modelling, simulation, communication'*. Nantes sept. 1991. (13 pp.)

Lindemann. J, 1996, *Low Cost Distributed VR*. KBS-Media Lab, Lund University. (40 pp.) http://it.civil.auc.dk/it/reports/vrlindemann/lcdvr.html

Modin, j, 1995, *COOCOM, New ways of using Information Technology for buildings design and management*. (COOperation and COMmunication in the building process). KBS-Media Lab, Lund University. (29 pp.)
http://www.it.civil.auc.dk/it/reports/coocom1_6_1995.pdf

Modin J, Engborg U, Christiansson P, 1994, Computer Supported Collaboration during Design and Maintenance. The IT-Tools Perspective. *BUILDING WITH IT. Collaboration, Communication, Integration. Conference October 17-18 1994*. The National IT-BUILDING program. Lund University. (pp 13-24).

Raskar, R, Welch G, Cutts M, Lake A, Steisn L, Fuchs H, 1998*, The Office of the Future: A Unified Approach to Image-Based Modelling and Spatially Immersive Displays*. University of North Carolina at Chapel Hill and NSF Science and Technology Center for Graphics and Scientific Viosualization. (10 pp.).
http://www.cs.unc.edu/~welch/media/pdf/future_office.pdf

Ditlea S, 2001, Tele-immersion. Tomorrow's Teleconferencing - Real-time transmission of real-life environments may be Internet 2's most visionary applications. *Computer Graphics World*. January 2001. (pp. 36-40).