Augmented Reality Concept in the Design of Innovative Working Environment

Evgenia Chernenko

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Abstract

This thesis analyses the current situation in the world of designing innovation working environments and emphasises the utilizing of Augmented Reality concept in the development of environmental features for creativity facilitation. The main accent is done on the issue of creating the hybrid space where virtual and real worlds are blended in a natural way and the psychological and mental issues of human mind and behaviour are considered while the creation such an innovative working space.

The prerequisites for the new office environment creation and the essence of knowledge work are considered. Several related projects, their general aspects, benefits and disadvantages are described. The concept of innovative working environment with the "real-virtual" integration is suggested.

Keywords: blending virtual and real, Augmented Reality, new working environment, innovative office, hybrid space, creativity support, ICT, netWork Oasis Glow.

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1 Introduction

Our reality, everyday life and work is such that sometimes we cannot be sure about some thing to be actually physical or virtual… It is so because the virtual life, virtual environment becomes the part of our daily activity, affects our minds and thoughts, our ability to conceive in non-ordinary way. One of the needs in modern Information and Knowledge Society is developing such kind of working environments that directs this influence so that it will increase human's productivity at the workplace, stimulate creative thinking and help to generate new ideas.

More and more organizations feel the urgent need in facilitating life-long learning of their employees, collaboration of experts and new ideas appearance impelling. The idea of creating a new flexible working environment that supports creativity, includes all necessary possibilities and facilities for people's work and meets all the requirements that are made to the modern working and learning place, appears in netWork Oasis project. One of several development directions in this project devoted to creation of the unique interface between virtual environment and real life (Glow subproject) so that virtual side could be perceived by the user like integrated part of physical one, and vice versa. The design of the environment with such kind of interface is the aim of this research work.

This thesis consists of six chapters. The first one is Introduction where research problems, objectives and methods are identified. The second chapter "Innovative working environment: the origins" discusses the research problem background and prerequisites for the idea of hybrid space appearance. It provides the classical definition of Augmented Reality (AR) technology, possibilities of AR systems application for designing of innovative working environment, and also discusses a new AR technology approach. The third chapter "Knowledge Work: New ways & technologies" discloses the essence of Knowledge Work, describes new working ways, innovative technologies and their cross-influence. The fourth chapter "Ideas from outside" includes the description of different projects where the research problem is discussed and similar ideas are realized (Office21, eOffice, OOTF, SANE). All the designing aspects and innovative ideas about the creation of future working environment that naturally integrates both physical and virtual spaces are considered in the fifth chapter "NetWork

Oasis Glow". It discusses the NetWork Oasis project and Glow idea of physical-virtual blending, the aims and reasons of the project, Glow design aspects, interfaces, the Flexible Lab testing experience and some challenges and future work questions. The last chapter is Conclusion where all results and future development ideas are described.

1.1 Questions to answer

The main problem discussed in this thesis concerns the designing of such an innovative interface that supports natural virtual-real integration in a new creativity supporting working environment for knowledge workers. The main feature of such an innovative hybrid space is its ability to represent this kind of blending in such a way that person could perceive the working environment like single, natural for human being space. From the standpoint of this problem several questions are considered in this research:

- What are the benefits and disadvantages of using physical and virtual environments in working process?

- What are the benefits of the space where both realities are blended naturally?

- How the idea of hybrid space can support creative thinking and the process of idea generating?

- Are there similar ideas in the world?

- How to blend two realities effectively and what is the criterion of effectiveness estimation?

- How to provide user-centered design?

- What tools and services should be supported physically and virtually?

- Is there exists some strategy for such environment developing?

- Which technologies to use?

The main question is: Why do people need such kind of working environments?

1.2 Methodology

Providing the methodology means defining the sequence or collection of processes that characterise the scientific investigation and acquisition of new scientific knowledge based upon physical evidence (Wikipedia 2005). The Science deals with assertions about the world in from of theories, hypotheses or observations. A lot of different methods have been proposed in purpose to decide between conflicting assertions. The use of suitable method(s) helps to determine the theories, hypotheses and observations that are acceptable.

The essential processes while applying the scientific method are *characterization* of the subject of the investigation, the *hypothesis* development that includes a suggested explanation of the subject, the *prediction* that is made from the hypothesis by applying deductive reasoning, and *experiment* that is designed to test the prediction (provide either confirmation or falsification of the hypothesis).

The methodology that was used during this Master Thesis creation corresponds to the described way of development, and includes several techniques and processes. Obviously, there was not pure scientific method application, but some adapted methodology that is suitable for the investigation devoted to the design of innovative working space.

First of all, the main question was done in purpose to identify the problem that was going to be discussed in the thesis. The way of problem definition and of main question introducing should be such that it is conceivably possible to answer it. The first attempts of knowledge obtaining start at this moment (Schafersman 1994).

The next stage is gathering the information relevant to the problem and attempt to answer the question by making observations. The observations were done by means of obtaining the data from the library literature, through the Internet by using the question words, their synonymous and relevant keywords, and from the conversations with colleagues. The observation takes place not only at the beginning of the research, but during the whole process of the investigation. Generally, the whole scientific process is iterative. At any stage it is possible that some consideration will lead to the necessity of reiteration of an earlier part of the process.

After the main amount of necessary information is gathered and the whole comprehension of the problem under consideration is obtained, there is a time for proposing a solution for the problem or answer to the main question. In terms of scientific methodology, the hypothesis is constructed at this stage. A *scientific hypothesis* is a testable and predictive solution to the problem that explains a natural phenomenon, process, or event (Schafersman 1994). During this phase of investigation a lot of different techniques are used in purpose to come up with all possible explanations about the problem under study: ideas from other fields, induction, own creativity as the main tool to develop innovation, or even systematic guessing.

The methods that are used at this stage to support the new ideas generating and developing are brainstorming sessions, discussions, debates and negotiations, different games, collaborative work activities and others. The *Brainstorming* method is a semi-structured creative group activity that used most often in ad-hoc business meetings to come up with new ideas for innovation or improvement. Members of the group are encouraged to put forward ideas about a problem and how it may be solved. The idea behind it is that a group of people can achieve a higher level of creativity than each of the participants separately.

Discussion can take place when there is a need to come to some particular solution for the problem that has several possible ways to be solved. Several key questions should be posed for keeping the focused discussion. The larger the group where discussion is held, the more likely that some participants will dominate and others remain silent. The groups' size should be chosen wisely in order to ensure that everyone has the opportunity to speak. When any discussion concludes, the main points must be summarized orally and in writing.

Debates help to clarify different positions on a controversial issue. They usually involve two or several small groups who plan and present arguments on different sides of an issue, which may not necessarily represent their personal views. Debates develop logic, understanding of an issue, and listening and speaking skills. Ideally a debate concludes with all participants' voting for or against the proposition.

A vulgar mistake that can be done at the moment of proposing the solution by non-critical thinkers is to stop here and be satisfied with the solution at hand. The lack of

scepticism can be the reason of non-reliable knowledge obtaining. The means of avoiding such error is to test the hypothesis. One can make an *experiment* that is the most well-known method of proving the validity of the hypothesis, or to *make further observations* which is used in cases when the problem of the research is not amenable to experimentation (e.g. questions about stars, galaxies, mountain formation, the formation of the solar system, etc.). Every hypothesis allows making certain predictions about the problem under investigation. Using logic and empirical evidence, it is possible to test the hypothesis by examining how successful the predictions are. If the hypothesis fails the test, it must be rejected and either abandoned or modified. If the hypothesis passes the further tests, it is considered to be a *corroborated hypothesis*, and can now be published and tested by other scientists. Only after all these actions the knowledge that one obtain can be considered as reliable. This is the "hypothetico-deductive method", so named because the prediction is deduced from the hypothesis, and then these deductions are tested. The hypothesis cannot be clamed to be "proved" in a strict sense. A highly corroborated hypothesis becomes a *scientific fact.* This is the type of reliable knowledge that is the closest to the humans' definition of "truth" about the universe.

The final step is to construct a *scientific theory*. A theory, therefore, is built of reliable knowledge (scientific facts) and has the purpose to explain the processes or phenomena. The scientific theories are the most reliable, most rigorous, and most comprehensive form of knowledge that humans possess. It is important to understand where scientific knowledge comes from, and how to emulate this method of gaining knowledge. Scientific knowledge comes from the practice of scientific thinking and this mode of discovering and validating knowledge can be used by anyone who practices critical thinking.

Summarizing the methodology that was used during the work, the following list of methods appears: defining the main problem; obtaining the data from the library literature, through the Internet and from the conversations with colleagues; information analysis and review (ideas from similar works and other fields of knowledge); proposing the ideas that compose a solution for the problem (at this step brainstorming sessions, discussions, debates, negotiations, collaborative work activities were carried

out); testing the proposed solution by means of experimental environment and summarizing the results.

2 Innovative working environment: the origins

This chapter is devoted to the description of different aspects and prerequisites that lead to the idea of new working environment creation. The main questions are "what are the reasons for creating an innovative office?", "what kind of human needs cause the necessity to create an office of the future?" and "what kind of environment it should be to meet all the requirements that are made to it in purpose to make people feel as much comfortable as possible wherever they work?".

2.1 From creativity facilitation to experts' net

The development of ICT tools can be considered like a starting point in the history of computer-based and computer-supported collaborative working environments. To be an actual creativity facilitator the working environment should have several special features and characteristics. The organizational knowledge creation process can be represented as a spiral that continues through face-to-face private, public and then virtual public and private communications (Nonaka et al. 1998). Hence the integration of both realities – physical and virtual – leads to the acceleration of knowledge creation process (Chernenko et al. 2004). The way to the idea of hybrid environment birth is described here.

2.1.1 Need to support creativity

The use of ICT tools gives users a lot of opportunities in their work. The reason is the numerous benefits of using ICT such as flexibility, time and money savings, use of interactive multimedia, learner focused learning, use of digital libraries and any kind of resources, etc. One thing that is missed in most cases when describing the benefits and features of ICT tools is importance to support creative thinking. The distinctive of a modern working or learning process organization is a possibility to perform it distantly. In any kind of such process it is crucial to support peoples' curiosity, to motivate them to participate, to inspire them for generating new ideas... The greatest challenge is how to activate the potential for creativity in knowledge work, and moreover, what is the nature of knowledge work, how it can be influenced and managed?

The goal of designing creativity support tools is "to make more people more creative more often" (Shneiderman 2002). This enables them to cope successfully with a wider variety of challenges. The users of such tools are usually knowledge workers, such as

scientists, artists, musicians, managers, teachers, lowers, etc. Ben Shneiderman defined four user activities which need promoting in creative work. They are *collecting* the material from previous works stored in libraries, Web and other resources; *relating* it to the real life by consulting with mentors, experts and peers at every stage of the creative process; *creating* possible solutions, generating new ideas and evaluating them; and *donating*, or disseminating, the results and contribute to libraries, Web and other sources of knowledge. There are a lot of ways how to support these activities, but the main challenge is to make a smooth integration between new and already existing tools such as various office tools, mobile devices, screens, etc.

2.1.2 Ubiquitous learning in working process

"Ubiquitous learning" and its appearance at the working place is the next step in the development of learning/working process organization. The challenge in such kind of learning and working is that not only required content should be available in any place at any time in any form, but the person should be also able to say the right thing at the right time in the right way. The features of ubiquitous working/learning process (Clue 2004) are *Permanency* (user's work is continuously recorded and he can never lose his work until it is purposefully deleted), *Accessibility* (an access to the documents and data is available from anywhere), *Immediacy* (immediate access to the information and quick problem solving at the place), *Interactivity* (interaction with experts, teachers or peers in form of synchronous or asynchronous communication), *Situating* of instructional activities (embedding the learning in our daily life), and *Adaptability* (obtaining the right information at the right place in the right way). Moreover, ubiquitous learning can happen in Computer Supported Collaborative Learning (CSCL) environments that focus on the process of social knowledge building and sharing.

2.1.3 Integrated environment

New ways of working and learning demand a new layout and usually completely new environment that provides all possibilities for people to use actually all the benefits of innovative working methods. It leads to the wide use of multimedia technologies, mobile communications, interactive graphics and flexible, user-centric environments. In this situation the gap between real, or physical, world with its characteristic features and virtual world with its possibilities for distant work and communication becomes

smaller. Finally, the line of this evolution is logically comes to the idea of combining these two worlds in a unique mixture – creating such an environment that naturally integrates the physical layout and virtual environment.

2.2 Physical and virtual working environments

Before describing the idea of blending *virtual* and *real* worlds, it is necessary to define what is meant by these notions in words of work and education. What is real, or physical, working environment, what is virtual, what kinds of activities are supported by them and what facilities they can provide.

2.2.1 What is the difference?

At present there exist two kinds of working environments, and accordingly two ways of working process realizations that are successfully used: (1) classical face-to-face way that suppose people's communication in one physical location and (2) modern virtual way using ICT that allows remote working.

The difference between these two ways of working is obvious. Classical way of work requires physical presence of people at one place. All communications between them performed in face-to-face manner. In virtual way of working the main feature is ICT use, i.e. the working process is performed distantly by means of some kind of virtual environment.

2.2.2 Benefits and disadvantages

Both classical and virtual ways of work have their benefits and disadvantages. The main point is that both of them are one-sided. Working in particular physical environment allows good possibilities for collaborative work, natural discussions and any kind of group activities, but it cannot provide an opportunity for organizing effective work under the projects where people from different parts of the country and even of the world take part. By means of virtual working environment the problem of distant work can be solved, but another one arises: how to make possible natural human interaction? Considering the features of physical and virtual working environments, we can emphasize the benefits and drawbacks of corresponding ways of working (Table 2.1).

Table 2.1 Benefits and disadvantages of Classical and Virtual ways working.

B/D Way of working	Benefits	Disadvantages
Physical	Possibility for face-to-face meetings gives the following: • quick solving of particular questions; • easily organized group-work; • social motivation; • sharing of tacit knowledge, skills and experiences; • immediate feedback; • exchange with physical objects; • psychological comfort of knowing people personally; • trust inside the group of people.	• no possibility to participate in working process remotely, to work in different locations and at any time; • need to present physically at the place in order to obtain the knowledge and information; • difficult to participate in different projects simultaneously; • difficult to communicate with colleagues and project members outside the physical location; • poor ICT use, hence a lot of handmade material that is difficult to share.
Virtual	• possibility to work from any place; • in case of possibility of asynchronous working process: work at any time; • use of computer simulated models; • possibility to read the materials or discussion flows afterwards; • no need for physical presence at the workplace; • saving time and traveling expenses; • possibility to be engaged in several projects simultaneously or work in different companies at the same time.	• need to be highly motivated to do your work not at the workplace, but in any place; • impossible to communicate with people in natural way (absence of face-to-face communications); • poor possibilities for group and collaborative work; • one can feel himself detached and isolated from the working process and from the real activities; • lack of information about people you are working with; • errors and different force major situations that can occur due to using different data transfer methods.

Table 2.1 shows that particular activities could be easily organized with one approach and hardly with another. For example, collaborative group-work could be easily organized in some local company, but it's hard to organize it for people who work in different cities or even countries. While the storage of created materials and access to them is in a sphere of virtual environment.

2.3 Idea of new working space

It's easy to notice that aspects that are benefits for one way of working cannot be considered as those in the other one. The question here is what kind of environment – real or virtual – is more effective for each kind of activity? After giving an answer to this question we'll get two lists of activities: for real and virtual working styles. However, the problem remains that we need to provide the environment that allows organizing any kind of activity that is necessary for working process organizing. This environment should avoid the disadvantages of these two ways of working; and the idea for providing it – *to blend real and virtual*, to make a mixture of these two working styles. The main direction is creating a unique interface between virtual environment and real life so that virtual side could be perceived by the person like integrated part of physical one, and vice versa. From human viewpoint it should be like a single whole that includes all possibilities for user to feel like there is no any line between virtuality and reality. It's very important to find an optimal balance between virtual and real to make the working process the most comfortable and suitable for every person with his/her own preferences.

2.4 Physical-Virtual artifacts

One of the techniques to bridge the physical-virtual environment gap is based on the utilizing of the concept of *Physical-Virtual Artefacts* (things that are present in the physical and virtual environments at the same time). The aim is to make a tighter coupling between physical and virtual artefacts as well as to provide a higher degree of freedom to choose how "physically" or how "virtually" one want to work, depending on task and geographical position, as well as upon personal preferences like working style or current mood (Pederson 1999).

The knowledge work environment should include as well as encourage the development and design of artefacts that to a high degree could be used in both physical and virtual environments (Fig. 2.1).
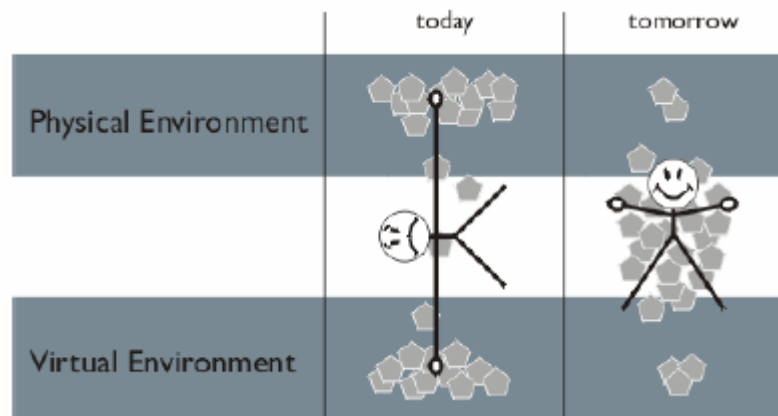
Fig. 2.1   Artefacts which are both physical and virtual at the same time

An example of a physical-virtual artefact is the "mouse device ↔ mouse cursor" artefact (Fig. 2.2) used to interact with popular windows-based virtual environments. The physical mouse device is shaped to fit the human hand while the virtual cursor is designed to not take up too much space, be visible on top of any kind of background and to have a distinct "action point". Physical and virtual "mice" complement each other in functionality and because of the tight coupling, the user tend to identify them as one artefact.
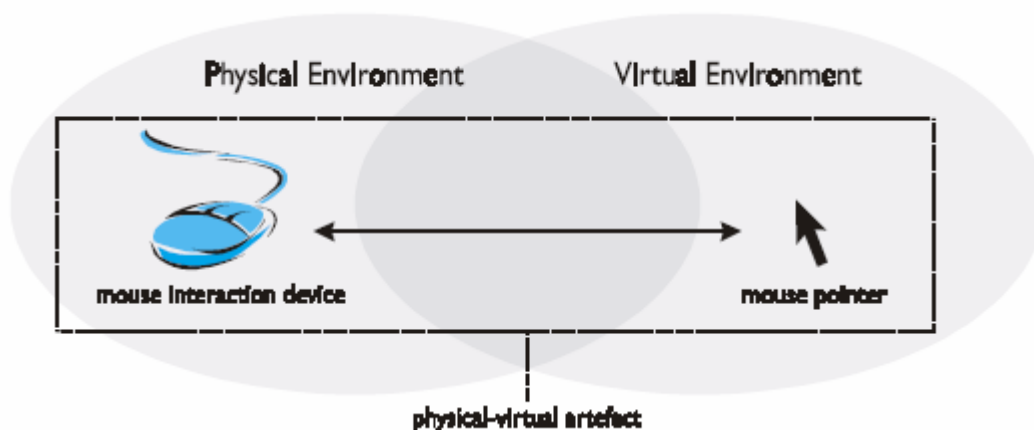
Fig. 2.2   Physical-Virtual artefact example

2.5 Augmented reality: classical definition

A lot of works that devoted to combining of virtual and real refer to Augmented Reality (AR) systems.

The difference between Virtual Reality (VR) and Augmented Reality is that VR immerses user inside a virtual world that completely replaces a real one; but AR allows user to see virtual objects superimposed on real world objects (Augmented Reality 2004). Virtual and real can be seen in the same space and ideally couldn't be distinguished. Augmented reality adds graphics, sounds, haptics and smell to the natural world as it exists.

At the very beginning of AR systems development it could display graphics for only one point of view (graphic is static and does not adjust with camera movements). Next-generation AR systems are more advanced and are able not only superimpose graphics over a real world in real-time, but also change those graphics to accommodate a user's head- and eye- movements, so that the graphics always fit the perspective. There are three components that are needed for AR system to work: head-mounted display (HMD), tracking system and mobile computing power.

2.5.1 HMD

HMD is a device that allows user to see the graphics created by AR system. There are two basic types of HMDs: video see-through and optical see-through.

Video see-through HMD: block out user from surrounding world. It uses video mixing technology: small video cameras that are attached to the goggles' outside for recording the current surrounding world view. Inside the goggles this recorded view is played in real-time. Virtual objects are superimposed on this recorded view. There exists one problem: the use of video camera lead to delays in image-adjustment when head moving.

Optical see-through HMD: simple approach that uses a mirror beam splitter – a half-silvered mirror that both reflects and transmits light (Feiner 2002). The beam splitter can reflect image from a computer display into the user's line of sight still allow light from the surrounding world to pass through.

Nowadays researchers use small liquid-crystal displays and advanced optical designs to create systems that weigh mere ounces. More improvements: a Microvision company has recently developed a **Virtual Retinal Display** that uses low-power lasers to scan images directly on the retina (Bonsor 2001). This kind of HMD is the most promise for an AR system (this is the opinion of Blair MacIntyre, director of the Augmented

Environments Lab at Georgia Tech). The reason is that the retinal-scanning display has the potential to be small. It could be like ordinary-looking pair of eyeglasses that will have a light source that can project images to the retina. The problem at present is in its price: Microvision display currently costs about $10,000.

Another approach involves projecting graphics directly on surfaces in the user's environment.

2.5.2 Tracking and orientation

The most difficult problem in AR systems is to determine user location with respect to his surroundings (Bonsor 2001). One more problem is tracking of user's eyes and head movements. Tracking system has to recognize these movements (registration process) because graphics should be projected to a real environment from the same point of view as user is seeing.

The outdoor AR system designed at Columbia University (Feiner 2002) handles orientation and position tracking separately. Head orientation is determined with a commercially available hybrid tracker that combines gyroscopes and accelerometers with a magnetometer that measures the earth's magnetic field. For position tracking the high-precision version of the Global Positioning System (GPS) receiver is used (real-time kinematic GPS with accuracy about several centimeters). Unfortunately, GPS is not the ultimate answer to position tracking. The satellite signals are relatively weak and easily blocked by buildings or even foliage.

For indoor applications the situation is different. There are several kinds of tracking systems: mechanical (the earliest designed by Sutherland and his colleagues), ultrasonic that uses transmitted acoustic signals to determine the user's position; improved versions of these technologies: electromagnetic, optical and video trackers.

The tracking problem is easy to solve for smaller space. For example there was developed a 500 square feet optoelectronic HiBall Tracking System at the University of North Carolina-Chapel Hill with accuracy in linear motion about 2 millimeters and angular motion less than 0.3 degree.

2.5.3 Mobile computing power

This aspect is one more challenge in AR systems. There is not enough computing power in available now wearable AR systems for creating 3D graphics. Researches have made a prediction that first practical portable 3D systems would be probably available in 2005.

2.5.4 AR systems applications and challenges

There are several areas where AR systems are used. They are collaborative work and design, medicine (e.g. surgery), education tools, games, robotics (for remote control and maintenance), architecture and interior design, military applications (battlefield AR systems – BARS) and some others. The issue of interest is how such kind of systems could be used in the designing of innovative working environment and generally is it possible to use it in such purposes. With regard to all the description of AR systems and the specificity of office design we can infer that there are some serious problems in using AR systems in offices. The main are:

a) Need to wear displays. Advanced AR system offer its minimal-size approach like only eyeglasses (or even contact lenses), but its cost is so high that it seems to be impossible to use it. Moreover, at least now there is no any commercial product.

b) Low accuracy in registration (ability to view virtual objects from any point).

c) Bulky hardware (if you use displays, cameras, pocket PC, … it's difficult to pay attention only on what you are want to do, but not on how to utilize all this stuff).

2.6 Augmented reality: office solutions

In view of all the problems of AR system utilizing we need to find other solutions of combining virtual and real to one integrated environment. Here I describe several AR applications that could be successfully used for office environment designing.

2.6.1 Everywhere Display

One interesting device that was developed by IBM is *Everywhere Display* (IBM Research 2004). Everywhere Display allows creating a system that transforms any surface into a projected "touch-screen". People can interact with the projected image by only touching the surface. Users can work together and looking on the wall or table or floor, or any

surface they want. This system contains an LCD projector, a mirror (for image deflecting) and a camera (for detecting hand/body activity).

There are a lot of advantages in such system in comparison to traditional Augmented Reality: no wiring, no need to wear any goggles or input devices, simple interaction, simple control (e.g. projector can be easily steered to a new surface by software command). Some interesting examples of Everywhere Display applications that are described in ED research are the follows:

Notification. Messages to user can be displayed in any place and surface. If the ED system is combined with tracking system that knows the user's position in the environment, the messages can appear on the surfaces that allow maximal visibility.

Location-specific information. Computer database corresponding to the content of file cabinet can be projected on any surface near it. It gives the possibility for easy file search and updating database.

Signaling. Different messages, pointers and labels can appear on any surface to support user orientation in the environment. E.g. a visitor can be guided to a specific location in a building by arrows projected in the corridors.

Deviceless remote control. Projecting the control bottoms on any surface that is suitable for user, he can control the device state.

Using such kind of technology like Everywhere Display paints a very interesting view of people interaction in working environment. Such kind of interface will allow easy communication and everywhere access from the real world to the virtual one. It will be perceived by users like integrated environment where the line between virtual and real is unnoticeable.

2.6.2 Shader Lamps

Quite important part in blending virtuality and reality in working environments belongs to creation of interior features, adding virtual pieces of art in physical working spaces. It could be for example some subject that changes its appearance randomly. The main idea is that the outcome of a computer graphic program is seen not on the screen, but in the environment. For example you can make the clue vase to be look like made of gold with some design details. Contemporary technologies allow producing such

systems; and OOTF project (OOTF project, 2004) has already introduced the *Shader Lamps* which by means of illumination, surface reflectance and special viewer location change the appearance of real objects and achieve special effects in the real world.

2.6.3 Magic Touch

Magic Touch is an object tracking system (Pederson 2000). The idea of this system is follows. If we assume that artifacts do not move unless moved by human hand, then all that is needed for tracking is to track hand movements and identify artifacts that are picked up/held/dropped along the way. All the artifacts in the system are instantiated in both physical and virtual environments (e.g. every document in office has its electronic version). Magic touch consists of four components: (1) an office environment with tagged artifacts, (2) wearable wireless tag readers, placed on each of the user's hands, identifying any tagged artifact the user takes in his hand, (3) a wireless location transmitter of user's hands position and (4) a database that links physical artifacts and their virtual representation (Fig. 2.3).
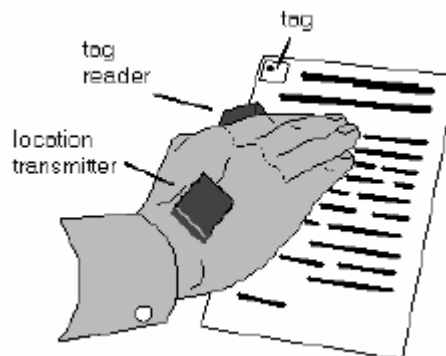
Fig. 2.3 One of the user's hands holding a tagged paper document

There are some interesting application ideas of this system:

- A Physical-Virtual (PV) search engine that performs search for both virtual and physical artefact instantiations.

- A PV mail box handling both physical and virtual mail.

- A PV paper basket handling and synchronising the discarding of PV documents.

- Tele-presence. By visualising the PV artefacts database and enabling the access to the visualisation through the Internet, users can visit Virtual Reality versions of physical offices.

- PV containers. Physical instantiations of PV containers (e.g. document folders) can be linked to sets of virtual artefact instantiations and vice versa, making it possible to "keep" both physical and virtual artefact instantiations in the same container, physical or virtual.

- Active volumes — physical space that the user explicitly has assigned some "meaning". The user could for instance define one part of the physical desktop as being a mail outbox or a paper basket.

- "Magic memory" allowing backtracking of past user actions and limited UNDO facilities.

- "Virtually filled" physical artefact instantiations. If the proposed system is combined with a motion tracked Head Mounted Display (HMD), users can handle blank papers while the actual paper contents is projected virtually.

2.7 Conclusion

The idea of creation a new working environment where real and virtual words are intermixed in one hybrid reality has a lot of points to come from. The integrated space seems to have a lot of benefits for supporting creative work, but there are some threats. If we create one reality out of two as a mixture of them, it doesn't mean that the benefits will include all the strength of components but disadvantages will vanish. At the same time it is not necessary that the benefits and disadvantages will remain the same. Here is the situation when mathematical principles do not work, and one plus one doesn't give two. It means that new space will get some characteristics of the components and something new. This "new" can be quite unexpected and actually contain some non-desired features. The possible benefits and disadvantages of new blended environment are analyzed and collected in Table 2.2.

Table 2.2 Benefits and disadvantages of blending real and virtual environments.

Benefits	Disadvantages
✓ Advanced possibilities for simulation, visualization and immersion (Augmented Reality) ✓ New ways of sharing tacit knowledge, emotions and feelings	✓ Not everyone has the opportunity to exchange with real physical objects and tacit knowledge like in real life
✓ Provides the feeling of "being there", no isolation from real activities and facilitation of networking and social stimuli ✓ Almost real presence, but not necessary physical	✓ Some people may feel anxiety of being too public or too much in the networks
✓ Modern tools for communication, more natural than used before → psychological comfort of knowing people ✓ Immediate feedback ✓ Easily organized collaborative learning and working ✓ Support for distant work from anywhere ✓ Possibility "to be" in several places simultaneously	✓ Need to negotiate time of meeting in advance to meet real people distantly → lack of possibility to asynchronous work
✓ Wide information search area ✓ Easy access and search of people and experts ✓ Access to materials and discussion flows afterwards ✓ Easier linking, gathering, storing and exchanging of knowledge	✓ Errors might still occur and lead to private information disclosure

The creation process of new working environment should have an aim to take as much as possible from the considered benefits and should try to avoid the obstacles.

3 Knowledge Work: new ways & technologies

This chapter describes the essential points of Knowledge Work and contemporary ways of working; knowledge work evolution, development and influence on the design of innovative hybrid space. The definition of Knowledge Worker is given, the main points of mobile work and e-work are considered, the intuitive human-computer interface is described, security services and tracking system for hybrid community environments are provided.

3.1 Knowledge Worker

The definition of "knowledge worker" says:

> *"Anyone who creates, develops, manipulates (including selecting and organizing), disseminates or uses knowledge to provide a competitive advantage or some other benefit contributing towards the goals of the organization. Thus, the product of a knowledge worker's work is intangible: knowledge is the addition of meaning, context and relationship to data or information (this is sometimes referred to as "mature content"). Knowledge workers typically work in a team (whether local or virtual), and make extensive use of IT."*
> (Harrison et al 2004).

Hence, knowledge work can be characterized as work which involves high level of interaction and autonomy. An important component of knowledge work is accessing critical information and converting it into explicit knowledge in order to become more innovative and more productive.

3.2 U-Theory

The described essence of knowledge work touches the principles of Otto Scharmer's U-Theory that was named for the shape of the path it follows (Scharmer 2004a). Scharmer states that all human and social entities have a large number of sources they can operate from. He states that there is a "blind spot" in the current leadership theory, and this blind spot is the source, the inner place from which an individual or collective agency originates.

In his works with leadership teams Scharmer realized that leaders (people who "rules or guides or inspires others" (WordNet 2004)) could not meet their challenges by operating only on the basis of past experiences. The learning process should be deeper

and should be tuned into future possibilities rather that simply reflect the experiences of the past. In order to enhance the ability for innovations creation, the leader, who is responsible person in this process, should find and shift the inner place.

McKinsey's Jonathan Day once noted about his experience in helping global corporations through the process of fundamental change: "What's most important is invisible to the eye." The purpose of Scharmer's work is to learn to see those origins of human action that remain invisible, as well as to see the whole process of coming-into-being of social action – both deeper layers and those that are at the surface. Just as a plant starts growing long before we see the sprout above the soil surface, the coming-into-being of social reality starts long before people behave and interact.

Sharmer developed seven different elements of attention and action, each with a different source (Fig. 3.1).
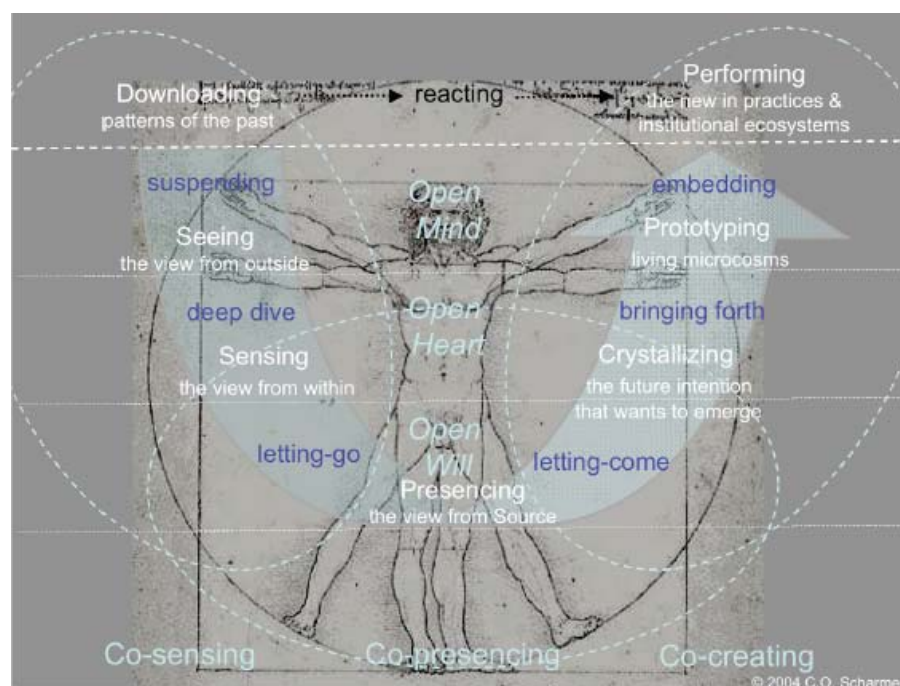
Fig. 3.1   Theory U: Seven States and Capacities, Three Movements, One Process

1) Paying attention: beginning to open up

2) Seeing: the view from outside

3) Sensing: the view from within

4) Presencing: the view from a surrounding presence

5) Crystallizing vision and intent

6) Prototyping living microcosms

7) Performing and embodying the new

The notion that demands explanation here is *presencing*. This is a term that blends two words: "presence" and "sensing". It means "to sense and bring into the present one's highest future potential—the future that depends on us to bring it into being" (Scharmer 2004a).

The U-process includes three different movements of awareness:

- co-sensing: opening up to the world outside where observer no longer separated from the observed;

- co-presencing: opening up to what wants to emerge; and

- co-creating: bringing the new into reality by activating a capacity for co-creation that no longer separates the intelligence of the head, heart, and hand.

Moving along the U-curve requires transforming one's thoughts, emotions, and intentions by:

- opening the mind: through the inquiries;

- opening the heart: by providing a gateway to sensing;

- opening the will: by opening up to one's higher abilities.

Seven States and Capacities in the diagram are Downloading, Seeing, Sensing, Presencing, Envisioning, Enacting, and Embodying (Scharmer et al 2004). The downloading is in the head. In order to go deeper, we open our mind for seeing and then our heart for sensing. Johann Wolfgang von Goethe summarized the business of seeing and sensing two hundred years ago when he said this: "Man knows himself only to the extent that he knows the world. He becomes aware of himself only within the world, and aware of the world only within himself." Each person makes sense on his own context, but socially we compose a new vision. Shared perception not only helps in shared understanding, but it is also a source of energy and power that moves us through this whole process. Accessing the dimension of will, we face the letting-go of our "hard will" and tuning into our "soft will". Letting-go turns into letting-come, and then redirection turns towards action.

Such new art of leadership requires a new leadership technology – a social technology of freedom – that focuses on methods and tools that help diverse groups of actors to see, sense, and create together in a way that transforms past patterns and actualizes future possibilities. There are three methods that were deployed on the field: phenomenology, dialogue, and collaborative action research. All three methods address the same key issue: the intertwined constitution of knowledge, reality, and self. All three follow the dictum of Kurt Lewin, the founder of action research, who observed: "You cannot understand a system unless you change it."

Scharmer says: Trust your hands. Don't think about it; feel it. "The wisdom in your hands is greater than the wisdom in your head will ever be" (Scharmer 2004b). That is the key principle we are working with.

3.3 Serendipity

The contemporary working activities imply such king of working life where you every day meet new unexpected people, visit new places, find new interesting things which never wanted to find and even never thought about. This is the way of working in new knowledge society, where working environment is full of *Serendipity*. The translation of this word from Russian is something like "intuitive astuteness", but the best definition to my mind is from Wikipedia: Serendipity is the "art of finding what we are not looking for by looking for what we are not finding" (Wikipedia 2004). In other words it is an accidental finding of something unexpected and useful while searching for something else entirely. For example, the discovery of the antibacterial properties of penicillin by Alexander Fleming was serendipitous, because he was merely cleaning his laboratory when he discovered that the *Penicillium* mould had contaminated one of his old experiments.

The word *Serendipity* was coined by British writer Horace Walpole in the 18th century from the tale "The Three Princes of Serendip" where the heroes make discoveries accidentally. The word *Serendipity* belongs to one of the ten English words which were admitted in June 2004 by British Translation Company like hardest to translate.

Serendipity has been recently used in connection with Internet, since the large quantity of available information provides chances to find unexpected relevant information

while surfing the web. In Science one speaks about serendipity when the discovery is made by reasons alien to the established research experiments.

The Knowledge Worker's way of everyday life and work is such that he meets new situations frequently and occasionally. Due to working in different places, everyday meetings with new people his life becomes full of serendipity. How to support such activities? How to gain from living and working in such way? These are the questions that turn the way of thinking to the more technological issues concerning the essence of mobile work e-work and connected to it technologies.

3.4 e-work: technologies for hybrid environment

Technologies are increasingly enabling intensive support for knowledge work, far beyond the scope of traditional work with PC. For example WLAN networks provide the necessary mobility in accessing information in flexible working environment. Using Internet all members of project teams are able to access document management systems and work together from different locations. New search algorithms help the user to find relevant information in a structured way. Thus, the electronic design of the world of work is not less important than all other aspects.

The central question is how to make it possible to use innovative information and communication technologies to achieve positive effects in creative work and to integrate them in the hybrid environment so that they would not scare the user with their complexity, but could be perceived by human like real assistant.

The users of such innovative environment should be freed from routine jobs and setup times in order to be able to concentrate upon the essentials of their job. Thus the task in introducing new technologies is to define the functionalities for efficient work support on an individual basis, suitable for the task in hand.

3.5 Mobile Work

A crucial issue in contemporary way of working is that the significant part of knowledge workers is no longer based on fixed location to carry out their responsibilities. Their tasks are done in different places as required. In one of the researches of Office21 project three discrete *work types* were defined (Spath 2003): *Stationary* which implies work at the desk; *Rotative* where work is done mostly in the office, but in different places within it; and *Mobile & Variable* that means often work out

of office and often travelling. According to these types, different technologies and equipment is needed to provide an access to information at any time in any place. Users in the *Rotative* work type category need it anywhere within their working environment. For example during a meeting in the meeting zone a secure Wireless LAN can be used. In the nearest future WLAN will be as secure as fast, so that it will be possible to work with multimedia and with sensitive data. For *Mobile* users both in-house and out-side wireless transfer technologies are needed. Even ad-hoc information exchange must be possible, for instance with the help of quickly installed peer-to-peer networks, involving outside project stuff who are not connected to the company network.

Besides this aspect of information exchange there is also one that concerns the communication between mobile devices, whether from PDA to notebook, from notebook to mobile telephone, or from digital camera to notebook. Bluetooth standards offer technology to achieve this. A new development in this field is "ZigBee" control/sensor network standard (ZigBee Alliance 2004) that was designed to enable reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard. The overall idea of ZigBee technology is to provide the ultimate flexibility, mobility, and ease of use for every day devices by embedding wireless intelligence and capabilities into it.

Using so-called Wireless LAN Hotspots, it will be possible for mobile workers whether they are on a train or in an aircraft to securely access company information. In addition to this, new mobile telephony standards – for instance, UMTS – will create rapid access in competition with WLAN Hotspots. This kind of access has the advantage that, on the one hand, it will be available in rural areas, and on the other it will enable information to be accessed in moving traffic.

3.6 Intuitive and ergonomic HCI

What kind of devices do we use at present to communicate with computer? Keyboard to input the information and mouse for control and configuration. They do have some disadvantages, caused, among other things, by the fact that for human being they do not represent a natural form of interaction. Moreover, for many purposes the input devices available today are unsuitable – for example, the mouse is not suitable for exact positioning. Today's input methods do not always meet user requirements. The

application in whole should be related to the overall purpose for which it is being used, the place in which it is being used and the preferences of the user. For example in private working a voice dictation could be used for inputting the text; during a meeting with several people one can use an inputting via a pen with reliable hand-writing recognition. Interactive surfaces or "intelligent pens" will be able to spontaneously visualize the ideas and record them. The main challenge is to analyze the methods of working in such a new environment and work requirements in order to provide the precise opportunities for interaction which will make the user's job easier and save him time and energy to other work.

Except the use of voice-based input and output it is conceivable that in the more distant future there may be intelligent systems which the user can control by means of expression and gesture. For example, spaces could react to the user and display information at his request in the direction in which he is looking.

Possibilities for output also play a central role. For instance, flexible working in office environments requires information to be displayed exactly where the user or team is working. For mobile users new display technologies, for example, Organic Light-Emitting Displays (OLED), provide a clear improvement in display quality because the displays are brighter, and at the same time the electricity consumption is lower.

3.7 Security services

A crucial element in the success of any innovations is the security of the services. The increasingly mobile working and the associated transmission of confidential information demands the close attention to the security issues. Because the transferred data and documents will then be stored on mobile devices which are not always subject to the control of the company and the users, attention must be also paid to the security of the equipment. Who has authorized access to the data during the transfer and after it is filed? Is the sender actually the person who was expected? And is his document original, and has not been tampered with? Are the working environment and the software protected in such a way that unauthorized persons cannot obtain access to the data and the equipment? In the event of loss or theft of mobile equipment is there an effective system of security for the data and documents? These are not new questions. The more the following aspects are conceptually resolved and implemented to a high

standard, the grater the security of the business process. One important aspect of security is the confidentiality of data. This is ensured by data encryption, transfer encryption, access protection and access control. The identities of person can be checked using digital signatures, smart card technologies, and also biometric procedures.

All these questions gain new significance because of required mobility of working. By data encryption or by concealing the important information it is possible to protect it efficiently against unauthorized access. Only someone who knows the right decryption code can read the data. Also the smart cards with biometric authorization can be used to check personal characteristics of the user, such as fingerprints. Protection against tampering with documents can be achieved by means of electronic signatures. It is similarly possible to use the biometric procedures to access mobile and private equipment and sensitive areas. Depending upon the specific purpose, voice recognition, facial and iris scans and other procedures can be used. At last, regular data back-ups, especially for mobile devices, can guarantee that there will be no loss of data security by the increasing use of mobile and flexible working.

3.8 Tracking and Identification

All the services and any kind of information can be provided to the user wherever he is at the given moment. To recognize the position of the user, cameras or so-called positioning systems can be used. These enable the user to be recognized by means of an active or passive "personal tag", which is assigned to him personally, and which he carries with him. The tag transmits the information to the antennae or sensors in the workspace. If several users are in the same area, these must be individually recognized by the working environment and served on an individual basis. In this way every user receives his information at the right location. This can be done for instance by using colour histograms of hands and faces (Spath 2003). Such approach comes from the research area called "emotion-based computing systems" that is very popular now and actively studied. There was no yet any market launch of such system, but even today similar concepts could be implemented using just mentioned positioning system that provides accuracy around few centimetres.

There are several technologies that could be used for user tracking and identification while being at the workspace: infrared sensors, Bluetooth, GPS, RFID and some others.

3.8.1 GPS

The Global Positioning System (GPS) is a satellite-based navigation system (Garmin 2005). GPS satellites move around the earth and transmit signal information to GPS receivers which use this information to calculate the user's exact location. Measuring the time of signal transmission from the satellite to the earth, the GPS receiver determines how far away the satellite is. Using distance measurements from several satellites, the receiver can determine the user's position. A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination and others.

The accuracy of the latest GPS receivers is very high and amounts three to five meters. This is good, but not enough for indoor applications. Moreover, GPS signal does not typically work indoors because the signal strength is too low to penetrate a building (Pateli et al. 2005). In spite of this fact, there exists an indoor GPS solution that can be applicable to wide space areas where no significant barriers exist. Indoor GPS takes into account the low power consumption and small size requirements of wireless access devices, such as mobile phones and handheld computers. Latest innovations in this area have delivered receivers to the size of a stamp. The small footprint combined with ultra-low power consumption and low cost make the indoor GPS positioning system feasible for tracking in the workspace.

3.8.2 RFID

RFID is a method of remotely storing and retrieving data using devices called *RFID tags* (Wikipedia 2004). RFID tag is a small device that can be attached to or embedded into a product. It contains antennas for receiving and responding to radio-frequency queries from an RFID transceiver. RFID tags can be either *active* or *passive* (Table 3).

Table 3. Passive and active RFID tags

Passive RFID tags	Active RFID tags
• do not have their own power supply (necessary for response power is provided by incoming radio-frequency scan); • the response is brief, typically just an ID number (due to power and cost reasons); • device is quite small: the smallest (2004) commercially available tag can be embedded under the skin (0.4×0.4 mm, and thinner than a sheet of paper); such devices are practically invisible; • practical read ranges are small: from about 10 mm up to about 5 metres, • the cost of one tag is about $0.25; the aim is to reach a cost less than $0.05	• have a power source; • have longer ranges; • have larger memories than passive tags (the ability to store additional information sent by the transceiver); • the smallest active tags are about the size of a coin; • many active tags have practical ranges of tens of metres, and a battery life of up to several years.

3.8.3 Bluetooth

As to Personal Area Networks (PAN), Bluetooth is one of the technologies of the future (Toshiba 2004). This technology provides a simple wireless connection between different types of end devices (e.g. a mobile phone and PDA).

In combination with RFID or WLAN, Bluetooth can be used for tracking. Using RFID tags and Bluetooth enabled RFID reader, it is possible to transfer data to other Bluetooth devices (Blueserker 2004).

The tags can be Bluetooth-based as well. (Yoshida 2003). Through wireless access points – combined with Bluetooth/WLAN technologies – installed throughout the working space, the tracking system allow quickly determine the location of the person. The tracking system can use dual Wireless LAN and Bluetooth technologies in its access points. Bluetooth is used for wirelessly tracking the tag, while WLAN forwards the captured data to the database.

There are several benefits of Bluetooth over other wireless schemes such as RFID. Passive RFID tags work only at distances of a meter or two. The capacity of RFID readers to read several tags simultaneously is also limited. Active RFID tags could track

30 to 40 objects per antenna, but this technology would not be suitable to handle an overflow crowd.

Bluetooth, in contrast, can track hundreds of tags at the same time. One more advantage is the robustness of Bluetooth's frequency hopping-based radio against extraneous noise and mechanical interference. A Bluetooth network also offers the option of adding other Bluetooth-based devices, such as mobile phones and PDAs, as access devices to interact with the information generated by the tracking system.

3.9 Conclusion

The new working ways of people who belong to Knowledge Society demands new theories to implement and new technologies to provide in purpose to create an innovative hybrid space in such a way that it would support the natural human activities in both virtual and physical environments. This chapter had an aim to give a common comprehension of how contemporary worker moves in Knowledge Society circle and how innovative technologies fit in those movements. Human networks, new technologies and tools for communication could help in knowledge work and new knowledge creation, in exchanging ideas and finding allies. The next stage is to find the successful implementations of all the ideas concerning hybrid space creation, new working methods and new technologies utilization and natural virtual-real blending. The next chapter is devoted to these purposes.

4 Ideas from outside

Creation of something new is always inspired by already existed things, theories, by something that is known and can be described. It is astonishing however that the same ideas can come to the mind of several people simultaneously. There is not rare occurrence when the same invention is done at absolutely different places in the world by completely unacquainted with each other people.

In the world of designing workplaces the situation as not different from just described. There are a lot of projects devoted to creation the working environments with all possibilities for people to feel themselves comfortable during their work. In this chapter some projects related to NetWork Oasis are outlined. One of them – SANE project – is considered in more details due to the similarity of ideas.

4.1 Office21

Office21 is a project of Fraunhofer Institute for Industrial Engieering IAO (Office 21 2004). The purpose of this project is the creative office concept development. There are a lot of different works under this project that devoted to the investigation of different forms of working and factors that influence an office performance, to the development of office landscape, different software tools for productivity analysis, innovative application scenarios and many others. Desk sharing, mobile working, video conferencing, WLAN, multimedia workstations and the "Interactive Creativity Landscape" are only some of the interesting examples. The main questions of the project are "What will tomorrow world look like?", "How will we live and work?", "How will our working environment be designed?"

What are we waiting from our future office environment? Electronic paper, flexible transparency displays, nanocomputers, tiny, almost invisible sensors, wireless networking with completely new types of equipment (Spath 2003). The computer will be omnipresent, but as a result of further development in miniaturization, will no longer be visible. High-resolution displays, voice entry and gesture recognition are the interfaces between human beings and machines. But even the latest technologies and the most progressive networks would be inefficient without the motivation of knowledge workers. The creativity is the basis for success. The ways of increasing creativity and inspiration, and raising mental and physical productivity affect the

changes in office architecture and hence in working and living environment organization.

The GENIUS II is the scenario that describes the future day of knowledge worker. Imagine a person Victor, a project manager of the construction company. He waked up in the morning, read his digital daily newspaper from the paper-like display and decided to drive into office because of meeting with his team. On the way to office Victor switches to autopilot and talks with his virtual assistant. This is a special computer program which has stored Victor's profile in its memory and acts like a secretary: performs a lot of onerous routine tasks, such as making bookings for trips, dealing with his mailbox and organizing his appointments. Victor is proud of his work and identifies himself with the company, with the building where he works, with its exclusive and expensive design. When he arrives at the office, he immediately puts his I-card into the sensor to identify himself. Clearly identified by means of biosensors, Victor is given access to all relevant areas, both spatial and virtual. The I-card also provides Victor with automatic control of the use of space and the atmosphere within it. Throughout the building rapid access to the net is always guaranteed via Bluetooth and WLAN.

The project teams in the company are assembled on an ad-hoc individual basis. They are located in different working environments on the different floors of the building. The structures of the offices in the building are partly open and communicative and partly closed and self-contained. This mixture of different office configurations gives the possibility for individuals to choose that where they feel the greatest freedom of action. Victor has to keep a cool head and concentrate on the essentials. He goes into one of the isolated thinking cells. Thanks to I-card, the space automatically adjusts to Victor's preferences for spatial values, such as light, temperature and how often these values change. On the wall-sized display Victor once again runs over the central planning information, he controls the flow of information with a mixture of directions given by eye, by gesture and by voice. Here the virtual assistant is also a reliable partner, he puts through to Victor only some selected important telephone calls.

After that Victor meets his colleagues who are working under the virtual model of the stadium in the special room. The windows darken and the model of the stadium hovers in the room, immersing the observers into virtual world. By means of this spatial model

the initial planning errors are quickly corrected. In parallel to the interactive changes made on the digital model, the bills of materials and calculations are automatically altered and simultaneously displayed. Soon the project is once again back within budget.

Now it's time to prepare for the meeting and to work out a strategy for the discussion. Victor goes to the creative area where, stimulated by measures designed to promote creativity, he quickly develops some good ideas and finds a successful concept. The rest of time before the meeting Victor spends in recreational area. He knows how important to be fresh and effective during the discussion with his project partners. After refreshing bath he visits the mediation area with fifteen minutes of autogenous training Victor prepares himself mentally for the crucial discussions.

In the meeting area the participants from overseas are connected via the large monitors. Information is directly exchanged between all the participants. Other languages are immediately translated faultlessly and almost instantaneously by the integrated by the integrated digital language assistant.

After the meeting Victor drives home. It is true today and it definitely will be in future, that a carefully-organized work-life balance helps to keep body and mind healthy.

4.2 eOffice

eOffice is a contemporary workspace in London with the latest technology that provides easy, flexible and cost effective office solutions with the benefit of state-of-the-art technology and nicely designed interiors (eOffice 2000). This is an innovative office space that includes all possibilities for individuals and small businesses. It basically concentrates on office interior, equipment and technologies. It includes advanced furniture systems, State-of-the-art environment (relaxing spaces, private rooms, etc), well-equipped meeting facilities, all security needs. eOffice facilitates networking among members in a professional but friendly and relaxed atmosphere. It includes a wide range of office options, from "virtual offices" where clients get a business address and a dedicated answering service to fully equipped workstations with high speed internet connection.

Pier Paolo Mucelli (Mucelli 2004), the head of eOffice, told that during his travels he "noticed the different standards in office environments, in particular in terms of

technology. Technology has had a critical impact on the way business is done and office space is managed. The office is changing from a physical place where you receive and store your information to an environment where you exchange ideas with colleagues and meet clients, suppliers and partners".

4.3 OOTF

Office Of The Future (OOTF 2004) is a project from University of North Carolina that has as a goal to develop a graphical display environment and 3D tele-immersion capabilities that allow distant people to feel like they are together in the same office space.

The basic idea of tele-immersion technology is to use per-pixel depth and reflectance information from visible surfaces in the office (walls, furniture, objects and people). Using this information one could then display (project) images on the surfaces. Distant collaborators can see each other through a large "window" in the connecting wall (automatically reconfigurable, wide-area, high-resolution display wall). Using of 8 projectors each with a computer-controlled pan, tilt and zoom adjustment for one image displaying allows creating geometrically and photometrically correct vision.

4.4 SANE project

SANE (Sustainable Accommodation for the New Economy) was a two-year multi-disciplinary research project supported by the European Commission. It was set up to consider the combined impact of the new economy on place, people and processes; and its objective was to enable space designers, technology developers and other professionals concerned with the workplace to move from a location-centric to a location-independent approach. The key operational goal of the project was to develop a united framework for the creation of sustainable, collaborative workplace for knowledge workers, encompassing both virtual and physical spaces.

This project has almost the same purpose and the same ideas that are going to be realized in the netWork Oasis. This is the reason to consider it in more details.

4.4.1 From working place to working environment

Physical space can be considered as one of all available natural resources, but there exist one significant difference: it can be infinitely reused over time and the act of

consumption doesn't destroy the resource. The difficult is that the industrial revolution causes the excessive use and lack of physical space for human purposes. The digital revolution allows avoiding this problem, providing a new realm of space – virtual, that is supported by contemporary technologies and capable to extend the physical environment virtually and infinitely.

Virtual environments give opportunities for the development of new forms of co-operation and collaboration. Nevertheless, these developments should take into account that the physical world remains an integrated part of the whole environment we experience. The main challenge that appears in connection with the design and management of such environment is how to utilize the strengths of both the physical and virtual environments, how to create a hybrid space, a new integrated working/learning environment that matches the needs of individuals and organizations.

The focus on knowledge work and increasing productivity leads to increased emphasis on creating the new working spaces. The latest technologies enable people to work anywhere, but the fact remains that people always choose to work somewhere. The factors that affect their choice have changed: there is no longer any need to be in specific place in order to have an access to information or to communicate with colleagues. Other factors become critical. The social importance of the workplace is increasingly emphasized. Human beings are social animals: we need to contact with others to give us a sense of purpose and worth. The use of technologies and virtual communities suggest new forms of social interaction. The increased range of possibilities that the latest and emerging technologies provide allow individuals and organizations to use hybrid environments in different ways by their choice to satisfy professional and social needs. The increased social role of the workplace will probably continue to blur the division between work and leisure. Some organizations has already admitted this blurring, and promote a "homing at work" rather that "working at home" strategy. It can lead to breaking down traditional components of work and office space to introduce domestic and social elements.

Within this new work/life culture the balance between employer and employee will need to be renegotiated. Through the last half of the twentieth century an expressions such as "9-to-5" reflected the main aspect of the normal working day, and working time

outside these limits considered overtime. The idea of "24/7" (working round the clock 7 days a week) that appears when speaking about "work facilities available everywhere", potentially threatens this consensus. In this context the mechanisms of work/life culture controlling should be radically rethought. A new consensus reflecting the interests of all must be constructed. Office is not merely a place of information and control, but a place for stimulating intellect and creativity. The office has to provide high quality and innovative features to be attractive for its workers and has to respond to the demands for healthy space.

The term of "workplace" should be redefined. It needs to be broadened from the narrow focus of the office building, to incorporate the various work environments and new ways of working. Rather than speaking about "workplace" it is important to talk about "working environment" – the creative space for knowledge workers.

With the rise of knowledge work, the provision of spaces for collaborative work is becoming more important. In context of knowledge work a single (an all-purpose) workstation is no longer sufficient. The idea is to offer a wide variety of spaces to accommodate the range of specialist activities within an organization. Staff should be able to move between alternative spaces that are suitable for their tasks along the day:

- small rooms/booths for concentrated work, or confidential telephone calls;

- open areas for informal meetings;

- quiet open plan areas;

- touch-down desks for ad-hoc or short-term users.

4.4.2 Idea of "flexiwork"

Current trend in Europe is so that workers use computers and telecommunications for flexible work (telework), working part time at home, part time in the office, and also working on portable computers on trains, airplanes and hotels or in shared facility centers. This type of telework is called "flexiwork" or "e-work", which means work performed "everywhere". The knowledge work in future will no longer take place just at the single workstation – in the owned office – but at multiple locations.

In spite of the fact that workers may use different locations for working purposes, the social interaction in physical space is necessary; and the following statements reflect mobile workers' motivation for coming to the office:

"They want to come to the office at least several tomes a week, not because it has specialized equipment or they have insufficient space at home, but because they miss camaraderie and social interaction at the office. They miss the opportunities for tacit learning, and for mentoring; the opportunities to get clear direction about the projects they are working on, and timely feedback about the progress they are making. They miss the energy that motivates them, and makes work tolerable, if not fun and exciting. People also come to office to concentrate". (Harrison et al 2004)

From here we can see that even in the context of remote working, face-to-face contacts are important for activities such as tacit learning and mentoring as well as making contact and networking. The described way of working leads to a new interpretation of the term "office", which goes beyond the traditional understanding of office spaces. In this context "office" may be any public or private place used for working purposes.

4.4.3 Integrating physical and virtual spaces

Over time, the visibility of technology diminishes. According to Weisner *"the most profound technologies are those that disappear – they weave themselves into the fabric of everyday life until they are indistinguishable from it"* (Weisner 1991).

As technologies become increasingly integrated into physical realm, we move towards the idea of hybrid spaces that encompasses both physical and virtual spaces. Acting within a hybrid space can be described as "any scenario in which an activity is executed in a combination of physical and virtual realm where ICT is an implicit and necessary component in the completion of that activity".

In the vision of future office, ICT will have two important functions – supporting interactions between knowledge workers and bringing a new quality to working and meeting rooms. Electronic wallpapers, for example, help to create knowledge-landscapes, changing space into virtual project offices, or enabling the transference of knowledge in other creative spaces. Workflow and document management systems, electronic brainstorming tools and live boards will increasingly change work processes in future office environments.

4.4.4 Efficiency vs. effectiveness

The development of the discipline of environmental psychology gave a fresh impetus to the idea of measuring the effects of the workplace. A lot of studies were devoted to the idea of increasing efficiency through the better design, increasing density, intensifying space use, etc. But in 1980s European companies began to realize that an emphasis on "efficiency" in the workplace was not enough; indeed, it can push the organization in the opposite direction to that of better profits and more effective operations as a whole. The intense focus on efficiency and cost saving had been, for many organizations, counter-productive. The focus on efficiency had been masking the need to focus on some broader measure of the contribution of people's work to the organization as a whole. Peter Drucker sums up this distinction succinctly: from concentrating on efficiency, the focus switched to effectiveness – from "doing things right" to "doing the right things" (Drucker 1966).

What exactly do we mean by "effectiveness"? It can be described it as a focus on:

- increasing value;

- using space to its full potential;

- having the right range of work settings to match the different types of work carried out;

- making the most of people.

The focus on effectiveness reflects many changes in organizational style and priorities. The importance of horizontal interaction across organizational divisions is highly increased, so that the value of interaction among staff members is now recognized much more clearly. People in organizations are enabled by technology to have a high degree of autonomy and use face-to-face interaction to improve their business transactions. The kind of workplace that truly supports this kind of business environment becomes a place for stimulating intellect and creativity. The focus moves towards enabling the knowledge worker to perform at their best. But this again raises the question of what is the knowledge worker's "best" and how can we identify when the working environment is contributing or hindering their work?

The workplace should be considered not only in terms of effectiveness ("doing the right things"), but also in the context of idea of workplace sustainability. To be effective in longer term, workplaces must contribute to the health and well-being of the organization, its stuff, its colleagues and the wider economic and social environment.

4.4.5 The distributed workspace model

The overall aim of the SANE project was the development of a united framework of space, human environment, processes and tools that are used for creation of collaborative workspaces for knowledge workers, encompassing both virtual and physical spaces.

Initial distributed workspace model emphasizing the importance of hybrid workspaces is shown on the Fig. 4.1.
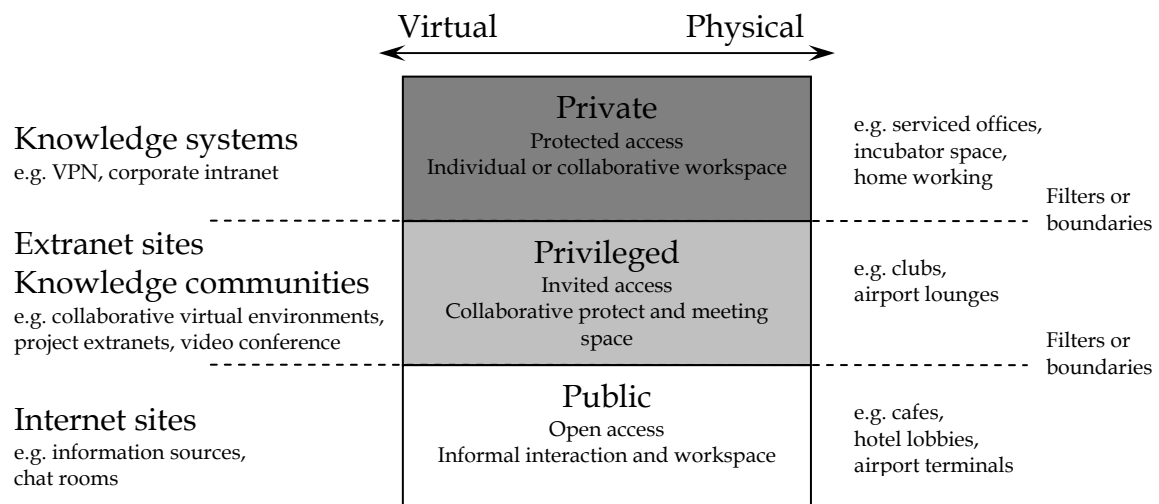
Fig. 4.1   Distributed workspace model

The workspace model that emphasizes the importance of hybrid work environments is based on the tripartite split of private, privileged and public spaces, and applied at two scales of focus: the virtual and the physical workplace and also to the larger scale environment in which knowledge work takes place, from the office building up to the scale of the entire city. The model must not only acknowledge but must focus on the way in which the limitations of a particular physical space can be overcome by the use of virtual worksettings.

In the past, descriptions of work activities have been generally connected with the medium through which the activity was carried out. Nowadays this way of thinking is

no longer appropriate for knowledge work. The means by which an activity is fulfilled is not a crucial moment any more. For example, a telephone conversation and a one-to-one video-conference can both be used for the same activity. A new approach to knowledge work activities is therefore needed – one that is independent of the medium, tool or communication channel used to carry out the activity.

The list of knowledge work activities that has been developed by experienced workplace professionals is presented in the Table 4.1.

Table 4.1. Knowledge work activities

Thinking	This is a prop-free work, involving only oneself and one's thought
Head down, concentrated work	This involves the use of electronic or paper-based documents or drawings; it is by definition an individual activity
Routine processing	This includes process (i.e. low concentration) computer work, filing, organizing, sorting, etc.
Collaborative thinking	Concentrated work in a group – a specific type of meeting
Other meeting/collaboration	Other types of meeting including counseling, disciplining, negotiating, presenting
Ad hoc informal interaction	Making contact; short unplanned interaction or collaboration

It's not an absolute categorization. There are many entities which do not fall into the precise cognitive categories that are created. For example is a telephone call an individual or a group activity? The right categorization should be determined pragmatically.

4.4.6 Workscape idea

The physical landscape of work can be described in three parts – work environment, work arena, work setting. Each is defined in scale and context in relation to others. A work setting (such as "an L-shaped desk and chair" or "a sofa") cannot be estimated without taking into account its surrounding context – the particular work arena (the collection of work settings which make up a coherent "place" both physically and

psychologically) in which the setting is located. In distributed workplace model not only work arena but also the wider work environment is taken into account. The reason is that activities that earlier took place in a single physical space, now can be performed even if one or more of the participants are in different locations. Virtual or hybrid work settings must also be included into understanding of the workplace. The combination of virtual and real work settings within a work arena, located in a work environment, is being described as *"the workscape"*. The workscape structure and some examples of its components are shown on Fig. 4.2.

Work setting	Work arena	Work environment

physical
    L-shaped desk and chair
    Small table/for 3-4
    Large table/for 6-8
    Sofa
    Quiet booth
    Browsery
    Seat
 	
virtual
    Video conference
    Instant messaging
    Shared visualization
    Chat room
    e-whiteboard
    e-mail
    VR world / avatar
    Text message
    Voicemail
	Team/project area
	Business lounge
	Club
	Café
	Picnic area
	Meeting room
	Meeting area
	Individual office
		Organization office
		Serviced office
		Business center
		Airport
		Railway station
		Street/city
		Park
		Transportation (train, plane, car)
		Home

WORKSCAPE

Fig. 4.2   The workscape structure

The same work setting can have different meanings depending upon a work arena and work environment within which it exists. These different workscapes will facilitate different types of activities. It is paramount to be able to establish the right kind of work environment for the activity.

In the traditional approach to designing workplaces, there exist a direct correspondence between activities and the physical work setting that best support them. Due to new technologies, the dominance of the physical setting in workscapes is eliminated across space and time, enabling a knowledge worker on one side of the globe to leave messages (text, voice, avatar or video), share documents, develop ideas (using for

example electronic whiteboards) or "meet" (via video-conference or teleconference) with colleagues on the other side of the globe. A decision what is the "best" setting for a particular activity thus involves consideration of the virtual work settings through which that activity can be carried out.

4.4.7 Implementation strategy

Using described concepts, it is possible now to construct a methodology for the creation and implementation of a distributed workspace strategy. This is divided into three parts: a methodology of place, of ICT elements and human factors considerations. Fig. 4.3 summarizes the process of creating a *methodology of place*.
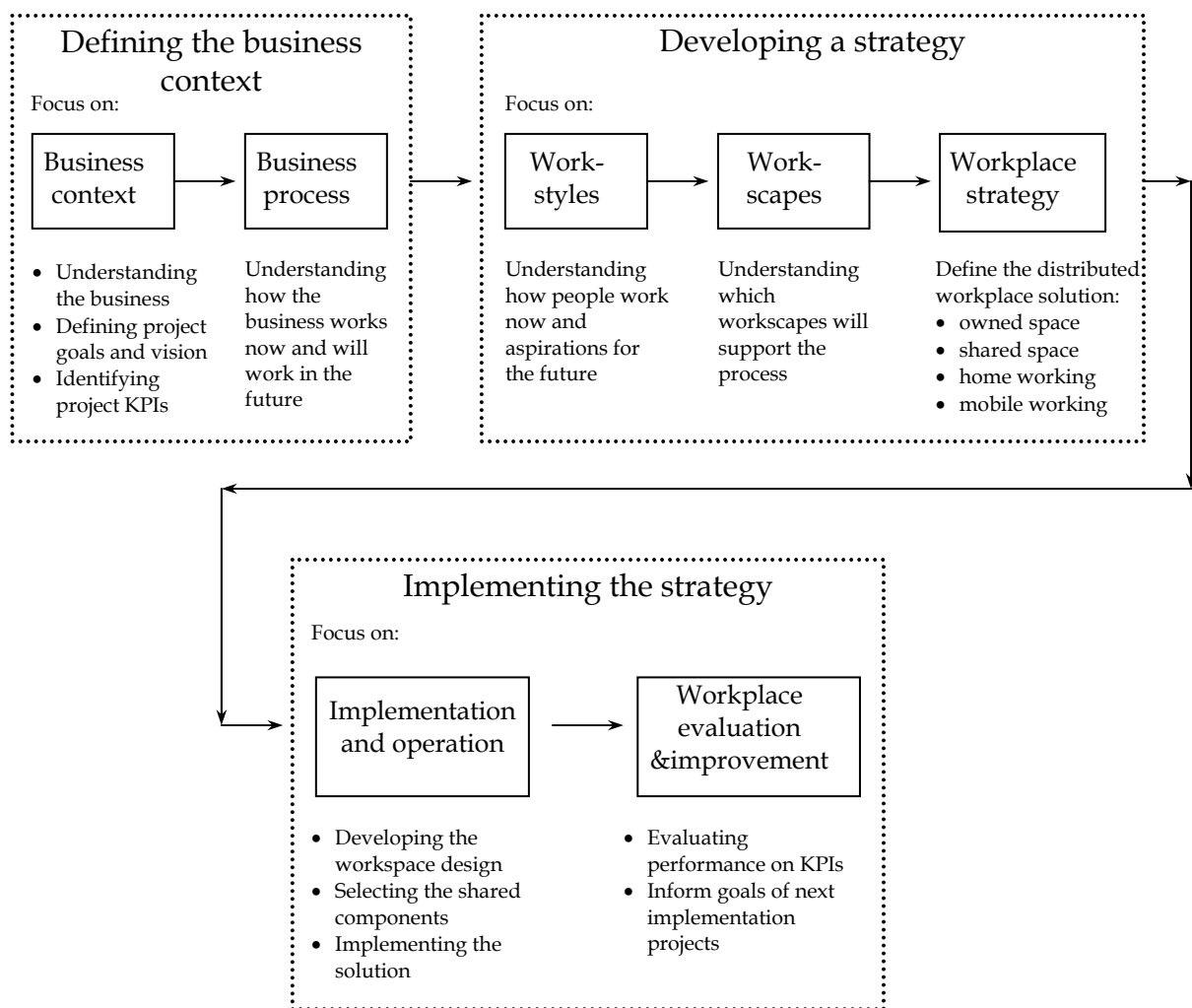
Fig. 4.3   The distributed workplace creation

The key *ICT issues* are concerned with availability and integration of services and impact of wireless technologies. The internet, and broadband in particular, has now become the foundation for the new economy with businesses of all sizes. With the convergence of the internet and mobile communications, m-commerce (mobile) is

becoming a key facet of e-commerce. It allows transactions and service delivery both in the business-to-customer and the business-to-business area, via a mobile telecommunications network.

Convergence of services is happening primarily through the use of internet protocol (IP). IP networks now support voice transmission (VoIP). The convergence of voice with data applications offer users more advanced applications. The possibilities of combining voice, data, fax and video are endless. There is a little doubt that in the nearest future it will be possible to utilize one terminal that will combine PC, telephone, television, video-conferencing and internet applications.

The wireless sector of telecommunications is the most rapidly developed area of communications. The reason and motivation is to have an access to information anyplace, anytime and anywhere. Two categories of wireless technologies are developed: mobile cellular communications (GSM, HSCSD, GPRS, and 3G) and Wireless LAN (IEEE 802.11b).

The topic of effective *human communications and collaboration* within and between teams of knowledge workers has been a major area of research in organizational psychology and computer mediated communications and has resulted in theories such as *social presence theory* – in which social presence can be defined "as the degree to which a medium is perceived to convey the actual presence of communicating participants" – and media richness theory. *Media richness theory* claims that different communication media can be classified according to their ability to convey knowledge and information.

Choosing one single medium for any task may prove less effective than choosing a medium or a set of media which the group uses at different times in performing the task.

Models of human communication can be used as part of the implementation process to explore work process at both the group and individual level. This should provide insights that will lead to the specification or use of appropriate workscapes and technologies to support the knowledge workers wherever they are working.

4.4.8 Organizational culture

The knowledge worker is now a valuable asset to the organization. Knowledge workers can be defined as the people in companies who make judgments; they have the know-

how and know-why of the businesses, acquired through training, experience or both. Their judgments and decision translate to actions that establish the policy and competence of the operation. Knowledge workers receive information, assimilate it, decide what to do and execute decisions (Fig. 4.4).
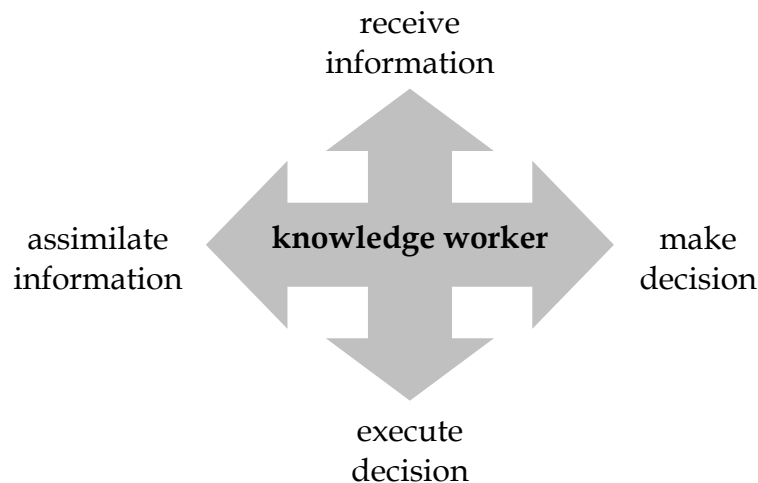
Fig. 4.4   Knowledge worker activities

Knowledge workers work with knowledge, both their own and that of other knowledge workers communicated through information systems and artifacts. As the information age continues, the rise of knowledge management will continue and the rise of knowledge worker as well. This shift has created a need for organizational cultures to support a sharing of knowledge and creating a knowledge culture.

A new corporate structure needs to be very loose and flexible, less hierarchical and with more opportunity for people to play different roles. Knowledge workers will move between teams, sometimes as team leader and sometimes as team member.

Knowledge workers are at the vanguard of a new style of work that is more autonomous, and a new style of management required. Rather than relying on controls, it is relying on people's own mental abilities to get the job done. Managers need to trust judgment, creativity and imagination. Rather than ordering and directing, management needs to concentrate on a coaching and encouraging.

Location independent working requires a degree of trust between employer and employee. Managing a virtual workforce raises the question for traditional managers:

"how can I manage them if I can't see them?" This leads to result-oriented approach of working.

Remote working can lead to feelings of isolation and employee can see themselves as working outside the corporate culture. A lack of integration of remote workers to the daily working life on site can be a problem if performance and behavior are not clearly defined. Video-conferencing, voice-mail, electronic live-boards, the Internet and intranets, groupware, virtual team rooms and web cams are just some of the technologies that enable people to work together no matter where they are based. Four team basics are identified as essential to the good performance of the team: the team must have complementary skills, establish goals, agree a common approach and a common purpose.

4.4.9 Workspace change management

Workplace change management can be defined as a structured program of interventions, activities and communications developed to encourage and support appropriate staff involvement in the design process. It is focuses on the people aspects of the workplace change, and on the emotional reaction to such changes.

In order to structure an appropriate workplace change program, it is necessary first to understand the likely reaction of the organization, or part of the organization, to the change event. Twynstra Gudde from the Netherlands developed a change framework for selecting appropriate change management approach fro different types of organizational culture (Table 4.2):

Table 4.2. Change management approach

Five perspectives (colours) on change

• Blue	logical, linear	*how do we get there?*
• Red	seduction, incentives	*what's in it for me?*
• Yellow	negotiation and agreement	*is everybody happy?*
• Green	learning through experience	*can I see/try it first?*
• white	ad-hoc and opportunistic	*if it feels right, let's just do it, shall we?*

what sort of predominant colour are the people in your organization?

does your change program recognize the respond to all these possible perspectives an how change can happen or are you alienating anyone?

For example it would be ineffective to implement a "white" approach (culture based on experimentation and feelings) to a solution with a group of project managers who are focused on milestones, critical paths and success factors (which is very "blue"). It is also important to note that organizations are likely to be "multi-colored", so a range of approaches and activities are likely to be needed to maximize the chance of success. These activities and approaches may include: interviews, presentations, questionnaires, focus groups, tours, exercises, clinics, mock-ups and pilot implementations of the new physical and virtual workplaces.

People must be at the centre of any workplace change initiative: indeed, it has been said that "people, being the most important ingredient in the workplace, are key to your success – or the reason of your failure". It is necessary to determine the appropriate level of user involvement and to establish at what point in the life of the workplace project it is most appropriate to utilize which change management intervention and communication tool. There are a number of diagnostic exercises that can help with this decision process.

Involving the user in the design of their workplace creates a space of which they feel a belonging and pride. It is one of the most powerful tools for wider change that an organization can use, albeit also one of the most expensive and time-consuming.

4.5 What is missed?

All development projects that are considered in this chapter discuss the future of working place from different perspectives. Office21 concentrates on the user's creativity and productivity supporting them by providing suitable surrounding environment. eOffice provides a high technology workspaces both physical and virtual. OOTF suggests the tele-immersion technology for facilitating people communication and creating the effect of presence during the conversation with distant workmate. SANE project seems to meet all the requirements of future working environment, but even here there are some challenges and difficulties.

In all projects the main accent in office design is made on the use of new technologies, means of people communication, new methods of organizing the working space and the whole working environment, including virtual. But there are some elements that are missed. It is not enough to concentrate only on the latest technologies and ergonomics during the innovative office creating. To contribute all his potential to the task knowledge worker should feel himself comfortable in all senses. Contemporary ergonomic solutions and all working facilities are definitely necessary. Office21 and SANE projects have a step further development in innovative office design: they also take into consideration the psychological aspects of human work and all the stages of creative process. It appears in office planning that is performed according to the human working activities and the characteristic features of thinking process during each activity. What is missed in almost all the projects and works devoted to the creation of future working space is that there is no any allusion to the creation of community, a space where people will work together and feel together. The working environment should give person a sense of belonging to it, a sense of his importance. One should feel himself like a part of community, but still remain a strong personality. Everybody in such working atmosphere should be aware of everything that happens both inside the office and outside its physical location. The use of technologies and communication facilities should be directed to the creation of such integrated environment where physical office, virtual space and the mental aspects of human behavior during the working process are blended naturally and support the community spirit.

5 NetWork Oasis Glow

In this chapter we will consider the netWork Oasis concept; it's physical and virtual environments as the background for Glow ideas and the Glow itself like one of the main directions in network Oasis development. Here all the ideas of Oasis physical-virtual integration are provided, the Flexible Lab testing experience is described and some challenge questions are considered.

5.1 NetWork Oasis project: "glowing" background

NetWork Oasis (http://www.network-oasis.com/) by Joensuu Science Park (www.carelian.fi) is a project devoted to the development of a totally new kind of working environment. It has an aim to realize the recent ideas in new ways of working that support creativity, learning and working by playing, life-long learning, problem solving processes and easy networking.

There are several aspects of this project development: layout planning, virtual environment implementation and supporting, content production, business focus, and some others, but here we need to consider some special points. The understanding of gist of blending two realities – virtual and physical – is seemed to be impossible without careful consideration of physical and virtual environments separately.

5.1.1 Physical space: Layout and Interior

The physical Oasis space needs to be described here in purpose to give a comprehension of what kind of real working environment the person meets entering the Oasis.

The main idea of physical Oasis space is that the whole workplace can be used as a working area and a place for communication. There are no fixed places for anyone. Users of space seek for the best place for each working activity. Diversity of space is created to fulfil the needs of different work patterns. The whole idea of space division and distribution is connected with main activities that take place during the working process. Instead of building fixed offices for every person or a group, there are several areas, or zones, for different kinds of work activities and individual preferences for concentration. The idea of dividing the space in such a way is not new. It was suggested, for example, in the work *Interactive Creativity Landscape*" of Office21 project

(Spath 2003). This work presents a prototypical realization of future creative office. The concept idea is that all working space is divided into several zones that support creativity in both individual and team work. Human brain experts were involved into this research in purpose to study creative process at its different phases. There are 4 phases of intuitive creative thinking in creative process:

1) Preparation (problem definition, information retrieval)

2) Incubation (intuitive information combining, finding an approach to a solution)

3) Illumination (sudden inspiration that generates ideas subconsciously)

4) Evaluation (solution verification and more precise definition)

According to this, there were designed the main elements for every zone of creative area (room content, room design, equipment, ICT, light, floor, space division). There are 3 zones and each of them has its own specific function:

1) Action zone: for preparation phase. People meet here, communicate, collect information.

2) Interactive zone: for verification phase. Include different kinds of technical equipment for teamwork (checking, controlling, working on the solutions).

3) Recreation zone: for incubation and illumination phases. This is the area that can be adapted individually for providing relaxation that support subconscious solution searching and creativity.

The ideas that are going to be realized in Oasis are quite similar. The Oasis space will occupy the 4th floor in the new building of Joensuu Science Park, Finland. (The whole Oasis floor space is around 1200 square meters.) There are several rooms and spaces that compose the physical environment and all of them have special names, purposes and missions. The names origin from the Oasis way of thinking combined with the philosophy of ReSpace-concept created by Architects Hakanen & Ylaoutinen.

The physical Oasis Layout (Appendices 1-3) contains following spaces:

Hall of Potential

This is the place for free developing. Here you come when you just have a problem that you need to solve, but you do not even have the exact questions to answer. This is the

place for the strict problem definition, for the comprehension of the exact issues you're going to deal with, for making your problem narrower and strictly defined. The atmosphere in this space is such that supports for idea generating, creative thinking and serendipity. The atmosphere is dynamic and a certain amount of chaos is accepted.

Temple of Challenge

This is the most amazing Oasis space. This a large room that has one wall as a big window and others as a one single semicircle. The circled wall is a huge display that can show any kind of picture, movie or video that user wants to see. If you feel sad, just choose the online transmission from Las Vegas night club and have fun! If your thoughts are full of chaos and you need to calm down, choose the view of the swimming fish.

This room can have several different purposes. One can for example put his mind and thoughts in order, meet people or just have fun here. But the most prestigious purpose of the space is to create a common commitment in the chosen challenge during a teams' visit in Oasis.

Hall of Results

In this place all the ideas are collected and converted to solutions. Here one knows exactly what he is dealing with, what direction he needs to follow and what kind of questions he needs to answer. This is the room for searching the exact solutions. The atmosphere here is peaceful and quiet.

Dialoggias

These are the meeting rooms. From Greek *"dialogia"* translated like *"doubt"* and means *"to reason through"* (Towns 2004). The primary idea of *dialogismos* is *thinking through* or over as with one's self, or in one's mind. Hence it comes to mean, in the plural, *speculations* or *reasonings*. One can interpret this word in the other way by translating *"loggia"* from Italian. The translation means "porch" or "terrace". During the Italian Renaissance epoch *loggia* was a public space for meetings and communications. There could be one more possible interpretation of this notion: for me *dialogia* seems like the combination of two words: *dialogue* and *logic*. The new meaning could be like the logical dialog or conversation between several people that is exactly the thing people do during the meetings.

Tandem Chambers

Here are rooms for working in pairs (or in triples). The ergonomic design of these rooms is non-common: there is a table without tablelegs at full wall length, a bed where you can lie while thinking or discussing and a huge window that goes to forest and sky. These rooms are also for down-head working. On one wall there is white board and other brainstorming tools for problem solving. Here you can concentrate on your task, work along and be sure that nobody will disturb you.

Solo cabins

These are very small rooms for short-time private affairs. They are 130x120 square centimetres, have table for laptop and chair-like support for comfortable standing. These rooms have an Internet connection and a power supply. The use of such small room could be a private telephone call or some urgent work that should be done in private. They also serve as an important possibility to change ergonomic conditions for a while. The idea is to use these cabins also as "avatar make-up" room, i.e. for adjusting the user profile settings.

Co-cabins

These are small rooms to provide an easy access to a place for confidential discussion between two to four persons. According to recent studies the great deal of the breakthrough steps takes place in meetings between couples of experts. Places which enable these meetings, that often take place by chance without planning, should be found all over the work environment.

Serendipity Café

His is the place of pleasure, encounters and not only mental, but also physical food. Here is the most probable place to meet somebody or something that you really do not expect. The vital aspect in such place is human diversity. Furniture arrangements are designed to give visitor a possibility to find a suitable way of being: sitting-standing, alone-together, in open space or in a lounge. This place has furniture, designed for awaking tribe instincts like totem-stands, and also a special fireplace which is designed to shift our mindset into our primitive origins.

Kitchen

Here you can prepare for yourself and for anybody something to eat. There are rooms and facilities for two teams to prepare a "lasting supper". The joint preparing of the food is the process that makes people to feel relaxed and comfortable. Here is the very good place to make new acquaintances.

Peripatos

This is a corridor, or passage, that has 2 metres width and 9 metres high, and goes along the Oasis. Peripatos unites all the rooms of Oasis to a communicative structure. Design is made to stimulate human interaction in all possible ways. The huge wall is decorated with the paintings of Italian Renaissance epoch (Sandro Botticelli) and is used in visualisation purposes as an example of the desired expression. Peripatos is the first impression Oasis gives to the visitor. Uniqueness is very important factor in design. Visitor should be secured from associations with everyday life and prepared for new experiences.

"Peripatos" ("peripatetic" in English) is a Greek word that means "walk around" (Suzanne 1998). This is the name of the ancient path, the walkway that circled the Acropolis. The boulevards along the path were shaded by trees and everyone could feel himself hidden from strangers (Aristotle 2004). About 335 B.C. Aristotle has founded the Lyceum in Athens – a new school of scientific discussion based on the syllogism ("deductive reasoning in which a conclusion is derived from two premises"). Aristotle often discussed topics with his students while walking along the peripatos. The Greeks used this word to signify "learning while walking" in a place that is sheltered (Peripatos 2004). This is a "peripatos" manner of thinking, discussing and reasoning.

Due to the purpose of the Peripatos (connecting all the Oasis rooms) its role in Oasis could be compared with one of the parts of human brain – ***Corpus callosum*** (in Finnish "aivokurkiainen") – the thick bundle of nerves that connects two cerebral hemispheres (ADEAR 2005).

Terrace

This is the open-air space of Oasis one floor up of Oasis rooms. You can get there using winding stairs in the end of the Peripatos. Green plants growing on the Peripatos balcony are seen here from the eyelevel as well as the paintings on the Peripatos wall.

They create an atmosphere of home and summer even at the winter time. Imagine how startling could be the view of the tropical plants and sensual paintings from the one side and a winter landscape and Nordic lights on the sky on the other.

Music room

This is the room that has several music instruments. One come here and play if he wants and can do it. The stressless and concentration playing in a band gives to brain the rest from problem solving. On the other hand playing in a band is good way of getting to know each other.

Sauna

Here is a good place for relaxation and friendly meetings. This is the real essence of Finnish human being.

It is necessary not only to create different spaces for every activity; it is also important how those places are connected to each other and how much time do you need to reach any of them. The reason is in specific feature of human memory that restricts the living time of your idea or some thought by several minutes. The working space should be designed so that the user is able at any moment to find a place with suitable atmosphere according to the current condition of his mind and of the task he is dealing with.

5.1.2 Virtual space: the Garden

The Oasis Garden is a virtual place which supports the users before, during, and after their stay in physical Oasis (Concept Document 2005). The implementation of Garden is based on a multipurpose ASP (Application Service Provision) network solution, Discendum Optima, which is a commercial Finnish product (Fig. 5.1). The services that Garden provides are available everywhere in the world where Internet access is possible to reach.

Fig. 5.1 Oasis Garden

The entire Garden workspace can be divided between different customer groups. Every user or group can use all implemented features, but also can modify them for the special needs. A special virtual workspace or user ID is created in a couple of minutes. According to different requirements most of Garden features can be easily enabled or disabled. The basic Garden features and possibilities are:

a. *Content production and management*, which covers three reserved areas in Garden:

- Action Plans folder (includes time-schedules, plans, targets, shared calendar)

- Subgroup areas folder (dedicated for subgroups)

- Material folder (for project level material)

b. *Interaction*, which includes discussing, commenting, working together on a document and other types. There exist a main discussion list, a possibility to add a comment column to any document, and there is a possibility to give a writing permission for some selected document to some person or group.

User profile basis allows adding new advanced features easily. Most applicable additional features are follows: Web-editor, Image editor, tools for compiling questionnaires and tables, chat, voice-chat tool, different applications for discussion list (learning diary, idea collection), archiving service and some others.

Oasis Garden can support the user in any stage and any kind of the work: the storage of any kind of information, documentation and idea development, all negotiations between customers, preparatory work (for face-to-face meetings), knowledge sharing. During the meeting Oasis Garden can help in making notes, collecting ideas, getting experts' opinions via voice-chat and others. The virtual space is on of the basic helpers of Oasis member.

There is also one small, but important function that exists in Oasis Garden: here you can find a link to the virtual space that is designed and developed to support the natural virtual-real blending, Virtual Glow.

5.2 What is Glow?

Glow represents one of the research directions in netWork Oasis project that has an aim to create a unique interface between virtual environment and real life so that virtual side could be perceived by the user like integrated part of physical one, and vice versa. From human viewpoint it should be like a single whole that includes all possibilities for user to feel like there is no any line between virtuality and reality. There is a goal to develop such kind of environment that would support creativity, interactions and new knowledge creation processes. Such natural combination of real and virtual composes so-called hybrid space that gives possibilities for real and virtual communications, data and knowledge exchange and provides relaxed atmosphere and supports user-centred design. Hybrid reality can be considered as a Playground for the Oasis Community. It helps in facilitating curiosity, creating effect of presence, diminishing the gap between participants from different parts of the world and involving more experts in creative collaboration.

One of the new features in such innovative environment is that it includes not only two already existing separate spaces – real and virtual, but as well some new perspectives like the mental dimension. In other words the human and the psychological aspects of personality behaviour and thinking processes are also taken in consideration when creating the new working space.

5.3 Glow design aspects

There are several Glow "rules" that were designed in purpose to support the Oasis way of working, as well as to define what is Glow, what are the main aspects in Glow ideas realization.

Virtual & Real

The main principle that is emphasized in the design process is "staying in Reality" over "diving into Virtuality". There is no any purpose to go deep into virtual reality, to wear bulky HMDs and forget about real life. We do not propose to substitute the reality by virtual life. We just have an aim to bring the virtual world features to the reality so that person could feel the natural "virtual" support in his everyday activities. In spite of the fact of increasingly ICT use in modern activities because of efficiency and other benefits of virtual environments in many situations, the physical environment cannot be replaced by virtual one. Besides the large number of social and cultural reasons, technologies are not able to support cognitive and perceptual abilities of humans, but the physical environment can. For instance, the paperless society which was forecasted and acknowledged by many people some decades ago has not become a reality at least partly because of the flexibility and ergonomic superiority of traditional paper in comparison to screen-based publications.

Body & Mind & Heart

The design is focused on users' mindsets, not only the usual physical ergonomics. Obviously, the careful physical layout planning, the innovative interior features and the ergonomic aspects are the things that are essential in the design of future office space. But this is not enough. User's mind and heart are the issues that are worth considering while the designing process. The way of going deeper in human mind and heart is similar to that was described in Scharmer's U-Theory.

Equipment & Substance

The focus is on substance of knowledge work, not only on the latest technological innovations. As already been mentioned, to meet all the requirements of contemporary environment for knowledge workers, there is not enough just to provide the latest technologies. Besides this the design should concentrate on the support of human

creative processes, collaboration facilitation and natural networking in hybrid community space.

Theories & Practice

Many theories have been presented in this area, but now we will test some of these in practise. Here are some of the theories that are taken as a background.

Japanese scientist Nonaka with his colleagues suggest the theory which states that the *Organizational Knowledge Creation* is realized in a spiral manner through the process of interactions between of tacit knowledge of individuals and explicit knowledge (Nonaka 1995).

Florida's theory about *"Creative Class"* declares that the places where talented people are attracted to and kept creative succeed in today's world's development (Florida, 2002). The ability to catch the attention of the talents and support their creative thinking is the determinative factor in further successful development.

Csikszentmihalyi introduces the *"Flow"* as the most creative state of a human being (Csikszentmihalyi 2003). "Flow" is the experience of feeling the deep enjoyment from doing some activity, and a feeling of being involved in it entirely. Creative people can experience "Flow" more often than others, but even they need to be facilitated to feel so.

Surowiecki proposes to use the *Wisdom of Crowds* to spread the knowledge in crowds from the bottom to the top management, to support decision making process and avoid mistakes (Surowiecki 2004).

Everything & Qualified

There is no purpose to transfer physical actions into digital side, but instead, it is important to find the optimal balanced solution for which functions should be digitalized and which not. It is impossible and, moreover, ineffective to make all working processes digital and virtual, because nothing can replace natural human communication, pen and paper, books that are nice to hold in your hands. The aim of virtual and digital actions is to help user, to enhance the quality of his work, but not to perform all his responsibilities and replace all working activities.

The environment should support making the work enjoyable so that one would be able to get fulfilment to one's life from the work and its results. By means of blending work, learn and play it is possible to create an engaging, challenging and productive environment.

5.4 User profiles

An important element for easy communication, information search and data visualization within intelligent work environments which can adapt to specific tasks is the individually-tailored presentation of information. The multidimensional user profile basis is one of the main features of innovative working environment that allows emphasizing user individuality while being the part of Community.

The way of profile construction and representation is specific and non-common that makes it easier for any community member to be aware about all other users' status, skills, activeness, availability, will to interact and communicate, mood and other things. User profile consists of three kinds of information (Fig. 5.2): *Static* (ID number, name, contact info, address, phone number, e-mail, MBTI type, nationality, etc.) – cannot be changed except in some rare cases; *Adjustable* (skills, quote, photo, sound, etc.) – can be changed by user through any medium in any point of environment; and *Dynamic* (status, availability, environmental info) – changes automatically or also can be easily changed by the user. The names of these three parts reflect the level of user possibility to change it.
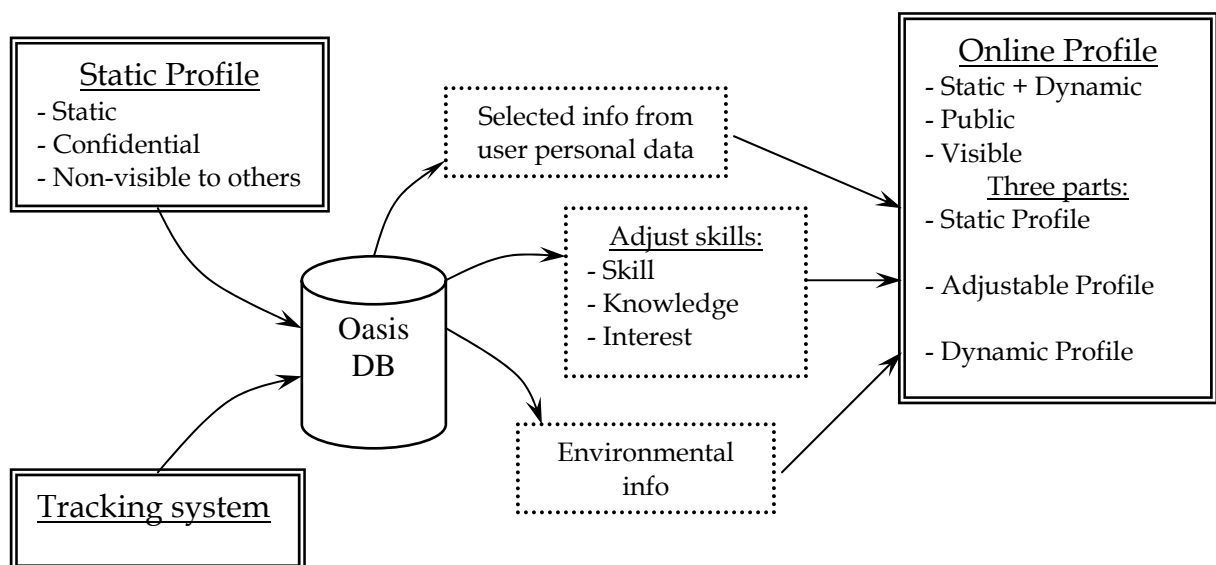
Fig. 5.2   Online Profile construction

All user data are stored in Oasis Database, but only some selected information (that user wants to be public and visible for every Oasis member) is used to form the *Online Profile*. It is used for visual representation of user's condition in the Community and looks like is shown at the Fig. 5.3.

```
                    Online Profile
Static (User data)
   ID              "132"
   Name            "FirstName LastName"
   Contact Info    e-mail, IM (public or hidden)

Adjustable (additional info)
Skills:  "skill"        Knowledge: 0.6
                        Will: 0.9
Quote:          "Wanna party!"
Photo:          "MyPicture.jpg"

Dynamic (environmental info)
Location:       Tokio
Status:         online / remotely online / offline
Availability:   0.7
```

Fig. 5.3   User Online Profile

5.4.1 Welcome Ceremony

When user comes to Oasis first time, he needs to perform some procedures that compose the Welcome Ceremony. User leaves his personal data, pays the registration fee, gets the ID and after that can use the entire Oasis environment and all the facilities that this space provides. While being inside the Oasis user should wear the special *tag* that permits to identify user's location and provide qualified and location-independent services. This tag could be in form of simple badge or ring, for women it can be in for of some kind of jewellery.

5.4.2 Avatars

The Online Profile is represented in a form of *Avatar* that could be any kind of creature. Originally word "avatar" means "incarnation", or "embodiment", this is a new-born Christ, a God coming down to Earth to help people. The modern use of this term is interpreted like sudden accidental help. In our system we use another but similar to modern interpretation of "avatar": this is a user representative. In simple words it's a picture that is depicted on the wall-sized screen of physical Oasis space and also at the

background of virtual environment. This creature behaves according to owner user behavior, i.e. according to the Online Profile settings. So, the Online Profile contains the data that directly affect the visual representation of user's Avatar.

Avatar Make-Up is a procedure of adjusting your profile according to your preferences when entering the Oasis or during your Oasis day. User can change his settings such as his availability, being busy, will to interact, as well as expertise in different areas (skills), the level of knowledge and interest in it, and others.

While adjusting the Online Profile, the user can choose what kind of his own data is shown to others and what is hidden. For example if somebody do not want to show his phone number, but want to be available from Oasis even if he cannot present onsite and don't have an access to the internet at some time, there can be an option to send a message to the user without opening his telephone number. You can simply click on user avatar and choose this service from the list.

5.4.3 User status

User Status is one of the most important and detailed parts of Oasis Glow concept. There are two modes that can be chosen by the user if he is physically participating in Oasis activities: *Default Mode* (User Status depends on the user location inside Oasis, e.g. if user is in Private Room, his status become "Do Not Disturb") and *Non-Default Mode* (User Status is changed manually by the user and the user movements inside Oasis do not affect the status).

The most interest concerns the Default Mode as dependent on user movements and automatically changed by the system. The idea is to use the colors like the representatives of user location and accordingly – user status (Fig. 5.4).
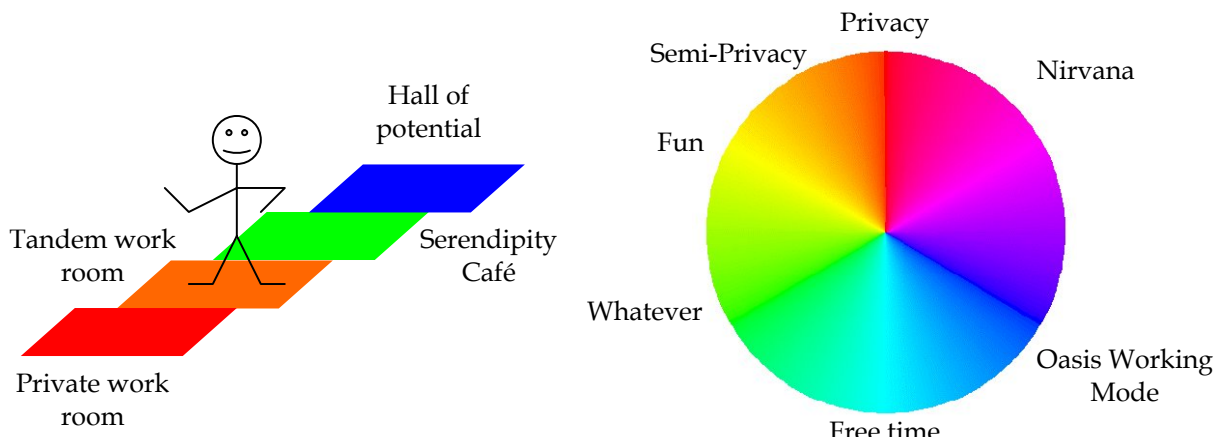
Fig. 5.4   User Status and corresponding colors

The scheme is simple: user location inside Oasis affects on the user status, and user status affects on the Avatar colour (Fig. 5.5).

Fig. 5.5   Location-Status-Colour dependence

For example, if user is working in private room of Oasis, his status automatically becomes "private" and avatar changes color to red. If he is in Serendipity Café, the system infers that he is not working at the moment and status becomes "free time".

Avatar appearance is also affected by other factors such as the user's will to interact and the user's activity; these can be represented like intensity and thickness changing.

Of course, it can be a lot of situations, when you can be busy sitting in café (meeting with colleague or whatever), or you are absolutely free when you are at the private area, and in this case you can just switch to the non-default Mode and adjust you status as you wish.

5.5 Displaying the information

The crucial element in the concept of innovative working environment is the ability to display information at any given position within a given space. To achieve this, it is possible to use different integration displays in the office furniture, flexible projections, electronic wallpaper and other. It is expected that within a few years electronic

wallpaper will be available; it would be able to display information using synthetic materials which glow when electric current as applied (Spath 2003). Combining it with the use of modern ICT it is possible to provide the required services at the right place and the right time in a personalized way.

5.5.1 Avatar Mirror

The large Oasis screen, so called *Avatar Mirror*, is a wall-sized display in physical Oasis space. All on-line users' Avatars appear on it in different forms, colours, sizes, etc. (Fig.5.6). Avatar Screen can be considered as a real-time image of Oasis Community: it is on the wall of the real space and also can be found in Virtual Oasis.
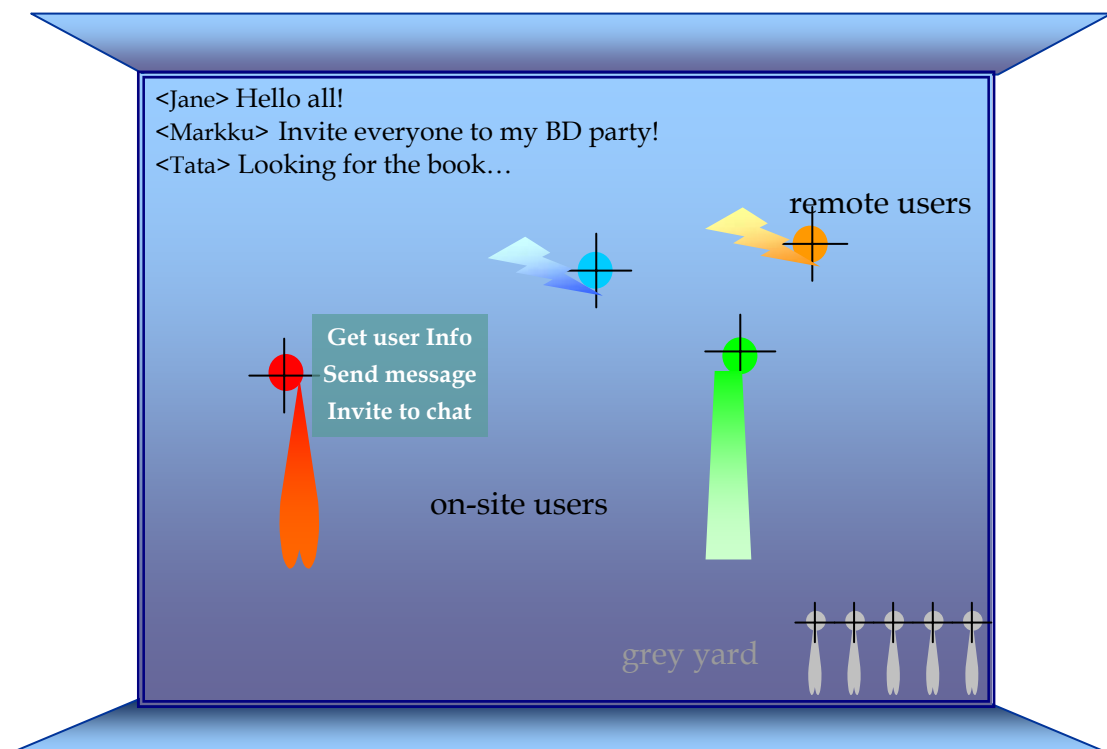
Fig. 5.6   Avatar Screen – wall sized image of Oasis Community

Such kind of feature makes people feel themselves immersed into the atmosphere of participation in all the activities of Oasis Community even if they are logged on remotely. It effectively blurs and even makes invisible the dividing edge between the real space and virtual environment and gives users a strong emotion of belonging.

The difference in visual appearance on the screen is dependent on several factors such as:

- Selected representation picture (user can choose any picture from the database to represent himself).

- Physical or virtual presence (those who are physically present in Oasis are in the full size in the main part of the screen; and all remotely logged-on users are in "flying" form in the upper part of the screen).

- User Status (available, private, …)

- Selected Avatar Screen Mode (pictures, text, sound, …)

- Kind of end-user device (laptop, PDA, mobile phone, …)

There is an option also for the user to make the view of Avatar Mirror looking in some special way for a short period of time. For example one can make requests like: "show the information flows" (lines with thickness depending on the amount of transmitted data between all active users appear on the screen), "show who is in Oasis Mode" (only user with blue color remain visible at the screen) or "show the experts in psychology" (only those who have some expertise in psychology remain visible on the screen). In the last case the search is performed not only among online users, but in the whole database of Oasis members. User can also choose the level of expertise, i.e. to request an expert in psychology with knowledge not less than 0.4 (such kind of knowledge level every user adjusts when making his profile).

Avatar Mirror has acquired its name for the following property: all the avatars of physically presented users according to users' movements in the room. Tracking system allows collecting user's coordinates in physical location and display his avatar in proper position in the screen. Using 3D graphics it is possible to do it in 3-dimentional scale. And if user comes closely to the mirror, his avatar also comes to the border. In the upper side of the mirror there are also public messages from users, this is quite similar to the chat. Some parts of Avatar Screen are interactive and react on user actions. For example when user comes closely to the avatar screen, the names of nearest avatars could appear.

Avatar appearance is also dependent on the medium. It could be not only a picture that is on the big screen and in virtual environment, but also only names could be written – the simple textual representation that is suitable for PDA and mobile phones, so you can access Oasis and see who is online and send a message to the Oasis environment from your mobile phone. Or one more possibility – to use sounds. The Oasis voice can tell you who is online, who is logging on or logging out, it can pronounce the messages:

the public ones and those that are sent to you personally. Such mode can be very useful if you for example driving a car.

5.5.2 Screens

Other devices where user can access the services are screens of different kinds. These are normal-sized screens embedded into the furniture of Oasis physical space, but with some differences from each other.

Public input screen can be simply used for everyone for public services like send public message. *Reactive output screens* have infrared sensors that detect user presence and can react on it by showing some information, e.g. advertisement or announcements. Screens with *ID based output* recognize you and your profile starts to affect the content stream. *Interaction Terminal* allows you to log in and to use it as your own. Your ID locks into this screen until you log out.

5.5.3 "Voice Showers"

Another feature for unusual information delivery is so-called "voice showers"; this is the profiled audio stream. Technically this is an audio waves transmitter with the narrow directional diagram that allows hearing the voice only in some particular Oasis places. Audio showers can change the output to match your profile. It can transfer messages for you, voices from the chat or any other information you like (can be adjusted by user's wish).

5.6 Virtual Glow

Virtual Glow is designed for distant work, using services and adjusting your profile. The interface is quite simple (Fig. 5.7). The background is the same like avatar screen, but there are some other options. Fig. 5.7-5.8 show the pilot version views of Virtual Glow interface. Basic Glow functionalities have been implemented using Macromedia Flash MX.
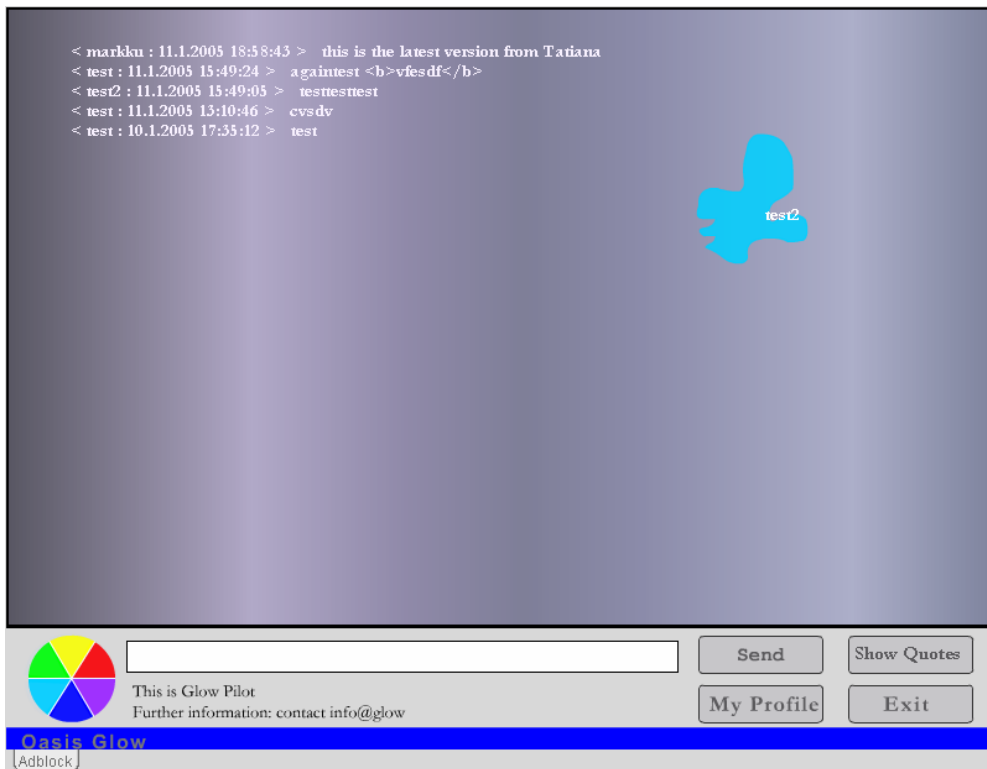
Fig. 5.7 Virtual Glow – main view

As one can see from the Fig. 5.7 currently there is only one user "test2" online, he has light blue colour, hence he is not busy now and he is somewhere in the Music Room or in Café. Clicking on somebody's avatar (but not yours), you get a list of options: "view profile", "invite to chat", "send message" and some others. Yours avatar is entirely in your hands: you can grad it and drop in any place, you can change the colour, availability, quotes and many other things. The main functional panel is in the bottom part of the Virtual Glow. It contains the colour circle for quick status adjustment, input field for messages and four buttons: **Send** (for sending the public message that was typed in the input field – message appear on the Avatar Screen straightway), **Show Quotes** (this button changes its functionality depending on the current state: it could be also "Who is who" if there is no notes near the avatars; and "Hide" if users' quotes are shown on the screen), **My Profile** (allows adjusting your profile in separate window – see Fig. 5.8) and **Exit** (asks if you want to save changes in your profile and logs out you from the Glow).

Fig. 5.8 shows the window where one can adjust its own profile.
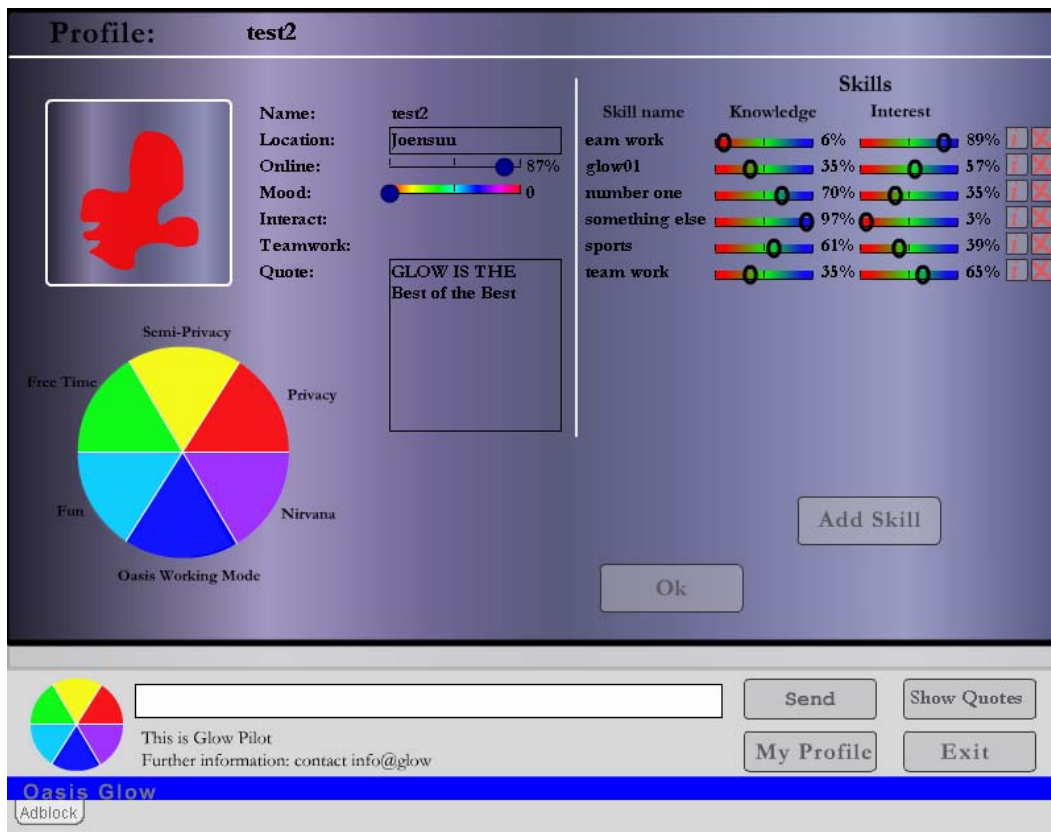
Fig. 5.8   Virtual Glow – adjusting your profile

Here you can choose your status by choosing an appropriate colour, identify your location, write your Quote, adjust the Online level, mood, will to interact and others. One of the main options is possibility to add, change and delete your skills. You can define the skill, your knowledge in percentage and the level of interest.

Virtual Glow is the basic way to make your avatar look like you want. Even if you are physically present in Oasis, you can simply use it for adjusting your profile, browsing through the Glow news, meeting new people, and totally for using all services that Glow provides.

5.7 Why to Glow?

One can ask: why do we need such kind of hybrid working space with naturally blended virtual and real environments? Why do we need Glow features?

The answer is many-sided. The main goal is creating a Community of experts, a society of trust and belonging. Glow features (like Avatar Mirror) provide the sense of everyone presence, creates an atmosphere of being immersed into the friendly environment with qualified services. netWork Oasis is a 24 hours/7 days Community:

one can work in any time from any place of the globe. Even in the middle of the night you'll be not alone in Oasis.

Such kind of environment gives the possibility to work with the best people. One can just type several words and through the Glow find a scientist, artist, sales man or any other person who is an expert in some particular area of knowledge and contact him using the most suitable at the moment way of communication. Glow provides the simplest way of searching an expert or a pair for the project, as well as for further knowledge sharing. netWork Oasis environment is full of Serendipity. You never know whom you can meet, what you'll find or what can happen to you.

Glow provides only qualified information services that are just one click away. Information search is based on your profile. All information streams are personalized to match user's preferences. All uploaded information is quality controlled so that Oasis database contains only qualitative and recent data.

Why we need and like such kind of Community? People's answers could be different, but I think everyone can find at least one he/she likes such working style for.

5.8 User involvement design

The importance of an early and on-going focus on user involvement into design of any kind of system that is created for user needs is widely accepted. The aim is to gain knowledge about users' practice and experience of system use so as to achieve more effective design (Wilson 1997). There are a variety of evaluation methods, varying in their formality, rigour and user involvement - the best method (or methods) depends on the nature of the product being developed, finances, and time constraints.

All these rules are valid for innovative working environment designing as well. For user involvement to be meaningful and effective, it must begin at the earliest possible stage and must be organised in a way that ensures that user really influences the design process. Users should be an integral part of the design process at all stages, including the initial concept definition, specification, design itself and evaluation.

Involving user to the design process could be realized by means of collecting the feedback in different ways. User feedback is the key factor in a user-oriented development process; this is the way to ensure that the outcome meets the users' needs and requirements (Waloszek 2004). User feedback is the essence to a user-driven

development process. Developing without listening to the users may be possible, but it is unlikely that such product will satisfy the users' needs. Only user feedback can ensure that users get what they want. Here are several ways of collecting users' feedback:

User Workshops

User workshop may involve a variety of forms of user feedback: it could be any kind of presentation, discussing with users, round tables, etc.

Mailing actions, Questionnaires

Mailing actions are a well established way to receive user feedback. Typically, questionnaires are made in a way when customers or users should fill some form in fixed or free-form answers. It is a very common situation when people do not fill and return such forms, because as a rule they are boring. So, the task to make the mailings more attractive for users could be quite important.

Online Services

Nowadays, online communication is becoming more and more popular. Many companies use an online feedback system for customers for a long time. Customers can report problems and propose development ideas. With the rise of the web, message boards or chat rooms provide more interactive ways of getting user feedback.

Contests

Contests are a good way to motivate user feedback because it evokes customers' "sport spirit".

5.9 FlexLab: valuable experience

The *Flexible Lab* in Joensuu Science Park is the research environment for the netWork Oasis project and prototype of future office environment. The Lab is a testing space for the new methods of the Oasis way of working. Thus Flexible Lab is a pilot version of the netWork Oasis. Here is the place where all the Oasis ideas are generated, developed, implemented and tested.

The idea of the physical space division in Lab is the same that is going to be realized in netWork Oasis. In the Flexible Lab no one has his own fixed place for work. Current researches showed that open-space working environment model is the most effective in

the distribution of area per person, interactions and creative thinking facilitation. Physical space in the Flexible Lab is divided according to the types of working activities and processes. The Lab contains private rooms for personal work, tandem and group work rooms in common area for collaborative work, separate room for group meetings with projector and white-board to make presentations and organize brainstorming sessions. It has several working areas that can be adapted to different learning, communication and working needs. The Lab supports different kinds of working activities as well as relaxation and calming down. Right near the entrance one can find a place for informal conversation with a Glow screen and a coffee-room. There are also comfortable arm-chairs in the far most part of the Lab where one can have a rest while listening to the birds sounds or enjoying the artificial sunlight (Fig. 5.9).

Fig. 5.9 FlexLab

5.10 Challenges

It's obvious that creation of something new is always accompanied by challenges, difficulties, problems, and we also have many questions that are disputable. And the most important is *how to keep community active, present and online?* The experience of using Virtual Environments for sharing information, discussions, etc. in different organizations shows that very common situation when there is no activity, no presence and no will to do anything in Virtual Net. It destroys all ideas finally.

One more: *How to motivate people?* This problem is related to the previous, but it wider. The question is not only in motivation to use virtual environment, but to be or not the member of such community like Oasis. Why to participate? What will make people pay for the membership? One can ask: why should I share my knowledge, my

expertise, my ideas with others? One should understand: you'll not only give but also get the ideas and help from other Oasis members.

Who is allowed, and who will define them? We are creating a community for the creative class people. But where is the line between those who can be the member and who cannot. By default Oasis is an open environment, everyone can participate, and probably the wisest solution is to give permission to everyone who wants.

How to organize production and upload of quality information to the system? The quality of information transferred and used in Oasis is one of the problems that has to be considered and solved very carefully.

How to organize continuous quality feedback? It seems impossible to suggest to users different long forms with questions, because it's boring and people will avoid to do it or do without pleasure and even not to tell the truth. The idea is to make a feedback in form of periodically appearing pop-up windows with the single question, for example: "how did you like last night party?" After answering the question system will give an answers statistic of other Oasis members.

How to organize production and upload of quality information to the system? The quality of information transferred and used in Oasis is one of the problems that has to be considered and solved very carefully.

These are only some of the problems. There are a lot of those that one cannot imagine at the moment and they will show themselves only after Oasis' opening in users' feedback.

5.11 Conclusion

The overall concept of netWork Oasis and Glow was designed by the team of people from different companies, cities and even from different countries. The hybrid Community space creation and natural integration of virtual and physical environments is a field of work that has been studied and developed during many years. This chapter has described the approach that is realized in Joensuu Science Park where in FlexLab environment all innovative working methods and new theories are tested and the concept model of hybrid environment is developed.

6 Summary

Creation of something new is always a challenge. Creation of Hybrid Community Space and such unique interface that naturally blends virtual environment and physical workspace is the challenge that demands a large amount of efforts, research activities, imagination, inspiration and creative thinking support. All these conditions for successful work under my Master Thesis were found by me in communication with Oasis team, in inspiring environment of Flexible Lab, in related to netWork Oasis projects and my own desire to be the part of this world of the great ideas of new working space designing and realization.

The aim the final words in this work is to infer the main results, give a summary about the work that was done and consider the question of future development of the work.

The general question that was discussed in this thesis is designing and creation of the innovative workspace that supports natural blending of virtual environment, physical space and human mental aspects in such a way that it facilitates creative thinking processes of knowledge workers.

The questions that we asked at the beginning of the work have been undergoing the changes during the research process. Some of them have merged into the single aspect, some of them have simply transformed and obtain another meaning, and now they are provided to summarize the main points of the work.

What are the benefits and disadvantages of using physical and virtual environments in working process? The result of considering both virtual and physical working environments separately showed that those activities that could be easily organized using one environment are hard to do with another. For instance, collaborative group-work and natural discussion could be easily organized in some local physical space, but it's hard to organize it for people who work in different cities and use only virtual environment for communication. From the other hand, the possibility of working in any place, at any time, use of computer simulated models, work in different projects at the same time are the opportunities that virtual environment suggests. From here the idea of the new working environment – the Hybrid Community space where virtual and physical naturally blended – was born.

What are the benefits of the space where both realities are blended naturally? There are a lot of benefits, and the main are the possibility of sharing tacit knowledge, emotions and feelings in a new way; the feeling of being at the place of real activity even during the distant work; facilitation of natural networking; modern, natural and easy-to-use tools for communication; easily organized collaborative learning and working, easy access to different people and experts in any area and many others.

What are the ways of bringing virtual into physical while hybrid space designing and how creative thinking is supported in this view? There are several means of bringing virtual side into physical space, and the most impressive is Avatar Screen which shows the real-time image of Oasis Community. It supports everyone's awareness of everything that happens in Oasis independently on your location, because one can reach the view of Avatar Screen also at the background of Virtual Oasis Glow environment. Other kinds of interfaces to the virtual world are different screens with user-profiled information streams, different environment features, such as voices from virtual Oasis. Profiled information delivery provides the most suitable way of people interaction, supports natural networking, easy experts search, so it provides all the possibilities for users to obtain the ideas from the communication with other people. In combination with the special division and distribution of physical space, these "windows" to virtual world support creative processes in human mind, facilitate curiosity and provides serendipity appearance while performing any kind of activity.

Are there similar ideas in the world? The related to netWork Oasis projects overview gives the comprehension of the situation in this field in the world. An innovative working environment creation is not a new topic for research. The SANE project for instance has a lot of similar ideas and development directions, but Oasis introduces a really new way of working, new interfaces, new Hybrid Space which has three components instead of two: virtual, real and mental.

How to blend two realities effectively and what is the criterion of effectiveness estimation? Effective virtual-real blending refers to the balanced planning of all the activities that should be performed either in physical space or in virtual environment. The main principle is that user still stays in Reality. There is no any purpose to digitalize everything, to make as much automatic activities as possible. The aim is to bring the virtual world features to the reality naturally and only like "virtual" support

for human. The physical environment supports cognitive and perceptual abilities of human, natural communication and hence, cannot be replaced by virtual one. The criterion of successful virtual-real balance in Hybrid space can be the users' feedback about the environment, therefore timely and well organized feedback collection plays a very important role in the design of such innovative workspace.

How to provide user-centered and user-involvement design? This is one of the most significant questions. The main point in successful user-oriented design is user-involvement methods utilization. Users should be an integral part of the design process at all stages. An effective design implies user involvement at the earliest possible stage. It is important for example to introduce just an idea to potential users, to outline features, benefits and possible obstacles and get the feedback. The purpose is to ensure that the product that is going to be realized is exactly the thing that people need and that it actually meets all the users' requirements.

Which technologies to use? The question about technologies refers to the whole environment, to the services and activities that are going to be realized in Oasis. The tracking system for example demands the technology (or technologies) that support user identification and localization (RFID, Bluetooth, indoor GPS). Easy networking and communication is facilitated by Wireless LAN, GPRS, UMTS. Augmented Reality features provide natural virtual support in physical environment. The use of technological innovations is not restricted by any other reason except breaking the balance between real and virtual activities. There is no any purpose to use WLAN connection for communication with the person, if he sits at the neighbouring table.

Why do people need such kind of working environments and hence what is the value of this research? The question is about the overall aim of creating an innovative Hybrid Space, defining its actual necessity for Knowledge workers and reasons for participating in such kind of Community. The contemporary knowledge work activities demand from people high ability to create something new, to solve different problems in non-ordinary way, to communicate via various networks and many others. The environment where people work and learn should support all these activities in the best and natural way. It should be realized according to recent ideas in new ways of working that support creativity, life-long learning, easy and effective networking, learning and working by playing and problem solving processes. A very important

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point is to evoke people's desire to participate, to be the member of such kind of community. Membership is not for free, so, the motivation issues are very important to consider, and marketing program should be wise and well-planed as well. To make people share their ideas, knowledge and expertise the strong stimulus is needed. And one of those is that it is not one-directional knowledge transfer, i.e. one not only shares his ideas, but also gets them from the Oasis people. The idea of Community is based on trust: one should feel himself safety and be sure that his ideas will not be stolen or used illegally.

The overall concept of future netWork Oasis and Glow subproject is still developed and not finally defined, but even now, during the design phase of the project, it provokes the great interest that goes beyond the Finland. The project is going to be completed by the year 2006. There will be one physical Oasis environment and a Virtual Network for remote participation. In future there are plans to create a network that will integrate several Oases from different points of the Globe by means of Virtual Net (Fig. 6.1).
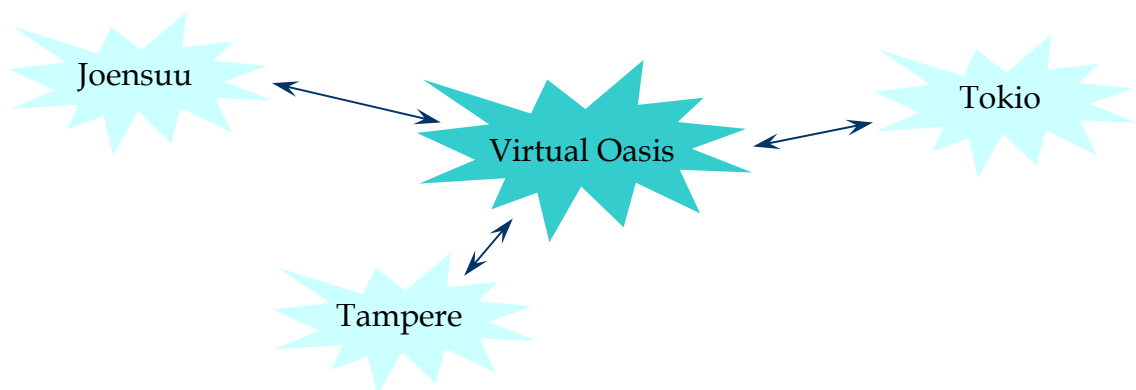
Fig. 6.1 Oases World NETWORK

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Appendix 1. Oasis Layout Plan (designed by Hakanen & Ylaoutinen)

Solo cabins

Solo Chambers

sauna

co-cabins

Hall of Results

Tandem Chambers

Vertical mindfield

Peripatos

Jamming/ meeting

kitchen

Mindsift

Serendipity Cafe

Temple of Challenge

Mindsift

co-cabins

Copying etc

co-cabins

Peripatos

Dialoggias

Vertical mindfield

Hall of Potential

entrance

solo-cabins

copyright
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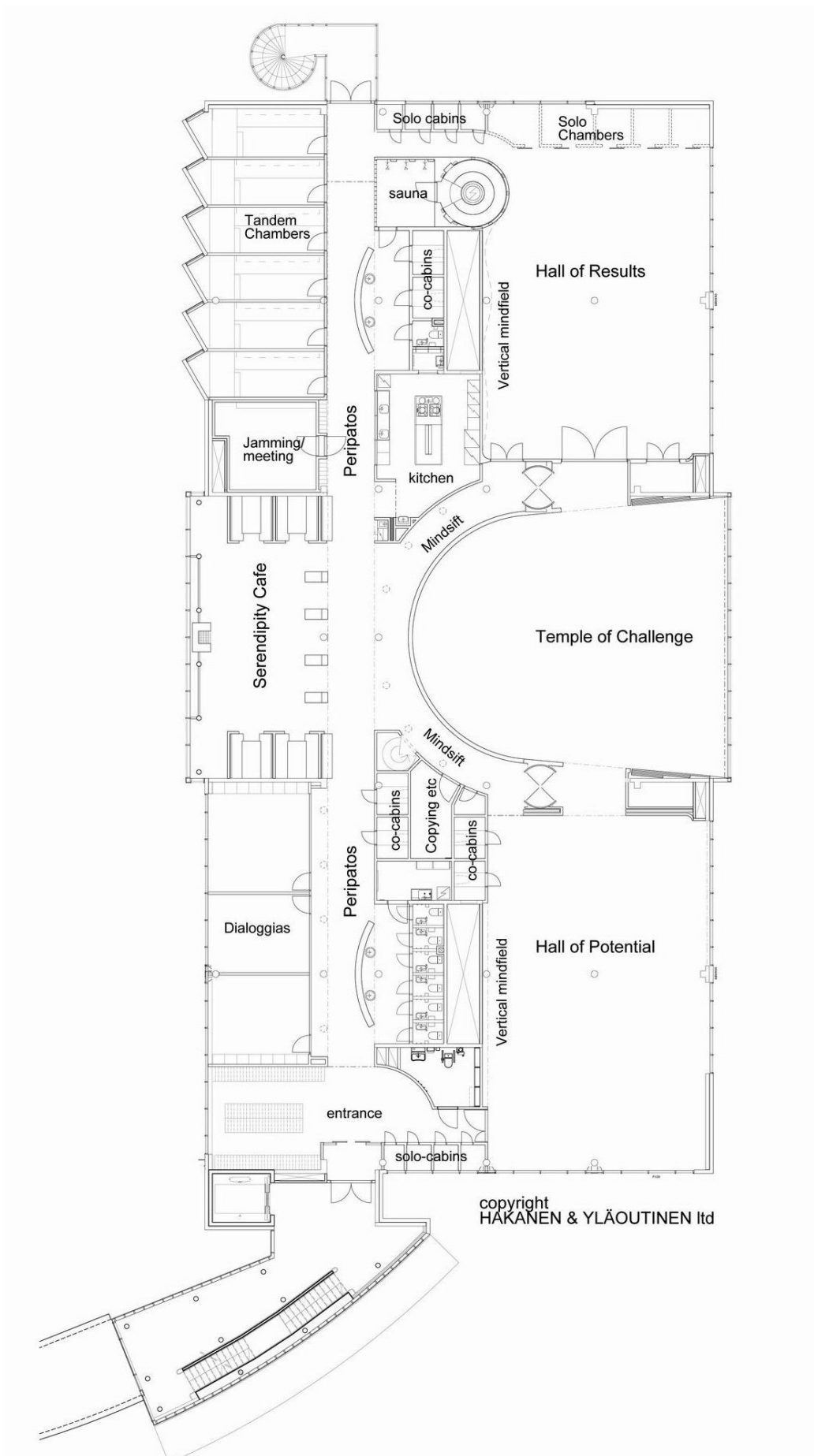
Appendix 2. Oasis General View (designed by Hakanen & Ylaoutinen)
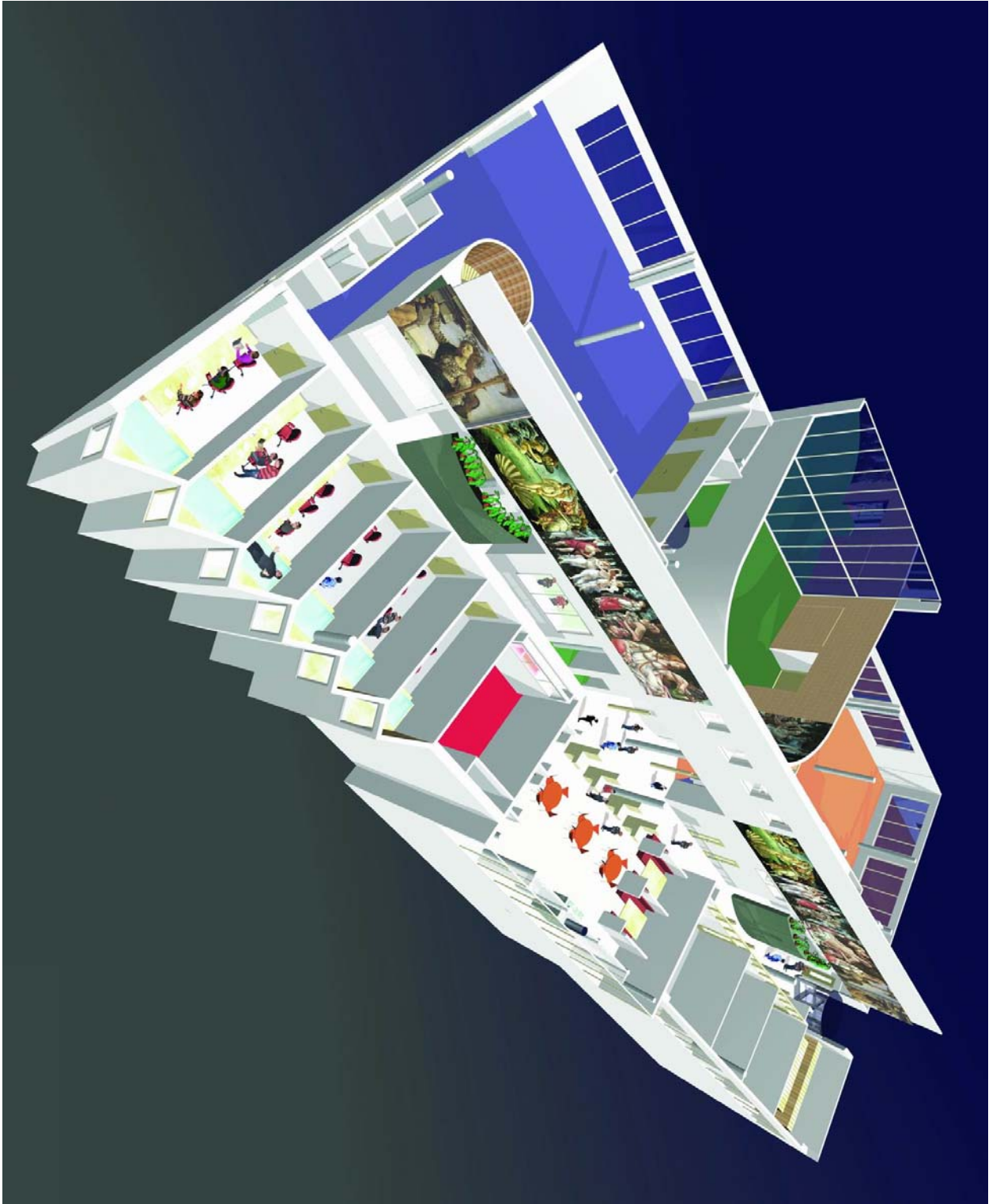
Appendix 3. Peripatos (designed by Hakanen & Ylaoutinen)

Appendix 4. An example of User Scenario of Oasis day

Camera detects the
movement on the Gate

Voice: "You should get an
ID to enter Oasis"

Enter the Gate

"I don't have ID"

"Get ID" procedure

"I have ID"

Includes:
- fill the form
- pay registration fee
- get the RFID tag

The first RFID detector identifies
the UserX. It means that he has
come to Oasis and now in the
process of adjusting his profile
before entering the Oasis (Avatar
"Make-Up"). After second detector
passing user appears as on-site
Oasis user.

Avatar "Make-Up"
procedure

Enter OASIS

Voice "Shower":
"Hello, UserX! You have
a new mail."

UserX goes to the Gate. After the first Gate
detector passing, system knows that user wants
to go off site. User's avatar becomes smaller and
after the second detector passing it disappears.

**Go through the
Peripatos**

UserX also can hear low
voices (optional) that are the
phrases from Oasis chat or
any other kind of information

Go to Exit

UserX works on his current tasks,
summarizes day results, makes plans
for next days, etc.

**Go to the Hall
Of Potential**

Take the MOM. (User can use
his own laptop or Oasis
computer.)

Go to the Hall Of Results

User purpose: check the mail. Actions: He
connects his laptop to the Internet (using
the MOM's wiring or through WLAN).
He logins (by fingerprint, password, etc.),
opens Oasis virtual workspace. Here:
announcements, Oasis people database,
search, IM.exe, etc.
Personal announcement: "UserY tried to
contact you by IM half an hour ago, now
he is offline". UserX can easily contact
him using the most suitable way that
system suggests.

During his rest at the Terrace UserX receives
a notification about message delivery and a
response from UserZ. Their meeting will be
the next week at the Temple of Challenge.
UserX makes a note at his calendar do not
worry about it: his avatar will remain about
the meeting beforehand.

Go to Terrace

**Go to the
"Dialogia"**

User has a project meeting
with three persons. They
are discussing for two
hours, solving the
problems, distributing
responsibilities.

UserX wants to contact UserZ who is
offline now. He tries to send him a
message by IM, and system suggests his
several options:
- send a message anyway
- send an e-mail
- send an sms (such option gives a
  possibility to contact UserZ without his
  private phone number to be open)

Now UserX wants to discuss his task
in this project with only one of these
three persons whom he'll work with
during several next months.

Go to the Serendipity Cafe

Go to Co-Cabins

UserY has returned to Oasis, and UserX
has got the message: "Hello, I need to
meet you today. Could we meet at the
Café during the lunch time?"