Abstract

The theme of this dissertation is the design of IT artefacts for increased well-being in the home. The goal has been to provide a better understanding of the coupling between design and health, and to give examples of how to design for increased well-being. The context for the investigation has been the home, and various research initiatives in smart homes and IT-supported care.

We create our reality in the form of material structures such as buildings, products, workplaces and homes. These artefacts are a reflection of ourselves, we have created them and we understand ourselves through them. Together with immaterial artefacts like political systems, educational systems and healthcare, they constitute our society. The totality of these material and immaterial artefacts forms the conditions of our everyday life. This investigation points at a new way to look at artefacts as social actors in an interactive world. In this perspective, use becomes a dialogue and cooperation with the artefact. Design work becomes a careful creative practice in which the focus is the interplay between the artefact and its social environment. Stress and ill-health is an indication that there is an unbalance in the interplay. Well-being on the other hand means that there is a balance between the artificial world and the individual. Design practitioners, and others that create our world, have an important task in designing new artefacts that do not reproduce obsolete or dysfunctional behaviour.

Inspired by coping theories, a salutogenic approach to design aims at identifying and strengthening the aspects of artefacts that help us handle adversities. This means to create artefacts that form a world, which is comprehensible, manageable and meaningful. People that live in environments where they cannot influence decisions, with high demands and

low control, are likely to become ill. But people that have environments, in which they receive feedback, support and can control their own situation stay well. With new, complex technology such as ubiquitous computing, it becomes even more important to support recognition and routines. And it becomes essential in domestic use and in IT-support for the disabled and elderly.

The empirical work reported here consists of four case studies related to IT artefacts for well-being. The case studies include field studies, critical analysis, design concepts, prototype building and evaluation. Based on the findings in these studies, four considerations for design of interactive systems for the home are suggested: design for understanding, for detecting and managing of errors, for disabling and for alternative coping.

Finally it is suggested that if research is to concern itself not only with evaluations and general laws, but also with ideas and practical examples of a better future life – then design knowledge becomes an essential element in research. In this endeavour we need more cooperation between practitioners from the social and technical sciences, the humanities and design.

Sammanfattning

Ämnet för den här avhandlingen är *design av IT artefakter för ökat välbefinnande i hemmet*.
Målsättningen har varit att öka kunskapen om relationen mellan design och hälsa, och att ge exempel på hur vi kan designa för ökat välbefinnande. Kontexten for undersökningen har varit hemmet och olika forskningsinitiativ inom smarta hem och IT-stödd omvårdnad.
Vi skapar vår omvärld i form av materiella artefakter som byggnader, produkter, arbetsplatser och hem. Dessa artefakter är på en nivå en spegling av oss själva, vi har skapat dem och förstår oss själva genom dem. Tillsammans med immateriella artefakter som politiska system, utbildning och sjukvård formar de villkoren för vårt vardagliga liv.
Den här undersökningen pekar på en ny förståelse av artefakter som sociala aktörer i en interaktiv livsvärld. I detta perspektiv blir användning en dialog och samarbete med artefakten. Designarbete blir en lyhörd gestaltningsprocess där fokus är på samspel mellan artefakten och dess sociala omgivning. Stress och ohälsa är ett tecken på att det finns en obalans i detta samspel. Välbefinnande å andra sidan tyder på att det råder en balans mellan individen och den artificiella världen. Designpraktiker och andra som formar vår värld har ett viktigt ansvar att skapa nya artefakter som inte reproducerar föråldrade eller dysfunktionella beteenden.
Inspirerad av coping teorier föreslås en *salutogenisk* inställning till design som syftar till att förstärka aspekter i vår omgivning som hjälper oss att hantera motgångar. Det innebär att skapa en värld som är *begriplig*, *hanterbar* och *meningsfull*. Människor som lever i miljöer där de inte kan påverka beslut, som ställer höga krav och ger lite stöd, kommer sannolikt att bli sjuka. Men människor i miljöer som ger bekräftelse, stöd och där de kan påverka beslut, har stora chanser till välbefinnande. Med ny kom-

plex teknik som ”ubiquitous computing” dvs microprocessorer som integreras i hemmen, blir det än viktigare att tekniken stödjer igenkänning och rutiner. I teknik för äldre, sjuka och funktionshindrade blir det en central uppgift.

Det empiriska arbetet som beskrivs här består av fyra fallstudier som handlar om IT-stöd för välbefinnande. Fallstudierna består av fältstudier, kritisk analys, utveckling av designkoncept och prototyper samt utvärdering med användare. Baserat på analysen av materialet föreslås fyra överväganden som bör göras vid design av interaktiva system för hemmet; Design för *förståelse*, för att *upptäcka* och *hantera* fel, för *avstängning* och för *alternativ* hantering.

Slutligen föreslås att om forskning inte bara ska handla om att söka generella lagar och utvärderingar utan också om konkreta ideér och förslag på hur en framtida värld ska utformas – då blir design en central praktik i forskning. I en sådan strävan behöver vi mer samarbete mellan praktiker från sociologi, teknik, humaniora och design.

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Publications included in this work

This dissertation is partly based on the following publications:

Books and Journals

"Visualising the Vague: invisible computers in contemporary Design", *Design Issues*, vol 20, Spring 2004, MIT Press.
"The Making of Brainball", in *Interactions*, Jan-Feb 2003, volume X.1 ACM Press 2003.
"Brainball – the true story" i *Friktion, om mötet mellan olikheter i IT-forskning*, Raster förlag 2003.
"Everything you ever wished for" in the catalogues for ed. Maria Lind *What if – Art on the verge of architecture and design,* Moderna Museet, Stockholm 2001.
"Behovet av design", Ed. Susanne Helgesson, *Svenska Former*, Prisma, Stockholm 2000.

Conferences

"Artefacts as Research" *proceedings of CHI '04*, ACM Press 2004.
"The Dysfunctionality of Everyday Things", *European Academy of Design*, Barcelona April 2004.
"Designing the invisible computer – from radioclock to screenfridge" Nordic Interactive 2001, Copenhagen, Invited speaker.
"Brainball- using brainwaves for cool competition", *poster, NordiCHI '00*, ACM press 2000.

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Semiotics in product design Tecnical report TRITA-NA-D0210, CID-rapport, CID-175, September 2002.
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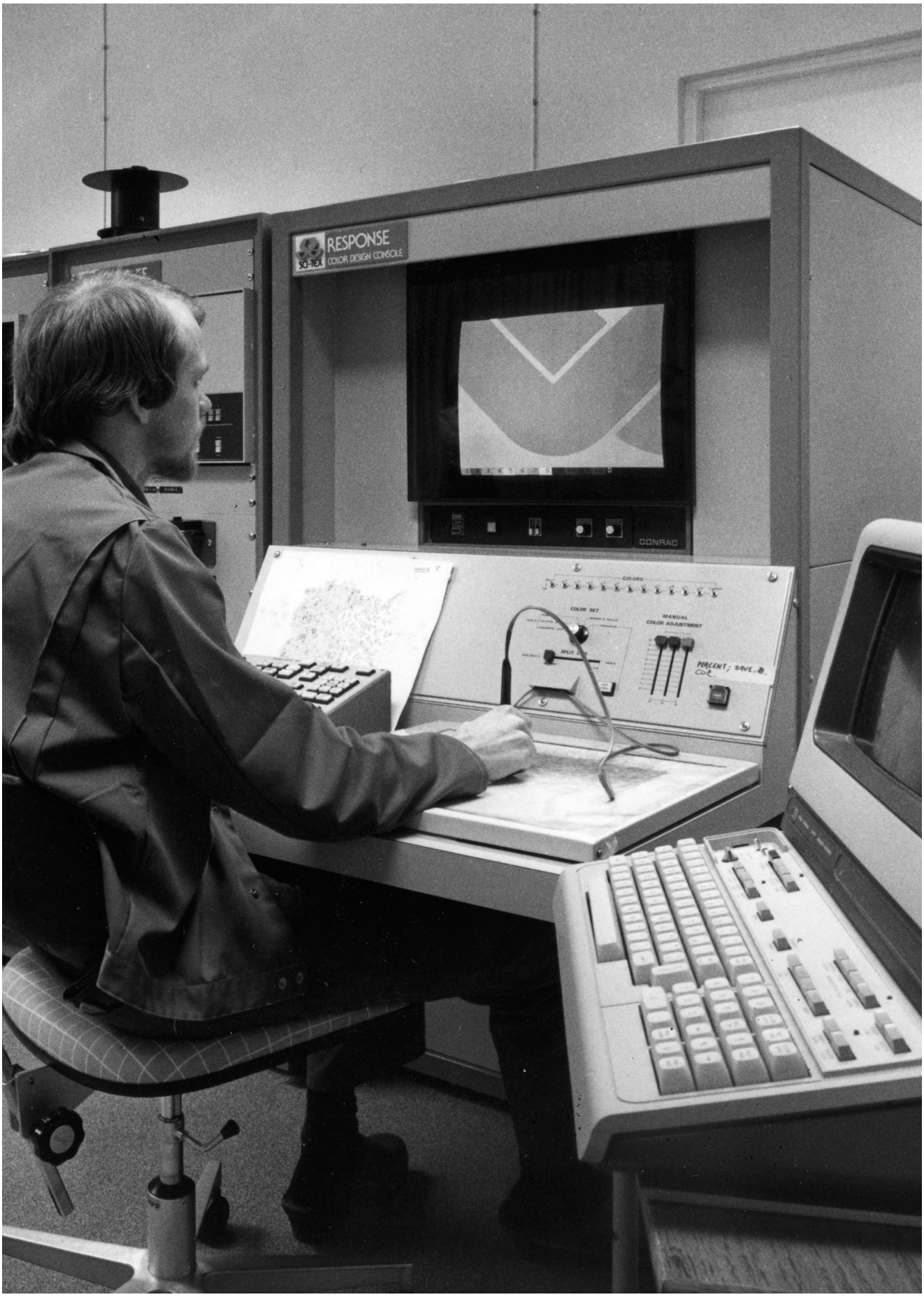
Chapter 1
Introduction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Introduction

Artefacts form our environment. We construct reality through acts that create material and immaterial structures: artefacts. Some of these are made by professional designers within the framework of the market economy, some are made by individuals for personal use, and some come about through the process of political decision-making. In all of these areas an interest in design is growing ever stronger. One reason for this has to do with the present-day criticism of the scientific view, which has characterised our thinking since the beginning of the modern era. A scientific view that researchers "discover" and "reveal" the secrets of nature, and were well-being and progress is simply a matter of finding the right bacteria or mathematical formula.

In a constructivist world view, however, the active creation of meaning, i.e. design, becomes central. There are no algorithms for how we shall build a good future. Social science becomes increasingly less dependent on natural science. Scientific activity is also something that is formed. New medicines are not only "discovered"; instead we form, create, and construct them. In short, we "design" them. Society and the artefacts that make up our world are the result of our own actions. "Everything" becomes design.

In the face of this relativistic abyss, we must regroup and establish some fundamental understandings about what it means to create a good world. For this reason it is valuable for the designer to look at the social sciences, psychology, and ethnology. What is the relation between the individual, human actions, and society? How can subjective actions result in an objective world? What fundamental factors are required to create a world that promotes well-being rather than creates stress?

The fields of departure for this work are industrial design and human

Opposite page:
The computerisation of craft: Control room at Borås textile factory 1988.

Previous spread:
Artist and textile designer Carl Johan de Geer working on a pattern.

computer interaction (HCI). These two areas are coming increasingly closer to each other as more computer technology is integrated into everyday products and housing. One focus of development today is moving towards ubiquitous computing, i.e. more and smaller processors that are invisibly integrated into objects and spaces. In this way is information technology (IT) is entering the homes, hidden in walls and products, aiming to support safety and well-being for the inhabitants. There have been a number of research initiatives in this area during the last decade. Many of them are related to demographic changes in society, with an increasingly older and less healthy population, and fewer hospital beds. Others are part of the general development in ubiquitous computing for the home, with services that increase safety and comfort.

This type of development, however, is not without risks. The introduction of computer technology into the workplace has not been painless, and there is a great risk that similar problems will arise in other contexts. This also leads to questions concerning how we interact with a technology that we do not see. What does the interface for the smart home of the future look like? What problems may arise and how shall we resolve them? There is a large potential for a computer technology that makes it possible to remain at home even when old and sick. In this context there are extremely high demands placed on IT artefacts, where they must support daily routines and needs rather than create uncertainty and confusion.

The theme of this dissertation is *The design IT artefacts for increased well-being in the home*. To understand this we must have insight into what creates well-being, and how this can relate to design. We need to understand what characterises the home as a context, and what demands are placed upon technology in the home. We also need to acquire a deeper understanding of the relation between artefacts and our daily lives.

The goal is to provide a better understanding of the relation between design and health, and to offer tools that allow us to design for an increased well-being. The ambition is not only to place design, IT and use in a larger perspective by applying theories from HCI, sociology and psychology, but also to offer concrete points of departure for design work.

This dissertation begins with a look at design by examining its theory and practice. This is followed by a study of how we live with artefacts, how we interpret, use, and create our reality through them. The context for the investigation is the home and its relation to technology, research,

and health. Four case studies provide insight into various aspects of the investigation, and are used as background material for analysis and discussion.

1.1 Design in context

Everything created by human beings has to take a physical shape, whether we write a text, cook a meal or furnish our home. Most of the environments that we live in are total creations by humans. There is little left of nature or a "natural" world unaffected by human beings. Nature and the world climate are very much a result of human activities during the last two hundred years. National Parks in USA, for example, are also a human construction, an artefact with roads, restaurants, car parks and a tampered wild life. We indeed live in an artificial world, as Herbert Simon[1] pointed out.

To design is something profoundly human. Ken Friedman[2] notices that the practice of design – making things with a useful goal in mind – actually predates the human race. A sharp stone used to crash a nutshell is a tool and therefore toolmaking probably preceded human language. The physical potential of our larger brain gave rise to a successful toolmaking that changed our mental conceptions. As toolmaking and tools became the conscious subject of our imagination, it helped us to survive and prosper as humans.

To use a stone to crack a nutshell is pre-human, but to decorate it and oneself is particular to the human race. During his anthropological studies in Brazil, Lévi-Strauss[3] noticed how natural categories such as trees, animals and the sky, were used for social categories such as tribes and clans. This totem language makes the social structure visible and gave form to a collective consciousness.

As civilisation moved on, the design task became more complex and specialised due to increased production of commodities and a market that demands a constant change in visual appearance. The modern, western culture we have today with its social structure and economical system is

1 Herbert Simon "The Science of Design: Creating the Artificial" in *The Sciences of the Artificial*, Cambridge, MIT Press 1969.
2 Ken Friedman, "Creating design knowledge: from research into practice". *IDATER 2000* Loughborough University.
3 Claude Lévi-Strauss, *Strucuralism and Sociological Theory*, London 1975.

closely intertwined with the production of commodities. All of them have to be designed. We are all shaping and reshaping the world we live in and aesthetical judgments are part of our basic human abilities.

What is design?

This dissertation deals with the borderland between industrial design and human-computer interaction (HCI). Both these areas are relatively new and have sprung from the revolutionary changes in the 20th century. Design is tied to the development of the market economy, and HCI to a new technology. Today they are brought closer to each other since computer technology is integrated in a wider range of products.

The concept of design is problematic, and used just as often in system design as in craft, but with different meanings. It seems suitable to begin this disseratation by accounting for its different meanings.

"Design" is both a noun and a verb, which means that it can refer to both an object and an activity. The word "design" comes originally from the Latin designare and means to decide, to point out; desi'gno means to reproduce, depict. In English the general meaning of design is giving form, constructing and planning. In Swedish, on the other hand, design is an imported word with a more restricted meaning: the forming of handicraft and industrially produced goods and environments.[4]

Design could be described in three ways :

As a product
As a process
As a practice

a) The *product* is the first aspect of design and refers to the physical form of an artefact, that is, the end result and object of the design process or design practice. By using the word design to denote the physical form we mean that the form has quality and results from a conscious design process by professional designers. Judy Attfield describes design as 'things with an attitude' – created with a specific end in view – "*Whether to fulfil a particular task, to make a statement, to objectify moral values, to express individual or group identity, to denote status or demonstrate tech-*

4 "An internationally used term for giving form, i.e., the forming of handicraft or industrially produced goods and environments. In everyday usage the word commonly refers to a product's form or appearance." Translated from The Swedish National Encyclopaedia.

nological prowess, to exercise social control or to flaunt political power."[5]

b) The design *process* refers to construction and problem-solving in general. This is what Herbert Simon refers to in his very broad definition: "*Everyone designs who devises a course of action aimed at changing existing situations into preferred ones. The intellectual activity that produces material artefacts is no different fundamentally from the one that prescribes remedies for a sick patient or one that devices a new sales plan for a company or a social welfare policy for a state*" [6]. Design as process refers to what people do when they exercise the general, human ability to conceive, create and change the course of action.

c) The third aspect, the design *practice*, refers to the activity of deciding the properties and shape of a physical artefact. People trained in this practice, designers, are experts in solving complex problems and to visualise and materialise the result aimed at a certain end user in a technical and economical context. Their main competence is in the field of practical aesthetics. The design takes form, not by immediately starting to build the end artefact, but with the help of a model or a sketch. According to some researchers the model is the core of designing (Schön[7], Archer[8]), the very thing that distinguish *making* from *designing*.

These three aspects are constantly confused and often make the discussion about design very difficult. For ordinary people, design is usually equal to attractive and original form, as in "this chair has a nice design." In professional circumstances it is common to confuse design as process and design as practice. It can be very disorientating to hear about design as a problem solving process, shared by everybody, and at the same time something that, for a substantial fee, will strengthen your products' competitiveness on the market.

In an academic context the process view has been dominant, resulting in a disregard for the particularity of professional design work. In economical or technocal disciplines, design is primarily regarded as a tool for product development in a market economy context.

These different views are based on three different and conflicting ways of looking upon the role of design. The first role, which developed slowly

5 Judy Attfield, *Wild Things, The material culture of everyday life*. Berg, Oxford 2000, (p 12).
6 Herbert Simon, ibid. (p 55.)
7 Donald Schön, *The Reflective Practitioner: How professionals think in Action*, Basic Books 1983.
8 Bruce Archer, "Systematic methods for designers". in ed. Cross, *Developments in Design Methodology*, John Wiley, UK 1984.

Cars in the form of vacuum-cleaners were manufactured by Electrolux in the early 20th century.

in England and Germany at the turn of the last century, arose out of an arts and crafts tradition where the product was at the centre. The design process was uninteresting: the important thing was the form, and the way it related to different contemporary ideologies and aesthetics. The designer was a sort of artist, and enjoyed a similar status.

This "artistic" view of the designer would gradually become more problematic. In the beginning of the 1960s there were attempts from several directions to make design work more rational, and to incorporate it into a scientific method. Design was seen mostly as a process that could be applied to different types of problems. This broad definition meant that design could fit into a scientific context, and that design became synonymous with planning and development in general. This view was eventually criticized as an erroneous simplification of design work. Instead the

focus was turned towards the designer's practice. Studies were carried out on how the designer actually works, and on what was unique for the practice of design. The design problem is a special kind of "wicked" problem, which is resolved through a dialogue with the situation. The designer's work is characterised by reflection in action, where the sketch and the model are central for the process of feedback between hand and thought.

This thesis takes its starting point from the design practice and the creation of an increasingly complex world. But everything artificial does not at all result from a professional designer. Just as the concept of design has many meanings, different design activities are conceived and directed towards a range of areas. The total of objects, activities, services and environments that fills the everyday world is what Victor Margolin calls the *product milieu*[9]. The product milieu is not a neutral layer. Margolin describes it as an "interactive presence in the life world". While it offers possibility for action, it also inhibits action not only through the material means of buildings and products, but also through immaterial artefacts such as legal codes and educational systems. The product milieu consists of three overlapping spheres: civic and state projects, the market and independent design. Depending on the degree of centralised planning and industrialised development in a society, these three areas have varying size and importance.

Civic and state projects consists of macro-scale design such as highways, city plans, public transport, public building, etc. These are mainly designed by public officials who conceive them and plan their execution. Here design is mainly process-oriented.

The market is "*the mechanism for the introduction and distribution of products through a mechanism of economic exchange*."[10] This is the field of product design and where most professional designers work.

Independent design belongs to neither of these areas, these are things that people make themselves. In a self-sustainable society this constitutes the majority of artefacts. People make their own clothes, build their own houses, make their own tools etc. Today most artefacts are part of the market or civic projects. But a lot of things are still made independently –

9 Victor Margolin," The Product Milieu and Social Action". In *Discovering Design*, ed. Buchanan & Margolin, University of Chicago Press, Chicago 1995,(p 122).
10 Victor Margolin, 1995, ibid, (p 128)

to save money, for satisfaction, or for empowerment. Even if we buy artefacts, there is a high degree of customisation involved in dressing, interior design, gardening or Do-It-Yourself.

Every discussion about design benefits from a clearer understanding of the different meanings of design as well as of the product milieu.

The design practice

Industrial design like all other design professions, is relatively young and tied to the advancing industrialisation and market economy during the 19th and 20th century. Changes within the field during this period have been extensive. From a primarily craft-based trade the work has changed to include knowledge about technology, market, use and methodology. There is still however a strong connection to the craft, which is apparent in the traditional method of education and its base in the practical/aesthetical dimension. There are also some strong disagreements within the trade. Some argue that design is more about function and ergonomics than about nice shape. Others state that design always will answer to people's need for aesthetic change and renewal. Some regard design as teamwork and others view it as an opportunity for personal expression and self-actualisation. Some see styling as an insult, while others argue that the main function of design is to increase sales with new attractive forms.

Designers act all the time between the poles of function and aesthetics, market and ethics. There is a need to define and demarcate here against other fields, and also to strengthen and develop the unique in design. But what the unique features are is also a cause for discussion. Should the designer be a middleman between producer and end user? Should aesthetics and form be central? Is knowledge about the market and style most important? Is it creativity, problem-solving and visualising of ideas? Or is it a combination of all this, an ability to create a whole, to make a synthesis of many disparate parts?

There is also a difference here between the various design disciplines. Whereas graphic, furniture and fashion design have obvious materials and a long tradition in form, function and technology, industrial design has a rather short history, associated with an economic system rather than with a material. In graphic design there are rules that build on how we interpret text cognitively and that facilitate the design. Industrial design on the other hand has no such connection to a material and use. Here the form depends on a number of conflicting factors such as user value, tradition and price.

These different attitudes also arise out of the different design roles previously described, which to a large degree are all still relevant.

The first "real" industrial designer is usually considered to be Peter Behrens, the German architect who in 1904 was commissioned by AEG as their designer. The term "Industrial Design" was coined in the United States during the 1920s. It was a term used on illustrations for advertising products and intended as a means to increase sales. Soon illustrators were commissioned not only to make flashy images, but also to reshape the form of the products. In the United States a type of designer emerged who, by creating continually attractive forms, i.e. "styling," could increase sales and ensure high profit levels for companies. In Europe, industrial design instead arose out of a mix of architecture, art and handicrafts, and had the ambition, as for example with the Bauhaus, to unite art and industry.

This "artistic" background was in certain respects to become a burden. The design profession had to work hard to convince companies that design was both an effective tool in the marketplace and a way of increasing product value for the consumer. At the same time, the presence of an "artistic" talent had a strong power of attraction for both clients and consumers alike.

What is usually missing in design education today, in all fields, is an element of critical reflection. Educational programs are mainly built up around practical design projects, and directed towards consolidating the professional role and creating effective practitioners. Theoretical aspects are limited to art history and ergonomics. Today both design education and the design professions lack any deeper connections to social theory, communication theory, economics, psychology, gender theory or HCI. This despite the fact that all of these areas are highly relevant to the forming of artefacts, and to the forming of our lives along with them. To put it more bluntly, one may say that the designer is good at forming artefacts, but bad at imagining how we live with them. The methods that do exist include user studies and tests of prototypes in connection with the development of products, but there lacks knowledge about how these products function in their use, or within a larger social context. When there is some form of feedback, it usually occurs through other professions, or through other departments within a company. To a large degree this is related to the designer's way of working as a freestanding consultant. A designer is commissioned in connection with the development of a new product, and when it is finished the task comes to an end. When feedback

is received, it is usually restricted to what the marketing department finds out.

Another problem with the design profession is the power structure it helps to maintain. Designers are highly qualified symbol-makers that make decisions which affects millions of people. But designers are almost exclusively from a homogeneous white middle-class background and in the case of industrial design, 90% are male. In design education 20-30% of industrial design student's are women, but apparently, many of them do not work with industrial design a few years later.

What the design profession needs is a broader discussion about artefacts and their role in people's lives and daily existence. Studies of individual objects need to be complemented with studies of how these objects function together, what kind of society of artefacts they form, how we understand and comprehend things cognitively and socially, what self-image they form, and how people create meaning, identity and value through things.

This is especially important now, when computer technology begins to permeate artefacts of all kinds. Things are no longer what they used to be; they are full of interactive services and sensors. They can react to implicit input, like a higher pulse-rate or recurring behaviour, just as easily as they respond to the pressing of a button. The twentieth century's mass production and marketing is also going through drastic changes. At the same time we face the challenge of the world becoming increasingly artificial, increasingly constructed. The product is not a single object in a mostly natural world. On the contrary, the artefact has become our nature, with the major difference that we humans are both its creator and its product.

Today many conceptual dualities like form/function seem old-fashioned. Form and function are not opposites, but two different aspects of the same thing[11]. The real challenge is not in these questions, but rather concerning what goals the products serve, what kind of world they form for human life.

Design and research

Research in design is quite young and a consensus about methods and research paradigms are not yet formed. One discussion is whether design should conform to established ideas about science and research or

11 Bo Westerlund, "Form is Function", *Proceeding of DIS '02*, ACM Press 2002.

whether it is something unique that should develop its own research agenda. Ken Friedman notes that all professional fields go through a transformation from practical to the scientific, and now it is design's turn. Look at medicine, technology and the law, which all began with a craft-related type of knowledge, and successively developed into science. The latest addition for example is health science, where "tacit" knowledge within health care is made explicit.

Christopher Frayling distinguished three types of design research, a typlogy which, although much debated, has been widely used: research *into* (or about) design, which is carried out by other disciplines such as economics, history, sociology etc; research *for* design, which is usually characterised as R&D; and research *through* (or by) design, in which the design practice has a central role to play.[12]

In general one may say that there is much more research *into* design than research *through* design. Research into design has a long history within the fields of economics, technology, history of art and cultural studies. Research through design, so-called practice-based research, has developed furthest in Great Britain, Australia and Finland, but the approaches and methods differ strongly between the various institutions. Some are more theoretical and analysis-oriented, others are based completely on practical work that is documented. In Finland a method is used where the practical and theoretical work are equally important, but they are evaluated by two different committees.[13] In the field of art it is often suggested that art and science are fundamentally different activities that can never meet. The fear is that any attempt to unite them will result in bad art, and that an academic text questions the artwork's role as a creator of knowledge. Within the framework of so-called practice-based research there are a number of different points of view, but what they all have in common is that they are all based on some form of design practice that involves realising projects. In my view, practice-based research shall be interpreted in such a way that the research *emanates* from the professional practice, or a problem connected with it.

Donald Schön[14] called the work of the practicing designer "reflection in action," and described it as a practice that oscillates between reflection

12 Alain Findeli ed, " Introduction", Special Issue: Design Research, *Design issues*, Vol 15, Nr 2, 1999 (p 2).
13 Henrik Karlsson, *Handtag, famntag, klapp eller kyss? Konstnärlig forskning I Sverige*, Skriftserie, Sister 2003.
14 Donald Schön, *The Reflective Practitioner, How Professionals work in Action*, Basic Books, New York 1983.

and action. He sees sketching, for example, as a concretising method to find a solution for the various demands required of the final product. A research that reflects on the practice of design is referred to by Schön as "reflection on action." It is impossible to reflect on a practice when in the middle of it.[15] In actual design work, reflection and action are connected with the overall goal of developing a solution. In order to formulate the notion of practice, we need to step out of it and observe it from another direction. We may also need concepts and tools from other disciplines in order to be able to articulate a practice, or to find ways of understanding problems within it.

Rittel and Webber[16] regard the design problem as a special kind of "wicked" problem that cannot be resolved with a reductionistic method. Donald Schön describes how a designer works continually with new projects filled with complexity and conflicts. Uncertainty within projects means that a designer cannot work with a predetermined method. Instead the designer proceeds from his or her experiences from other projects, which function as a library of allegories for the new project. Pelle Ehn[17] suggests, based on Wittgenstein, that design work can be seen as a language game, where the various design projects have a family resemblance. Design work may be seen as a dialogue with materials and the situation, a bricolage, where the designer moves forward by testing various possibilities.

In the same way, design-based research may be seen as a situated design process. There are no ready methods, only allegories to transfer from other fields or similar research. A conventional science does everything to avoid this type of uncertainty and lack of control. Experiments are carried out in a laboratory where all factors of uncertainty have been removed, and where the validity of the results can be ascertained. But even this is a design process, argues Ranulf Glanville[18]: "*We design experiments, but we also act as designers in how we act in these experiments.*" He continues: "*(scientific) research is a brand of design in which the designer is central, and through which we construct the world of (and according to) the scientific knowledge that we design*." According to Glanville, design research should

15 Peter Winch, *The idea of a Social Science and its relation to Philosophy*, Routledge and Kegan, London 1958.
16 Rittel and Webber, "Planning Problems are Wicked Problems", Nigel Cross, ed. *Developments in Design methodology*, John Wiley, UK 1984
17 Pelle Ehn, *Work-oriented design of computer artefacts*, Almquist & Wiksell, Falköping 1988
18 Ranulf Glanville, "Researching Design and Designing Research", in Alain Findeli ed., *Design issues*, Vol 15, Nr 2, 1999

not adapt itself to the conventional positivist network of rules, but instead should assert "*the primacy and centrality of design both as an object of study and means of carrying out a study.*"

In Laboratory Life,[19] Bruno Latour and Steve Wolgar made ethnological studies of research laboratories. To describe the process of what is referred to as "knowledge production," they observed the social relations and meaning construction that occurs in the daily praxis of research. How are scientific problems formulated, and what makes them qualify as problems at all? From these studies emerged a constructivist point of view – that facts and reality, even within science, are constructed rather than discovered.

In her dissertation on Interaction Design, Ylva Gislén[20] makes a connection between practice-based research, science and technology studies (STS) and feminist critique, where all is treated as a critique of conventional science. Within feminist science theory this critique has been taken further than Latour and Wolgar. Donna Haraway[21] and Sandra Harding[22] have shown how conventional theory of knowledge is an extension of a patriarchal will to power and superiority, where instrumental rationality stands above practical action, expertise above democracy, man above animal and man above woman. Seen in this context, design research becomes part of a larger scientific paradigm shift.

Method is, to put it simply, the way you did, or normally do, something. What methods you choose therefore depend on the nature of the problem or investigation.

Lincoln and Cuba[23] remark that questions of method are subordinated to questions of research paradigm, which they define as the basic belief system, or worldview that guides the investigator. Both qualitative and quantitative methods may be appropriately used with any research paradigm. Design research takes place in circumstances where different methods are appropriate depending on the context and the goal. Design has a unique set of characteristics, but is also an activity that cuts across all disciplines. It is therefore difficult to formulate one methodology or even

19 Bruno Latour, Steven Wolgar, *Laboratory Life: The social construction of scientific facts*, Sage, Beverly Hills 1979
20 Ylva Gislén, *Rum för handling, kollaborativt berättande i digitala medier*, Blekinge Institute of Technology Dissertation Series No 2003:04.
21 Donna Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature*, Routledge, New York, 1991.
22 Sandra Harding, *Whose science? Whose knowledge? : thinking from women's lives*, Open Univ. Press, Milton Keynes, 1991.
23 Lincoln and Guba, in *Handbook of Qualititative Research*, Denzin and Lincoln, eds. Sage Publishing, CA, 1994

research paradigm that covers all these activities. The choice of methods is therefore more dependent on the type of question asked than on design as a single discipline.

There have been several attempts to fit design into a natural science paradigm. Herbert Simon's suggestion for a science of the artificial[24] was one; the founders of the design methodology movement made others (more about this in chapter 2). But neither of these attempts have been very successful; instead there has been a growing insight that there is indeed a specific "designerly way of knowing."

Susan Roth remarks that "*design seems particularly well-suited to the employment of qualitative research methods applied within a constructivist paradigm*".[25] A constructivist approach seems analogous to design thinking – we design/construct the world we are living in. Different worldviews are mirrored in their artefacts which also serve to maintain these "realities."

Lionel March[26] used Peirce's [27] concept of "abduction" as a starting point to describe design. March claimed that design was neither inductive nor deductive but a third kind of thinking that is not part of the scientific paradigm. Typical for a design proposal is not that it is logically correct but that it initiates new forms.

Herbert Simon also emphasized that design is about how *things ought to be*, as opposed to natural science which studies how things are. Building on Simon, Dahlbom calls for a whole new design-oriented science that deals with artefacts rather than nature. Society is a construction, an artefact, and social science should therefore be a science about artefacts.[28] A science of artefacts is not interested in finding the truth, but instead explores possibilities for our future living that will provide a good life. Dahlbom therefore proposes an artificial science as a normative, design-oriented study of the qualities of artefacts in use.

24 Herbert Simon, ibid

25 Susan Roth, "The state of Design Research", in *Design Issues*: Volume 15, number 2 1999.

26 March, "The logic of Design", in Cross 1984.

27 C.S Peirce, *Chance, Love and Logic,* Kegan Paul, London 1923.

28 Bo Dahlbom, "The Idea of an Artificial Science", Dahlbom, Beckman, Nilsson, *Artifacts and Artificial Science*, Almquist & Wiksell, Stockholm 2002, (p 9-42).

1.2 Design and Computer Science

While industrial design has focused on adapting itself to the twentieth century's industrial society, the rest of the world has become highly interested in design.

Back in the 1960s Herbert Simon proposed the establishment of the Science of the Artificial. The goal of design, according to Simon, was to "*devise a course of action aimed at changing existing situations into preferred ones*." Simon's work led to a general interest in design theory within computer science, an interest that has grown steadily over the years.

human-computer interaction is a cross-disciplinary subject that was developed to make computer applications more accessible to the user. HCI has developed from the three parent disciplines of computer science, psychology and social science.[29] The ambition here is to form the basis for software development, and to understand how these artefacts function in their use. At first, methods from experimental psychology were applied, which were based on strong scientific ambitions. The experiments were carried out in laboratories with control groups, and tests were performed to investigate isolated movements and work tasks. The computer applications written as a result of these studies were almost exclusively directed towards the workplace, and aimed to increase efficiency and reduce mistakes in the use of the programs.

At the end of the 1980s, critical voices were raised against these reductionist methods. Critics pointed out that actions take place within a specific context, and that knowledge arises and is transmitted within a social situation. Many of these critiques came from the new field *computer supported cooperative work* (CSCW). They argued, that to understand how computer applications work, these must be studied when they are used in the workplace, not in the laboratory.

The 1980s and 90s saw a broader interest in design, with the development of graphic interfaces and object orientation. It became clearer that a successful computer application must be easy to use, contain easily grasped metaphors, and have an attractive interface. Design was seen as an alternative to the reductionist, engineer's method of development. One way of creating holistic solutions focused on the user's experience rather than on technical functionality. The last ten years has seen ethnological studies and

29 Monk and Gilbert ed. *Perspectives on HCI: Diverse approaches*, Academic Press, London 1995.

participatory design[30] take on an increasingly large role in the design of computer systems and HCI has developed to a multidisciplinary field. Through its connection to sociology and ethnology, there is a strong degree of reflection within HCI. In other words, here one finds both a focus on the user's everyday life and the ambition to see the artefact in a social context, an approach that has been lacking in the field of design.

A large issue within computer technology is making the technology more ubiquitous, i.e. having it present in more objects. Computers are no longer only boxes with a screen, but microprocessors integrated into daily objects of all kinds. The telephone, which was previously known as a tool for communicating at a distance, is now a mobile miniature computer with a camera, printing functions, a calendar and a radio. Indoor sensors register temperature, movement, light and air. Artificial organs replace one's own, monitoring for example sugar levels in the blood and dosing insulin accordingly. Instead of having one complex machine that does everything, and therefore is vulnerable, we shall have several dedicated tools. Computer technology, according to Mark Weiser,[31] will melt into everyday life and become invisible.

There is no longer any question that design is important for system design, and there are many stories about both success and failure to prove it. Yet, there is a long way to go to make design a self-evident and integrated part of software design. Design is still in the outskirts of HCI rather than in the centre. Students in software development are rarely taught design as are designers rarely taught cognitive psychology or human-machine interaction. There is much to do to make compatible interfaces between the disciplines as well as developing each field to meet the requirements of an accelerating technology.

Computers at the office and at home

There are many examples of how computers created problems when they entered workplaces in the 80s and 90s. Computerisation was shown to disrupt routines, de-skill workers and disable communication and social interaction at work. And the problems are not over. A recent Swedish study described a small company, of 50 employees, that worked with

30 Bødker, Ehn, Kammersgaard, Kyng & Sundblad, "A Utopian experience". In Bjerknes, Ehn, Kyng, *Computers and democracy – A Scandinavian challenge*. Avebury 1987, (p 251-278).
31 Mark Weiser, "The Computer for the 21st Century", *Scientific American*, vol 265, no 3, sept 1991.

sheet metal and where the production flow was very graspable. When the computerised production system SAP/r3 was introduced due to demands from a large customer, 7.5 new people had to be employed to make the system work. The head of the engineering workshop who was responsible for education of the system said: "*I used to tell the workers: Don't try to understand what you are doing. Just learn the commands and screens that are used, otherwise you go crazy*".[32]

Another well-known problem with computerised work is static working postures and monotonous tasks. Particularly work on visual visplay units (VDU) can be hazardous to health. Main problems reported are visual discomfort and repetitive strain injuries, including pain in the neck and shoulders, mouse arm syndrome and problems in wrist and hands.[33] Stress-related symptoms, such as headaches, stomach problems, irritation and fatigue are also common.[34]

In a study I made at the Swedish tax administration the telephone operators had three different display units and three keyboards of different shapes. They used to put one of the keyboards on top of a pile of catalogues to get a better working posture. All the operators had post-it notes on a particular place on the receiving unit. Beneath that post-it note was a display with the number of waiting incoming calls. When the number reached over a hundred (which it usually did) it was too stressful to watch, the operators explained.

A recent study in a Swedish call-centre showed that almost 8 out of 10 workers suffer from pain that could be related to working with computers. Other risk factors are of a social nature such as high demands, poor control over workload and poor relation to management and colleagues. There is a large body of research and knowledge about health problems and risk factors in computer related work. Some positive changes have been made in ergonomics and quality of display units, one of them is the TCO certification. Hundred million users are estimated to have TCO certified PC's. Despite that, Inger Boivie points out,[35] ill health related to VDU work seems to increase rather than decrease.

32 *IT-kartan 2000. En rapport om LO-medlemmars IT-användning*. LO 2000

33 Aarås, Horgen & Ro, "Work with the visual Display unit: Health Consequences". *International Journal of Human Computer Interaction*, vol 12, no 1, 2000.

34 Smith, "Psychosocial aspects of working with video display terminal (VDT's) and employee physical and mental health". *Ergonomics*, vol 40, no1, 1997.

35 Inger Boivie, *Usability and Users Health Issues in System Development*, Licenciat, Uppsala University, 2003.

The computerisation of workplaces has undergone a revolutionary and at times rather painful development. Today we see a development where computer technology and networks enter the home in a similar way. But the home is an environment that differs from that of the workplace, and therefore places new demands on computer technology. Technology in the home must be subordinate to normal routines, aesthetic values, and emotional needs. It must adapt to the inhabitants of the home, a situation very different from that of the workplace, where workers must adapt to the technology, and the demands for rationality, performance and efficiency. Johan Redström[36] argues that when computer technology becomes increasingly integrated into daily life, there are new demands for objects to have a meaningful presence in our lives, and that they are designed in a way based on aesthetics rather than a narrow functionality.

Ubiquitous Computing, with its integrated computer solutions and its ambition to "weave itself into the fabric of everyday life," seems to be especially suited for the home environment. The goal is to have the technology melt into the home environment in a seamless way, and to support the routines and needs of daily life. At the end of the 1990s we saw this development take place mainly in two ways: on the one hand in the so-called smart home, with alarms, surveillance cameras and security services aimed at an older, wealthier target group, and on the other hand with the development towards home care and IT-supported housing for the elderly, chronically sick and disabled. The intention is for an increasingly larger population of elderly to be able to continue to live at home even if they are sick or become absent-minded.

The challenge we face is not only about integrating technology into the home, but is also about making sure that this technology, in contrast to that of the office, shall support the health and well-being of our lives, and help us to manage daily life. This type of future development places high demands on our being aware of the conditions and needs of everyday life. If computer technology shall truly be invisible, it must function extremely well. The question is: will it?

Is there something about new technologies as such that causes stress? Studies made on work related diseases from the beginning of the 20th century seem to suggest that.[37] In 1900 Swedish workers suffered from

36 Johan Redström, *Designing Everyday Computational Things*, Doctoral Dissertation, Göteborg University, 2001.

tuberculosis, rheumatism, silicosis and poisoning. But those who worked with new technologies such as electricity, telegraphy and steam engineers suffered mainly from neurosis, overstrain and neural diseases. Karin Johannisson has observed that these professions were tied to technologies that signalled the breakthrough of modern times

1.3 Living with artefacts

One important reason for the ongoing initiatives in IT-supported home care is the changing health picture. What we might see is the beginning of the demographic development towards an increasingly older and sick population. According to a study by the National Institute of Public Health,[38] Sweden's large group of people born in the 1940s, now in their early 60s, are increasingly fragile and sick. The average lifetime in Sweden has increased by ten years since the 1950s. In ten years time the group above 65 years of age are estimated to constitute 25 % of Sweden's population. Many other western countries have similar problems, but Sweden will sooner than other countries have a large group of elderly, above the age of eighty [39] [40]. The elderly, and particularly those above eighty, consume a large part of the total healthcare cost. Costs for elderly tend to rise with average life length. Most people are relatively healthy until eighty years of age, after that the risk for diseases or combinations of illnesses increase.

The trend towards an aging population is accentuated by decreasing birth rates. In the future fewer young people will have to support and take care of a growing group of elderly.

Just as alarming is the increasing ill health among women between 30 and 49 years of age. Stress, worries, high demands at work and from family create a life situation that is likely to cause ill health. Mental problems and stress are one of the big healthcare problems facing us today and studies show that 30 % of all diseases are related to stress. Stress generates

37 Karin Johannisson, *Kroppens tunna skal*, Norstedts Förlag, Stockholm 1997.
38 Anna Hedborg et al. *Analys av Hälsa och Arbete*, Folkhälsoinstitutet, 2003.
39 Statistiska Centralbyrån, *Sveriges Framtida befolkning. Befolkningsframskrivning för åren 2000-2050.* SCB-tryck Örebro, 2000.
40 Anna Essén, *Kvarboende och äldrevård i hemmet med modern teknik*, Report, Institute of the future, 2003:27, Stockholm.

insomnia, weakens the immune system, increases the blood's ability to coagulate, increases the disruption of cortisol and adrenalin in the blood and gives rise, in turn, to a whole lot of stress-related illnesses like stroke, insomnia, gastric ulcer, depression, back troubles and fatigue. Consequently, on the top list of medical prescriptions are anti-depressives, sleeping pills and sedatives, that is medicines that are related to stress and mental problems.

Studies that measure the total amount of ill health in the society find that mental problems are the largest cause of functional disability. Every second woman and every fourth man will, sometime in their lives, suffer from depression.[41] The World Health Organisation (WHO) believes that depression, in addition to smoking, are the greatest health problems in the 20th century and that depression will probably be the main cause of work-related and functional disabilities amongst adults.[42]

Burnout is a kind of exhaustion depression caused by too much work and pressure over a long time. A recent study made on 67 Swedish women with burnout symptoms [43] claims that stress gives the same brain damage as stroke. The central nerve system is affected, which substantially limits the brain's normal ability to learn, remember and handle new information. These women describe that they cannot make the simplest decision or remember anything new for even a short time. The writers conclude that we need to adapt working places for our brains as well as for our bodies. Work should be judged and adjusted to brain ergonomics to prevent cognitive overload.

Other diseases that increase are: back problems (25% of long-term sick leave), osteoporosis, asthma and allergy and old age diabetes (type II). [44] Back-related problems are the most commonly diagnosed cause for people taking long-term sick leave. It has increased dramatically over the last ten years, especially among men with trouble in their shoulders and necks. This is believed to be related to an increase in the amount of computer-related work characterized by long hours of static sitting.

To sum up, we have two parallel trends in the future health picture: one consist of general public health problems with increasing stress-relat-

41 Gunnar Ågren, *Folkhälsa i Framtiden*, Folkhälsoinstitutet 2000, available at www.fhi.se
42 Murray and Lopez 1997, in *Behandling av personer med depressionssjukdomar*, SBU 3/99
43 Rhodin-Nyström, Sandström, Lundberg, *Proc. of International Neuropsychological Society,* Stockholm 2002
44 "4:e Septemberundersökningen av pågående sjukskrivningar", Riksförsäkringsverket, Dnr 9161/99-430

ed diseases, the other is caused by an aging population with diseases related to old age.

Design and health

In an historical perspective, living conditions have been the object of many studies and preventive measurements. The large increase in health and age during the twentieth century is mainly caused by preventive actions and structural changes in society such as better hygiene, better housing, better diet and safer working conditions.[45] It is likely that the ill health we are facing today require the same kind of preventive measurements.

During the last century, design and social engineering has been regarded as a tool to increase health among the general public. In the Swedish functionalist tradition of the 1930s and 40s, apartments were built to accommodate hygienic bathrooms, a kitchen built according to rational principles and sleep-enhancing bedrooms. The houses were built in airy park-like environments, surrounded by sun and fresh air. Bacteria and poverty, the main causes of ill health, would be wiped out with science. The engineer, as Le Corbusier reminds us, is healthy, happy and strong!

Many of these housing areas like Årsta, from around 1950, in south Stockholm, would become icons for good and functionalist building, but some that were made during the peak of high modern rationalism were horror examples of alienating concrete suburbia.

Stress and mental problems are one of the main ill health problems that are facing us today. Surely the reasons for stress are as complex and difficult to cope with as modern life, and are intrinsically a part of it. But something modern lives are full of, both at work and at home, are products. Is it not reasonable to think that all the artefacts that we live in somehow affect us? That they perhaps create a basic stress level that makes us less resistant towards ill health?

Is there anything designers and developers can do to solve these problems or are they beyond the scope of design?

The International Academy of Design and Health[46] (IADH) was founded as recently as 1997 and looks at the therapeutic benefits of design. Their main background is in the design of health care buildings, but

45 *Längre liv och bättre hälsa – en rapport om prevention*, SBU rapport nr 132, Stockholm 1997
46 www.designandhealth.com

the focus is widening to regard all aspects of our built environment that affects health. "*The quality and character of the designed environment should be considered to be a powerful instrument capable of importing and strengthening health processes*."[47]

Does artefacts cause stress or are they only part of a stressing situation?

Well-designed and positively experienced environments enhance the ability to cope with stress. But inappropriately designed psychosocial environments may be a source of stress and frustration, and thereby affect our well-being and health, claims Alan Dilani.

This is true not only for healthcare buildings but for our total environment including the products we use and meet daily. Artefacts should reinforce positive aspects and strengthen our capacity to deal with adversaries and stress factors. But first we need to find out what these positive aspects are and how they affect our health.

Stress, relaxation and artefacts

In order to better understand the relation between stress and artefacts I made a quick survey. The goal was firstly to see what *situations* made people stressed and what made them relaxed, and secondly what *products* that were stressing and relaxing. Is there a connection between stressful situations and products? The questionnaire was sent out to two organisations, one health centre in the north of Stockholm and one consultancy in IT-design and media with several offices in the country. Most of the surveys were sent out and answered on e-mail; some were distributed by hand and returned anonymously in a letterbox. About 40% of the employees answered, in total forty-three people, twenty-four women and nineteen men in the ages between twenty-seven and fifty-nine.

After the background data (age, sex, profession) came four questions, two concerning stress and two concerning relaxation. The questions were to be answered on a blank space, were the respondents where free to make remarks or describe situations.

47 Alan Dilani, ed. *Design and Health - The Therapeutic Benefits of Design*, Svensk Byggtjänst, 2001, (p 35.)

To the first question "*What makes you stressed*?" the most common answesr were: *Too much to do*: Too many e-mails, commitments, phone calls, meetings and projects. *Lack of control, powerlessness*: technology that does not work, computers, software, servers, unclear organisations, misunderstandings, delayed trains, other people. Spending a lot of time trying to fix these things with no success. *Disturbing audial and visual environments*: cell phones that ring during meetings and concentrated work, piles of papers, messy environments, irritating sound environments, printers, sound interfaces; things that do not fit in or can not be mended.

The most common *artefacts* that cause stress are computers and telephones. Other annoying artefacts that were mentioned several times are servers, printers, vacuum cleaners, cords, cars, car queues, alarm clocks, bills, disturbing sound environments, things that are sorted but do not "fit in" anywhere; half important papers like information about one's pension or things that are broken and cannot be mended.

The next question was: *What makes you relaxed*? The answers to this were even more coherent than the questions about stress. By far the most relaxing activity is listening to music, which was mentioned by half of the subjects. *Calming activities*: Sleeping, bathing, lying down, drinking alcohol, peace and quiet. *Enjoyable activities without a clear goal*: Listening to music, walking, being in nature, gardening, cooking, watching movies, sports, yoga, being with friends and family. *Activities that gives (a sense of) control*: clean the desk, make what-to-do lists, finish jobs, making backups, sorting papers in folders, doing familiar things with well-known objects, reading the morning paper. Repairing things. Having just enough to do.

The *artefacts* associated with relaxation were related to these themes mentioned above. Music scored the highest, followed by hot baths, beds and sofas, books, candles, musical instruments and kitchen tools. Cups with hot liquid, nice pictures, photos and a clean flat also made you feel good. Beautiful and functional things were mentioned, special glassware, a gardening tool or a familiar painting. Some people felt relaxed by survival kits, manuals, fire detectors, tools and extra batteries. One person mentioned his four year old server that enabled him to get hold of old files wherever he was in the world.

Differences between men and women where rather small. Women were more stressed by losing control or by feeling powerless then the men where. Men on the other hand were more stressed by other people that

were slow, incapable, disrespectful or incompetent. More women were mentioning problems in combining family with work, mostly women found picking up kids from school or kindergarten to be very stressful.

There was no significant difference between the working places or different tasks except for one: all of the secretaries, (three) were stressed by people that complain and whine about things that can't be changed.

Just for the pleasure of it

The most stressing activities and products are those with high demands and little control.

One woman writes: "*The increasing amount of e-mails feels overwhelming and almost impossible to get rid of. I'm worried about missing important meetings and people get annoyed because they expect quick answers.*"

The constant ringing of cellphones in meetings and conversations is another annoying phenomenon "*When I talk to somebody and their phone starts to ring, it feels like they don't really want to have this conversation. It's very frustrating.*"

Stress is often audial or visual: "*Unmade dishes are very stressing if you have to see it. Just knowing about it does not have the same effect.*"

The most relaxing activities and products that people report about are just done for the pleasure of it. Repetitive activities like baking, ironing or mending tools are also rewarding and relaxing, but only if they are done in their own speed and preferably with a visible result. Familiarity and routines are relaxing like reading the morning paper, taking the same walk, things from your childhood or your trusty tools. Many people mention time lapses when they can not do anything particular, for example journeys or breaks: "*Long periods of time that are not interrupted by something, like long walks, sauna baths, baking or train journeys.*" Today such "waiting time" has been rationalised away from work – we are supposed to be efficient all the time.

Activities and things that are relaxing do not render the same long and engaged answers as activities and things that cause stress. Many people give vivid descriptions of what stresses them, but they merely lists the things or activities that calm them down. This suggests that we do not actively think about what pleases us, it is just there, invisibly. As soon as something is frustrating and problematic it comes into our attention.

Understanding everyday life

Today we see how computer technology is increasingly miniaturised, and has become more integrated into daily life. The home is the next stop in the diffusion of computer technology. Soon we will have broadband not only in home computers, but also in refrigerators, bathtubs and beds. The technology will support our well-being and security, and make it possible to remain at home even when we become old, sick or disabled. Special alarms, electronic locks and automatic lighting are being developed. In the near future there will be an outpatient healthcare that includes pain management and taking specimens at home. The bathtub regularly monitors your EKG when you bathe, and registers changes. The refrigerator knows your diet and warns you if there is too much fat in your food. Gauges on your arm measure your pulse, movements and temperature; any sudden changes and your relatives will be alarmed. But most of all, technology will make it easier to maintain contact with family and friends. Solitude and a lack of social networks are just as detrimental to health as a bad diet. All of these artefacts will ease daily life, and make it possible for society to take care of its elderly without draining too many resources.

Or is this really the case?

There are many horror stories about the automatic home, where the inhabitants become prisoners of technology. If we only look realistically at how technology in the workplace functions, there is every reason to be sceptical. Will home care be continually plagued by server breakdown, hard disk crashes and overburdened networks? Will stressed-out technicians replace home care and hospital personnel? Will we be forced to change longstanding routines in order to adapt to technology?

To avoid repeating the same mistakes we experienced from office computerisation, we must be better prepared. We need to understand the home as the context of a practical everyday life, and how technology may support this in a way that does not create frustration.

Aesthetic and design questions will be central when technology goes from the anonymous environment of the office to the personal milieu of the home. We need to develop systems and products that are intuitive in their use by having them refer to objects that have been around us before. At the same time, new artefacts should not be based only on old metaphors, but must also create their own. How we interact and control complex systems is another important area. How does one create an interface to a system that builds upon implicit input?

In the face of this complex challenge, a multidisciplinary strategy is required. Neither the designer, HCI researchers, or systems engineers can manage it alone; we need to collaborate, and our point of departure must be the human being. To do this, we must first understand more about how humans and objects function together, and how this complex relation is formed. We create our reality in the form of actual material structures consisting of buildings, products, workplaces and the home. These artefacts are on one level a reflection of ourselves; we have created them and we understand ourselves through them. Together with immaterial artefacts like political systems, educational systems, healthcare and culture, they create our society. At the same time the totality of these material and immaterial artefacts forms our everyday life. And as we have seen in surveys and studies of workplaces, they create stress and bad health. How can it be that we create a reality that also makes us sick? And what can we do to change this?

Sociology is the study of how society is formed, and of the relation between the individual and society. It can be used to understand the connection between human action and artefacts.

According to health sociologist Aaron Antonovsky, health is directly dependent on to what extent we perceive the world as meaningful. For health sociologists this is mainly related to human relations. I would argue that the material culture is just as important for our making sense of things, and therefore our health.

Do products affect our health? My answer is yes, in a number of ways. The most obvious is that they physically affect us. But they might also affect our health in that they materialise patterns of behaviour that are destructive, chaotic and incomprehensible. If we suppose that the world around us is a reflection of ourselves, is it even possible for us to have "healthy" artefacts?

Today the largest common work disability among adults is depression. It is about time that we start to look at the mental implications of the products that we design.

The subject of this dissertation is design of IT artefacts for the home that will support well-being. The ambition is that the dissertation will be useful to researchers and practitioners involved in designing artefacts for a better life by providing examples with both critical analysis and concrete advice. The next part of this chapter will describe the research questions, the methods used and the empirical work that was done.

1.4 Research Questions

The theme of this dissertation is *The design IT artefacts for increased well-being in the home*. The theme spans over a number of subjects that needs to be better understod.
We have to find out what creates well-being and how this can relate to design. But we also need to study the causes for distress and irritation. We need to understand what characterises the home as a context, and how new technolgies has been introduced in the home. We need to acquire a deeper understanding of the relation between artefacts and our daily lives.

The goal is to provide a better understanding of the relation between design and health, and to offer tools that allow us to design for an increased well-being. The ambition is to contribute with both critical analysis and concrete proposals and to place design, IT and use in a larger perspective by applying theories from HCI, sociology and psychology.

The five central questions are:

Is the relation between well-being and design?
Why do we create a world that make us ill?
What characterises the home as context for new technology?
How can interaction design promote well-being?
What are the implications for design practice?

This dissertation includes four case studies of different character. Three of them, *Virus*, *Living in Ubiquitous Confusion* and *The Photo messager*, are related to the same large project in IT-support for home care. Whereas one, *Making Brainball* is mainly based on a discussion about design-oriented research and practice versus theory.

It has been my explicit ambition to not only write a theoretical or a practical dissertation, but to also work with a dialectical relation between the two. For this reason, the perspective shifts frequently between critical reflection, practical design practice and evaluation with the user. The dissertation is an example of how to do design research and should therefore be viewed as a contribution to the discussion of the possibilities and conditions of such research.

The design projects reported here have a conceptual and innovative character, but at the same time they are entirely realisable technically and practically. The projects can be viewed both as physically formed arguments in a discourse and as concrete proposals for solutions.

1.5 Method

The methodological origines for my work are to be found in industrial design and human-computer interaction. These two areas are coming increasingly closer to each other as more computer technology is integrated in everyday objects.

The questions that are asked, however, are mainly founded in the work of the practicing designer. They dela with how to address complex problems when developing artefacts that include interaction with computer technology. The goal of the investigation is therefore to inform design practice with concepts, advice and examples.

Design research is still young, and there are few if any established traditions within the field. As a rule, design dissertations today are written within or in collaboration with another discipline, which serves as a supporting framework for the design researcher. For my work, HCI functions as one such framework. The method, i.e. "the problem-solving approach," is subordinate to the issues and the development of the project. Most important is that each method is relevant for its context, and that it helps in answering the question that is raised.

A general methodological framework is to be found in two sources. One is Donald Schön[48] and his ideas about the nature of design work and how implicit knowledge in practice can be made explicit through a reflection on action. Inspired by Schön one main goal has been to unite practice and theory. I have regarded research as a possibility to deepen and develop theoretical questions that have no place in design practice, and allow them to meet and converse with practice. The field of HCI is increasingly approaching the field of design, and has a number of experiences and methods that can throw light on design and interaction. On the other hand I do not wish to write a "pure" HCI dissertation without carrying out a closer investigation in my own core discipline, inspired and informed by methods from HCI.

The other starting point is Bo Dahlbom,[49] who calls for a new design science that actively reflects on and suggests solutions for the future everyday world. If we want to influence the future we need to learn how to control technology and make predictions, i.e. models, of how this future might

48 Donald Schön, 1983, ibid
49 Bo Dahlbom, 2002, ibid.

be designed. Dahlbom calls for a technically oriented social science or a socially oriented technical science that can make "future archaeology". Such a science of the artificial is not interested in finding the truth but with exploring possibilities of our future living that will provide a good life.

Complex questions about design, "how things ought to be," cannot be resolved through a traditional reductionistic method. They require a broader effort. Peter Ullmark[50] remarks that designers are usually better at finding solutions to complex problems since they are used to working with more variables. Instead of reducing the problem they put up temporary models and try to make solutions out of them. The final model that is the result could be characterised as condensed rather than reduced. All aspects are there, but are hidden by subordination.

The goal with scientific research is traditionally that it shall result in generalised and transferable knowledge. Design project, on the other hand, are usually context-specific and situated. They are made particularly for one certain target group and task. How can design research fit into the scientific paradigm? I would argue that they can do this in two ways. The first is that design concepts can be used as models of an imagined reality. As such it can be tested by users and discussed and evaluated critically. If the model is built into a functional prototype the answers will be empirical, much the same, as in natural science.

The second way is that design projects can be used as allegories for future projects. The criteria are not exactly the same but there can be a family resemblance between the two that makes it possible to transfer the results from one context to another.

Combining the creative and generative methods of design with the reflective and socially informed methods of HCI is one way of achieving the new design science that Dahlbom calls for. The overall goal is not to find the truth about the world at hand or even to perfectly understand it, but to use this knowledge to inform practices that will create, or make models of a better world of artefacts.

The four case studies deal with different aspects of designing information technology for increased well-being in the home. Each of them has its own set of requirements that form the methods chosen. In most cases, however, there is some kind of iterative loop between critical analysis, empirical data and designing protoypes.

50 Peter Ullmark. "Research by Design", Innovativ Design, Chalmers, 2004, unpublished paper.

Brainball focuses on stress and relaxation through biofeedback in an entertaining way. Here the approach was more exploratory and focused on the interdisciplinary process. A functioning prototype was built and a comprehensive test on users was carried out to answer questions about users relaxation and biofeedback.

Virus and *Photo Messager* were two more typical design projects that included stages of analysis and evaluation. *Virus* investigates general public health problems and suggests solutions that can be implemented in the home. The project began with a preliminary study, continued in an analysis and synthesis phase, returned to a brainstorming and idea-generating phase, and resulted finally in a number of design proposals. The *Photo Messager* was a result of the *Virus* project and is a product that facilitates telephone communication for the elderly and disabled. The project went through a design and development phase, four functioning prototypes were built, and evaluation with users and a focus groups eventually led to the development of a commercial product.

The case study Ubiquitous Confusion is based on seven in-depth interviews and participatory observations carried out over a two-year period. The material from the study was then transcribed and coded into groups in order to find typical situations and problems. This is a method far removed from the practicing designer, but one that is common within ethno-methodology and sociologically inspired HCI.

A multidisciplinary context

An important aspect of the dissertation is that it has been carried out at the Interactive Institute. The Institute was founded in 1998 and operates in the borderland between art, technology, science and enterprise. The institute is organised with research studios located throughout Sweden, where each studio has a unique orientation and a director responsible for the studio activities. The Smart Studio where I have worked aims at creating new fusions of art, design and technology. The research is carried out from a design perspective, focusing on innovative applications of technology that generate new questions. There is an interdisciplinary and exploratory approach with a focus on generating prototypes rather than methodological reflections. A praxis of method has developed successively during the five years the studio has been in existence. At the same time, the focus in the studio has changed from applied- and design-oriented to more explorative- and art-oriented. But there has always been an

interest in working in an interdisciplinary manner, and to test ideas in functioning prototypes and physical forms.

Each project begins with a description of the problem, and a context where the artefact shall be located. Then follows a period of idea generation and brainstorming, where the conceptual "raw material" is created. During this idea-generation phase, creative methods are sandwiched with discussions of a more critical and scrutinizing character. Here members with different backgrounds and areas of knowledge complement each other, contributing with viewpoints that gradually sharpen and refine the concept. Often the discussions break down and must be postponed to a later time – a pause, however, that is important for the process. In the end, the ideas that have emerged are evaluated, and decisions are made as to which shall be developed further. Finally one idea remains that is built into a prototype. When the product or work is completed, it is tested and presented in its environment. Reflection on the work takes place in the form of discussions before and after the project. Purely academic papers, on the other hand, occur less often. One early variation of this process is described in the case study "*Making Brainball*" in Chapter 2.

The main difference between the work of the Smart Studio and conventional product development is that a variety of perspectives from artists, systems experts, behavioural scientists, designers and electronic engineers are equally important and so well integrated. Another unique aspect is the explicit ambition of creating an innovative and interesting artefact that articulates or exemplifies a critical issue without merely being an "illustration." It is our conviction that practice-based research has its own "language" of arguments in physical form that cannot be transferred to a linguistic language without losing something of its content.

The design projects have been developed in collaboration with other members of the Smart Studio, but my research process shall not be seen as identical with the Smart Studio's process. As the only doctoral candidate in the studio, my goal has been not only to take part in the projects but also to reflect on them, gaining knowledge for a dissertation. The goals of the others have been more directly coupled to the individual project's realisation and success.

1.6 Research Process

Brainball was the first project to be carried out while working with the dissertation, and was important in formulating the research agenda. The goal with Brainball was twofold: first to test creative methods and an interdisciplinary way of working, and second to investigate biofeedback as an aid to interaction. The project was thus an investigation into how we design, and the benefits of a design-oriented approach, as opposed to, a more conventional research.

Brainball, as an "anti-game" created during the information technology boom, met with great success at a time when stress and exhaustion from overwork became ever-increasing phenomena. It was clear that Brainball had a relation to a larger social problem, and the potential to be developed further. When the first prototype of Brainball was completed, a number of questions arose: How was the game experienced? Did playing Brainball lead to relaxation? Did the users experience an ability to control their brain activity with the help of biofeedback from the game? To get answers to these questions we performed user tests on Brainball. Over 200 people played three games and then filled out a questionnaire. The answers were compiled and studied statistically. It was clear that people genuinely experienced an ability to control their brain activity through feedback from the ball. Galvanic Skin Response (GSR) monitored during the game confirmed that the users were relaxed.

So Brainball started as a highly exploratory project and went on to become a highly controlled laboratory study on users. As a project it dwells in the borderland of art, science, enterprise and interaction design. But there have been problems when it comes to reflecting about the work in an academic manner, as the case story will describe.

Around the year 2000 there were several initiatives within the field of information technology in the home, many of which were coupled with well-being and healthcare. I became interested in placing social problems such as stress in relation to artefacts in the home. Was there a coupling between artefacts and well-being? Can objects around us create stress, or help us to relax? A quick survey concerning these questions (presented previously in this chapter) showed that certain artefacts can genuinely make us feel bad, while other objects contribute to calmness and well-being. Objects may be regarded as reflections of ourselves, and may contribute towards reinforcing and maintaining existing patterns of action, but how does this actually happen?

These questions could not be answered by merely making design proposals. Here there was a need to look into various theories from sociology, psychology, semiotics and gender studies. The theories are used both as tools for analysing existing artefacts and as starting points for future design projects.

Semiotics is useful for analysing layers of meaning in artefacts, and how we create meaning through them. Social Action Theory, especially in the work of Berger and Luckman,[51] describes reality as a social construction created through our actions. The design and development of artefacts usually takes place in the "system world" in rather tight economic and commercial frames. Therefore, the results of design-processes are products of the system and its values rather than expressions of the life world. The large amount of stress-related symptoms today, points at an asymmetry between the objective "system" and subjective life world.

But what shall we do to change this unbalance? Can we create artefacts that help people cope with problems instead of creating distress?

How we cope with artefacts resembles to a great deal how we cope with life. Health sociologist Aaron Antonovsky[52] argues that we have to look at the factors of life that enhance health instead of simply identifying symptoms of diseases. He has developed a scheme for understanding how we cope with strains of life, called Sense of Coherence, with three central concepts: comprehensibility, manageability and meaningfulness. Can Antonovsky's concept be applied on artefacts to support successful interaction and increase well-being?

The next issue was to understand the home as a context for the discourse. What characterises computerised technology in the home and how does it differ from a workplace context?

New technologies that have entered the home during the last century are related to large changes in society such as the womens movement and the "lack of servant's." Gender theory can be used to understand the domestification of technology and the dream of the "caring" home. It is also a useful critical tool to discuss power issues and identity in relation to design. The dream of the caring home is related to Mark Weiser's idea of ubiquitous computing and also underlies the ongoing initiatives in home healthcare. What does it mean to hide computer technology in the home in order for us to accept it? What are the real implications of ubiquitous computing in terms of interaction design and understanding?

The empirical work in the thesis is centred around one large research

How can IT support sleep and relaxation?

initiative in technology-aided support called *Kvarbo*. Two experimental flats were equipped with information technology that would enable inhabitants to remain living in their home even if they became old, ill or disabled. The flats were subsequently tested by users with cognitive disabilities for two years and evaluated by Danderyd Hospital. The Interactive Institute had a small part in this large project, in a parallel project called *Virus*. In the Virus project we asked how public health problems could be reduced or rehabilitated through technology-aided support in the home. The focus was broad and explorative. Influenced by Antonovsky, the intention was to look at information technology in the home in a new way, not only as remote control devices and alarms, but also as an active aid in prevention.

The preliminary study included a broader analysis of public health problems and changes in the overall health picture. The next step was the design phase, in which we would generate a number of proposals for products. The concepts we developed were sharply different from the services currently available for the Intelligent Home. Instead of remote controls and alarms, the proposals here concerned, for example, how one could encourage movement, and in this way prevent backache or sleeplessness. As design concepts they provided models for how IT in the home could (or should) be used and inspire to future development. From several concepts one, the *Photo Messager*, was selected for implementation.

In connection with work on Virus I became interested in seeing how the Kvarbo flats functioned in practice. The final case study, *Living in Ubiquitous Confusion,* is based on in-depth interviews with six households that lived in the flats for a period of 4-6 months.

Kvarbo was one of the first "smart" homes where people had resided over a longer period. It was therefore a golden opportunity to study how technology-aided support for the disabled functioned in actual use. Could the residents interact with the technology? What happened when problems arose? How did they experience the technology? How well did the technical support function?

In my analysis I have searched for typical occurrences, with a special focus on breakdown situations in the relation between user and technology. The starting point for the analysis is the discussion about ubiquitous computing, in particular regarding its design, interaction, and use. The users' experiences point to several problems that must be dealt with within ubiquitous computing, and give suggestions for what should be considered when designing technology-aided support for the home.

The *Photo Messager* is a device that can support and facilitate communication by simplifying the handling of incoming telephone messages. It helps people with memory problems to easily maintain telephone contact with relatives and friends. We were influenced by the idea that information technology should support daily life, and be subordinate to existing routines. People often have photos of family and friends out on display, why not use these pictures to simplify and remind about communication? At the same time we were critical of the general trend in ubiquitous computing towards invisible interfaces and implicit input. The goal was to create something that felt obvious, simple and clear, that was invisible in use, rather than perceptually invisible.

Six households in the Kvarbo flats tested the prototype of the Photo Messager during a two-year period. We also had a reference group that tested and discussed the Photo Messager, and they provided feedback about its use. This project can be seen as straightforward product development. What made it different, however, is the thorough user evaluation and its contribution to the discussion about interaction design and ubiquitous computing.

During this process we established contact with Polycom AB, a company that manufactures communication tools for the disabled. The result was that Polycom developes the Photo Messager into a commercial product that will be introduced in April, 2004.

1.7 Reading Instructions

The chapters in this book are rather freestanding and could be read according to the reader's background and interest.

This first chapter provides an overall introduction and background to the dissertation. Here I present the startingpoint, approach and methodology.

Chapter 2 gives a background to both the practice of design and research within design. Here I present developments in design theory during the latter half of the twentieth century, and a discussion on design process and practice. A case study exemplifies the discussion of practice-based research.

Chapter 3 examines theories from semiotics and social action theory in order to understand how we live with artefacts, and how we construct our world through them. I argue that artefacts can be seen as social actors and design as forming the interplay between the artefacts and the world. Finally I use coping theories to understand the relation between artefacts and well-being and how design can support our coping with stressors.

Chapter 4 gives a background to the home as a context for the investigation, and describes the demands that are placed on computer technology in the home. I describe the basic ideas of ubiquitous computing and the problems and potentialities with this approach. I show how the approach to hide new technology in the home is not new and how this can be analysed with the use of gender theory. Finally I describe the *Virus* project, where we developed IT artefacts to increase well-being in the home.

Chapter 5 contains two case studies that were situated in Kvarbo experimental flats. The first, *Living in Ubiquitous Confusion*, is based on interviews with residents and point to some of the interaction problems that might appear with technology based on implicit input. The other concerns the design and evaluation of a design prototype, the *Photo Messager*, installed in the apartments. The product tries to meet some of the problems that were found in the previous case such as interaction, use of metaphors and understanding.

Chapter 6 attempts to answer the research questions that have been raised in the beginning concerning the relation between interaction design and well-being and its implication for design.

Chapter 2
Giving Form to Artefacts

Giving Form to Artefacts

As we have seen in the previous chapter design is both a verb and noun which means it can refer to both an activity and an object. When design was mainly a craft based activity the main focus was on the object. During the 20th century the focus shifted to regard design as an activity, first as a process and later as a practice. This chapter gives a background to these changes by describing the development of design theory or design methodology from the mid 20th century until today. While it started with a wish to make design scientific it ended with a realisation that design has a unique set of characteristics that need a research agenda of its own. Post-modern critiques then changed the agenda to see the design product in a cultural context of consumption, use and identity.

The second part of the chapter looks deeper into the practice of design and what makes it different from a process oriented view of design. It also examines the role of design and tacit knowledge in a research context. The chapter ends with a case study, "Brainball", that exemplifies the discussion.

2.1 Design theory – a background

The 1950s were the peak of modernism and the industrially produced artefact. The critiques against the consumer society hade not yet started, USA was the ideal for the western world and science was unquestioned as the highway to happiness.

In the USA industrial designer was a highly fashionable profession; In Hitchcock's film North by Northwest from 1959, the glamorous, blond leading lady, played by Eve-Marie Saint, introduces herself to Cary Grant

Brainball was the result of an interdisciplinary reserach project. Here we have an artist, a designer and an engineer hard at work.

as:" My name is Eve, I'm an industrial designer". Her name and profession is the clue to her character and much of the plot. Eve seduces Grant, an advertiser, just as industrially designed goods seduced the American consumer. But Eve is not just a designer, she is in fact playing a dangerous game working for the foul and greedy enemy, a foreign art collector. Grant is betrayed, and indignantly scorns Eve for her deceit as a woman and designer. But behold, Eve is not evil, she is a fact a double agent working for CIA only disguised as a seducer. In the end we are reassured that she (and industrial design) is in fact on Grants (and advertisements) side.

With the development of computer technology and artificial intelligence, design issues became an interest not only for popular culture but also for the academic community. In 1969 Nobel Prize winner Herbert Simon proposed a science of the artificial world, based on biology, cybernetics and engineering[1]. The modern world is an artificial world, Simon argues, but modern science is a science of nature. While the natural sciences are interested in how things are, the science of the artificial is interested in how things might be. Simon attempted to make a bridge between artefacts and natural science by providing a very broad concept of design: "everyone designs who devices a course of action aimed at changing existing situations into preferred ones". An artefact can be thought of as an interface, Simon says, between the content and substance of the artefact on one side and on the other its environment. The two sides, the structure and the environment fall under natural sciences, but the interface itself, the artefact belong to the artificial sciences.

Only by holding on to the "process of design itself" will it be possible to develop a science that encompass both "human purpose" and "natural law" (p. 4). We can see how Simon in his attempt to make design respectable in the eyes of empirical science turns design into a general problem solving process. With such a general definition of design, Dahlbom remarks,[2] Simon had no problem making the science of design congruent with traditional science.

A few years earlier practising designers had become interested in making this essentially craft-based discipline a profession based on scientific

1 Simon, Herbert "The Science of Design: Creating the Artificial" in *The Sciences of the Artificial*, Cambridge, MIT Press 1969.
2 Dahlbom, Bo "The Idea of an Artificial Science", in Dahlbom, Beckman, Nilsson, *Artifacts and Artificial Science*, Almquist & Wiksell, Stockholm 2002.

principles. The Design Methods Movement began with the large international conference "Design methods" in London 1962. Cross, who was one of the initiators, regards the years from 1962 to 1982 as the time when design theory was established as an academic discipline[3].

The first theorists were influenced by systems engineering and the development of expert systems and AI, something they had in common with Herbert Simon. They regarded design as a problem solving process, which was structured according to analysis, synthesis and evaluation. Every problem could be divided into sub problems and then solved rationally. Once you analysed the problem the solution would come "naturally". The idea was to establish scientifically based rules for design problems where the designer would be the expert and to adapt the product to the system. It is interesting to read those early, and very influential, attempts to align design development with a reductive, positivistic thinking. Christopher Alexander[4] describes the design of an Indian Village in a set of mathematical variables programmed for the IBM 7090. "The beauty of this description is that we can now give it a mathematical interpretation, compatible with the real world facts though nonetheless artificial, which suggests criteria for decomposing the system of requirements into subsystems, and these themselves into further subsystems, in such a way that each subsystem contains a set of requirements very densely connected internally, yet as much as possible independent of the requirement in other subsystems." (p. 40)

Later, Christopher Alexander[5] developed an idea called design patterns that has been quite influential in software design. Alexander claims that architecture should express the patterns of use of space that permit the buildings' occupants to carry out their daily actions effectively. Buildings and spaces can be described and generated through these pattern languages in infinite ways. In a similar way, users action and needs at work can be seen as patterns that are combined into program design.[6]

By the early seventies, Horst Rittel[7] among others, criticised the previous theorist for their simplified conceptions of the design process. He suggested a second generation where the design process should be seen as

3 Nigel Cross, ed. *Developments in Design methodology*, John Wiley, UK 1984.
4 Christopher Alexander, "The determination of components for an Indian village", in Cross, 1984
5 Christopher Alexander, *A Pattern Language*. New York, Oxford University Press, 1977.
6 James Coplien, Douglas Schmidt, *Pattern Languanges of Program Design.* Reading MA: Addison-Wesley 1995.
7 Rittel and Webber, *Planning Problems are Wicked Problems*, in Cross 1984.

interplay between the designer's ideas and the users criteria. Rittel and Webber argued[8] that design is foremost a way of handling value conflicts and that design problems are of a typical kind "wicked problems" where the relation between goal and means is not very clear. The understanding of the problems grows from the work to solve it. Design should be regarded as a negotiation process where the arguments are delivered and weighed against each other, so that a shared understanding of the problem and the solution successively appears among the participants. The second generation also criticised the first for their idea of the designer as a tabula rasa that without preconceptions could find out all the objective facts about a design task.

The second generation was opposed to the idea of the designer as an objective expert. Instead the designer should work together with users, acting as a coach that would help users develop their ideas. An infamous example of an extreme user directed design was the University dormitory in Louvain by Luicen Kroll. Apart from being regarded as very ugly the building also turned out extremely uncomfortable and dysfunctional and resulted in a bad reputation for user participation.

The search for describing what design actually was, led some researchers to do empirical studies on design projects. Jane Darke[9] studied practising architects and noticed that they very early had to limit the possibilities in a building project by establishing a "primary generator". This early idea guided the work through the difficult first phases and was changed according to the requirements in the project.

Bryan Lawson[10] compared how different groups of people solved problems. He found that people with a background in natural science tend to be problem-oriented, which means that they tried to find the only rule that would solve the problem. Designers on the other hand, tend to be solution-oriented, they want to solve the problem quickly by delivering many different concepts that could be developed and refined. The empirical studies led many researchers to realise that the systematic design methods of the first generation did not apply to real cases.

By the end of the seventies Geoffrey Broadbent[11] became representa-

8 Rittel and Webber, in Cross 1984, ibid.
9 Jane Darke, "The primary generator and the design process", in Cross 1984.
10 Bryan Lawson, *How designers think*, Architectural press, London 1980.
11 Broadbent, "The Development of Design Methods", in Cross 1984.

During the 1930s and 40s, Svensk Form gave courses in how to furnish your own home.

tive for a new school of design theory that was critical of the previous generations for their lack of broader outlook. The third generation went back to study the special traits of design knowledge and thinking. They regarded design knowledge as a kind of tacit knowledge that is implicit and contextual and applied different philosopher's work to design theory. Lionel March[12] claimed that design was neither inductive nor deductive but a third kind of thinking that is not part of the scientific paradigm called" abduction". If induction shows that something is de facto the case, and deduction show that something is logically the case, but abduction show that something is possible. Abductive thinking appears in the creative design work, something March called "productive thinking". March suggested that the design process should be divided in three phases: The creation of something new, through abduction; formulating criteria for usability, through deduction; the search for knowledge about values and behaviour, through induction.

Typical for the third generation was the idea about design thinking as an inherent human activity, as fundamental to humanity as language.

Philosopher Janet Daley[13] suggested that our way to interpret and understand physical objects should be the base for an epistemology of the design process. Our perception of artefacts is a combination of inherent schemas and social value systems. Using Chomsky's ideas about inherent language structures and Wittgenstein's theory on language games, she remarked that what can be explicitly expressed is only a small part of what meets our perception and of the social value systems that surround us. A large part of the designer knowledge is implicit in the sense that it cannot be expressed in a discursive language. Daley advocated that the design process should be seen as a family of language games in Wittgenstein's sense.

In the mid eighties came a number of important books that sum up the previous twenty years and sets the research agenda for the next decades. Cross, Development in Design Methodology[14] from 1984, contains most of the important texts from the movement. Donald Schön's book The reflective practitioner[15] from 1983, studied the practice of design and has been very influential. Schön noticed that the designer always worked

12 March, "The Logic of Design" , in Cross 1984.
13 Janet Daley, "Design, Creativity and the Understanding of Objects", In Cross 1984.
14 Cross, 1984, ibid
15 Donald Schön, *The Reflective Practitioner- How Professionals Think in Action*, Basic Books, 1983.

with a Model of the end artefact. This model was in constant change, updated against constraints provided by users, commissionaires, financing or structure. Another typical feature of design work was reflection in action, which meant that the reflection was an integrated part of the practical design work on e.g. the model. Sketching was a way of thinking about all aspects of the project and uniting them to a whole. A designer does not use a fixed set of rules, but a library of cases that function as an allegory for the new problem. Schön was critical to the "means and goals" model of development that was the norm in planning and construction during the twentieth century. This method had no room for iteration or for handling changes once the initial criteria was set. The design method, Schön argued, was more open and at the same time more precise since it was centred on a physical model of the artefact. Schön turned back the focus of design on the profession and the tacit qualities in the design work. His work was seminal in bringing knowledge about designerly methods to a wider public in computer science, organisation theory and management.

These first twenty years had started with a view that design could be turned into a scientific discipline but ended with the realisation that design is something fundamentally different, a tacit, inherent human competence. The process view of design, proposed by Simon and the founders of design methodology, was complemented with the view of design as a unique practice.

Design in a cultural context

If the early development in design theory still dwelled in a positivistic or slightly post-positivistic paradigm, the 1980s meant a big step into postmodernism and alternative worldviews. This change brought a renewed focus on the material and symbolic qualities of the product itself and a return to the romantic view of the designer.

Having lived a rather humble life during the 1970s, the design scene literally exploded during the 1980s. The economic upswing was reflected in a great interest in design both from consumers and producers. New theories from postmodernism, cultural studies, business and management were picked up and combined with design ideas. French thinkers like Foucault, Baudrillard and Lyotard were used to criticise modernism and point to a less positivistic view of design both as process and aesthetics. Theories from language and communication were used to understand architecture and design. The product could be seen as a text, that was read

by the user and that could communicate all sorts of things.

In Italy the design group Memphis, founded 1984, used fake materials and a violent mix of classical and pop cultural references to question design norms. In USA the former Ulm Design School student Klaus Krippendorf used theories from semiotics to advocate a new understanding of design as a form of communication. Krippendorf and Butter co-edited an issue of Innovation where they launched the theory "Product Semantics", that seeks to understand the symbolic qualities of the artefact as it appears in the context of use[16]. They criticise the modernist linear approach to communication and suggest a new paradigm of design with an emphasis on meaning, understanding and co-operation. These ideas were soon to be picked up by Michael and Catherine McCoy, at Cranbrook Academy of Art. Cranbrook was already legendary for having been the school of the 50's American design wonder like Eames and Saarinen. Now Cranbrook became leading in implementing the ideas of product semantics in experimental and visually groundbreaking design concepts. They set out to find a new aesthetics for technology heavy products and at the same time criticise our everyday conceptions of culture, nature and design in thought provoking design prototypes called "design polemics".

"Regional" design, as opposed to the modernist "universal" design, emerged in different areas. One of the most prominent was in the region Catalonia in Spain that freed from fascism could cherish their own identity and design heritage. The Catalonian designer Xavier Mariscal was even commissioned by the Swedish Social Democratic party to do a redesign of their logo, which resulted in a smiling, "young" and dynamic red rose.

In 1988, John Thackara edited Design after Modernism[17], which brought together some of the most influential contemporary thinkers in design and post-modern theory. Here different writers examine product design in the "postmodernism condition" of society and phenomena such as information technology, the crisis of the city, craft and beauty. But the authors are not altogether critical of modernism. The theme of the book, writes Thackara, is that if progress and modernisation have ceased auto-

16 Kalus Krippendorff & Reinhardt Butter ed. "Product Semantics: Exploring the Symbolic qualities of Form" *Innovation*, vol 3 no 2, 1984.
17 John Thackara ed. *Design after modernism– Beyond the Object*. Thames & Hudson, London 1988.

matically to benign, it does not follow that modernism's strategic drive to make them so has failed.

During the early eighties scholars in Cultural Studies showed how design could be integrated in a much wider cultural framework using theories from sociology, anthropology and social history. Objects and design was discussed not in terms of aesthetical objects but primarily as part of consumption and use. In The social life of things – commodities in a cultural perspective,[18] from 1986, a number of social historians and anthropologist describe how people attribute meaning to things as a result from human transactions and motivations. The contributors examine how things are sold and traded in variety of social and cultural settings, both past and present. The same year Adrian Forty published his seminal book, Objects of Desire, Design and society from 1750-1980 [19]. He describes the design of objects as a result of social, cultural and technical forces rather than the decision of the single designer. It made a very strong case against the Pevsnerian[20] approach to design history as the result of a number of "great men". As Forty remarks "The study of design and its history has suffered from a form of cultural lobotomy which has left design connected only to the eye, and severed its connection to the brain and the pocket." (p.6)

Another important contribution to the understanding of design in industrialized society was anthropologist Daniel Miller [21] with his book Material Culture and mass-consumption. Material Culture refers to the whole spectrum of material goods: of production, consumption, use and waste and has since the mid-eighties become a fairly established field within cultural studies. Such influences forced design historians to expand their subject from the rather narrow examination of designers' work to include issues such as modernity and post modernity, and the relation between cultural categories such as gender, sexuality and ethnicity.

The responsibility of the designer was a question raised already in the early 70s, by the American designer Victor Papanek. His book, Design for the real world,[22] from 1973 (first published in Sweden with the name

18 Arjun Aoppaduraj ed. *The social life of things – commodities in a cultural perspectiv* Cambridge Univ. Press, Cambridge, 1986.
19 Adrian Forty 1986, *Objects of desire– Design and Society 1750-1980*, Thames & Hudson, London, 1986.
20 Nicholas Pevsner, *Pioneers of modern Design: From William Morris to Walter Gropius,* Harmondsworth, Penguin, 1977.
21 Daniel Miller ed., *Material Cultures and Massconsumption*, Oxford, Blackwell 1987.
22 Victor Papanek. *Design for the real world: Human ecology and social charge*, Bantam Books, Toronto 1973.

Miljön och miljonerna, Bonnier 1970) was a forceful statement for a more socially concerned design practice. In fact it was so strong that he was expelled from the American society of industrial designers. By the mid 1980s ecologically conscious products had become accepted and a new wave of "Green design" appeared with a more industrially friendly approach. It was clear that in addition to social and environmental benefits, the field of green design was a whole new market for designers to explore.

Enzio Manzini, professor at Politecnica di Milano, sees the environmental challenge as something that can generate a new sensuous horizon for design and can be the source for vast cultural transformations.[23] He advocated a natural shift towards a "garden" of more sustainable goods. The designer's task is to make sustainable alternative appear desirable to the consumer and part of an attractive lifestyle. Following this line of thought, Manzini, Zachhai and later Thackara,24 have suggested a transformation of design from products to services, where the designer will no longer be a product architect but a director of experiences and events.

Design is one of the forces of society that makes gender visible and tangible. One of the first volumes to examine this was published in 1984 entitled, Making Space: Women and the Man-Made environment.[25] It was edited by the feminist architecture group Matrix, and as the title suggests argued that patriarchal values dominates in architecture design, defining the role for women to play in its context. Feminist writers sought to highlight the role of design in the creation of gender stereotypes as well as the domination of men in design professions, history and education. A view from the Interior: Women and design, edited by Judy Attfield and Pat Kirkham in 1989[26] brought together many important writers and highlighted women's role as both producers and consumers of design. The "interior" referred to in the title was intended as a metaphor for the archetypical feminine position in design. A number of case studies were made on female/male partnership in art and design and suggested that such relationship may be mutually supportive; yet while opening up opportunities for women it may also marginalise them.

23 Ezio Manzini, "Prometeus of the Everyday", in *Discovering design*, ed. Margolin. The University of Chicago Press, Chicago 1995.
24 Johan Thackara,"The Design Challenge of Pervasive Computing" *Proceedings CHI '00*, ACM Press 2000.
25 Matrix, *Making Space: Women and the Man-Made environment*. Pluto Press, London 1984
26 Judy Attfield & Pat Kirkham ed. *A view from the interior-Women and Design*, The Womens Press Ltd, London, 1989.

The recession during the early nineties forced unemployed architects and designers into a self-critical, theoretical position outside the mainstream of commerce. There was time and opportunity to question some of the ideas that were taken for granted during the previous decade. At the same time artists started to look at design and architecture for inspiration, aesthetics and content. The artistic input influenced designers to look at their own work and context with a critical perspective. Typical for this new generation is that they wanted to combine theory with practice and present examples on how new ideas could be materialised in artefacts. Graphic designers Ellen Lupton and Abbott Miller[27] used ideas from continental philosophy to deconstruct graphic design and examine issues such as representation and meaning. They used for example Foucault's text The archaeology of madness and substituted

the words madness and medicine with design and aesthetics, with a result that was both amusing and bizarre.

Industrial designer Anthony Dunne and interior designer Fiona Raby argue that product design's strong ties to the marketplace have left little room for speculation on the cultural function of electronic products. In Dunne's book Herzian Tales [28] he explores electronic products in a broader context of critical thinking on its aesthetic role in everyday life. "Critical Design, or design that asks carefully crafted questions and make us think, is just as difficult and just as important as design that solves problems or finds answer" [29] he argue. Its purpose is to stimulate discussion and debate amongst designers, industry and the public about the aesthetic qualities of our electronically mediated existence. Critical design extends the limits of lived experience as opposed to experimental design, which only extends the medium. Dunne and Raby combine their statement with a number of case studies that explore the invisible qualities of electronic products. The critical design approach and the cross fertilisation between art, design and architecture have been the most prominent tendencies in design theory in the change of the millennium.

The nineties were also the time when information technology entered design. This meant an enormous input of technological tools, business opportunities and aesthetical discussion that could be explored from a de-

27 Ellen Lupton, Abbott Miller, *Design, Writing, Research*, Phaidon, London 1996.
28 Anthony Dunne, *Herzian Tales*, Dissertation, RCA, London 1999.
29 Anthony Dunne and Fiona Raby, *Design Noir: the secret life of electronic objects*, Birkhäuser, Basel, 2001. (p.58).

sign perspective. Information technology also brought a whole array of theories from HCI, computer science, and cognitive psychology that influenced designers' work.

2.2 Design and HCI

Human Computer Interaction developed as a multidisciplinary field that draw on a number of different methods and areas to understand and improve computer use. Monk and Gilbert regard the three parent disciplines to HCI as: Computer Science, Psychology and Social Science. The book Perspectives on HCI [30]from 1995, consists of contributions from these areas plus ethnography that was beginning to have an increasing impact on system development. However, there is no recognition of design other than in the meaning of construction. One important contributor to the study of usability is Donald Norman, a psychologist that once coined the term "User Centered System Design" (UCSD). He criticised everyday products like stoves, fridges, microwave ovens, light switches or telephones and remarked that they had an interface with a very poor correspondence to our mental model of the product[31]. Norman argues that products have to be tried on end users and not only by their designers and clients. Large artefacts like telephones system has to be evaluated for their usability and not only on price and performance. Design to Norman is mainly something that favours appearance at the expense of function. In later writings however, Norman acknowledges design as a tool for better usability.

The frustration with current practices in system design, and the rift between theory and practice led many researchers to look at the emerging field of design theory for inspiration and help. Terry Winograd and Fernando Flores[32] were two computer scientists that recognize design methods as a way to improve usability in computer systems. Another group was centred around the cooperative design method, among them Pelle Ehn, [33] Yngve Sundblad, Susanne Bødker and Morten Kyng.

30 Monk & Gilbert, *Perspectives on HCI: diverse approaches*, Academic Press, London, 1995
31 Donald Norman, *The Psychology of Everyday things*, Basic Books, New York, 1988
32 Terry Winograd, Fernando Flores. *Understanding computers and cognition: A new foundation for design,* Reading MA, Addison-Wesley 1987
33 Pelle Ehn, *Work-oriented design of computer artefacts,* Almquist & Wiksell, Falköping 1988

Cooperative design were primarily ideologically motivated; including workers in development of IT artefacts, would lead to increasing democracy and control of working conditions. In USA, Cooperative Design was known as Participatory Design, and has mainly been regarded as a way to increase user and client acceptance, as well as a tool to raise designer knowledge about end users. The early work of cooperative design included practicing industrial designers that brought a range of mock-up and modelling methods to research. The practitioners found that a cardboard box easily could simulate a computer or a work situation and thereby facilitate communication between designers, workers and researchers. From these early experiments, ideas developed that the design process could be regarded a language game in Wittgensteins sense. [34] As long as everybody agreed in what game was played there were no need for articulation and description of work practices. The implicit skills and practices inherent in the work could be shown hands-on, rather than described and formalised in an objective and distanced way. The goal of the process was to reinforce and enhance skilled workers control over process and methods in their work.

In Sweden, architect Jerker Lundequist had used design theory applied to system development already in late 70's[35]. His work was a source of inspiration for system designer Erik Stolterman[36], who set out to make system design practices understandable and to reveal the hidden rational behind the work. The purpose of design methods, Stolterman argues, is to develop designer's design ability and to create a readiness to act, not to guide them in a specific design situation.

Graphic interfaces

The first computers, from 1946 and in the 1950s and 1960s, were mainly calculating machines and used by the programmers, natural scientists and engineers themselves. The "interaction" was mainly input via punched tape or punched card, and output mainly text on electronic typewriters. Direct communication with the computer was limited to controlling its flow of jobs via text on a console, a text terminal.

34 Ehn and Kyng, Cardboard computers: Mocking-it-up or hand on the future. In Greenbaum and Kyng (eds), *Design at Work*, Lawrence Earlbaum Ass., Hillsdale, NJ ,1991

35 Jerker Lundequist, *Norm och modell*, Dissertation, KTH, Stockholm, 1982.

36 Erik Stolterman, *Designarbetets dolda rationalitet: en studie av metodik och praktik inom systemutveckling*, Dissertation, Umeå Universitet, 1991.

Mufi is an interactive sound installation. Jumping and dancing on the tiles on the floor creates different rythms and music.
By Anders-Petter Andersson

During the 1960s the first experiments with direct interaction in graphics, via truly interactive devices with immediate response, were made in computer science laboratories. Notable are the interactive graphics environment, Sketchpad, developed by Ivan Sutherland at MIT in 1963[37], and the Augment environment, "augmenting human intellect", developed by a group around Douglas Engelbart[38] at Stanford Research Institute and shown live to an audience of 2000 people at a conference in San Francisco in December 1968.

There were most of the features of today's interactive personal computer demonstrated, e.g. text windows, the mouse, word processing (including cut-and-paste), hypertext and hypermedia, e-mail, video conferencing and sharing material for on-line cooperation, all with an emphasis of being powerful and easy to use. Special effort was put on industrial design of the work console on a chair for comfortable use.

This development did not have an immediate impact on the broad use of computers. The equipment was huge and not even transportable, for the demo a 50 km radio link was used, and cost millions of dollars, but it inspired continued efforts at other research institutions, especially in the free thinking San Francisco Bay area, with its revolts towards the established such as the hippie movement.

Xerox PARC (Palo Alto Research Centre) was established in 1970 as an interdisciplinary laboratory for designing interfaces, originally as an inspiration for making better interfaces to photocopier users and repairpersons, but soon with much broader scope. Alan Kay,[39] the inventor of the concept of personal computer formed a group including some of Engelbart's co-researchers. In the early 1970's they developed the graphic workstation, with overlapping windows, icons, the desktop metaphor and drag-and-drop operations, the SmallTalk programming environment, educational environments for school children's exploratory learning of physics and mathematics, and desktop publishing applications based on "WYSIWIG", What You See (on the screen) Is What You Get

37 Sutherland, I.E. "Sketchpad: A Man-Machine Graphical Communication System", MIT Lincoln Lab, TR 296 , Jan 1963, and *Proceedings of the Spring Joint Computer Conference*, Detroit, Michigan, May 1963.
38 Engelbart, D.C. & English, W.K. "A research center for augmenting human intellect", *AFIPS Conference Proceedings of the 1968 Fall Joint Computer Conference*, San Francisco, CA, Dec 1968, Vol. 33, (pp. 395-410) and videos on http://sloan.stanford.edu/mousesite/1968Demo.html
39 Kay, A. (1977): " Microelectronics and the personal computer", *Scientific American*, Sept 1977, (pp. 231-244).

(printed). From the same laboratory also came inventions that made the computer develop as mediator for human communication, e.g. the Ethernet for high-speed computer networks, the laser writer and a predecessor to the Postscript language for document typography description. Proverbial citations from Alan Kay on design and development are "Simple things should be simple. Complex things should be possible." and "Do not predict the future, invent it."

In spite of inspirations from the PARC researchers in the "computer for the people" movement, Xerox never introduced this technology for broad use, but only as the expensive Xerox Star (1981), intended for company executives. The technology is very well summarised in an article by Smith & al. [40] The graphic interaction technology was taken up by Apple Computer in their Lisa (1982) and Macintosh (1984-), which made it affordable for broad groups of users.

Based on these technological advances and a growing insight that for making useful, easy and powerful applications not only technical but "human oriented" competence from social sciences and design competence was necessary, a new research area was formed, human -computer interaction. It was first closely connected to computer science, and then more independent, based on anthropology, psychology, sociology, linguistics and graphic design as well as technology, and in the latest decennium also media and communication e.g cinema studies. Examples of important early results were the power of "direct manipulation"[41] interfaces (with pointing devices and direct feedback) and methods for involving end users in all phases of development of computer applications (the Scandinavian "school" from around 1980).[42]

Due to this development, graphic designers were increasingly used to make interfaces comprehensible, logical and easy to use. The principles of layout and typography could successfully be applied to computer interfaces. Designers were also good at imagining appropriate representations of reality for icons and interface design.

40 Smith, D.C.S, Irby, C., Kimball, R., Verplank, B. & Harlem, E. (1982). "Designing the Star User Interface", *Byte*, vol. 7, no. 4, (pp. 242-282), April 1982.
41 Shneiderman, B. (1983). "Direct Manipulation: A Step Beyond Programming Languages", *IEEE Computer*, August 1983, (pp. 57-69).
42 Bødker, S., Ehn, P., Sjögren, D. & Sundblad, Y. "Co-operative Design - perspectives on 20 years with "the Scandinavian IT Design Model", Keynote presentation, *Proceedings of NordiCHI 2000,* Stockholm, 2000.
43 Terry Winograd ed., *Bringing design to software*, Addison-Wesley, New York, 1996

In Bringing design to software, Terry Winograd[43] brings together seminal writers and researcher from the field of software design and usability such as Mitchell Kapor, Don Norman, Donald Schön, David Liddle, Gillian Crampton Smith etc. Methods and practices are introduced from pattern language, ethnography, participatory design, prototyping and combined with short case studies. Winograd makes a distinction between Software design, which is an integrated part of the construction process, and Interaction design, which solely deals with the user interface. Mitchell Kapor argues that the goal is to "Create a role for the software designer as a champion of user experience". Kapor makes analogies between software design and architecture, both of them are results of functionality, technology and art or in Vitruvius terms: Utilitas, Firmitas and Venustas.

With this book, it was clear that design and usability could not be ignored in software development. There is no longer any question that design is important for system design, and many stories about both success and failure to prove it. Yet, there is a long way to go to make design a self-evident and integrate part software design. Design is still in the outskirts of HCI rather than in the centre. Students in software development are rarely taught design as are designers rarely taught cognitive psychology or Human Machine Interaction. There is much to do to make compatible interfaces between the disciplines as well as developing each field to meet the requirements of an accelerating technology.

During the end of the 1990s there has been a growing discussion about the importance of "Art" or pleasure in use of software design. How can we make artefacts so that they are not only robust and functional but also delightful, attractive, and even beautiful? Donald Norman argues that emotions play a fundamental role in use of artefacts and that attractive software is easier to learn and use.[44] In this context design and aesthetics will come to play a fundamental role.

2.3 Understanding Design Practice

Design theory started with a wish to incorporated design in a scientific paradigm. As we have seen this attempt soon met strong criticism and an

44 Donald Norman, *Emotional Design: Why We Love (or hate) Everyday Things*, Basic Books, 2004

insight that design has its own unique set of characteristics that needs to be studied in its own right. Many regard design as something opposed to science, a way to handle conflict, insecurity and the unknown. An inherent human ability associated with imagination and problem solving.

But if design is a general human ability what is then typical for the design profession? Many researchers have tried to answer this question, some by studying practicing designers, others by ideas from philosophy.

Everything we make needs to take a physical form. Even texts and speech need a physical form or we could not read it or hear it. Many people witness on how their thoughts get clearer while they write them down. Writing is itself a craft where the choice of word, the style and format are just as important for the message as the underlying idea. How you do it, is equally important to what you do. "The media is the message," claimed Marshall McLuhan in the 1960s when television had appeared as a new medium. Television is a medium with a strong sense of reality. Almost everything can with a few dramatic shoots become "true" in the television news. This brings up the question of how to present something that is so strong that it cannot be "given form" without loosing some of its authencity, for example stories about the Holocaust. The primary documentary form is the speech by an eyewitness: this is the ultimate form of convincing television.

The ability to give form, to realize an idea to a concrete artefact is what distinguishes design from general problem solving writes Bo Dahlbom.[45] He criticises Simon's definition of design because it makes design synonymous with planning, decision-making and problem solving in general. "An interest in the process of design rather that in its products will turn the sciences of the artificial into methodological disciplines, rather than substantive sciences of our artificial world."

In Swedish we have a word called gestaltning which describes the work of giving form. It is the same as the German gestaltung but lacks a correspondent in English. It means (roughly) "to give form" but also to make a meaningful whole out of disparate elements. When we design for example a telephone we "give form" not only to loudspeakers and cables, but to the idea of telephoning. When the telephone was new it was not self-evident how this brand new activity would look like. The first telephone by Ericsson from 1880 looks like a small cotton reel on a stand.

45 Dahlbom, 2002 ibid.

The next version was a highly ornamented and large, wall mounted piece of machinery suitable for the well-off home or office.

The giving of form is an active process and implies that there is something there that takes form. This process can be viewed as interplay between this basic but vague vision and the contextual restraints such as time, material, production, market, personal preferences etc [46]. Something is expressed through the forms that meet our senses and mind. The product then becomes a sign for a number of denotative and connotative meanings that the users actively construct. To what extent the designer is aware of those meanings is an open question and might vary from case to case. The second highly ornamented telephone was most certainly a conscious design for the wealthier clientele that would afford such a new and costly artefact. Gestaltning, just as aesthetic knowledge, is closely connected to the experience and use of the artefact. Part of such competence is to understand the context and history of the aesthetical references of the artefact and the context of its use. But, there might be other references on an ideological level that the designer is not aware of. (This is discussed further in the semiotics session)

Gestaltning is also a concept in art, film and theatre, but unlike design it is not used to describe planning processes in general. Gestaltning always refers to a material end product, whether it is a theatre play or a painting. It is therefore, I argue, the nucleus of the design practise.

Aesthetics is central in gestaltning and a basic part of the designers' professional knowledge. The aesthetic knowledge is based on long and deep intellectual as well as practical knowledge of the subject, and a "repertoire"[47] of similar problems and enquiries. But the knowledge differs from scientific knowledge in that it is not verbal or explicit but mainly tacit, implicit and based in the activity itself. Several professions are based on such situated knowledge such as nurses judging patients, architects that design, musicians, actors etc. These professions have in common that they are not taught by explaining how to do but by showing how it's done. Aesthetic knowledge is very difficult to describe in words and is a form a tacit knowledge comparable to other craft or action-based skills. To exemplify what an aesthetical skill is we can make an analogy with music. Most people enjoy listening to music and playing instruments, but

46 Erik Stolterman, 1991, ibid.
47 Schön, *The Reflective Practitioner- How practitioners work in action.* Basic book, New York, 1983.

some people have professional training in this and are more skilled then the layman, both in playing and in judging music. Music is universal and a fundamental human activity and animals don't play (even if some of them sing). Music comes in a large variety and in many styles that have their own set of rules and context. You can't compare a piece by Bach with a song by Beatles, especially not making judgements about value like: Bach is better then Beatles or music "should," sound this or that way. But it is still possible to say if something is wrong, false, doesn't swing, in the wrong key, but such judgement can only be done in a certain context.

The term design has a general meaning and refers to a basic human activity of making artefacts, but that does not mean that everybody is equally good at practical aesthetics, just as everybody is not equally good at playing music. On the other hand only you can decide what music you like to listen to, what clothes you like to wear and what you tools you like to work with. The use and preferences of an artefact is always situated, contextual and personal.

2.4 Case: Making Brainball

Designers usually start from a vague idea that is realised in a dialogue with the situation and the material at hand, while conventional research (ideally) start from an explicit plan that is subsequently implemented. In conventional research the final result of the work is not an artefact but the paper presented at a conference. Therefore the scientist have a need to make the project explicit during the work . For conventional art and design there are no such requirements of a post-product reflection. The artefact itself and how it is received by the users/audience is the main goal. But when designers become researchers and researchers designers these habits, ambitions and conventions are destabilized. Designers are forced to reflect about their practice and researchers to be more materially concrete. But is it even possible to translate the implicit practice to a linguistic form? The linguistic result of the project described below became not an "objective" account but rather a verbal interpretation of it.

Brainball was one of the first large projects to be completed at the Interactive Institute and the one that has received the most media attention. It embodies the guiding ideas of the institute as something new, multidisciplinary, exiting and technically pioneering. As a result, it became an

The final prototype of Brainball was built for the world exhibition in Hannover. behind the players is a screen with respresentations of their brainwaves.

icon for the new design-oriented research performed at the institute.

Brainball is a good example of the qualities that are likely to appear when practicing designers and artists are involved in a research project. Designers and artists are trained at gestaltning and have a passion for realizing ideas into material artefacts. It is also an example of the problems of combining the tacit work of design with the demands in research to be explicit.

A anti-game

Brainball consists of a headband with electrodes that reads a player's brain activity using an electroencephalogram (EEG). Two players sit opposite each other at a table, each wearing a headband. In the middle of

the table from one short end to the other is a clear plastic surface with a small steel ball rolling on top of it. When either of the players presses the Start button, the ball rolls away from the person who is most relaxed and toward the other player, the only way for the other player to defend is to become more relaxed. When the ball reaches one end the game is over. Next to the table is a display of the players' brain activity and the current state of the game. The display gives the players feedback on their brain activity and allows the audience to follow the game and watch the players' EEG levels.

Brainball is an ambiguous object. It dwells in the realm between art and research, entertainment and science, method and object. Brainball can best be described as an anti-game. In most games success is achieved as a result of activity, decision-making, and physical coordination. In Brainball none of these capabilities counts. Here the goal of the players is to achieve—nothing. Unlike ordinary games, Brainball uses something that is invisible—the electrical activity of the brain—and transmits it to a ball moving on a table. You cannot use common game abilities such as concentration or winning instinct, to achieve your goal.

But Brainball is also very unusual for an information technology-based gaming device. Unlike other games, it is devoid of sounds, blinking lights, action, and sensual stimuli. The emptiness of Brainball makes it open to interpretation and reflections on what it is and how to use it. It has come to embody issues about stress and burnout and the complex task in contemporary life of having to be able to simultaneously relax and compete.

Despite its tranquillity, Brainball is a very public game. It always attracts large groups of people watching the game and following the brain activity of the players. The task of relaxing very quickly in a competitive situation is regarded as difficult but fun. As one devoted player remarked, "You must not be afraid to lose! That's the trick!"

We have noticed that people trained in relaxation techniques and meditation are superior at playing Brainball. On one television program two yoga masters competed and the ball did not move at all. Conversely, giggling, fidgeting, and changing position makes you a hopeless loser. People that have suffered from burnout or nervous exhaustion have difficulty relaxing but are fascinated by the possibility of seeing their own brain activity.

Humble Beginnings

Brainball began as a workshop in the Smart Studio at the Interactive Institute. The institute had been set up only six months earlier with the Smart Studio as one of four research groups (currently there are 10 studios). Smart Studio was then a group of eight people with backgrounds in visual arts, product design, engineering, and computer science that were searching for relevant research questions and working methods. One of the important visions for the institute was to have multidisciplinary teams producing new and exciting research. The goal of the workshop was therefore to do something where everybody in the studio could take part and contribute equally.

One member who had worked with creativity methods led the workshop. We started with a brainstorm session at which we came up with different ideas or areas we could develop. Themes such as awareness, emotional communication, physical interfaces, light, office parties and biosensors emerged.

We then screened these ideas to identify practical limitations such as time, technology, cost, or interest. Finally we had a voting system in which each of us had five balls that we were to distribute in plastic mugs, one for each suggestion. Two of the group members put all their balls in the biosensors mug (which was not considered fair play by the others). As a result, biosensors won.

The next step was to decide what we could do with biosensors of which none of us had previous knowledge. The two designers who thought of the idea had only vague suggestions, obviously influenced by science-fiction movies; of products that were like pets and that you wore like an extension of the body. The computer scientist of our group knew about Ross Picard, a computer scientist at the Massachusetts Institute of Technology who had done work with biosensors. Biosensors could measure physical data from breathing, pulse, temperature, and conductance.

On the basis of this knowledge we decided to create a game in which players competed in relaxation. Here, the key elements to Brainball began to appear: the biosensors, the game, and the central motivation for the game.

A month later we held a one-week workshop in which the prototype for the game was built using a borrowed set of biosensors, including an EEG and an old plotter that would move the ball using data from the EEG. During the workshop we experimented with the EEG and differ-

ent biofeedback, such as sound and became aware of its inherent attraction.

We discussed how we would present it and how to play it, but in the end we did not have time to develop the game design further. By the end of the week we had an open house and a small party where we showed our work to colleagues and guests. Only five minutes before the guests arrived, Brainball actually worked and we were able to try it ourselves. Brainball became an immediate success at the party. Lots of people gathered around the table and watched this rather slow game with enthusiasm and fascination. We were amazed ourselves at how public and fun the game was and how well the game concept worked.

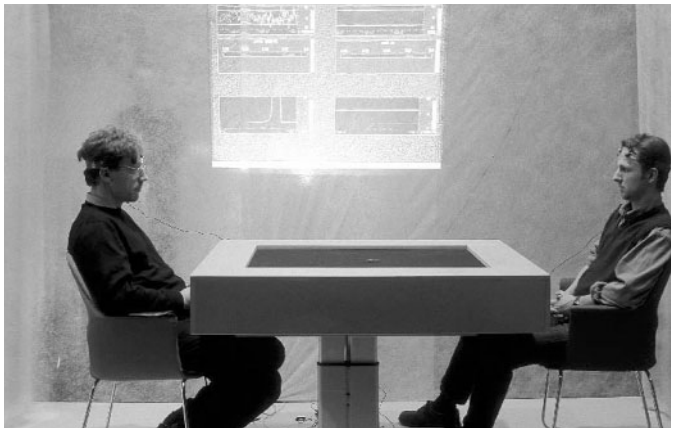
Word of the game spread and people kept dropping by to play a set or two. Instead of packing it up and putting it in the cellar, as we had planned, Brainball was being permanently displayed in our research lab.

Above: A one day brainstorming workshop developed the basic idea of the game.

Below: The first experiments to measure the brain activity.

A measure of activity

The concept of measuring the electrical activity in the brain is called electroencephalography (EEG). Signals are measured in microvolts using electrodes positioned on the scalp. The analysis of continuous EEG signals or brain waves is complex. Different waves are categorized by the frequency of their emanation and can be seen to correspond to certain types of brain activity. Beta waves lie typically in the range of 14 to 30 Hz and are associated with an alert state of mind. They can reach frequencies of up to 50 Hz during stress or intense mental activity. Alpha waves, in the frequency of 8 to 13 Hz, are usually quite strong in a relaxed state; they diminish in amplitude when a person is stimulated by light or attempts mental efforts. Theta waves, at 4 to 7 Hz, rise during drowsiness and are usually strong in children with attention-deficit disorders. Delta waves, below 3.5 Hz, occur during deep sleep.



The first prototype was build on a one week workshop and used an old plotter to control the ball.

For medical purposes, EEG machines have been used since the 1970s to trace brain activity and brain function deficit. In clinical psychology, biofeedback using EEG machines has been used to treat neuroses, panic disorders, and attention disorders (ADHD and ADD) with good results. Some children with mild attention disorders can attain good results with as few as five to 10 sessions. Research has also been carried out using EEG as an input device for computers and for the physically disabled. Mind Mouse from Leapfrog Technologies uses EEG and electromyography (EMG) to elicit tiny muscular movements on the forehead to control the movements of a mouse cursor on a screen. Disabled or injured people can learn how to control a mouse cursor just by thinking about a word or a movement. The U.S. firm IBVA has explored EEG as an input device for various manipulations of abstract forms on a screen, for example, to change colours and forms of graphic patterns or to light up a building. Recently Sony worked with EEG as a game input device.

The relatively high expense of EEG makes it difficult to obtain for private use. There are also few examples of artists using EEG. One exception, however, is the Swedish artist Ola Persson, who has used EEG on plants. Plants also exhibit electrical activity at very low frequencies, which appear in human beings during deep sleep and coma. In the piece Yucca Invest, Persson placed electrodes on yucca palms and connected them to a program that sells and buys stock. Touching and talking to the yucca palm create a stimulus that affects the program. One yucca palm has been very successful on the stock market, with a mean far above the stock index.

User evaluations

We conducted user studies on Brainball with a researcher from a business faculty. The aim of the test was to study the use of Brainball, subjective and objective times during games (which will not be presented here),

stress levels, and how the subjects perceived the game. During the test, stress was measured by using a galvanic skin response (GSR) sensor.

The test was divided into two parts: Competition, where to goal was to relax and Cooperation in which the players must cooperate in moving the ball from one side of the table to the other by alternating stress and relaxation. Finally, players fill out a form, answering questions about gender, age, perceived time of the game, and attitudes toward the game.

It turned out that playing Brainball did make users more relaxed. Both the GSR values and the evaluations showed great significance in the result. General attitudes toward Brainball were very positive; it was considered interesting, exciting, and more than 90 percent of the subjects wanted to try the game again. Women were significantly more enthusiastic about Brainball than men. Though women stated that they were more stressed than the men, the GSR and competition results showed no differences between the sexes. In fact the GSR showed that stress levels were lower during competition than during cooperation. Women found competition more fun and men liked cooperation better.

The results suggest that the male preference for competition is neither biological nor normative. How you compete and in what play a significant role. If the quantitative results questioned traditional gender thinking, the qualitative results supported them. When losing, women tended to blame themselves; they were stressed, nervous, had a lot on their mind, or experienced difficulty in relaxing. The men, however, tended to blame the equipment: it did not work, biofeedback was not clear, or the outcome was predestined. When winning, however, both sexes said that they were good at relaxing and many mentioned that they practiced relaxation techniques. This might support the concept of gender as something cultural, transmitted, and cultivated within a social group.

The King of Sweden watching a game of Brainball.

Having to compete in relaxation is a contradiction in terms and thought provoking. Can

we compete and relax at the same time? According to the user test the answer is yes. The main issue Brainball raises is connected to stress and relief. Stress is becoming a widespread problem, a mal de temps, a typical disorder of the late 20th century. Burnout was adopted as a clinical description in 1998 in Sweden. Since then the number of people suffering from this syndrome has increased dramatically. This is a probable cause for the interest in Brainball and suggests a course for further development. The attempt to combine relaxation with a game is an interesting aspect for future development. The high level of interest shown in Brainball by users and the media suggests that it may have widespread future possibilities in various applications related to stress and relaxation.

2.5 Research + Design

We are confident that Brainball owes its value to the multidisciplinary team that stood behind it. The project is a mixture of technical naïvity, conceptual sharpness, and prototype-building efficiency that is not found in only one profession. Software designers alone would not have had the knowledge and the persistence to go through the difficulties of translating a two-dimensional interface to a three-dimensional one. After all, an image of a ball moving on a screen would not have been as fascinating as a real ball rolling on a real table. Only artists and designers would have been naïve and courageous enough to believe in the idea of biosensors as product input for a one-week workshop.

Entering design into research raises the issue of what precisely is the core of design research? A great deal of research has been conducted on design from various angles: the value of design from the perspective of business or ergonomics, design methods for product development or design and material culture.

None of these areas includes designing artefacts themselves; researchers from economics, behavioural sciences, engineering, or sociology merely use the artefacts as an object for their study. For a practicing designer entering research, it seems difficult to imagine how the field would be advanced without including the central activity of design as in giving form to a material artefact.

Research is presented as a rational activity in which a number of questions are answered by applying a set of methods and preceding in an or-

derly fashion, and in the end the result will answer the questions. Many have criticized this approach since research includes a number of less rational decisions and actions. Design problems that occur in real life are often "wicked," that is, not simple and ordered as in an experimental situation. They are not likely to be repeatable, and there is not one answer to the problem. A solution to the problem might often come from playing around with and arranging the facts in new ways and not from deducing objective facts. The process of creating something new is not a matter of calculated choice, argues Claude Lévi-Strauss. Rather, it involves "a dialogue with materials and means of execution" [48] where the materials that are at hand "suggest" the course of action. Donald Schön describes the design process as "reflection in action," whereby the designer works with a design model in dialogue with the context and the problem at hand. The solution usually appears in this process of arranging design elements in different patterns and structures.

In aesthetic practice, it is common that working with the materials at hand provides a way into the subject. A designer might know of all the criteria for a product but still not be sure how to execute it. Sketching or making mock-ups (3-D sketches) is usually a way of visualizing and embodying these implicit ideas. This does not imply that the designer does not know what he or she is doing or that the work is based on some vague "feeling." Designers rely on long, intense training in their respective subject and material. As described in section 2.3 the "aesthetic intuition" is based on long and deep intellectual as well as practical knowledge of the subject and a "repertoire" of similar problems and inquiries.

Description or interpretation?

Since Plato, the material world has had a subordinate position in the Western mind. For Plato the idea or concept was always superior to the actual object. Roland Barthes observed that in classic writing, "the writer is always supposed to go from signified to signifier, from content to form, from idea to text, from passion to expression."

Aesthetical practices involve a certain amount of starting with the material world and letting the content appear out of that. Is there a knowledge that is unique for this activity? And how can we combine it with traditional verbal analyses?

48 . Lévi-Strauss, Claude. *Structural Anthropology*. Penguin, New York, 1972.

My thesis is that aesthetical practices have the possibility to embody and materialise issues that previously have not been raised. By doing so, they can point at ideas or solutions in ways that are different from textual or verbal analyses, especially since the nonverbal communication in an artefact might be difficult to discuss or present in a verbal form. A piece of art can be magnificent to experience and be a milestone in art history and still reject analysis or slip away from being described with words. This is one of the great problems of research in art and design. What role shall the artefact have and what role the text? Some art institutions claim that art and verbal communication are so far apart that a textual companion to the artefact is unnecessary. At Helsinki's University of Art and Design, the doctorate in design consists of two parts that are judged by two juries: one for the artefact and one for the text. An infamous example is the dissertation by the well-known textile designer Riita Nelimarkka. She created a practical piece that was approved by the design jury, while the textual companion to her piece – a dialogue with herself – failed on the grounds that it was not academic. Nelimarkka appealed and finally received a passing grade on her text.

Brainball itself defies description. We tried in different situations to write about it, but failed. At one time the Interactive Institute planned to write a book about multidisciplinary work and three members– including me – from the Smart Studio were asked to collaborate. After days of discussion and of transcribing tapes (on my account), we managed to send in a text that the editor thought was frightfully boring. We were on the verge of giving up when a colleague suggested that we should not "write about it," but rather "give shape to it" in the form of a play. And that is what we did. My colleague had a background as a playwright and helped me with some basic structure. The play almost wrote itself – it was that easy– and the editor was very pleased.

Our experience and that of Riitta Nelimarkka point to the difficulties of making an objective and true account of creative development, because it is more appropriate to make another "design" or interpretation. The logical verbalisation of an interpretation is another interpretation until perhaps you have distanced yourself from the process so much that you can relate to it.

There are a number of conclusions to be drawn from this study. One is that design practitioners are useful for materialising abstract ideas and that it may be important to have a competence for gestaltning in a re-

search project. Something important happens when an idea is transformed to concrete artefacts that can be experienced. The experience and use gives a dimension to the research issue that is beyond merely observation and reflection. Some issues need a material embodiment to be raised and discussed. Brainball does in itself embody well-known issues about competition, stress and relaxation but with a totally new and inexperienced angle. It also demonstrated that IT-games do not have to be a lot of lights, sounds and violence to be captivating. There are numerous opportunities in exploring games for relaxation, biofeedback and self-knowledge that incorporated more than hand to eye interaction.

The Brainball case also shows some of the difficulties in combining a typical design practice with a reflective approach. Reflecting - on – action is not possible while acting; it needs distance, analogues and concepts that can be used on the practice. To develop tools for such a reflection is part of an agenda in design oriented or design based research.

The case demonstrated that there is need for design practice in more areas than commercial product development. In a commercial context the strong reality forming ability becomes a way to maintain norms, in a research context it may be a way to change them.

Donald Schön remarks that you have to do something before you can understand it. This is a good argument for professional designers to get involved in research in their own field. There is knowledge in the practice of design that a non-designer will have large problems to understand but nevertheless of great importance that we develop and articulate. Design became a buzzword during the 1990s and is still used as the magic thing that will create demands, save economies and make everybody happier, by taking care of "users needs". If these claims are to be more than empty words we need to examine them critically and sharpen up designers' knowledge about what they are doing and why. This work cannot only take place within conventional product development. There needs to be a space where design knowledge and conditions can be examined freely and in depth, a space for research in the practice of design.

Chapter 3
Living with Artefacts

Living with Artefacts

"A commodity appears at first sight an extremely obvious, trivial thing. But its analysis brings out that it is a very strange thing, abounding in metaphysical subtleties and theological niceties"
Karl Marx, Das Kapital.

While the previous chapter looked at theories for design, this chapter examines what it means to live with artefacts. Things are not only formed by us, they also form our world and provide a physical setting for our actions. But how do we interpret meaning from artefacts and how do we construct and maintain reality based on these artefacts? How is it possible that we can form a world that at the same time makes us ill? These questions are answered by looking at theories from semiotics and social action theory. Semiotic theory provides us with tools to analyse different layers of meaning in artefacts and how these meanings are constructed. It is helpful in the difficult, and much discussed, issue in design between form, content and function. Social action theory shows how reality is a social construction where typified actions become objective phenomena. Artefacts can be seen as typifications, commonsense interpretations, knowledge "at hand" that constitutes a taken for granted model of the world. Without them, the world would appear as completely unstructured and chaotic. I am arguing that products can be regarded as social actors and that the ways we handle things remind how we handle strains of life. Finally coping theories are used to understand the relation between the world of artefacts and human well-being and to make guidelines for how we can design artefacts that support health.

A radiopiano from the 1920s show how the form of the radio was not yet established.

3.1 Semiotics and Design

Contemporary Semiotics study how meanings are made and are not only concerned with communication but also with the construction and maintenance of reality.[1] Semiotic theory is useful to understand how we construct meaning from artefacts and it introduces a range of concepts that we need to analyse how computer technology is designed.

Semiotics became a popular approach to cultural studies in the late 1960s, partly as a result of the work of Roland Barthes. In his book *Mythologies*[2] he analysed advertisement and media and showed how seemingly familiar things signify all kinds of ideas about the world. Barthes essay about Citroen D.S belongs to the classics in early design semiotics.

Semiotics in product design grew out of the main body of communication theory and later cultural studies. One approach deals mainly with the correct way to design artefacts so that they are easy to use and to understand. This is both a result of modernist design theory (a product should communicate the correct way to handle it and its function) and a reaction against "black box design" of high modernism in the sixties and seventies. Product semantics was a theory developed by Reinhardt Butter and Klaus Krippendorf, [3] in the eighties and was influenced by contemporary continental philosophy. They choose the word semantic (meaning) to emphasise this aspect of communication. They introduced the idea of a product as a text with levels of meaning and criticised the blank design of modernism. But even there the lines between the post-modern and semi-modern ideas were blurry. While Krippendorf emphasised socially constructed meanings, Butter was more pragmatic and advocated a step-by-step method to correct design. The "good design" approach is strong in Sweden where Rune Monö has taught Product semiotics in design schools for almost twenty years. His book *Design for product understanding* [4] tries to develop a language of form for product designers mainly based on Peirce and the German linguist Karl Bühler. In Finland Susan

1 Chandler, *Semiotics – the basics*, Routledge, London, 2001, See also the extended netversion at www.aber.ac.uk/media/Dokuments/S4B.
2 Barthes, *Mythologies*, Hill & Wang, New York, 1967.
3 Klaus Krippendorff and Reinhard Butter, "Product Semantics: exploring the symbolic qualities of form". *Innovation*. vol 3 no 2, 1984
4 Rune Monö, *Design for product understanding*. Liber, Stockholm 1997

Vihmas doctoral thesis *Products as representations*[5] from 1995 makes a similar effort to develop guidelines and tools for designing and analysing products based on the concepts icon, index and symbol. These works are helpful for designers who want practical support, but their use of semiotics is too narrow to give a whole picture of how semiotics can be applied on design. Many key concepts are simply left out or considered irrelevant.

It is easy to forget that meaning is not "sent" to us from an object, it is actively constructed. Products and objects do not carry meaning like water in a bucket, it appears when we interact with them. The interpretation is always depending on context and background, particularly when we come to meta-meanings like branding, cultural codes etc. it presupposes a very good recognition of the culture or subculture it refers to.

My ambition is not to make a checklist for good design but to see how semiotic theory could be applied on the world of artefacts to increase an understanding of the complex relation between meaning, interpretation and form.

Terminology: The sign

The Swiss linguist Ferdinand de Saussure is one of the founders of semiotics "which studies the role of signs as part of social life".[6] Umberto Eco states "semiotics is concerned with everything that can be taken as a sign". Semiotics therefore studies not only "signs" in everyday speech such as traffic signs, symbols or pictures but everything, which "stands for" something else. This also includes our material culture such as buildings, furniture and products. The most common object for semiotic analysis is a "text". A "text" usually refers to a recorded message, so that it is physically independent of its sender or receiver. It could be a book, a picture, TV-program, film or a product. A text is an assemblage of signs (such as words, images, sounds, gestures) constructed and interpreted with reference to the conventions of a particular genre and medium of communication.

The sign is the central term in semiotics. Saussure defined a sign as being composed of:

5 Susann Vihma, *Products as representations – a semiotic and aesthetic study of design products*. Dissertation, University of Art and Design, Helsinki 1995

6 Ferdinand de Saussure, *Course in General Linguistic*, London, Duckworth, 1916/ 1983.

The Signified (signifié) – the concept it represents

SIGN

A signifier (signifiant) – the form that the sign take

A sign must have both a signifier and a signified; you cannot have a meaningless signifier/form or a meaningless signified/concept. The two always go together, they are like the two sides of a coin and Saussure introduced a model where they are represented on each side of a line.

Taking an example, the word "table" is the signifier and it represents the signified concept "table". It doesn't necessary refer to a real table, but a general concept of a table.

A sign on a shop door that reads "open" signifies that the shop is open.

Subsequent semioticians have criticised Saussure for neglecting the real world and have reclaimed the materiality of the signifier. This is also the approach that I choose to have. The Signifier is the physical form of the object, the aesthetics. This is what we see, touch, smell and experience. The Signified is the content, whatever meaning we make out of what we meet and experience. Another semiotic model by Charles Peirce includes the real object "the table" and is turned into a triangle. Louis Hjelmslev has used the terms content and expression to refer to the two concepts and has addressed the complex relation between form and content in the sign itself.

In a design perspective the real thing is our working object, therefore the signifier, the form is at the centre of our interest. But semioticians rarely deal with real things but with signs for them. So if the word car signifies the concept car, what does the real car signify? A car signifies a car does it not? Well not quite, though with objects it is very easy to let the signifier and signified melt into one. The world around us of products and buildings becomes naturalised; it seems to be a natural, unquestionable status quo. Not a constructed piece of human artefact. We usually fail to realise that the most obvious and self-evident around us, the real world – isn't that self-evident after all.

Psychoanalytic theory also contributed to the revaluation of the signifier. The French psychoanalyst Jacques Lacan sought to highlight the primacy of the signifier in the psyche by rewriting Saussure's model. He put the Signifier on the top represented by a big S and the signified below the bar represented by a small s.

$$\frac{S \text{ Signifier}}{s \text{ signified}}$$

Lacan wanted to show how the signified inevitable ”slips beneath the signifier and refuses definition”. To Lacan expressions like anger, happiness etc where signifiers of psychological events. Negative feelings without expressions turned into anxiety. Rewriting the Saussurean model for a design perspective would look like this:

S – Signifier, the expression, The FORM, the aesthetics, Objective – outer world

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s- signified, the content, The CONCEPT, what it stands for, Subjective – inner world

The artefacts in this representation are the line. It is an interface between the objective outer world and the subjective inner world. What we see is the outside form, the aesthetics; on the inside is the content and identity. These two sides are dependent on each other. If something is changed on the form, it will change our perception of the object. The only way the object communicates with us is through the form, which we perceive through our senses.

Denotation and connotation

Denotation and Connotation are two basic concepts in semiotics. Denotation refers to the literal, actual meaning of a sign – *what* the product is, i.e. a chair, a telephone, a book etc. To denotation I also add the obvious function of an object: how to handle it. You sit on the chair, you use the telephone for making phone calls etc.

This sounds straightforward enough but in a world of technological and product development, recognizing *what* it is and *how* to handle it can be very difficult. This is also the domain where most product semiotics dwells. Products should be unambiguous and easy to use, clearly communicating their function. Preferably you should not need a manual to use simple product or a computer programs. Cognitive scientists such as Donald Norman and numerous designers have helped to develop this field during the last decade. Designing self-evident products is today a question of letting the designers and users be part of the production cycle from an early start. The knowledge is there, the question is of how to bring it in. (This important issue is however not the scope of this text)

Connotation is *how* you do it, the choice of words or media. In the picture below we see two chairs. The denotation is similar, they are both chairs used to sit on, and they are both made by Swedish designers and have become design icons of their time. But the connotation is radically different. One is made from natural material, bent birch wood and wo-

Concrete by Jonas Bohlin from 1987
Eva by Bruno Mattson from 1934

ven raw textile, the other one made from concrete and steel. One uses organic forms, it seems to follow the body of the user, silently supporting and providing a comfortable rest without imposing itself. The other one is made from two flat blocks of concrete and a very simple geometric shape of the steel frame forming the arm handle. It uses the basic signs of a chair, a sitting area, a back and a handle, without actually looking like it would be made for resting on. In many ways it paraphrases Gerry Rietvelds experimental Red/blue chair from the 1920s as an aesthetical provocation. It pushes the modernistic aesthetic as far as it gets and signals its death here it is already post-modernism.

Denotation and connotation are often described as different levels of meaning. Barthes introduces the idea of different orders of signification. The first order of signification is that of denotation, this is the sign consisting of signifier and signified. Connotation is the second order of signification, which uses the denotative sign as its signifier and attaches to it an additional signified.

In reality it is difficult to separate the two levels, Barthes himself later gave priority to the connotative level and notes that is no longer easy to separate the ideological from the literal. Fiske warns, " It is often easy to read connotative values in denotative facts."[7]

Myth

Denotation and connotation combine into the third order of signification, which Barthes calls Myth. For Barthes myths were the dominant ideologies of our time. " *…Myth has in fact double functions: it points out and it notifies, it makes us understand something and it imposes it on us…It transforms history into nature*" writes Barthes in a famous example from Mythologies.

Signs and codes are generated by myths and in turn serve to maintain them. Myths can be seen as extended metaphors. Like metaphors, myths

7 John Fiske, *Introduction to Communication studies*. Routledge, London, 1982.

help us to make sense of our experience within a culture.[8] For Barthes, myths serve the ideological function of naturalisation. Their function is to make dominant historical and cultural values; attitudes and beliefs seem entirely "natural", "normal", obvious and commonsense – and thus objective and true reflections of "the way things are". Contemporary sociologists argue that social groups tend to regard as "natural" whatever confers privilege and power upon themselves.

"*Unlike the more or less ephemeral media, design has the capacity to cast myths into enduring, solid and tangible form, so that they seem to be reality itself.*" writes Adrian Forty.[9]

Returning to two chairs, we can try to reveal what myths or dominant values they reflect. The Bruno Mattson chair was first designed in 1934. It is comfortable, modern, and natural and does in every way embody the modernistic ideas of honesty in form, function and material. The chair follows the human body in a design that is both elegant and functional.

It has become a design icon for its time and reflects the new dreams of "Folkhemmet", the Swedish social democratic vision of a "people's home" that became closely allied to Modernism or Functionalism. A modern political idea that was "humanistic" and "supportive" to the "body" of the Swedish people, than for example the ideas from Bauhaus or Russian constructivism, and also easier to accept, less assertive and provocative.

The other chair by Jonas Bohlin from 1987 sends a totally different message. Here the modernistic aesthetic has become empty signifiers that can be used for provocation and a formal experiment. The chair is clearly not comfortable and it is certainly not humanistic. It was made in a time when the Swedish social democratic visions were falling apart. The people's home was not for everybody and we were left with an experiment in concrete, similar to late modernism tower-block suburbs.

As Barthes pointed out the myth level is culturally situated, it is not likely that a person from a different culture would interpret the chairs in a similar way.

Medium

Signs and codes are always anchored in the material form of a medium. It

8 George Lakoff andMark Johnsson, *Metaphors we live by*, Univ. of Chicago Press. Chicago 1980
9 Adrian Forty, *Objects of Desire, design and society 1750-1980*, Thames & Hudson, London 1986

might refer to such different categories as typewriting, print, film, radio, handwriting or different types of mass-communication. Marshall McLuhan famously declared, "The medium is the message". The kind of medium you choose (or not) affects the content of the message.

The media that are typically judged to be the most realistic are photographic – especially film and television. James Monaco suggests that "*in film the signifier and the signified are almost identical…the power of language systems is that there is a very great difference between signifier and signified; the power of film is that there is not*". Even if we don't mistake a film for a real thing we need to remind ourselves that what we see is just one of many possible representations. But compared to products or buildings film seems as solid as a daydream. Even a design model is given a weight and solidity that makes it appears real because you can touch it. A material model, even if it doesn't work, sparks people's imagination the way a sketch or a computer-designed image would never do. With design "reality speaks for itself" and what is said renders an aura of truth.

Cranbrook Academy of Art in USA was soon to pick up the new ideas of product semantics in the late 80's. They had intense discussions about form, technology and design and begun to visualise their ideas with product models. This approach, called product polemics, was a way to start a debate about meaning and culture that were far more convincing than mere texts. Lisa Krohn's Phonebook signalled a new approach to personal information technology and the use of metaphors in design.

Satori pet TV, by Peter Stathis, from Cranbrook Academy of Art, 1988

To denaturalise the obvious is one of the great challenges of semiotic analysis. It is only then we can see what is in charge of the meaning making and whose power it is supporting. Making alternative models like Cranbrook is a good way to challenge this superiority.

Interpretation: form and matter

Since Plato the material world has had a subordinate position in the Western mind. For Plato 'Form' was the creative force that manifested itself into the soulless flesh. The concept or idea was always superior to the real world object. To experience a piece of art or a text was to see through it to the thought within.

The aesthetic confusion of the 20th century led to a revival of these ideas during early modernism. In a Deutsche Werkbund congress in 1911 the German design prophet Hermann Muthesius claimed that Form was superior to matter.

"– Much higher than function, material and technology is the *form*. If the *form* didn't exist we would still be living in a barbarian world"

The kind of forms Muthesius advocated were abstract "essential" shapes and a standardised production system. In the audience were the young architects that would shape modernism: Le Corbusier, Mies van der Rohe, and Walter Gropius.

With them decoration became banned from architecture and design, which should be made of simple geometric forms and clean surfaces. The idea was to make the signifier, as invisible as possible so that the true idea, the *form* would show through. This did in fact deny the material aspect of their work and lay the ground for a building industry that became careless about material and sensual experience. But all modernists were not as idealistic as the Germans. In Sweden modernism became a lot more pragmatic and politically allied with the young social democracy. In spite of that they were just as aesthetically neoplatonic oriented as their German colleges.

In the book "acceptera" from 1931[10] Swedish design theorist Gregor Paulson, architect Gunnar Asplund and friends, advocates an ethically based aesthetic, with honesty in form, function and material as well as an self-evident *form*. This book has been enormously influential in Swedish design and architecture and is clearly echoed in Monö[11] when he disappointedly remarks about a line on a handle "from a semantic point of view this is false. It has been placed there purely for decoration."

The idea to take away the references from products in order to make them more justified soon became general modernist aesthetics. It culminated in the high modernism of the seventies, with its austere concrete buildings and black box design.

But taking away the signifier from the things doesn't make them more spiritual. A raw concrete building with identical windows is not experienced as honest and true but as inhumane and boring. What the modernist didn't realize was how we human beings tend to interpret meaning into everything including a white surface.

10 Gunnar Asplund et al, *acceptera*, Stockholm: Tiden 1931.
11 Rune Monö, 1997, ibid.

Hjelmslev[12]means that both expression and content have substance and form. The same expression in different forms means different things. The actual material in itself has references and gives the content a different meaning. That is why exactly the same mug in plastic means a different thing than one in ceramics.

The idealistic orientation in design is just an aspect of the trend that permeates every angle of western thought. The French poststructuralist Jacques Derrida[13]criticised Saussure's suppression of the materiality of the sign and the primacy of the spoken word over the written. From Plato to Levi-Strauss speech has being regarded as a sign of truth and authenticity. Speech had become so thoroughly naturalised that "*not only does the signifier and signified seem to unite, but also, in this confusion, the signifier seems to erase itself or become transparent.*"[14] In seeking to establish "Grammatology" or the study of textuality, Derrida claimed the primacy of the material world. Roland Barthes also sought to revalorise the role of the signifier in the act of writing. He argued that in classic writing "*the writer is always supposed to go from signified to signifier, from content to form, from idea to text, from passion to expression*" For Barthes writing was a way of working with signifiers and letting the signified appear out of that. Subsequent theorists have tried to materialise the linguistic sign, claiming that words are things and texts belong to the material word.

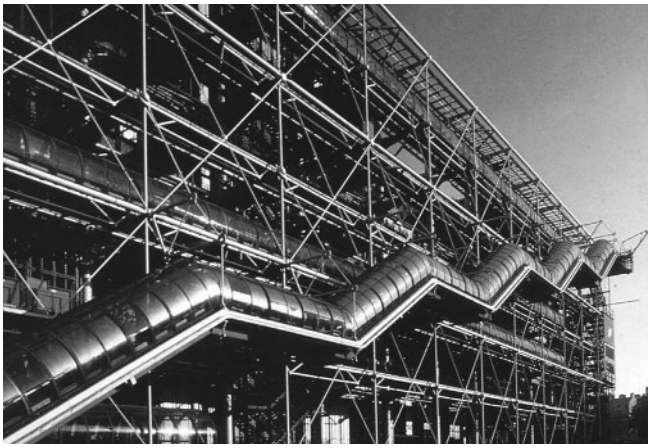
Claude Lévi-Strauss made an observation of what he called bricolage. The process of creating something is not a matter of calculated choice but rather involves "a dialogue with the materials and means of execution."[15] In such a dialogue, the materials that are ready at hand may "suggest" the course of action and the initial aim may be modified. The context for Lévi-Strauss observation was "mythical thought", but Chandler suggests that bricolage can be involved in the use of any medium for any purpose.

Robert Venturis "Less is a bore,"[16] paraphrased Mies van der Rohes famous slogan 50 years earlier "Less is More" and signaled a new approach towards the material that precedes Derrida. And just as Barthes, Venturi claims that architects should work with the references and culture that surrounds them revalorising fake material and historical ornaments.

12 Louis Hjelmslev, *Prolegomena to a Theory of Languange*, Madison, University of Wisconsin Press, 1961.
13 Jaques Derrida, *Of Grammatology*, Baltimore, John Hopkins University Press, 1976
14 Derrida ibid.
15 Claude Lévi-Strauss, *Structural Anthropology*, Penguin, 1972.
16 Robert Venturi, *Learning from Las Vegas*, MIT Press ,Cambridge, Mass. 1972.

Influenced by semiotic practice and poststructuralist critique, design and architecture started to look at the artefacts as "texts" that could be read and the material world as a paradise of signifiers.

The Italian design group Memphis, founded in 1981, made furniture that must have been a true modernists worst nightmare, a celebration of materiality. In Sweden postmodernism and the Memphis group had a very chilly reception. It was considered superficial, commercial and identified with the american concept "styling". In the Swedish context the signifiers became nothing but empty, which show us that meaning is truly not universal but individually constructed. For a Swedish eye a Bruno Mattson chair from 1934 is immensely more readable than a Jonas Bohlin "Concrete" from the eighties. It speaks to us about history, values, politics, ideals and broken dreams.



Centre Pompidou, by Roger and Piano 1972-76. A building turned inside out, displaying structure and escalators, is one early example of a critique of the modernist aesthetics.

As Wittgenstein put it: "What something tell is dependent of its usage".

Designing identity

Saussure pointed out that meaning arises from differences, and identity and differentiation are closely related. Design is important in constructing identity whether it is on a personal or on a national level. In the adolescent search for identity, clothes are used to give new meaning/identity to the wearer. Corporate Identity became a fashion concept in the 1980s but has been used by successful companies since the dawn of industrialisation. Even before that, nations have used design to construct or strengthen a cohesive identity. When the nationalist movement in Finland became strong in the end of the 19th century, artists, writers and architect put a lot of energy in creating a genuine Finnish style.

The first edition of the Finnish epic Kalevala appeared in 1835, compiled and edited by Elias Lönnrot on the basis of the folk poems he had

collected in Finland and Karelia. Finland was then a part of the Russian empire and had before that belonged to Sweden for 700 years. The Kalevala marked an important turning point for Finnish-language culture and boistered the Finns' self-confidence and faith in the possibilities of a Finnish language and culture. The Kalevala began to be called the Finnish national epic. Subsequent researchers have questioned the authencity of Kalevala as a consistent epic, but it certainly served its purpose to prove a genuine Finnish identity. Poet Eino Leino, composer Jean Sibelius, painter Akseli Gallen-Kallela, sculptor Emil Wikström and architect Eliel Saarinen were inspired by Kalevala and embodied this vague Finnish heritage in their work. Villa Hvitträsk was built 1901–1903, by three architects, Herman Gesellius, Armas Lindgren and Eliel Saarinen in a national romantic style. Small windows, big open fireplaces and an arts and crafts-inspired design helps to create a traditional Finnish, yet contemporary and attractive style. In 1917 Finland became an independent country.

Villa Hvitträsk was built 1901–1903, by, Herman Gesellius, Armas Lindgren and Eliel Saarinen

Adrian Forty makes an amusing analysis of how streamlining became *the* style of America consumer industry in the mid twentieth century. The slick, clean surfaces were not only a nice and modern style but signified the hygiene, cleanliness and comfort that were shared by all Americans irrespective of national origin. Another important constituent of the idea of Americanness was the belief in material prosperity and the abundance of commodities, which thus needed to be freely available and identifiably American. The problem then was to discover the characteristics that would make products identifiable as American and create a cohesive mass market. Americas culture is full of confirmations of what it means to be American, a characteristic that seems odd to non-Americans, but has been very important to the development and cohesion of the nation.

In Sweden, modernism (funktionalism) has been very strongly connected to the social democratic movement and the creation of the socalled peoples-home (Folkhemmet). City centres, Folkets hus and "Konsum" stores were build in the new democratic and international style that

A Konsum store from the world exhibition 1930 in Stockholm.

promised a new and better life. In that way the actual building itself became a visual metaphor for the democratic ideology that transformed the country.

Function follows form

During the nineteenth century, form was seen as distinct from function. The style of a building or an object was based on political values and morality and was not related to its practical uses and construction. A chair in a smoking room looked very different from a chair in the ladies' lounge not because men and women sat differently but because the chairs' primary function was to state the differences between masculinity and femininity. When the Duchess of Hallwyl furnished her newly built, highly modern palace in Stockholm in 1893, the dining room was decorated in the Renaissance style, the men's smoking room in the Arabic style, and the ladies' lounge in the Rococo style. Style had a symbolic meaning and was, above all, a way of demonstrating one's values. But nineteenth-century values and traditions collapsed in the wake of the expansion of capitalism. From 1850 to the beginning of the 20th century, history is heavy with the weight of the numerous publications that examined the relation between style and design. Augustus Pugin and John Ruskin, William Morris, Gottfried Semper, Owen Jones, Herman Muthesius, Nils Månsson Mandelgren, Ellen Key and Gregor Paulsson are a few of the names here.[17]

By the beginning of the twentieth century these ideas had ripened and Sullivan formulated this in his dictum "Form follows function." For Sullivan, this meant seeing the building as an organic whole, and not as an inside and an outside without a relation to each other. But we have to understand Sullivan within his own context. In 1904 when he finished the Schlesinger-Meyer house in Chicago, there had been a hundred years of aesthetic chaos, of shifting styles and fashions that succeeded each other within the framework of early, aggressive capitalism, and of aesthetic

17 Bo Grandien, "Det skönas värld eller Venus i såskoppen". Kerstin Wickman, ed. *Form genom tiden*, Svensk Form, Stockholm, 1992.

debates that had led nowhere. Technology and science, on the other hand, were seen as fields governed by rationality, progress, and method. New materials such as steel, sheet glass, and cement led to new construction techniques and forms. Technological development paved the way for a society in which rationality and scientific methodology was supposed to guarantee a functional society with its own appropriate aesthetic.[18] By the middle of the twentieth century, rationality was triumphant. The last ambiguities in design were to be erased with the help of strict, scientific methodologies.

Today we have the opposite problem, standing before a technological and functionalist tidal wave. Within product and software design, technological criteria and maximum functionality have set the pace for a long time, and this has resulted in products that are of dismal use-value. A normal, little radio has a list of nearly a hundred functions. So do cell phones, Videorecorders not to mention PDA's. According to its ads, a Palmpilot V can guide even a jumbo jet, whatever good that might do us. There is little chance that we will ever manage to get through the manuals for all these gadgets and even less so of using all the functions fully. And the more things we fill our houses, workplaces, and pockets with, the less we manage to actually use them. During the previous decades, Sullivan's dictum has been paraphrased many times. Postmodern semioticians claimed that "Form follows fiction", playful Italians came up with "Form follows fun" while disillusioned architects countered with "Form follows anything". Perhaps it is time for a complete change in perspective. We find ourselves today at a point where technology and science are as complex and strained as aesthetics was a hundred years ago. Perhaps it is time to see how aesthetics, in a wider sense, could guide technology. Function follows form: design as a way of creating meaning and comprehensibility in a world of over-functional chaos.

3.2 Design and social action

Design is a social activity, taking place in a social context. It affects our behaviour, by providing possibilities for some actions and by inhibiting

18 Margolin, "The product Milieu and social action", *Discovering design*, The University of Chicago Press, Chicago 1995

other actions. Artefacts also play a fundamental role in affording symbolic values that are used for social interaction.

Social theory offers tools for understanding human actions and how these are being objectified in society. Social Science is one of the corner stones of HCI and plays a fundamental role in the field. Designers and design theorists, however, have tended to look at design as a form of science, natural or artificial, rather as a social practice. [19] Design theory is typically confined to the individual product and the process behind it, it also covers the user's experience and handling of the product. That millions of these products to a large extent forms our everyday life and constitute the material background to our society is normally not dealt with at all.

Artefacts are also conspicuously absent in the social sciences. Social theorists have dedicated themselves at examining the motivation and consequences of actions but not the role of products in these actions. Only some theorists in the Marxist tradition have discussed the role of the product or "commodity" in a political economy.[20] Victor Margolin criticises social scientists for their disinterest in design activity and products. "*According to these theorists, it would seem that humans live in a world without products and act in a vacuum*."[21]

My interest in sociology in a design context is mainly located to a cluster of activity theory, symbolic interaction and phenomenology. I am interested in understanding how the product is related to human action, both as a result and a precondition for action.

But what is the power balance between people and products? To what extent do we read, adapt and learn what the product suggests, and to what extent are we free to use and interpret the product the way we prefer? How is it possible that we can produce a world of artefacts that at the same time make us ill?

Social action theory

Social action theory has developed from phenomenology, which is the philosophical tradition most associated with our everyday life and artefacts. Among theorists from phenomenology, who have influenced design, is Harold Garfinkel who founded Ethnomethodology. Garfinkel

19 Margolin, *Design Discourse*, The University of Chicago Press, Chicago 1989
20 Margolin, 1989, ibid.
21 Margolin, 1995, ibid, p 121.

studied how people made sense of their everyday life, and attempted to visualise and analyse this knowledge. From Garfinkel follows a tradition in HCI that emphasises the study of work in its social context with contributors such as Lucy Suchman,[22] John Bowers[23] and Liam Bannon. The work of these researchers shows that knowledge and communication is embedded in the context, and that people's behaviour are situated actions rather than predefined plans.

Alfred Schutz deepened the analysis of the criteria we use when we interpret and create meaning in our world and developed a "phenomenology of the social world."[24] Schutz claims that most social knowledge arises from practical knowledge about how things are done. He argues that ordinary people just assume that everyday social world is experienced in a common and shared way. The "objective" nature of everyday life is just taken for granted by social actors. The way we understand and interpret reality is by making *typifications* of routine events, people and experiences. Our everyday reality is built up by different types that make it possible to identify and recognize the world. Typifications makes the everyday world meaningful, makes it appear normal and well known.

For example, health professionals use not only medical categories on patients, they also use informal labels that help them make diagnostics and pass on information to each other. Lorber[25] identified two types of problem patients, the "forgivable" and the "wilful", where the first type was demanding, but seriously ill, grateful and therefore forgiven, and the latter type seen as uncooperative and deliberately awkward.

Health care staff uses typifications, however, not simply to make judgements, but also as a means of interpreting the experiences of their everyday working lives. Typifications are commonsense interpretations, knowledge "at hand" that constitute a taken for granted model of the world. Without them, the world would appear as completely unstructured and chaotic.

Schutz ideas of typifications and roles were used by his students Berger and Luckmann in *The Social Construction of Reality: A treatise in the soci-*

22 Lucy A. Suchman, *Plans and Situated Actions: The problem of Human Mashine communication*. Cambridge University Press, Cambridge 1987

23 Bowers, J, Button, G. & Sharrock, "W: Workflow from within and without - Technology and Cooperative Work on the Priont Industry Workfloor", *Proc. ECSCW´95*, pp.51-66, Stockholm, September 1995.

24 Alfred Schutz, *The Phenomenology of the Social World*. Evanstone, Ill. 1967.

25 J Lorber, "Good patients and problem patients", in Conran and Kern, *The Sociology of Health and illness*. 1981.

ology of knowledge ,[26] a book that had a big impact on social science. How is it possible, ask Berger and Luckmann, that subjective meanings can become objective facticities?

They attempt to show that reality is a human construction, and exists both as objective phenomenon and as a result of actions that express subjective meanings. Social life is based on the social interaction that takes place in everyday life. Face to face meetings are the prototype for interaction, this is when the other person is most real. The more distant and mediated the interaction becomes the more we tend to use typifications. The social structure, claim Berger and Luckmann, is the totality of these typifications and the pattern of interaction that they establish. When human actions are repeated more and more often, they are no longer perceived as individual actions but as occurring in a pattern. Typified actions become *institutions* that no longer have a connection to individual actions. Institutions provide people with pattern for actions, create social control and security and make actions outside the institutions appear as less self-evident. The Institutions become over time released from their origin and becomes objective facts – a cogent reality.

In this way social roles are created that becomes objective or inter subjective phenomenon in society. Over time these roles becomes part of history and acquire a historic existence. The original intentions behind the actions are *externalised* into roles that acquire an objective character. *Reification* is the understanding of human phenomena as things. The objectified reality disconnects from its human origin and appears as a thing or a natural phenomenon. The contradiction then appears that human beings regard themselves as a product of these things rather than their originator.

Internalisation describes the process where objectified reality returns to the individual via socialisation. The primary socialisation is the first worldview we acquire as children. The child identifies with significant others, (typically their family) and internalise their roles and reality. Attitudes and values from significant others are generalised into general views: from "Mother doesn't like when I shout" to "You don't shout". This process is called the *generalised other*, and shows that society and identity have been internalised into the individual. Secondary internalisation is the internalisation of sub worlds, for example a profession, another

26 Peter Berger & Thomas Luckman, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge,* Anchor Books, New York, 1976.

culture etc. If these sub worlds are in conflict with the primary world it might result in problems and the primary reality becomes threatened. *Reality maintenance* is an ongoing process to keep our worldview coherent and meaningful. Everything around us helps to maintain our everyday world: conversations, objects, routines, work etc. Berger and Luckmann give an example of a man that wakes up from a terrible

Långholmen prison from the 1950s. The guard in the middle can overlook all prisoners, but they cannot see each other. From *Man to Man* by Mats Hjelm.

nightmare. The dream reality threaten his awake reality while he slowly gets up to have breakfast and get dressed. The familiar routine of the everyday world brings him slowly back to normal. He goes to work and on the train to work the dream disappears and he has safely returned to the "day reality".

Socialisation might fail if there is an asymmetry between subjective and objective worldview for example due to disabilities or diseases. A counter identity can be constructed when a group of individuals live together in a stable social life. People that suffer from lepracy and live together in a community can establish the view that lepra is not a punishment from God but a trial, and that God particularly love the Lepra sick who will acquire a strong and just character due to their suffering. "True" stories that are told among lepra sick demonstrate that lepra is not a contagious disease as opposed to the general view and a new identity is objectified in the lepra community.[27] In this way identity is formed and maintained by social processes in a dialectic relationship with the surrounding world.

27 Georg Drakos, *Makt över kropp och hälsa: Om Leprasjukas självförståelse i dagens Grekland.* Brutus Östlings Bokförlag Symposium, Stockholm 1997

Symbolic Interaction is a branch of sociology founded by George Herbert Mead[28] that has a lot of common with social action theory. Mead developed ideas about role acquiring and how objects carried meaning and thus became symbols. Symbolic Interactionism emphasised that people mark their meaning into the world. An object acquires meaning when the individual acts against it. Human action is a construction rather than a reaction.

Habermas belongs to a branch of phenomenology. His concepts of the life world and the system have been widely used and are now standard concepts in social studies. The *life world* is the everyday world we live in consisting of human relations, the *system* is global economy, technical developments, business, and politics, large structures that we cannot influence directly. We need both the life world and the system but the problems in society occur because we tend to neglect one of them. Usually the system expands on the expense of the life world. In *The theory of Communicative Action*,[29]Habermas gives a powerful argument for the continuity of rational enlightment. He claims that language has an inherent goal, which is mutual understanding. In the deepest meaning of language is an aspiration to agreement, a communicative nature. Here is hope that society can improve if we can keep the public conversation open.

Design as social action

If design is regarded as an inherent problem solving capacity, then the idea that design is a form of social action is close at hand. Even design in a narrower sense, as a conception and planning of products, relies on action. The only difference between design and other human activity is that design aims at changing our material reality in a more concrete manner. But the idea of design as social action is not widely spread. One exception is "Activity theory", based on the work by the Russian psychologist Vygotsky that has been used in HCI research. This theory has a lot in common with symbolic interaction and phenomenology by emphasizing the importance of the everyday life for human knowledge and development. According to Vygotsky, a person's activity, language and learning can only be understood as part of a larger social interplay. Activity is the smallest common denominator between mind and society that can be

28 Georg Herbert Mead, *The Philosophy of the Act* , Chicago 1972
29 Jürgen Habermas, *The theory of Communicative Action*, Polity Press, Cambridge Mass. 1991.

subject to analysis. The understanding of one's action can best be understood as socio-cultural interpretations that are projected on to the circumstances by the participators. Drawing on his ideas a theory has developed that put equal emphasis on thought and action, the social and the technical, the individual and the communal. In HCI, activity theory is used to understand how a system development process in a working place changes the understanding of the work that is going on in this context. Engeström[30] and Nardi[31] are some researchers that have developed Vygotsky's ideas in system development.

Victor Margolin uses social action theory as the basis for interpreting the relation between actions and objects. He proposes the concept "Product milieu" as a unified field of products that cross the entire social sphere in which humans act. The product milieu is not a neutral layer that mediates between motivation and subsequent action. It is an interactive presence in the life world. By becoming aware that everything around us is designed, and therefore the result of conscious actions, we also realise that we can question and change the way things are. Margolin recognizes design as a fundamental constituent of all human action. He attempts to restore more power to the social actor, but also acknowledges that the product milieu has influence on the way one lives.

Margolin argues for three spheres of design in the product milieu; *Civic and state Projects*; *The Market* and *Independent design*. The relation between the product milieu and action is twofold. Products become part of the milieu through acts of designing and making. At the same time designing and making also depend on products. Margolin then draws on Schutz and Luckmann to show how action is a component of everyone's daily life. According to Schutz and Luckmann, intentions become manifest and are codified as *projects*. The goal of the project is envisioned in advance and individual steps of actions relate to this goal. Margolin argues that the project *plan* is also a design of action, a broad concept that denotes the relation between project and acts. The design of products is a particular form of action that results in a product milieu. To the degree that actions depend on products, the design of action is thus shaped by what is available in the product milieu.

30 Y Engeström. *Learning by expanding: An activity theorethical approach to developmental research.* Helsinki , Orienta-Konsultit 1987.

31 B Nardi, ed. *Context and Consciousness: Activity theory and Human Computer Interaction.* MIT Press, Cambridge MA, 1996

The social construction of design

Berger and Luckmann showed how society could exist both as an objective reality and as a result of subjective actions. I would argue that we could regard products much the same way. Everyday patterns are externalised into products where they become part of the objective reality. The society we live in, these houses, objects, and artefacts, are all externalisations of our actions, values, and social relations. Thereby certain behaviours become typified and their inherent codes are strengthened. We regard them as "natural", self-evident obvious expressions of how things really are. Objects are an important part of the ongoing reality maintenance, ensuring us that everything is normal. To travel to a distant country is literally a kind of escape from reality. Everything is new, exciting and frightening, providing an open space for the individual to slip out from the normal identity and to behave in a new way. The physical everyday world around us, with buildings, objects, home and work are probably one of the strongest forces that maintain reality.

It is difficult to ignore the objective facticity of a product the way you might ignore certain behaviour from your neighbour. Even if they are one-of-a-kind objects made by hand, they participate in reality. When objects are multiplied through mass production, their meanings acquire a legitimacy that goes beyond the individual to the general. Individual actions, the intentions behind the design, are externalised into objective reality. The road there is short, much shorter than the one needed for groups of people to form a social pattern. In this way coincidences, improvisations, and short-term needs can become materialized reality through mass production and electronic dissemination.

In a society of market economy we can ask ourselves what patterns are being materialised through mass production? What meanings are objectified and turned into a reified reality? It is rather clear that most product development takes place within the System world where economic interests are the first concern rather than human well-being. But are there any counter forces to this unbalance in reality production? Ethnographic methods have been an established method to understand users needs. Large companies for a consumer market like IKEA, Apple and Ford, use anthropologists to make field studies and interviews. In HCI, ethnomethodology has been important in providing an understanding how knowledge is maintained at work. The risk with methods that study "reality" is that they merely confirm the typifications and roles that already

exist. To break with an established pattern require always an ethical judgement. Japanese white ware producers discovered that Japanese women did not like the appearance of laundry machines. As a result they made the laundrettes smaller, pink and softly curved.

Gender is an area where typifications are objectified and reified into a reality that is almost impossible to change. Artefacts make gender real by constantly providing different products for men and women. Producers can always claim that they merely provide different designs and then it is up to the individual consumer to make their choice. But the choice is always confined to the products on offer in the shop. Femininity and masculinity is accentuated with thousands of attributes aligned in clusters. To break with this objectified reality requires that a counter identity to be formed in an alternative social setting.

Products as social actors

Meaning appears in a social context when people interact with each other. According to Blumer, human action is a construction rather than a reaction, Berger and Luckmann showed that reality is a social construction. We tend to regard objects as dead things, as commodities that serve us and can be used according to our motives. Artefacts are regarded as a part of a natural scientific schema that can be controlled and systematised. But in fact the artificial world reminds more of a living organism, constantly changing, aging, growing, entertaining and playing us games. Margolin describes the product milieu as an interactive presence in the life world. "*We are always in the middle of it and we experience it as something lively, flexible and even aggressive*."

What happens if we look at the product as another social actor? The object is there with certain properties and much like a person. We believe that the object belongs to an inter-subjective reality that is shared and understood in the same way by everybody. But our interaction and construction of a product differs between different people. If a person and a product share the same culture, history, aesthetics and values, the interaction is likely to go better than if they have different backgrounds. When I stayed in a hotel in south Spain and failed to turn the shower on (I had to take baths for a week) it was obvious that the water tap and I "did not speak the same language".

Erik Stolterman[32] remarks that most people experience computer ap-

32 Erik Stolterman, *Designarbetets dolda rationalitet*, Dissertation, Umeå University, 1991, p169,

plications not as passive objects but as living things. The user develops different intuitive strategies to find rationality in the behaviour of the application. Stolterman suggest that software design should include defining the characteristics of the "role" of the applications. A role is characterised by "expected behaviours and norms" and guides the users idea of the application. The artefact as social actor will have a relationship to different users, it self and the surrounding world. The character will also know something about its own capacity and its goal as well as have a basic ideas about knowledge, behaviour and judgement. To design computer application, Stolterman suggests, will be like forming a social actor and the designer as the author of the role.

The relation between products and people resembles to a large extent by that between two persons. The idea that artefacts are social actors helps to understand the conditions for our interactions. The role of the designer then changes dramatically. The designer can no longer be regarded as the person that shapes the final form of the artefact, the demiurge, who sends out his creations to the masses of consumers to satisfy their needs.

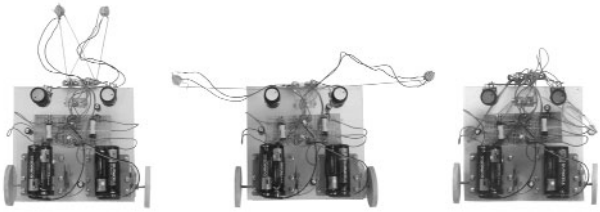
The final form and modes of interaction is rarely received and interpreted by the user in the way the designer intended. The designer instead could be understood as a parent that carefully guides the product on its way to existence and maturity. A sort of "mothering" into being, rather than a patriarchal creation. When the product is released into the social world it possesses a certain register of characteristics and affords certain types of action. How it will be understood and used, however, depends on the construction made by the people that interact with it.

We often experience the artefact as something alive, with an intention of its own. "It doesn't want to!" we shout out in distress, when the door refuses to open or the car does not start. A social scientist would argue that a product does not have intentionality like human actors. No, that is right, not in the sense that they have a free will, but to some limited extent they have intentions. If artefacts are understood as materialised subjective actions, then it would be strange to think otherwise. A lock on the door keep some people, out and let some people in, a narrow doorway can have the same function for a person in wheelchair. In Copenhagen it is not allowed to bring baby prams on buses in the rush hour. This intention was effectively embodied in the old buses in Stockholm that had a handle placed in the middle of the doorsteps with the result that prams

could not be brought on board. Langdon Winner[33] explains how the New York Highway overpasses, was built low enough to prevent public transportation from reaching the beaches.

A society of products

The professional designer is an important part of the maintenance of reality - or the change of it. But he or she is far from the only one responsible. The production of artefacts is a complex process partly guided by economic interests. Designers usually regard themselves as taking care of users' interest. They are aware of usability and they often perform user studies or market analyses. It is interesting to notice, however, that these user studies usually limit themselves to functional and ergonomic issues. Designers tend to look at the interaction between the product and the individual user but forget that these products form our whole life world. We now live in a society of products that creates its own living conditions. How well are those conditions actually fitted to human beings? As we have seen in the introduction the world of artefacts is not very well adapted to human minds. Artefacts do help us top become more efficient, mobile and provide comfort, but they also create stress, discomfort and alienation. Things are not perceived as dead objects that serve our interests but as a living, changeable, interface that affects our action space. When artefacts become filled with computer technology they become even more alive. They can communicate with each other, and help us remember events, predict behaviour – or refuse to do so. The more we become dependent on artefacts in our daily life the more we need to know that they are worthy our trust.



This little antropomorphic creature by Pablo Miranda, from 2004, have two sensors on the sprouts that each control a motor.

If we regard artefacts as social actors then our view of the interaction between artefacts and people will change. The world of artefacts becomes a social world and the interplay between artefacts and individual can be likened to the interplay between the social world and the individual. The interplay between society and the individual has been explored in social theories on a general level. Health sociology has studied how our health is

33 Langdon Winner, "Do Artifacts Have Politics?" In *The Whale and the Reactor*. The University of Chicago Press, Chicago, 1986.

related to social factors. Now we can use these theories to understand the relation between the world of artefacts and human well-being.

3.3 Coping Strategies

In psychology, the way we deal with the strains of life are called coping strategies.[34] Coping strategies can be successful, which means that the troubles are dealt with and disappear or the strategies can be less successful, the problems stay or get worse. Coping is a process that includes both problem solving and emotional reactions. Problem solving could be to take measures in order to influence or change the situation. The emotional reaction might be a defence reaction in order to handle a difficult situation or a direct reaction to the emotion. The most stressful situation is when you experience that you can't do anything; this is when many people are stroken by panic anxiety.

In a report[35] by the Swedish institute for Medical Evaluation (SBU), 499 studies on treatments for depressions have been classified and evaluated. Through the large quantity of studies some general deductions can be made. The treatment with best result and longest lasting effect, was cognitive therapy where the patients learned new coping strategies. To summarize, these included strategies to help people to cope with feelings of meaninglessness, enhance feelings of control over ones life and finding strategies to handle the disease and its consequences.

Other effective treatments are psychotherapy and light physical activity, for example walks in nature. Studies show that a mild depression gets better if the person takes a walk, three to four times a week for about one hour. Nature has a healing influence on stress, depression and general rehabilitation. Studies show that hospitals surrounded by nature and parks, have quicker recovering of patients than hospitals surrounded by buildings and car parks.

It is also clear that people like to do things that they are good at and feel that they control. We enjoy our work because we are skilled at it and it gives us self-esteem to know that we can handle a difficult situation. Learning to master something new can also be tremendously rewarding.

34 Lazarus R S. and Folkman S. *Stress, Appraisal and Coping.* Springer, New York, 1984
35 *Behandling av personer med depressionssjukdomar.* SBU nr 3 1999

Most people clearly remember when they managed to bike for the first time in their life.

A useful concept from psychology is "locus of control" (LOC). It means to what degree a person experiences that she/he is responsible for what happens or whether it is outside his/her own control or understanding. To be able to control or influence ones own situation is crucial for mental well-being. Another related concept is "demand-control-support", developed by Theorell and Karazek.[36] This model states that psychological demands imposed by the environment have different effects on health depending on the balance between the three components. High demands can be coped with more successfully if there are resources available to influence decisions and social support from workmates and colleagues. A combination of high demands and low level of control is labelled work strain and extensive research has proven that people in this group are more exposed to cardiovascular risks than other groups. A combination of high demand and high control is called active work, whereas low control and low demands is labelled passive work. The model also emphasizes the importance of support as central when handling strains at work. Theorell argues that this model may be successfully applied to architecture.[37] Environments that stimulate democracy or social support could be designed to help workers cope with strain.

Sense of Coherence

The increasing ill-health in society is a cause of alarm but how do we define health? United Nations definition of health is "A state of physical, mental and social well-being". Health sociologist Aaron Antonovsky[38] claims that with such a definition of health, everybody is ill. Health becomes equal to perfection, to the absence of any strains in life – and life, remarks Antonovsky includes inevitably adversities. Health and ill-health cannot be regarded as dichotomies but as a continuum where we are in constant movement from one side to another.

A *patogenic* view looks for causes for the disease, whether it is bacteria, psychosocial or chemical factors. The *salutogenic* view, advocated by

36 Karazek and Theorell, *Healthy Work: Stress, productivity and the reconstruction of Working life*, New York, Basic Books, 1990.

37 Töres Theorell," Physiological reactions to creative and less creative environments". In *Design and Health: the Therapeutic Benefits of Design*, Svensk Byggtjänst, 2001

38 Aaron Antonovsky, *Unraveling the mystery of health, how people manage stress and stay well*, Jossey-Bass, London 1987.

Antonovsky, is interested in health and what can keep us healthy. Instead of focusing on the stressors we should think in terms of what keeps us moving towards the healthy side of the continuum.

When Antonovsky studied survivors from concentration camps he found that almost all of them suffered from post traumatic stress disorder. But the surprising thing was that some of them did not. They even regarded themselves as happy. This made Antonovsky become interested in why some people seem to be able to go through terrible hardships in life and stay well. Life is always full of strains, what is it that makes some people survive while others break down?

Antonovsky made several deep interviews and after years of research he could see a pattern consisting of three factors that he called Sense of Coherence. To optimise the chances of successful coping with a stressor, one must believe (1) that one *understands* the problem; (2) that one has at ones disposal the *resources* that are needed; and (3) one must *wish* to cope with the problem.[39]

Comprehensibility – refers to the extent to which one perceives the confronting stimuli, deriving from the internal and external environments, as making cognitive sense, as information that is ordered, consistent, structured and clear. Rather than as noise – chaotic, random, accidental, and inexplicable.

Manageability – the extent to which one perceives that resources are at one's disposal which are adequate to meet the demands posed by the stimuli that meets one. If one has a high sense of manageability, one will not feel victimized by events or feel unfairly treated by life.

Meaningfulness – the extent to which one feels that life makes sense emotionally. That at least some of the demands posed by life are worth investing energy in, are worthy of commitment and engagement.

Of these three concepts meaningfulness is the most important. You can go through almost anything if you feel that it is meaningful and that it will lead to something good in the end, something that is of emotional value for you. So a situation can be both impossible to understand and manage – as long as it is meaningful you can still survive. The other way around, a life that is easy to grasp and handle, but low on meaning, usually has a direction towards ill health. If you do not wish to solve the problems that come up, the negative spiral begins. The first sign of a beginning depression or burnout is usually that everything seems meaningless.

39 ibid. (p 16).

Comprehensible, Manageable and Meaningful

It is striking how well Antonovsky's concepts are applicable on our world of artefacts. If we make a slight shift in focus of The Sense of Coherence towards artefacts this is how it reads; We optimise our chances for a successful interaction with an artefact if we believe that (1) we can understand the artefacts; (2) that we have at our disposal the resources that are needed to handle it; and (3) if we wish to cope with the artefact.

Objects and places need to be Comprehensible, that is, you should understand what they are and how they work. It shouldn't be any doubts about the entrance to a building or how to turn the tape-recorder on. Products should appear coherent, structured, and logical and their function should be analogous to their appearance. If you perceive a product as logical and clear it is usually easy for you to find out how to use it. Something is not comprehensible when it appears chaotic, random, accidental or inexplicable. A product with high Comprehensibility supports understanding and makes it easy to remember how to use the product.

Manageability is about how you handle products. Objects have to be Manageable in the sense that you should know what to do to reach your goal, whether it concerns finding you way in the subway or sending a fax. If you do not know how to handle them, the information should be easy to acquire and understand. An important aspect of Manageability is customisation. If a product does not suit you, you should be able to change so that it does. For example you should be able to change the height of the chair so it fits your size or the contrast on the computer screen. If this is not possible the product is low on manageability. Many products that are mentioned in the survey (described in the introduction) are low on both comprehensibility and manageability. When the computer hangs up, when the printer refuses to print or the emails cant be picked up they drive us crazy because we do not understand why they do us this and how to handle it. It is now that we feel powerless and without control as many people mentioned in the survey.

Some products are easy to grasp on a technical level, but less easy on a mental level, and may provide no support for customisation, examples of that are timetables, calendars, door handles, stove-controls etc. Telephones are easy to grasp, they ring because somebody wants to get hold of you, but they are just as frustrating when we do not have the time to answer.

Comprehensibility and Manageability are closely connected and need to be in an organic relation. The understanding and handling of a prod-

uct are two sides of a coin. If you find your computer Comprehensible and logical you will no doubt find out how to solve a problem if you encounter one. But if your computer is an unsolved mystery that only causes you trouble and acts totally without logic, you might just leave the problem unsolved and find another way to get what you want.

The motivation for solving a problem is related to the last concept: Meaningfulness. If your computer is meaningful for you, or what you do on it is important, you will have the motivation to search for a solution to the problem even if you find it hard to understand. A product is Meaningful when it has emotional significance to you, when you wish to interact with it. When it is part of something that you like and are motivated to do. When you invest energy and time in something it becomes meaningful to you: involvement creates meaning and this goes for products too. Something you have lived with for a long time, have repaired and taken care of becomes meaningful. Operational function does not have to be a prerequisite to meaningfulness but it often is. Something beautiful, or old and fable, can have an important social or emotional function and meaning. Working in the garden, listening to music or taking walks is nothing that presents a "result" or that you immediate benefit from, but they are the most relaxing, anti-stressing activities.

Meaning is the most important component in Antonovsky's Sense of Coherence, but is something very rarely mentioned in product or IT design. Here is where we can find the motivational factor, which could help us cope with the stressors in products. That is the salutogenic approach according to Antonovsky.

Making sense of things

This chapter points at a new way to look at artefacts as social actors in an interactive life world. In this perspective use becomes a dialogues and cooperation with the artefact. Design work becomes a careful guidance into being, where focus is one the interplay between the artefact and its social environment. Stress and ill-health is a sign that there is an unbalance in the interplay. Well-being on the other hand results as a balance between the artificial world and the individual.

The act of designing is basically a way to bring sense to a world of random and chaos. We all have it with us like an inherent gift. When we design our homes and gardens it is a reflection of a God-like giving of order. Nowadays, ordinary people rarely design their whole environment.

The origin of most artefacts that create our life world is beyond the individual's memory or experience and has therefore become institutionalised. Artefacts are typifications, commonsense interpretations, knowledge "at hand" that constitute a taken for granted model of the world. Without them, the world would appear as completely unstructured and chaotic. In that sense artefacts help us to structure and make sense of the world.

But artefacts also objectified obsolete, contradictory or dysfunctional patterns. Even if they make us unwell, they are perceived as natural catastrophes rather than human products, and therefore impossible to change.

Many artefacts, among them particularly information and communication devices, cause stress and ill-health. If we regard artefacts as social actors forming a social world of artefacts that we are a part of, then it is close at hand to look at coping theories to understand the relation between artefacts and people.

Antonovsky use the three concepts Comprehensibility and Manageability and Meaningfulness to describe important aspects of how we perceive life. To succeed in coping with stressors we must first believe that we understand the problem, and then that we have the resources needed to manage the problem. But most important is our motivation which Antonovsky call meaningfulness.

In many languages there is a connection between meaning and the senses. In Spanish Sentido means both sense and meaning, in English we have sense and make sense. Human beings experience and understand the world through the senses. Aesthetics in the Greek meaning of the word refers to what meets the senses and is today widely understood as the total experience of a product.[40] When the world around us appears as random, chaotic and *incomprehensible* it is devoid of meaning. The process of making the world meaningful include making it comprehensible and manageable. Meaningfulness has nothing to do with satisfying demands, which is the basis for the market economy. Fulfilling desires for food, drink, entertainment, shopping etc does not necessarily make you happy. Meaningfulness rather appears when we engage in something, when we feel connected, committed and emotionally engaged. Products that are emotionally sustainable are more meaningful to us and

40 Jerker Lundequist, "Konst och teknik", *Dialoger*, Trelleborg 1999, (p 50-51)

have a longer life cycle.

So aesthetics can be understood not as knowledge about beauty, but as an epistemology that helps us understand and interpret reality to make it meaningful. The key to create a world of artefacts that makes sense, both in the cognitive and emotional sense of the word, lies in aesthetics, the total experience of the product.

There is a great need of increased comprehensibility and manageability when it comes to products but the greatest challenge of them all is to make the new technological artefacts a *meaningful* part in our life.

The KLIV project is a dialogoriented project aiming to explore how learning processes in careunits can be enhanced. Short videos made by the staff, circulated in handheld computers support peer-to-peer learning.
KLIV is a joint project between the Intensive Care Unit at Malmö University Hospital (UMAS) and the Interactive Institute.

Chapter 4
New Technologies in the Home

New technologies in the Home

The home provides an almost insatiable market for technology and product design. The shelves and walls of a home are filled with technology, from household appliances to heating systems. Since the early 20th century technology has entered homes faster and more pervasive than the centuries before, accompanied by ideas about scientific management, liberation of women or the home as an automated caretaker.

During the last decade, the interest in ubiquitous computing has brought a new focus on integrating computer technology in a seamless and pervasive manner in the home. For a few years Smart, or even intelligent, homes seamed to be the next great technical breakthrough. Theses homes would not only be comfortable and safe but also take care of our increasingly older inhabitants. But what future does ubiquitous computing actually suggest and what does it mean to live in it? What does it mean to make computer technology invisible? How can you interact with an invisible artefact?

Feministic theories suggest that hiding technology and products means naturalising and normalising something complex and problematic. Instead, it is argued, design should be used to express and visualise these complex issues.

The chapter ends with a case study "Virus at home", where to goal was to meet the challenge of contemporary ill-health with IT-applications in the home for increased well-being.

The most extreme manifestation of the home as a small factory was "The Home Research Institute" (Hemmens forskningsinstitut) established in 1944.

4.1 At Home with Technology

In Merriam-Websters dictionary Home is defined as:

1: one's place of residence

2: the social unit formed by a family living together

3: a familiar or usual setting: congenial environment; also: the focus of one's domestic attention

4: a place of origin, also: one's own country <having troubles at home and abroad>

5: an establishment providing residence and care for people with special needs <homes for the elderly>

There is not one single definition that captures the different meanings of a home. A home is where we live, but it can be very different in terms of size, use or other inhabitants. A home differs from a workplace, but that does not imply that there is no work done in the home. A normal family with two children spend on an average (including weekends) 3-4 hours daily on household work. Many people also have the main part of work in other people's homes, such as caretakers, cleaners, nurses, carpenters, plumbers etc.

The home is something private, secluded from the public world and eye. It is not a place where anybody can move about freely that does not live there. You are supposed to feel at ease in your home, relaxed and safe. Though private, the home has long been a keen spot for researchers to investigate. Some researchers argue that information technology means that we are working more from home[1]; workplaces will soon become merely meeting spots on café's. Others declare that the home is obsolete; technology has made us nomads, moving about freely in the global village selling services to each other.[2] Both of these views have yet failed to come true. Studies show that we are working just as much from home today as 15 years ago: about 7% of the population work between 1-5 days at home.[3] Some people have always worked at home others have brought home papers to catch up. Sturesson even remarks that information technology obscured working at home since the technology often failed to function.[4] As for the home becoming obsolete, there is a lot of evidence

1 Anders Ewerman, "Den informationssociala revolutionen", i *Handla*, Nerenius &Santerus Förlag, Stockholm, 1997.
2 Bo Dahlbom, *Makten över framtiden*. Liber, Stockholm 2003
3 SCB, *Arbetsmiljöundersökningen 2001*, Dnr AM 0501
4 Lennart Sturesson, *Distansarbete, Teknik, Retorik, Praktik.* Carlssons förlag, Stockholm 2000.

for an opposite trend. The home is becoming more and more important. Magazines about home design, decoration and architecture flourish. Do-it-yourself TV-programs and journals, are increasingly popular and house renovation has for many become a favourite hobby. These programs and journals advocate the idea that the home is the place on earth that is entirely yours to control and beautify. But the perfect home needs a lot of work and appliances to become true.

The servant of the future

One important reason for the development of household appliances in the 1920s and 30s were the lack of servants. Young women of lower classes would rather go to industry or office with 8-hour working time than to devote their life to other people's homes. This was a large question among the middle classes and thereby also in public debate. The accelerating industrialisation and professionalisation of society was considered a real threat to the stability of the homes and family values. Public debate concluded that middle class women in the future would have to do with just *one* help to cope with household work. This could only be done with the help of electrical appliances such as vacuum cleaner, fridge, iron, mixer and even laundry machine! "Everything points at electricity as the servant of the future," predicted the Swedish lady magazine Husmodern[5].

Another solution was to make household work scientific and rational. The Swedish "Housewife Movement" (Husmodersrörelsen) would advocate modern machines and methods as a mean to keep the home as it used to be. "*In rational, planned home care, as required by the time, we shall once more find the old routines, the old working pace that bestow the home with its priceless feeling of safety*."[6]

Per Svensson remarks that this would have several benefits: The home would be able to keep a high standard despite the vanishing servants. Men would not have to face unwanted competition by women at work. If household work was professionalised it would be more attractive for women to stay in the home. The point with timesaving household appliances was therefore not to afford women to work out of home, but to encourage them to work in the home and thereby fulfil their most important role as keepers of homes and family.

5 Per Svensson, *Svenska hem, en bok om hur vi bor och varför*, Bonnier Fakta 2002.
6 Elleanor Lillienhök, *On the ten year anniversary of Housewife movement*, cited in Per Svensson, 2002, ibid

The most extreme manifestation of the home as a small factory was "The Home Research Institute" (Hemmens forskningsinstitut) established in 1944. The institute was heavily influenced by Frederick Taylor's ideas of rational organisation of work. One of the pioneers to apply these ideas on homework was Christine Frederick who published "*Scientific management in the home*" already in 1914. Frederick described the new rational tools and methods as an "antidote" to young girls "unnatural" desire for a career.

The Home research Institute was eager to make homework a scientific discipline and to maintain a high scientific reliability. They measured frequencies of work, time consumption in different methods, number of steps, durability of tools etc. According to Britta Löwgren,[7] the research was almost impossible to understand for other than professional domestic scientists. But the Home research Institute also popularised its findings and some important results became building norm for kitchen design.

By the mid-sixties the ideas start to enter that a home could be made so efficient that it somehow took care of itself. Kitchen appliances, rational methods, prefab food, non-iron clothes, preschools and other efficient routines would make the housewife superfluous. In Sweden this had an ideological background and was part of the ideas advocated by Gunnar and Alva Myrdal from 1940s and onwards; every adult person should have a paid work. In the 40s and 50s it was not self-evident how this was going to be solved and different strategies was discussed such as community houses or kitchens.

Electrolux automatic vacuum-cleaner "Trilobyte" from 2001.

The automated home is another, primarily male dream that has appeared at even intervals during the 20th century. A "Home of the Future" has been a reoccurring theme on world exhibitions or trade shows around the world. Here are kitchen that cook by themselves, floors that clean themselves, clothes that jumps into the automated laundry room an back to shelves by themselves, rooms that senses your mood and put on appropriate music. Civil engineer Bertil Domeij prophesised in 1945 "*The cleaning of this dream apartment will demand a minimum of work since the vacuum cleaner has been replaced by automated dust sucking in electrostatic way*."[8]

Gradually, the idea matured that domestic work would be done by it-

7 Britta Löwgren, *Hemarbete som politik*. Almquist & Wiksell, 1993.
8 Per Svensson,2002, ibid

self with the help of progress, technology and efficient design.

The fifties and sixties abounded in visions about "Future Homes" with helicopter platforms on the roof and mummy instructing the robot. In film and media mechanised homes has been treated with more scepticism, Jacques Tatis *Mon Oncle* (1958) describes a home that devours its inhabitants and Peter Sellers *The Party* (1968) describes a fashionable automated Hollywood home, accidentally manipulated by Sellers. The many contemporary research initiatives in Smart homes do not try to answer to any of the misgivings in these films. Rather they work in the techno-positive tradition as that they bring to life the old dream of technology as the perfect caretaker.

So first the servants disappeared and then the housewives. Today we are facing the threat of a disappearing health care system and an elderly population. Will technology solve that too?

"*The sad thing with all these visions of a future, work free home is that they seldom are realised*", remarks Per Svensson.

Does technology liberate women?

In a world of gender dichotomy it is easy to associate technology with men and homes with women. Men are over represented in technical educations, in product development and design. Electrolux, the world largest producer of white-ware, did not have a female designer employed at their design centre in Stockholm until mid 1990s, and then it was only as graphic designers. Until 1995 Ericsson cellular phones were not adapted to the register of female voices since no women had been involved in development or testing of the phones. My husband always thought I was crying when I phoned him since my voice sounded broken. Women are habitually not supposed to be interested in, nor competent at handling technology.

Homes on the other hand are the domain of women. Women have the largest responsibility for the home, and all the reproductive activities that goes on there like feeding, cleaning, nursing etc. Even though most adult women have fulltime work they still do the main part of household work including taking main responsibility of the children. Women also take large interest in the decoration and furnishing of the home. During the 19th century the main purpose of the home was to be like heaven, a stronghold of virtue and beauty, and a contrast to the strains of the working place. By the change of the century this view was replaced by the idea

that the homes main function was as a source of physical welfare and health. Bacteria, dust and dirt were the greatest threat to the families' welfare and no longer moral decay. At the same time the main focus of the home is changed from living room to kitchen and bathroom. The families' health is directly related to the cleaning standard in the home, which of course depends on the woman. Women's organisation started to look at science and technology with a new interest: home and technology came to a new understanding.

"*Each year – almost each month – science bring some new discovery to the home. Ether waves are utilised for the preservation of food; wireless waves are made to boil water for the household; invisible rays protect homes from unwelcome intruders; and many other such wonders are rapidly being included in every household services.*"[9] as was declared in England 1935.

The new focus on hygiene, the lack of servant and a desire from industry to increase use of electricity converged in the early 20th century. Household appliances became a familiar and cherished part of the home – a technology made domestic, suitable for women unlike computers and cars.

In gender studies two opposite views about the relation between gender and technology has developed. One is technology as a tool for patriarchal exploitation of women and the other technology as a way of liberating women from duties. The first opinion leads to a rejection of technology and the other of an acceptance of it. Anne- Jorunn Berg[10] remarks that the first view emphasise how male power is reproduced through technical solutions. Many feministic researchers have pointed at the puzzling phenomena that technology seems to reproduce existing division of labour and inequality between the sexes. The other view, that technology can be seen as a liberating force, has not been very successful in feministic research.

It is interesting to see if there are any resemblances between the introduction of electricity and household appliances and the emerging research in ubiquitous computing. Can feministic theory throw any light on what these new ideas mean?

9 *The Home of Today,* Daily Express Publications, London 1935
10 Anne-Jorunn Berg, "Kön, teknik och vardagsliv – en enda väv eller skilda världar?", ed Sundin & Berner, *Från Symaskin till Cyborg*, *Nerenius & Santerus*, Falun 1996

4.2 Ubiquitous Computing in the home

Since Wieser launched the concept of ubiquitous computing (ubicomp) in 1991,[11] it has become one of the hottest research areas in computer science. Ubicomp, the idea of invisible and non-obtrusive computing, seems particularly appropriate for domestic environments. Homes are, unlike working places, not built to accommodate crowds of computers and cables. Homes are filled with large furniture and decorated in traditional ways with inherited items. The home of the Future, declares Stefano Marzano, head of Philips Corporate Design, will remind more of the home of the past than of the home of today.[12] In this well-known quote Marzano shows surprising similarity with the advocator of the Swedish Housewife movement. Philips project *Visions of the future* made IT appliances for social and emotional communication. All technological gadgets will be gone; a beautiful painting on the wall will also be the Television and the computer screen. The decorative object on the table will be a communication station, and the compact powder a mini-computer.[13]

Ubicomp is particularly suitable to the home because it is based on the assumption that computers are better if not seen. As Weiser puts it: "*We believe that people live through their practices and tacit knowledge so that the most powerful things are those that are effectively invisible in use, this is a challenge that affects all of computer science. Our preliminary approach: Activate the world. Provide hundreds of wireless computing devices per person per office, of all scales (from 1 inch displays to wall sized). This has required new work in operating systems, user interfaces, networks, wireless, displays, and may other areas. We call our work 'ubiquitous computing'. This is different from PDA's, dynabooks, or information at your fingertips. It is invisible, everywhere computing that does not live on a personal device of any sort, but is in the woodwork everywhere.* "[14]

It is easy to be swept away by the enthusiasm and magnitude of this project and it is clear that developing technology for this grand vision is going to keep researchers busy for a foreseeable future. Though Weiser emphasize the importance of understanding everyday practices for

11 Mark Weiser, "The Computer for the 21st Century", *Scientific American*, vol 265, no 3, sept 1991,
12 Available at http://www.design.philips.com/casa/start.htm
13 *Vision of the future*, V+K Publishing, Bussum, 1996
14 M. Weiser, "The world is not a desktop" *ACM Interactions*, vol 1, no 1, Jan 1994

Ubicomp design, his vision is mainly technically cantered, based on an assumption about "natural" development.

The Ubicomp vision stirred the imagination among media, technologist and the research community in much the same way as William Gibson's "Cyberspace"[15] did a decade earlier. But unlike Gibson's dystopic, cyberpunk vision, Weiser imagines a more optimistic future: "*Machines that fit the human environment instead of forcing humans to enter theirs will make using a computer as refreshing as a walk in the woods*."

Though imaginative and captivating, cyberspace was confined to the virtual world inside the computer. It fitted well with the emerging computer networks and world wide web but its commercial potential was still limited. Ubicomp on the other hand had the possibility of enhancing every item in the whole wide world. There is not a single sock that will go untagged when the computer scientists are finished with their job to "*Provide hundreds of wireless computing devices per person per office, of all scales.*"

What is Ubicomp good for?

Weisers main argument is that truly useful technologies are the ones that disappear. Instead of having single computers or PDAs, computer technology should "*weave themselves into the fabric of everyday life until they are indistinguishable from it*"[16]. Consider writing, argues Weiser, an information technology that now is ubiquitous in industrialised countries. Writing is present everywhere from street signs to candy wrappers, the constant background of these writings does not require active attention, but the information is there if you need it. This is the reason why research should focus not on improving desktop computers but on integrating computer technology into the surrounding world.

In a scenario Weiser suggests that Ubicomp might include: Automated household equipment, voice interfaces, semitransparent windows and walls that conveys background information about weather or activity, smart pens with scanner, ID tagged objects, fore-view mirror in the car informing about traffic ahead, live video boards, personal ID systems, personal recording appliances and information accessibility. In short: a comfortable, practical life that anticipates your needs and with a focus on

15 William Gibson, *Neuromancer,* Ace Books, New York 1984
16 Weiser 1991, ibid

The controlroom of Philips fullscale laboratory home, where domestic life can be studied.

making information available everywhere.

When analysing the scenarios it was found that Ubicomp consists of three main design concepts:

- Background information available everywhere
- Augmented or multi-functioning objects
- Implicit input and anticipated use

So Ubicomp has the potential to make life easier, but what do we really need and how shall it be done? Questions like this has generated a whole lot of research about needs and daily practices in the home. Since the mid 1990s ethnographic studies, interviews and living laboratories that study the home have increased dramatically. Researcher emphasize that homes are distinctive design domains with priorities and concerns that are quite different from workplaces.[17] [18] Activities in the home are informal, daily and have no clear beginning or end. Multiple activities operate concurrently and users switch attention between different concerns. Purchase is not only based on cost and utility but also on aesthetics, affection and self-image.[19] New technology in the home has to fit in with domestic routines[20], values[21] and aesthetics. These criteria put demands on design for the home that are quite different from those at the workplace. Ubicomp have so far inspired many design concepts that are imaginative, inspiring and fun, but few of them have proven really useful or tested by users in real life setting.

The invisible tool

Weiser based his idea of invisibility on Heidegger's observation that a familiar tool becomes invisible in use.[22] We do not longer "see" the tool we use but concentrate on the execution of the work. An artist is not paying

17 Hindus et.al, "Casablanca: Designing Social Communication Devices for the Home", *Proc. of SIGCHI '01*, ACM Press, 2001.
18 D. Hindus, "The importance of Homes in technology research", In Streitz et.al, eds *Cooperative Buildings, Proc. Of CoBuild '99*,. Springer-verlag, Heidelberg, 1999.
19 G Abowd, E Mynatt, T Rodden, "The Human experience", *Pervasive Computing*, jan-march 2002, ACM Press
20 P. Tolmie et.al, "Unremarkable computing", *proc. of CHI '02*, ACM Press 2002
21 G. Bell et.al, "Designing Culturally situated Technologies for the Home", *Proc. of CHI '03*, ACM Press 2003
22 Heidegger, *Being and Time* (Translation of Sein und Zeit) State Univ of New York

attention to the pen in his hand but on the object he is drawing. Likewise computer software should disappear in use so that the user can concentrate on the work that is being done through the program. It is only when something goes wrong with the tool, that the attention is directed towards it.

Art historian Peter Cornell[23] remarks that in this moment the ordinary tool ceases to be a mundane object and transforms to a piece of art. We focus our attention on it and "looks" at it for the first time. What distinguishes art from everyday objects (except the intent) is that the latter are familiar, non-obtrusive and ordinary. When Duchamp took a bottle dryer and put it upside down in a gallery he made us "look" at this mundane object for the first time – and created the first example of a ready-made art.

Philips concept for a bathroom mirror with built-incomputer screens, 2003.

Now, a computer program is unfortunately not changed into art just because it hangs up, it just makes us very distressed. But the idea that everyday objects should be so familiar and non obtrusive that they vanish from our attention is a valid observation, emphasized by for example Bødker. [24]

Making computer technology invisible by building it into other items, however, is not the same thing as invisibility in use. If you do not see something how will you know how to interact with it? How will you even know that it is there? Invisibility in use grows out of a deep and intimate familiarity with the objects and the action it is used for. Objects such as keys, pens, musical instruments, screwdrivers, scissors or tools that are used in daily work or routines, are familiar, at hand and taken for granted. In contrast ubiquitous computing seems to address this issues by suggesting a perceptual invisibility, by hiding computer technology "in woodwork everywhere".

Peter Tolmie[25] and colleagues contribute to the discussion about invisibility in use, which they find a "difficult ambition." To understand how invisibility in use appears they study domestic routines. Routines are the very glue that priorities and needs of family members circle around. Routine events are invisible in use for those involved in them, - no one is taking notice of them. An

23 Peter Cornell, *Saker – om tingens synlighet*, Gidlunds, Stockholm 1993
24 25 P. Tolmie et.al,"Unremarkable computing", *Proc. of CHI '02*, ACM Press 2002

alarm clock that goes off is not commented about from the mother in the next room. That does not mean she did not hear it, if she had not heard it, it would be noted, something would be out of routine. Tolmie et.al notices that truly "natural" and self-evident activities and events are unremarkable. Embedding computational technology in everyday objects is likely to change the semantics of the object and make us notice it in a way that disturbs the routines it was there to support. The challenge for design, the authors conclude, "*is to go beyond simply focusing upon the perceptual qualities of a device and to make computational resources unremarkably embedded into routines and augmented action.*"[25]

We might wonder if Weiser's ambition is to make nature out of culture? His focus on "natural", "self-evident" activities point to that, along with his claim that using a computer "will be as fresh as a walk in the woods."

Coping with errors

Ubiquitous computing requires a whole new design paradigm of a more revolutionary kind than the now familiar desktop metaphor. The complexity of Ubicomp systems requires that the interface provide a mental model that is extremely easy to learn, that fits our routines and that unwanted actions are easy to stop. Some of the great advantages of the desktop metaphor is that is easy to learn and that every action is readily visible, understandable, reversible and that many programs and actions can be viewed and handled simultaneously. Today no such interfaces exist in Ubicomp; as a matter of fact there is very little discussion available of how interaction should be done or how to cope with problems that appear. Some important work has been done by Belloti et. al,[26] who looks at interaction with sensing systems and present a framework for addressing design challenges. They conclude that conventional Graphic User Interfaces (GUI) are not appropriate for sensing systems and suggest that designers should look at human-human Interaction used by social scientists for inspiration. Conversation analysis gives valuable knowledge on how people address, attend and politely ignore each other. The authors uses Normans seven stages of execution as a starting point for five issues that address communication with sensing system: Address, Attention, Action, Alignment and Accident.

26 Belloti et. al, "Making Sense of sensing systems: Five questions for designers and reserachers", *Proc. of CHI '02*, ACM Press 2002

Though this work brings up important questions it does not cover malfunctioning systems or system breakdowns. What do we do when our future Smart home hangs up or collapses? Will we be able to even unlock the door?

4.3 Design – Visualising or hiding?

What does it actually mean to hide something? Within product development and advertising, design is commonly used to disregard chronology and semantics. New, unsettling objects can be made to seem old and familiar, or vice versa, something old can acquire a new, "modern" look. The success story of the twentieth century is intimately connected to technological development and objects associated with this "progress", with Industrial design as an important tool in this process. In the beginning of the twentieth century, Peter Behrens started working for AEG, Allgemeine Elektrische Gesellschaft, a company that primarily produced electricity and had begun to enter the consumer market. The problem for many electricity companies at the beginning of the century was that usage was divided unevenly during the course of the day and that it is difficult to store electricity. There was a peak during the morning, and then during the day consumption fell to almost zero, and then rose to its maximum during the evening hours. In order to meet demand, the companies had to have the same high capacity at every hour. This was obviously not profitable and many shrewd men were wondering how to increase demand for electricity during the day. One of the most successful ventures turned out to be kitchen appliances. The electric stove, mixer, toaster, washing machine, kettle, heater, and iron were all developed in quick succession, to name just a few products. Behrens designed electric kettles in three different materials and with around ten different patterns in order to satisfy every taste. [27]A similar development occurred in all new technologies. The radio, for example, was developed during the beginning of the 20th century, but was perceived as being too difficult and dangerous to use in the home. Radio manufacturers resorted to different strategies to overcome this. One was to change public opinion using advertising and "radio events". Another was to use design to make the radio

27 Adrian Forty, *Objects of Desire , design and society 1750-1980*, Thames and Hudson, London, 1986

The archaic radio design,
The Suppressed radio design,
The Utopian radio design

more acceptable. Radios could be built into traditional wooden cabinets, or concealed in a grandfather clock or an armchair. But it was not before the radio found its rounded, utopian form in Bakelite that it became a product icon.[28]

In 1932 we could read in Svenska Slöjdföreningens magazine Form that "The radio as a cultural phenomenon is still very much in its formative stages. The chaotic lack of style in radio broadcasts has slowed down innovation within the industry. As far as the appearance of these devices is concerned, it can be noted that they have still not become an item of furniture that fits naturally into a room. The average radio with its built-in speakers still uses forms reminiscent of an oversized, clumsy table clock." [29]

The development of radios went through three design phases: the archaic where the product imitated a well known older artefact, the suppressed where tho product was hidden in something else and the utopian, where the form suggested something entirely new and modern. Adrian Forty remarks that this evolution has appeared so often in industrial design that they might be said to from a basic grammar. We can see the same development today within the field of so-called smart homes. Broadband and IT technologies are entering our homes across a wide

28 Forty. 1986, ibid
29 Red Lasse Brunnström, *Svensk Industridesign — en 1900-talshistoria*, Norstedts, Stockholm, 1997.

range of applications. From the first stages of crude technology and archaic solutions it has now entered a stage of suppression. The products should not be seen at all.

Design express the product

Internet fridge from LG Electronics. The computer his hidden in the door and a screen is placed on the front panel.

How believable is it that we will build technology only in order to hide it? The radio armchair was never a hit and the radio clock did not have its break-through until 50 years later, and then it was the clock that was built into the radio, not the other way around. Every period and every technology needs to develop its aesthetics in an organic relationship with its own time. Hiding technology also means that we put aside and naturalise something very complex and problematic. Product design and aesthetics is what literally expresses the product. The product can be read as a text that conveys a number of semantic messages. On the denotative level it tells us what it is and how to use it. When we analyse it we can detect the connotative levels where issues about culture, identity and context are buried. In his book *Mythologies*, Roland Barthes explains the way myths work and the power they have on the way we think. Taking a lot of examples Barthes shows how seemingly familiar things signify all kinds of ideas about the world. As Forty remarks: "*Unlike the more or less ephemeral media, design has the capacity to cast myths into enduring, solid and tangible form, so that they seem to be reality itself.*"

One such myth would be that household work nowadays is fun, easy and efficient compared to the old days when housewives were chained to the kitchen. Household appliances are considered to have freed women up to do paid work and made housework fun and fast. Housework is seemingly done by itself with the housewife only supervising the work. Household appliances were advertised as the "solution to the servant problem". But in fact, a range of studies [30] shows that

30 Ellen Lupton, *Mechanical Brides – women and machines from home to office.* Princeton Architectural press, New York 1993

women spend more time doing household work today that in the twenties. This is explained by raised standards in cleaning, cooking and clothing. 80 years ago, shirts and underwear were at most changed after one week of use; today we rarely wear the same garment more than a day. So instead of sending laundry away to a cleaning lady once a month, the washing machine is on every day.

Hiding or not hiding – that is the question

Making or not making technology visible is a long debated issue in industrial design and architecture. One of the main criticisms by the modernists in the beginning of the twentieth century was the inconsistent use of material, styles and ornaments during the previous century. The American architect Sullivan coined the expression "Form Follows Function", claiming that function was superior to form. Honesty in form, function and material was another well spread motto. This meant that no material or function should be hidden behind something else, but clearly and honestly presented in the final design. But this was mainly a theory of aesthetics. In reality, most modernistic buildings hide all of their construction under smooth and white surfaces.

There are many reasons for hiding something, one is that it is ugly or untidy. In a recent study [31] five families were asked to take pictures of ugly and attractive things in their homes. Most of the ugly things were technical appliances such as stereos, television sets, computers, bundles of cables and light switches. We might also hide something because it reminds us about something unpleasant, or because we do not want to deal with it right now. In a therapy situation the psychologist tries to unravel the memories and feeling of the client that he/she has repressed into the unconscious. The main idea is that such unconscious material still affects the client even if he/she is not aware of it. Problems generally appear less frightening if we just look at them. Another reason for hiding something is that we do not want others to find out about it. It might cause problems or challenge our own position. Power is often concealed and therefore less obvious and harder to criticise.

31 Beaudouin-Lafon et al. *InterLiving Deliverable D1.1*, "Cooperative Design with Families", 2001. CID, KTH, *InterLiving Deliverable D2.1*, "Technology Probes for Families", 2002. CID, KTH.

Criticising Ubiquitous computing

Augustin Araya[32] has analysed the technological thinking that underlies ubiquitous computing using Heideggers idea about technology as "conditions of possibility", and explored how technology reveals itself to man. According to Araya, Ubicomp changes the surrounding world to become not a separate entity but an extension of ourselves. Constantly responsive, subjective, movable and reproducible, it changes according to our needs and fantasies. This leads to two observations; one is that Ubicomp can be seen as a way to obliterate "otherness" in parts of the surrounding world by penetrating it with computer technology. The second is that Ubicomp obscures "otherness" in parts of the surrounding world in such a way that we are not aware of it; everything is apparently normal. Araya describes this phenomenon as double invisibility: The penetration of computer technology in the environment becomes invisible: The effects they cause are invisible to us because we cannot see them.

This reminds us of the double invisibility-making [33] in feministic theory: The dominating culture becomes invisible because it is the natural, the self-evident, normality above interests of gender, class and others: A culture in opposition becomes invisible because it gets less room in the public space and appears as vague, indistinct and temporary.

By applying the theory of the double invisibility to Ubicomp, the suggestion to massively penetrate the world with invisible computer technology, appear as a way to normalise, naturalise and reify computer and information technology. The invisibility creates a power position where it is nearly impossible to criticise or change the prevailing system. Feministic theory also points at possible ways to act: to make relative the self-evident and to visualise the vague.

Product designer and writer Anthony Dunne[34] argues that mainstream industrial design uses its powerful visualisation capabilities to propagandise desires and needs designed by others, thereby maintaining a culture of passive consumers. He suggests that design research in the aesthetic and cultural realm should draw attention to the ways products limit our experiences and expose to criticism and discussion their hidden social and technical mechanisms. Central to Dunnes and partner Fiona

32 Augustin A. Araya, "Questioning Ubiquitous Computing", *Proceeding of CHI'05,* ACM Press 1995.
33 Louise Waldén, *Genom symaskinens nalsoga*. Carlssons förlag. Stockholm 1990.
34 Anthony Dunne, *Herzian Tales*, RCA, London 1999.

Rabys work is a consideration of the imperceptible electromagnetism that surrounds us. From the "natural radio" emitted by the suns activity to the radiation leaking from appliances, Dunne and Raby attempt to visualise the invisible. In a series of conceptual design proposals they criticise and visualise aspects of electronic culture that have very rarely been dealt with within product design or art.

Visualising the vague

Design is a powerful tool that allows values and cultural codes to be materialised into factual objects, thereby making them a "natural" part of the world. Design can also be used to criticise and deconstruct such values, but because design finds itself operating within a commercial framework this rarely occurs. In the design of computer and IT artefacts there is usually very little time for explorative and critical aesthetics.

In the light of the discussion in this text it seems a dubious approach to merely make computer technology invisible. Information technology is too problematic and powerful to be domesticated and hidden behind or in a familiar appliance. An environment penetrated by invisible computers will most likely affect the way we perceive ourselves as subjects in relation to an objective environment. It also appears as a way to normalise, reify and naturalise computer and information technology, thereby making it a natural fact more than a cultural phenomenon. But something hidden or invisible will not only exercise power, it will also be impossible to understand and interact with. A breakdown situation requires that we can communicate to solve the problem. Every technology needs to develop its aesthetics in an organic relation to its own time. Instead of hiding computer technology we should use the power of design to visualise and express this complex issue – to visualise the vague and make relative the self-evident.

4.4 Design and preventive actions

During the 20th century, living conditions has been the object of many studies and preventive measurements. The large increase in health and age during the last century is mainly caused by preventive actions and structural changes in society such as better hygiene, better housing, better diet and safer working conditions.[35] It is likely that the ill health we are

35 *Längre liv och bättre hälsa – en rapport om prevention*, SBU rapport nr 132, Stockholm 1997

facing today require the same kind of preventive measurements.

Design and social engineering has during the last century, been regarded as a tool to increase health among the general public. In the Swedish functionalist tradition of the 1930s and 40s, apartment blocks were built to accommodate hygienic bathrooms, a kitchen built according to rational principles and sleep enhancing bedrooms. The houses were built in airy park like environments, surrounded by sun and fresh air. Bacteria and poverty, the main causes of ill health would be wiped out with a scientific approach. Many of these living areas, like Årsta in south Stockholm, would become icons for good and functionalist building, but some that were made during the peak of high modern rationalism, were horror examples of alienating concrete suburbia. Architecture in Sweden still suffers from the backlash of the unpopular housing programs of the 60's and 70's.

Swedish industrial design is well known for ergonomic working places and products for elderly and disabled. This is due to long and generous founding from RFSU rehab and the Swedish Fund for Working Conditions (Arbetsmiljöfonden).

But what are the main causes for illness today?

Public health at the change of the century

In Sweden spring 2002, the cost for health insurance is increasing with 25 million skr (3 million dollars) every day. Long-term sick leaves are peaking and there seem to be no end to the development. What we might see is the beginning of the demographic development towards and increasingly elder and sick population. According to a study by the National Institute of Public Health,[36] Sweden's large group of people born in the forties are now in their early 60's and increasingly fragile and sick. More alarming perhaps is the increasing ill-health among women between 30 and 49 years of age. Stress, worries, high demands at work and from family creates a life situation that is likely to cause ill health. This is typical for Sweden and is probably related to our high rate of women with small children that work full or part-time. But women in all industrialised countries go on sick leave and see doctors twice as often as men. From the mid 90's an increasing number of women from low paid public work were diagnosed as Burnout, soon followed by high paid men from the industry.

36 Anna Hedborg et al. *Analys av Hälsa och Arbete*, Folkhälsoinstitutet. 2003.

What is considered a public health problem varies between cultures and in time. In Sweden six diseases are considered public health problems: cardiac diseases, mental ill-health, cancer, diseases in the movement organs), accidents and allergies.[37] Depending on how you measure the illness, their importance differs. Cardiac diseases cause most deaths but mental problems have the highest score of disability adjusted life years (DALY's). Diseases in the movement organs, for example back pain, cause few deaths but are the diagnosis behind 45 % of early retirements of the women and a third of the men.

Some health trends are positive, for example deaths caused by cardiac diseases that have decreased with 30-40 % the last decade. Suicides have gone down dramatically, due to new forms of treatment, as has many forms of cancer. This means that people can come back to work after a disease and that we have a longer predicted age.

On the other hand we have diseases that increase, which are: back problems (25% of long-term sick leave), depression and nervous problems, osteoporosis, asthma and allergy, old age diabetes (type II).[38] Back related problems are the most commonly diagnosed cause for people taking long-term sick leave. It has increased dramatically over the last ten years, especially among men with trouble in their shoulders and necks. This is believed to be related to an increase in the amount of computer related activities characterized by long hours of static sitting. Mental problems and stress are another of the big healthcare problems facing us today. Studies that measure the total amount of ill health in the society find that mental problems are the largest cause of functional disability. Every other woman and every fourth man will, sometime in their lives, suffer from depression.[39] The World Health Organisation (WHO) believe that depression, in addition to smoking, are the greatest health problems in the 20th Century and that depression will probably be the main cause of work related and functional disabilities amongst adults.[40]

Burnout is a kind of exhaustion depression caused by too much work and pressure over a long time. Since Burnout was made an official diagnose in Swedish medical care in 1998, the amount of people with burnout

37 *Folkhälsorapport 2001*, Socialstyrelsen (Public Health report 2001)
38 Gunnar Ågren, *Folkhälsa i Framtiden*, Folkhälsoinstitutet 2000, available at www.fhi.se
39 Gunnar Ågren, 2000, ibid.
40 Murray and Lopez 1997, i *Behandling av personer med depressionssjukdomar*, SBU 3/99

have increased with 300% each year. A recent study made on 67 Swedish women with burnout symptom[41] claims that stress gives the same brain damages as stroke. The central nerve systems is affected which substantially limits the brains normal ability to learn, remember and handle new information. These women describe that they cannot make the simplest decision or remember anything new for even a short time. The course proceeds with increasing emotional reactions, chronic fear, anxiety, fatigue and a range of body symptoms. The writers conclude that we need to adapt working places for our brains as well as for our bodies. Work should be judged and adjusted to brain ergonomics to prevent cognitive overload.

An important factor in future health panorama is the demographic development towards an increasing elderly population in western countries. The average lifetime in Sweden has increased with ten years since 1950's, and the amount of people above 65 has increased from 10% 1950 to 17% 2000. More than 1,5 million people in Sweden are above 65 and more than 100 million people in Europe. In ten years time the group above 65 years of age are estimated to constitute 25 % of Sweden's population. Many other western countries have similar problems but Sweden will sooner than other countries have a large group of older elderly, above 80 [42] [43].

Elderly, and particularly above 80 year, consumes a large part of the total sick and healthcare cost. Cost for elderly tends to rise with average life length. Most people are relatively healthy until 80 years of age, after that the risk for diseases or combination of illnesses increase. Alzheimer, Dementia, Osteoporosis and old age Diabetes are diseases that mainly effects people above 80. The trend towards and aging population is accentuated by decreasing birth rates. In the future fewer young people will have to support and take care of a growing group of elderly.

An important aspect of healthcare is an increase in physical activity. We feel good if we are physically active and are better equipped to meet setbacks. Both back problems and mental problems are one of many diseases where physical activity can be preventive and relieving.

Scientific documentation clearly shows that regular physical activity

41 Rhodin-Nyström, Sandström, Lundberg, *International Neuropsychological Society,* Stockholm 2002

42 Statistiska Centralbyrån, "Sveriges Framtida befolkning". *Befolkningsframskrivning för åren 2000-2050.* SCB-tryck Örebro, 2000.

43 Anna Essén, *Kvarboende och äldrevård i hemmet med modern teknik*, Report, Institute of the future, 2003:27, Stockholm

The Virus project .
Two flats in an apartement block in central Stockholm were equipped with IT-aided support.

prevents a number of illnesses such as heart and blood vessel disease, certain tumours, old age diabetes, osteoporosis, overweight, mild depression and anxiety. A disease can also have a milder development if the patient is physically active.[44]

To sum up, we have two parallel trends in the future health panorama: one consist of general public health problems with increasing stress related diseases, the other is caused by an aging population with diseases related to old age.

4.5 Case: Virus at home

The *Virus* project takes a close look at increasing stress and ill health in society and suggests IT solutions for the home that will prevent and rehabilitate these problems. Back problem, stress related diseases, insomnia and depression are among the most common reasons for disability among working adults today. These diseases reflect the general state of society with static work, physical inactivity and increasing mental and cognitive strain.

Smart homes today enhance this trend by providing complex solutions for alarms, automated functions and remote controls. In contrast, Virus aims at enhancing aspects of the home that help us cope with stressors and thereby remain well. We suggest solutions that would prevent backache or insomnia rather than taking care of the problems caused by it. Based on studies on the general state of ill health, Virus suggests products that attempt to increase physical activity, support sleep and facilitate social awareness. All the design suggestions are fully realisable in terms of technology, but visionary in terms of function.

Project Background

Virus was performed at Smart Studio/Interactive Institute, Stockholm and was done in cooperation with the larger project *Kvarbo* (Stay home),

44 *Fysisk Aktivitet för nytta och nöje*, Folkhälsoinstitutet 1999:8, ISBN 91-7257-020-2

short for *IT-based care products for the home*. The guiding idea with Kvarbo was that you would be able to live in your home even if you became old, ill or disabled. The objective was to build two experimental flats that would be evaluated by users for a two-year period. The role of the Virus project was to identify new, unnoticed needs of a practical, social or emotional nature. The project would run parallel to Kvarbo and inform it with ideas, experiences and design proposals. One important limitation with Kvarbo was that it was not decided who would live in the flat or what disability these persons would have. Therefore we decided to have a more general approach.

The goal of Virus was *to prevent and rehabilitate common ill-health problem with IT-appliances in the home.*

The project consisted of two parts:

– A prestudy, with interviews and background analysis.

– A design phase, with conceptual design proposals.

The project team at Smart/II consisted of five people; one engineer, one industrial designer, one designer/ HCI researcher, one artist and one behavioural scientist. All five people worked part time in the project and were focusing on different phases.

Related work

Work that relates to the project is to be found in two main fields: one is commercial "Smart home" appliances; the other is in research about IT-aided home care.

The first group consist of electricity and IT-providers that regarded smart homes as a large and profitable market. They were mainly aiming at the large and wealthy generation born in the 1940s and influenced by Mark Weiser's scenarios for ubiquitous computing. The products available were mainly limited to alarms of different kinds and remotely controlled shades and lamps. Appliances were connected to the internet and could be controlled from a web page. If some of the alarm was triggered an email would be sent to a given address. But the products were expensive and difficult to install. In spite of heavy marketing, all of the companies founded in the IT-boom in the end of the 1990s went bankrupt a few years later, such as Frontyard, Ehem, Sensel, and E2Home etc. Other operators were building companies that saw IT-services as a way to increase user value of their flats in a competitive market. They installed for example electronic tags (instead of keys) for common spaces in a building and

computers in each flat, where laundry rooms could be booked.

Another background for the Virus/Kvarbo initiative is to be found in IT-aided home health care. This research is related to the increasing ill health among working adults in western countries and the demographic development towards an older population. Other important reasons are raising care costs and difficulties in recruiting professionals to the care sector. With the technology available today it would seem likely that an increasing number of care services would be available to elderly and chronic ill in their homes. But the industry has been very slow to react to this increasing market. Some reasons for the slow development are the lack of evidence of economical benefits of implementing IT-appliances and a fear that technical solutions will replace human care and reduce quality.[45] The goal of Kvarbo was to provide such an examples of benefits, costs and technical solutions. But the idea was not to build a hospital at home. The technology should be inexpensive enough to be realistic to buy or lease for an average person.

There is, however, three projects in Sweden relate to and precede Virus/Kvarbo. CID (Centre for User oriented IT-design) at KTH (Royal Institute of Technology) in cooperation with The Interactive Institute and Telia developed a showroom apartment called ComeHome that focused on the use of live video communication in the home. Large video screens were used for live communication and followed you as you moved through the rooms.[46]

Hjälpmedelsinstitutet (Swedish Handicap Institute) has equipped a flat called Smartbo, with a large amount of IT-aids for disabled people to demonstrate the possibilities for handicap aid.[47]

Danderyd Hospital developed @Home,[48] (part of the EU project Facile) an apartment situated in the hospital, used to judge abilities of people with brain damage. In this flat patients could live up to one week as part of their rehabilitation program. Apart from @Home in Danderyd Hospital none of these homes where build to actually live in, ComeHome, for example lacks a bathroom, and none where designed for permanent stay.

45 Anna Essén, *Technology-aided Seniorcare at home*. Report at Institute for Future Studies.
46 S Junestrand & K Tollman, "Videomediated communication for Domestic environgments". In Streitz et.al (eds) *Cooperative buildings – Integrating information, Organisations and Architecture, Proceedings of CoBuild '99*. Springer 1999.
47 www.hi.se/smartlab/
48 Support@Home- trygghet och frihet hemma, www.ds.se/facile/
Report "IT for improved quality of life in housing" Stockholm 18th February 2000 http://www.infra.kth.se/bba/

Another related project is the Aware Home at Georgia Tech, a living laboratory equipped with sophisticated technology to support elderly residents.[49] The goal is that elderly eventually will live there for some time and try the solutions. Another source of inspiration have been Bill Gaver and colleagues with a project on elderly in different European communities.[50] This work is particularly interesting for introducing "Cultural probes" a method where users inform the design process with inspiring and personal experiences. Gaver and Martin[51] describe how they use conceptual design proposals as an example of research through design, balancing concreteness with openness to spur the imagination and allow the emergence of a design space together with their partners. They describe the concepts as placeholders, occupying points in the design space without necessarily being the best device to populate it.

Research agenda

Whereas Smartbo and @Home were made for people with severe mental and/or physical disabilities, all the rest of the smart homes can in fact only be used by people with exceptional mental capacities. A person with an average computer experience would find it very difficult to live in, not to mention to install, some of the smart home products available on the market. One researcher in the Smart studio tried to install products from eHem in her house as part of a research project. Not only was it technically complex, she could not think of any real uses for the functions. When she realised it was not Mac compatible she gave up. Some visitors to ComeHome reported that they would go crazy to live with such amounts of large screens, sounds and images. It is clear that this technology is still on an experimental level and not sufficiently adapted to "real" users. But most of us are neither severely handicapped nor computer and electronic experts. In the Virus project we asked ourselves if there is anything available for the large group in between? Is there IT-equipment that is easy to use and that fulfils the need of moderate absentmindedness and viruses that most of us suffer from? We found that none of the entrepre-

49 C D Kidd et. al, "The Aware Home: A Living Laboratory for Ubiquitous Computing Reserach". In Streitz et.al (eds) *Cooperative buildings – Integrating information, Organisations and Architecture, Proc. of CoBuild '99.* Springer 1999.
50 W Gaver and A Dunne, "Projected Realities: Conceptual Design for Cultural effect," *Proc.CHI '99*, ACM Press, New York 1999.
51 W Gaver & H Martin, "Alternatives: Exploring Information Appliances thorugh Conceptual Design proposals" *Proc. CHI 2000*, ACM Press, 2000

neurs or the research projects had looked at this issue. The products available in the Smart home business mainly consist of remotely controlled appliances or alarms. The practical benefits for this was small as was confirmed by the reluctance of the market. It seemed that they would only appeal to people with extremely large need for control. The research projects on the other hand were focusing on people that already were severely disabled which most of us are not.

We were influenced by health sociologist Aaron Antonovsky and his ideas about a salutogenic approach. A salutogenic approach looks at conditions that make us stay healthy as opposed to a traditional pathogenic approach that finds out the cause for illness. Could we find a way to support functions in the home that help us cope with stressors? Would there be a way, we asked ourselves, to enhance aspects of the home that keep us healthy?

The Virus project is situated somewhere between a conceptual design proposal and a research project resulting in functioning prototypes. Our aim was to keep a visionary and conceptual approach without loosing sight of the original set of problems or moving away from the technology of today. The goal was to make suggestions that would be implemented in the flats without conforming to any implicit ideas about e-health or Smart living. All the design suggestions are fully realisable in terms of technology, but visionary in terms of function. They are therefore to be seen as both polemic concepts and real design proposals. We wanted the project to provide a base for discussions about the role and future of IT in home health care.

Design proposals

When we decided to work with the general ill-health problems we argued that an elderly population shares many of the general diseases. Problems like backache and insomnia are not confined to a certain age group. The question was if we can design IT-artefacts that prevent any of these health problems or are they beyond the scope of product design? We believe that large problems in society should be met by research and that product development cannot only be left to commercial companies. Design and HCI are not likely to change the future health panorama but even a minor contribution can have impact. Another important mission for research is to point at alternative ways of action. Design concepts can, with Gaver's words, be seen as placeholders that occupy a design space.

They act as tools for our imagination and widen the possibility for future development. By providing several, different accounts of future artefacts, and life worlds we are free to choose.

The starting point for the design proposals was that they should prevent and help to cope with our most common health problems in the home. By studying the contemporary health panorama, we have arrived at two broad trends in society that affect our health:

Firstly: *Mental overload*, which causes stress, burnout, insomnia, stroke, mental problems etc

Secondly: *Physical inactivity*, which causes back problems, cardiac diseases, osteoporosis and old age diabetes.

We realised that these two trends are connected like two sides of coin. We have a cognitive overload and too little physical activity – this should be the other way around. The implication of this would be to help people to relax mentally and to increase their physical activity. How can this be done with IT-support in the home?

A long phase of discussions, workshops, interviews, idea generation and evaluation took place. How do we support relaxation in the home? Many activities that take place in the home are done for the pleasure of it and relax the mind such as cooking, gardening, reading etc. Another important aspect is not to be disturbed, by for example phone-calls, while you are winding down. Which of these should we focus on? How do we support physical activity without being obtrusive and create a bad conscience? Many people hate sports of any kind. Can movement be "disguised" as something else and pleasurable? We were reminded that loneliness is hazardous for our mental health. In some cases we need to be made aware of whom we can call or what takes place outside our flat.

This work generated around 70 different ideas that subsequently were filtered down.

We finally decided to focus our proposals on three areas:

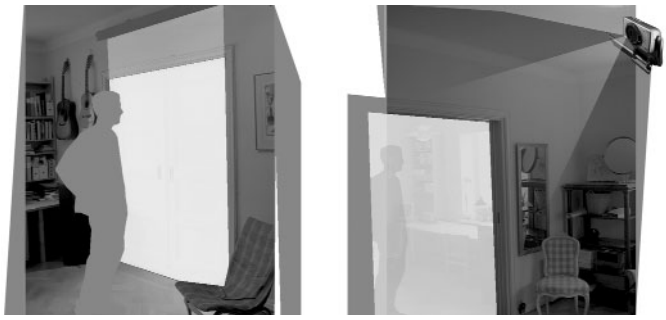
Space for movement

Sleep and relaxation

Awareness

The final report[52] consisted of fifteen proposals in these three areas. This case study will present nine of these concepts.

52 *Virus: IT, hälsa och framtidens boende*. Report, Smart studio, Interactive Institute, Stockholm 2001.



The area in front of a door is often the only free space in a home.

Space for movement

The home today is designed for stillness, relaxation, for entertaining friends, and for sleep. As a rule, there usually is no place to move around at home even if one wanted to. The home's physical activities are limited to household work such as laundry and cleaning. Physical activity is not addressed within research concerning IT supported activities in the home. Venkatesh maps 13 areas in everyday life for household with IT support, from home shopping to food preparation[53] but does not mention exercise. Junestrand record as many as 61 activities going on in the home, without even coming close to physical activity.[54] It seems that physical exercise in the home is as alien to research as making dinner on grand central station. In spite of that many people do physical exercise in the home. You may workout in front of a video, stretching, sit-ups, yoga or simple physical therapy. Many people buy foldable home exercise equipment, they workout shoulders or stomach with sit-up boards or dumbbell. But the home gym usually ends up in the cellar and the dumbbells in the closet. Computers have been criticised to make users passive, particularly youths that spend too much time in front of computer games. Some efforts have been made to meet this critique such as dance mats for games. But IT has so far not been used to enhance grown up to exercise.

We believe that it is about time to revalue physical activity in the home. Not everybody has the time or possibility to go jogging or to a gym. Our climate does not allow walks and outdoor activities all the year. It is likely that those people who do not do regular physical activity are the ones that need it most: Elderly, parents of young children, functionally disabled or chronicly ill. But the home has not got the space or the tools that support exercise in a natural and non-obtrusive way. These concepts launch a new look at our physical needs – to create space for movements.

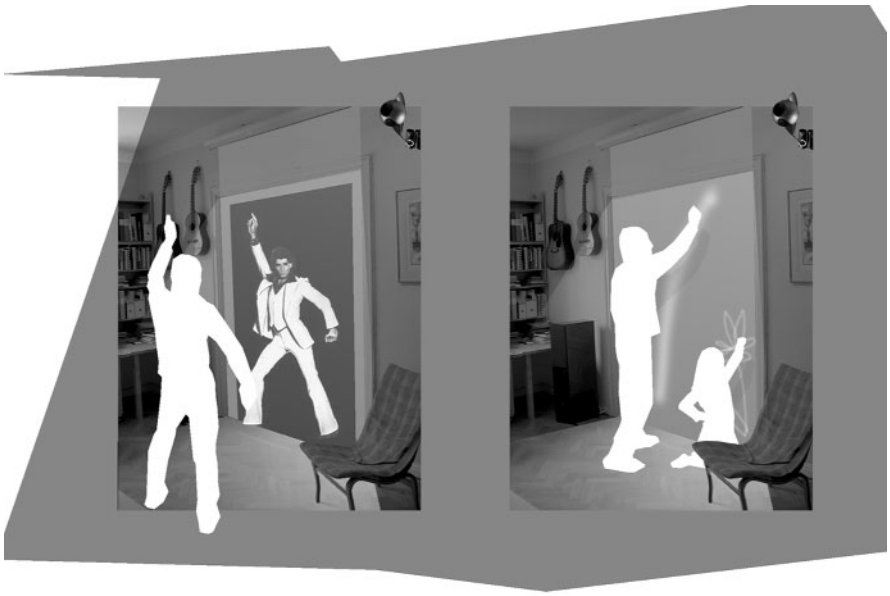
The design suggestions are primarily aimed at those who do not regularly do physical training. The objective is to make products that support

53 Alladi Venkatesh, "Computers and other interactive Technologies for the home". *Communications of the ACM*, December 1996/vol 39

54 Stefan Junestrand, *IT och bostaden – ett arkitektoniskt perspektiv*. Licensiat, KTH 1998.

spontaneous movement through different types of media feedback, and to think in new ways about furniture that can aid physical exercise.

Video door. One obstacle to physical exercise in the home is that there usually is no space for it. The design suggestions are based on the observation that there is usually an empty space in front of the doors at home. We suggest that we use this space for exercise, by installing a moveable screen in the door opening with back projection, cameras, motion detectors and sensors. This system can be used for a number of applications that support and encourage movement.



Interactive Gogo. Dance is a form of movement that occurs spontaneously and is also fun. It is also a good fitness activity for people of all ages. But dance is essentially a social activity, and so it can be boring to dance on one's own. Gogo is a digital dance partner with a sparkle in his eye that makes it fun to dance. One can select music and dance partner. A motion sensor detects if one is moving, which controls the gogo dancer. As soon as one stops dancing, Gogo also stops. But, if one continues to dance, so will Gogo.

Body painting. A camera with computer vision reads the movements of the person in front of the screen and transforms these to colours on the screen. The idea is that you should be enticed to stretch your body. Digital pens can be used for a greater precision. This product suits everybody that is interested in the relation between the body, impression, art and creativity. It can be practised alone or in a group and preferably together with children. It can be used for body and paint therapy.

Angle video. This application has grown out of the need to be able to see oneself from another angle. A camera in the ceiling records you and projects the image on the screen. Here you can contemplate your body posture; see yourself doing different movements and what it looks like from the side and from behind. The idea is to increase the body knowledge and in a calm environment get familiar with ones body.[55]

Sleep and relaxation

An increasing number of people suffer from insomnia and stress symptoms. For many, this is caused by an increase in tempo and demand in their work or private life. For others, insomnia is the result of illness or too much sitting still during the day. We believe this is a very interesting area for future homes and we have developed a number of product suggestions that have themes relating to relaxation, sleep and dreams, based on electroencephalogram (EEG) that read the electrical activity of the brain. These suggestions should not be seen as medical equipment, but rather as aids to learn to relax. The suggestions have a playful and curious nature but with a serious side. They are built around accepted technology from brain

55 A similar idea was later developed simultanously by Smart studio in the Refashion project and by IDEO for Prada.

research that is not yet included in consumer products. We do not claim to be running clinical research or to be able to cure insomnia. We offer a method to apply new technology in an important area.

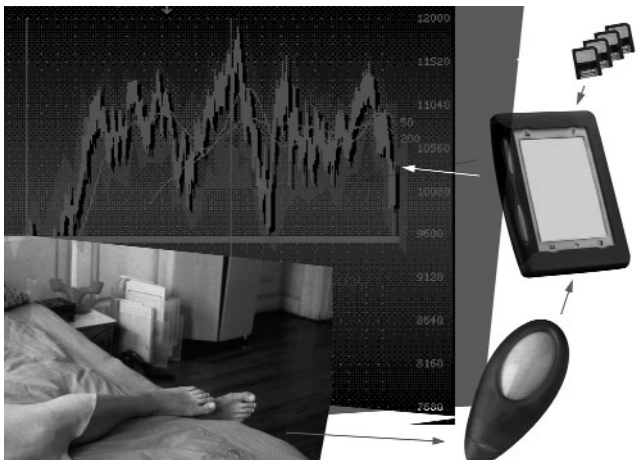
Braindrain is a product that, via biofeedback, helps one relax and fall asleep. It is built around an EEG device that, with the help of certain audio and visual feedback, helps people to strengthen the calming brain waves and dampen the stressful ones.

Meditation/concentration – Audio and visual feedback of Beta and Alfa waves, gives a relaxing entertainment "relaxtainment". The feedback can be graphic patterns, sounds or playing simple games. This is particularly interesting for functionally disabled or lame, that can't use their body fully. Studies also show that children suffering from Attention disorders are very low on Beta waves. This therapy can help them increase their beta activity in a playful way.

Relaxation –By listening to sounds it is quite easy to enhance Alfa waves in the brain. Alfa waves appear when you are relaxed, but awake and help to calm down.

Falling asleep – Theta waves appear during drowsiness and when you are falling asleep. Audio Biofeedback, in combination with warmth and vibration, will teach you how to enhance theta waves and thereby falling asleep.

Sleep log with dream recorder. During sleep, regenerative activities occur in the body. The immune system strengthens and, in dreams, one handles unconscious material and the day's events. Many people with disturbed sleep are interested in how the night's sleep has been. Through EEG, a kind of "log" or feedback on the condition of the sleep can be kept. The log does not offer concrete answers, but rather shows a number of curves representing sleep activity. It is possible to learn a lot about one's sleep by studying the patterns and interpreting events. The sleep log also includes a microphone and a cassette player that is always kept by the bed and is triggered by sound. This means you can easily record your dream. Your speech is later converted to text and stored together with your sleep log for that night.



Smart wakeup. To wake up in a subtle way is a common wish.[56] This smart alarm clock knows when you are ready to wakeup. The smart alarm is set on an interval of 30 minutes. Sensors in the bed reed your sleeping patterns and wakes you up when your sleep is light instead of being dragged out of a deep sleep. This makes you wake up alert and fresh instead of drowsy. Would you like to wake up in Paris? Sounds and smells from other places can make it fun and pleasurable to wake up.

Awareness

To be able to communicate with one's immediate surroundings and relations is crucial for our well-being. We have seen how simple products in the home can increase the feeling of presence and security, but also how they can support social contacts in an apartment block. Communication does not always have to be high-resolution and multimedia based. Sometimes a subtle message can deliver a strong feeling of presence and solidarity.

The Gossip camera is a modern cousin to the gossip-mirror – it supports the opportunity to see what's going on in the near community without leaving the flat. On the Television there are channels that shows for example the entrance, the backyard, the local grocery, the square or the post office. Elderly often have a desire to draw back from active life without totally losing contact with the environment. This gives an opportunity to see what's going on.

56 Eggen et. Al." Interaction Concepts for the Ambient Home. Faculty of Industrial design", Eindhoven University, 2001.

The Photo Messager is a tool for supporting and enhancing communication and facilitate the handling of incoming telephone messages. It helps people with concentration and memory problem to easily maintain telephone contact with friends and family.

The Photo Messager combines a photo-album with a telephone and an answering machine with number display. Pre-programmed telephone numbers are connected to pictures that are put into large "buttons". If any of these people are calling or have left a message, their picture flashes. Press on the picture and the message is played. To call them, just press another time.

The Photo Messager is a product that suits people in many phases of life. The teenage family may want to separate messages to different family members. If you have a sick elderly parent you want to know if they called with a quick glance. Many elderly, sick or absentminded experience an ordinary answering machine as difficult to handle. At the same time there is a great need for easy communication with family and friends. Photos and pictures and an extremely simple interface make the Photo messenger easy to handle and enhances an emotional relation to the person online.

Discussion and future work

Three proposals from Virus were considered particularly interesting for the Kvarbo apartments: the Gogo dancer, Braindrain and the Photo Messager. Finally it was decided that the inclusion criteria for the residents of the apartments would be cognitive disabilities, which is usually acquired in traffic accidents of by stroke. The Photo Messager was considered to be most useful for this user group and when the company Frontyard was interested in cooperation it was decided that this product should be developed.

The Photo Messenger was developed into four functioning prototypes, two of them were placed in the Kvarbo apartments and the other two placed in ordinary families. The design and evaluation of the Photo Messager is described in Chapter 5.

The Virus project has been reported about in various occasions and al-

ways met with enthusiasm and interest. The idea to start from general ill health in society has been considered refreshing, new and the proposals as creative and fun. Particularly the Gogo-dancer has met a lot of positive "want that" responses. The idea to use biofeedback for relaxation games has been explored in Brainball (described in chapter 2) and the concepts presented here are suggestions for future work in this area. These ideas have been picked up by The Sonic studio at Interactive Institute who are presently working on a project that uses music and EEG for biofeedback.

The goal of Virus was to generate ideas and design concepts for implementation in Kvarbo. But it was also a project in its own right, pointing at the connection between public ill-health and design for the home. Back problem, stress related diseases, insomnia and depression are among the most common reasons for disability among working adults today. These diseases reflect the general state of society with static work, physical inactivity and increasing mental and cognitive strain. The products available in Smart homes, such as remote controlled light and shades, excessive alarms and web interfaces to home appliances, are likely to increase immobility and mental overload. Thereby they are adding to a problem rather than helping out. Virus aim is to start a discussion about the goal and means for IT in future homes. How can alternative scenarios to Smart homes look? What is home health care from a salutogenic perspective? The design proposals can be realised with existing technology in quite short time, but they are also tools for the mind, placeholder in a design space.

It is interesting to notice, however, that the product chosen for development, the Photo Messager was perhaps the most conventional, "normal" product of them all, and among those that were least related to the discussion about ill health. It was easy to see the practical use of it, particularly for the user group. But it also points at how difficult it is to change preconceptions about what home health care and Smart homes are. In Sweden, research funding is granted more easily if you have an industrial partner for the project. This means that projects often are limited to those that fit the business plan and self-image of a company and other more speculative designs are not considered to "fit in". Success on the market is one good way to judge the potentiality of product, but it cannot be the only criterium, simply because those who make the decision have preconceptions that might limit their views. We must not forget that all de design decisions we make affect the life world, which in turn affects us.

New products change our lives by providing possibilities for some actions and inhibiting others. If it is not physically possible to workout at home, we will not do it. If the home is filled with information appliances such as computers, sound systems, projection screens and Television in each room, we are more likely to watch a film than turn it all off and go to bed. If the telephone answerer is invisibly disguised in the software of a telephone company and requires you to dial a number to check it out – then it is likely that you will forget about it and miss social contacts.

Bo Dahlbom[57] argues that in order to influence our living conditions we must learn how to control technical development. Society is a construction, an artefact and social science is therefore an artificial science. Social science has borrowed models from natural science and history and tried to find the natural find laws of society or to interpret and understand what takes place. But, argues Dahlbom, our interest in artefacts is not primarily general laws or interpretation. We are interested in how well they work and if they could be improved. Our central concern when it comes to society should be to find out how to solve the problems and to build a better future. This is a concern for design – how things *ought* to be.

In this argumentation Dahlbom makes a bridge between research and design, a relation that has been widely discussed. If research is to concern itself not only with evaluations and general laws but also with suggestions and practical examples of future life world – then design becomes a central practice in research. Dahlbom's understanding of design is similar to construction and he is most concerned with technical development. But I believe that his ideas are just as valid for other aspects of the design concept. In research and development, the physical design of artefacts is just as important as the technical construction. In fact when it comes to developing scenarios for a future life – it is central.

57 Bo Dahlbom, *Makten över framtiden*, Liber Ekonomi, Malmö 2003,(kapitel 11).

Chapter 5
Interaction Design and well-being

DATAKRAFT
E2
HOMIE

Interaction Design and well-being

This chapter describe two cases that develops the discussion about interaction design and ubiquitous computing. The first case gives an account of the Kvarbo experimental flats and user's experience of living there. The second case describes the design and evaluation of the Photo Messager, a device made to simplify telephone communication.

The analyses show that the ambition to let technology become an integrated part of everyday life and mainly based on implicit input is highly problematic. Less complex and tightly coupled systems are more likely to function without problem. Computer technology can be successfully integrated in homes, but we need to find the proper metaphors that support understanding and interaction.

5.1 Case: Living in Ubiquitous confusion

This casestudy describes users experience of two experimental flats called Kvarbo. They were designed to enable occupants to remain living in their home even if they became old, sick or disabled. The development is part of a trend to make computer technology increasingly ubiquitous, "invisible", and integrated in everyday artefacts. Instead of screens and explicit commands, ubiquitous computing suggest interaction through implicit input and anticipated behaviour. Interaction problems and troubling technology is very rarely addressed. It is assumed that assisting and invisible technology will not only work smoothly but also normally not need support, troubleshooting or control.

This study presents the result from interviews with six households that lived in Kvarbo 4-6 months each. The goal was to find out how users ex-

This cabinet in the hall was the only place where one could reset the smart home.

perienced the flat and to present recommendations for future design initiatives in this area. The study shows some of the typical breakdown situations that are likely to appear with IT support in the home.

Research background

There are many initiatives today within IT-appliances for care, safety or increased comfort in the home. Many of them are related to the demographic change that is shared by all western countries. The objective is to provide possibility to "stay in place", i.e. remain living at home for elderly and disabled. Others are sprung from the development in Smart or intelligent living, where IT is used to control or automate functions in the home.

The home differs significantly from the workplace and technology in the home has to subordinate to domestic routines, values and aesthetics. It has to be more robust than computers at work since there is no support available and it has to fit into the private spaces of the home. This seems to be perfectly aligned with Weiser's vision that computers should "weave themselves into the fabric of everyday life until they are indistinguishable from it".[1] But the idea of ubiquitous computing is not unproblematic as as been discussed in section 4.2. The challenge for ubiquitous computing is thus to enhance everyday routines and artefacts with computer technology in an unobtrusive way, while at the same time afford interaction, feedback and control.

Project Background

The background for this initiative is the ongoing demographic development towards an ageing population, raising care costs and difficulties in recruiting professionals to the care sector.[5] One solution is to offer technology aided healthcare services in the home and provide opportunities for elderly and chronic ill to stay in their home. The goal of Kvarbo was to provide a large-scale test and evaluation of a home assisted with tech-

1 Mark Weiser, "The Computer for the 21st Century", *Scientific American,* vol. 265, no 3, sept. 1991
2 Weiser, 1991, ibid.
3 Belloti et. al, "Making Sense of sensing systems: Five questions for designers and reserachers" *Proc. of CHI '02,* ACM Press 2002
4 P. Tolmie et.al, "Unremarkable computing" *Proc. of CHI '02*, ACM Press 2002
5 Anna Essén, *Technology-aided Seniorcare at home*. Report at Institute for Future Studies. 2003:27

The livingroom in the small Kvarbo flat was appreciated by all the residents.

nology. The flats were equipped with all kinds of IT-appliances that would create comfort and safety for elderly and disabled: alarms, remote controls, sensors and communication devices. The research initiative included the development and installations of the technology, a five-month test time and a two-year evaluation period when people with cognitive disabilities would live in the flats. This was the first large-scale test of "Smart" homes in Sweden where users actually lived in the flats for a longer period.

At the beginning of the project it was not decided who would live in the apartments and there were no explicit health care systems installed. The IT-support was designed to be of a general kind, providing safety and comfort for a large group of elderly, chronic ill and disabled. Later, however, it was decided that Danderyd's Hospital would conduct the evaluation and select users from their clients. Danderyd's Hospital already had experience from a similar home furnished with IT, called @Home, where they used to judge patients abilities to perform daily activities. It was decided that users in Kvarbo would have cognitive disabilities, meaning brain damage, usually from stroke or accidents. Many functions in Kvarbo were designed to support people with a bad memory or physical disabilities. The ambition was to embed the IT functions so that they would be unobtrusive, "invisible" and support everyday life. The input was mainly based on sensor technology or implicit input, where certain behaviour was anticipated. The alarms would prevent accidentally leaving the stove on or forgetting to turn the water off. A voice would alarm if the balcony door were left open at night or when you closed the front door. All electricity and lamps would be turned of at night and when the front door was locked. A safety alarm was installed for emergency situations and the Photo Messager facilitated telephone contact. A laptop installed in the kitchen had a diary and functions to remind about appointments. In the doorway was a box where deliveries could be made. Electronic keys made it possible to open the door remotely and for certain people at certain times. Motion detec-

tors triggered lamps in the hall and bathroom and in the night a soft light was turned on if somebody went up. Lights and shades could be controlled remotely.

People with brain damage are extremely diverse in terms of age, background, personality and symptoms. It depends basically on how large damage they have and where it is situated in the brain. Some of them are very tranquil and relaxed whereas other easily get nervous and stressed. Some have physical disabilities others suffer mainly from a bad memory. Each of these people, as we shall see, had different needs, experiences and expectations of the Kvarbo apartments.

During the test time of two years, six households stayed between four and six months in each of the two apartments. The smaller, two-room flat, was occupied by single person households whereas the larger, three-room flat, was inhabited by married couples.

Research objective and Methods

This study reports from users experiences form the Kvarbo flats, focusing on breakdown situations. It gives valuable information and critical distance to the interaction and design of assisting technologies for the home.

My general questions were:

How did the users experience to live in Kvarbo?

What conclusions can be drawn regarding the design of home health care?

The interviews took place in the apartments at the end of their stay. It was recorded and then transcripted. The identities have been changed in order to keep them anonymous. The couples were interviewed together except for David and Eva that were interviewed separately. The Smart studio at Interactive Institute had developed a communication device called the Photo Messager that was installed in the flats. Because of this we had the opportunity to follow the inhabitants life and make interviews about their experiences. Most of this material is based on interviews but some of it is based on observations and my own experiences in being a part of the project.

The material is very rich and can be analysed in several ways. In this study, however, I have concentrated on interaction problems and breakdown situations. I will not go deeply into each function but rather generally describe different kinds of situation and analyse their cause. Finally I will present some general conclusions that can be drawn from this work regarding design of IT-support for the home.

The occupants where very accommodating but also often difficult to interview since they easily forgot our meetings or their own experiences. It was sometimes hard to judge whether they had forgot what happened, in exactly what way the technology had been malfunctioning, whether they were trying to please the interviewer or keep their integrity by refusing to do so. If they had "normal" spouses that had lived there too, the interviews went much smoother. They remembered more details, were more elaborate in their descriptions and generally more critical to the malfunctions. Users attitudes to Kvarbo were clearly influenced by other factors in their lives. Those who did not have a flat or disliked the place they lived were considerably more positive to Kvarbo than those who were pleased with their own home. Some of the stories told here are crazy and humorous and makes you feel sorry for the poor people living there. I have been asked why this was tested on disabled people and not on cognitively "normal" for a start. Though I believe that feedback and troubleshooting would have been more efficient with normal users, the disabled did not mind at all. They liked being able to try cutting edge technology and live in a fashionable new flat. As one user described it –*When you are old and disabled you often feel that society forget about you and don't care. It made us feel important.*

Analysis: Strange and unpredictable

In the following stories told by occupants in Kvarbo we will see some fairly typical examples of what might go wrong in a Smart home. As we will see it consists of; *an unpredictable event; lack of adequate support; and a seemingly random solution.*

Bertil is 62 and had stroke ten years ago. He lived in Kvarbo with his wife Birgitta who has retired early. This couple was the first to move in during the evaluation time and have had a lot of problem with the technology during their six-month stay. Birgitta recalls one incident: *"last weekend our daughter was here and helped us clean the flat and then suddenly there were no water in the taps! Typical when you are about to clean the floors! So I called the support but they didn't know anything. He asked us whether we locked the front door (it turns the water off) and I answered no, I hope not, because we are three people at home cleaning. Well, he answered, those things happen. The computer probably "got the idea" that we had locked the door! Later another guy called up and told me to go to the computer cabinet in the hall and pull out a cable marked "Data" and then put it back in five*

seconds. You know that would not be the first thing to come into mind. So we pulled the cable out and the water returned…then, the next day I had an email that the leakage alarm had been trigged!"

Bertil sighs: "It has been a catastrophe…almost"

The "data" cable was installed on top of a cabinet and you had to climb a ladder to reach it. Birgitta remarks that they were lucky their daughter was there because both Bertil and she are dizzy and cannot climb high.

Patrik 33, was injured in an accident and lived by himself in the small flat. He has also experiences of troubling systems: "*The blinds in the bedroom have to be up or the kitchen doesn't work.*" Patrik demonstrates: he takes the remote control and lowers the blinds, all the lights go out in the kitchen, " *I did not know that for a start...had to have my coffee maker in the hall for two months…totally worthless …When I moved in here I was so happy, but nothing worked… I had to press the timer in the kitchen… then it worked for 15 minutes and then you had to press it again because I didn't understand that the blinds had to be up …until they told me…That's why I want to stay here, to see what its like when it works…"*

Those two stories are typical for the first two inhabitants in Kvarbo. "Smart" mainly meant that separate objects and functions were connected in strange and unpredictable ways. Patrik "did not know" that the blinds in the bedroom had to be up in order for the kitchen to work. Well, how could he? Instead he had to press the timer in the kitchen and then he could cook for 15 minutes until the timer went off. Since this happened during the summer and nobody had anticipated this kind of problem, Peter had to wait for two months until support found out what was wrong. Apparently Peter did not press the Good-morning button in the morning that raises the shades and turns electricity on, because he did not want the shades to be up. Peter now makes his coffee in the kitchen instead of on the hall floor.

What we have seen here are examples of two typical chronologically related events.

Firstly, something unexpected happens; there is no water in the taps or electricity in the kitchen. When this happens the occupants are trying to deal with the problem, by looking in the manual or calling support.

Secondly, the support fails to help; they do not know why something happen, or what to do and the manual does not mention the problem. Technical support might suggest explanations that are not plausible like "have you looked the front door". Sometimes they distrust the occupant's description.

The solutions is random or unexpected; It might include pulling out cables in strange places, it might involve manipulating other parts of he system as in the case with the blinds. The reason for the two events is however different. In the first case, it was probably an oversensitive sensor under the sink, in the second case a bad social fit between anticipated behaviour and real.

– Something unexpected happens; there is a lack of adequate support and a random or unexpected solution.

Demanding new behaviours

The Good-morning and Good-night button.

Motion detectors and sensors of different kinds are installed in the flats to avoid buttons and reacts directly to users behaviours. As one example, water taps are controlled by movement and not by ordinary water handles, to facilitate washing of hands and avoid that absentminded occupants leave the water on.

The idea with sensors, as expressed by Weiser and others, is to make interaction with technology implicit, based on and integrated in everyday actions and not explicit as keyboard commands. As we shall see in the following examples sensor technology does not support ordinary actions in an unobtrusive way. Instead, functions controlled by sensors often interfere with everyday activities and forces them to change.

Next to the bed is a small box with two buttons: the *Good-morning* (with a sun) and *Good-night* (with a moon). In the morning you press the Good-morning button and a selection of lamps are turned on. In the evening you press the Good-night button and all lamps and electricity in the apartment are turned off and a *Guide-light* function is activated. The Guide-light is activated by motion detectors and turns on a soft light in the bedroom and hall when somebody goes up in the night. When the motion stops the light is turned off.

This simple and agreeable function is the cause of much irritation. Birgitta describes: "*You went to bed and pressed the Good-night button and all the light was turned off. Then ten minutes later all the light would suddenly start shining brightly. So you pressed the Goodnight button again, the light turned off and then when you were just about to fall asleep it would turn on again. You would press the button again and it would go on like that until it finally stopped…*"

All households except one removed the Guide-light function by taking away either the motion detector or the bulbs in the lamps.

Johan 26: "*The only thing that troubled me is that thing that senses when you get up. Its too sensitive, it's enough to get the hand outside the bed and it goes "blink" and the light goes on. I've been waken up in the middle of the night…But then the glue came loose on the sensor (motion detector) so I could turn it around*"

Maria 35, has troubles with concentration and dizziness after a stroke. She was the only one that actually liked the Guide-light "*When I first moved in the light was on all night, but soft you know…I thought it was supposed to be like that because I did not know. But now it works and I really like it because I walk up at night and I am tired and wobble a lot…"*

Some appliances have alarms installed. Under the sink is a sensor that disconnects the water if it gets wet; it also sends an email about it, which Birgitta described earlier. The fridge alarms if the door is left open and the stove if a plate is too hot. It reacts if something is burned or if the plate is left with nothing on top.

Eva, the "normal" girlfriend of David finds the stove-guard annoying "I*t goes off too quickly. You can't drain the water out of the spaghetti without it starting to yell. You have to first turn the stove off and then drain it. You can't even pull the saucepan a bit off the plate or it starts to yell*"

In Patrik's apartment the kitchen, as the reader might recall, is mysteriously connected to the blinds: "*The stove-guard is worthless…When it starts to yell the blinds in the living room makes this terrible sound!*" He demonstrates by turning on a plate, after a few seconds an alarm goes off and the blinds starts to tremble with a muffled sound that is reinforced by the loudspeakers. It really sounds terrible.

After functioning well during the first month for Birgitta and Bertil the stove-guard turned over-efficient and immediately disconnected the stove when you turned it on. For a few days the family could not use it at all. Then support personel disconnected the stove-guard, which also had the effect that no electricity sockets were available in the kitchen. Birgitta was unhappy that the stove-guard did not work because now she did not dare to leave Bertil by himself in the flat in case he would turn of the stove and forget about it.

Another unpopular function was the sensor in the water tap, which turns the water on if it senses movement. About half of the occupants find this the most disliked function along with the stove guard. The water goes on but stop after just a few seconds even if your hands are there.

When the guidelight was activated a soft light was turned on in the bedroom and hall.

It is difficult to find out just what trigs the sensor, there seems to be no logical relation to how you move your hands and when the water flows. The most disabled occupant of Kvarbo had weak hands and difficulties handling many devices. She was most likely one target group for the function, but was instead the person that was most irritated on precisely that function. Disabled users are very depended on routines and that familiar devices work according to schedule or they get very frustrated.

In addition to the above mentioned examples we have many more that shows how technology forces new behaviour. The Good morning button cannot be used if someone stays in bed because it turns the light on in the bedroom and raise the Venetian blinds. So if one person gets up to make breakfast and the other stays in bed, only some lamps work and the timer in the kitchen has to be pressed every 15 minutes.

Instead of supporting daily activities in an unobtrusive and invisible way they create irritation and forces the user to act in a way that conforms the functionality of the sensor. From the above examples I argue that: *Sensor based technology and implicit input often force new behaviours in daily activities instead of supporting the old ones*.

To blame yourself – or others

If technology is perceptually invisible and input is implicit, how will you know of something has gone wrong? If you in addition to that have a very bad memory and are unsure of what has actually taken place, how will you then be able to distinguish your own mistakes from malfunctioning devices?

David 26, had three strokes in a row and memory disability after being severely assaulted. He is constantly worried that he might forget something and that he might cause an accident due to his bad memory. David loves the Kvarbo apartment, particularly the Good-by lock that automatically turns on alarms, and cuts electricity and water in the kitchen.

"It makes me feel safe. I forget to turn things off, you know… have to walk around and check all the time…I would really like to have a flat like this "

Eva, David's "normal" girlfriend is not that impressed by the technology. She likes the Goodnight and Good morning button because she is lazy, she says, and hates the fridge because the alarm goes on in the evenings and sometimes in the middle of the night. The Guide-light did not work properly so they turned that off. She thinks that technical support could be a lot faster and that they seem to have a bad internal communication.

David, her boyfriend, was interviewed at another occasion and has a different picture. He can't recall any problems with the technology except when he caused it himself.

"Once in the beginning the alarm on the front door went off, because I locked the wrong lock. But except from that there hasn't been any problem".

David is easily stressed and worries a lot. The Kvarbo flat makes him relaxed and he feels safe. In his worldview he is the one causing mistakes and the flat the one that prevent him from doing it. Therefore occasional technical mishaps is forgotten or perhaps never even noticed. Eva on the other hand is in control of her life and has no reason to overlook the faulty flat. She is also the one that notices when something does not work and that calls support to have it mended.

There is a laptop in the flat with a calendar that send an sms to your mobile phone to remind you when you have an appointment. David likes the calendar a lot and writes all his appointments there in order to be reminded. At one instance the computer crashed but David did not notice. After a week he noticed that he had missed some important meetings and Eva suspected that something was wrong with the computer and called technical support. At the interview, one month later, the computer is still not working. Eva is slightly irritated but David doesn't seem to remember the instance.

–How do you distinguish your own mistakes from malfunctioning technology?

Smarter than a key?

One large problem in Kvarbo, as we have seen, is that the installations do not support everyday activities. In some cases this is due to malfunctioning or over reactive sensors, but in other cases well-known interaction devices have been replaced with new and unfamiliar ones.

One such device is the front door were the ordinary key have been

The electronic door tag was difficult to use for all the residents.

changed to a "tag", an electronic key, that can be programmed to let some tag keepers in at certain times. To activate the "Good-by" function, the tag is combined with a code that only the resident knows. Above, David described when he triggered the alarm when trying to close the front door. Now we shall see what Birgitta and Bertil think about the lock:

"Q -What do you think about the door-lock?

Bertil–*Well it's so and so…you could do without it.*

Birgitta–*For you it has been a burden to learn these manoeuvres*

Q- Can you describe how you do?

Bertil – *I press zero, and then the code and the tag!*

Birgitta – *No, you forget to choose if you are going in or out. If you go out, how do you do?*

Bertil – *It was A wasn't it?*

Birgitta – *No, it was B.*

Bertil – *Luckily there is a manual out there…first you press B, then the tag, then the code, then the tag again.*

Birgitta – *That's when you go in.*

Bertil – *Right, that's when I go in.*

Birgitta – *If you go out and do like that, there's a red lamp and it's locked. When you go in you press A, the tag, the code and then to make the door really open you need to take the tag again. So there are too many elements. For us it would have worked better with an ordinary key*."

So Bertil, with a bad short-term memory, has problems handling the front door. But even a person with normal memory is not crystal clear about the use. When asked to describe how to unlock the door Eva answers, "*You press A, then you press the code. No, the tag. Then you press the code and then the tag again. To lock you don't need the code. Yes, you need the code but you don't need to press the tag a second time… (laugh)*"

These examples show that the tag is very difficult to use. For people with bad memory it is almost impossible, even cognitively normal users have problem to remember the different steps and codes. Bertil would

have preferred a normal key and some users suggest that the tag would be better without a code. In any case it is important to remember that new technology never should replace old one.

– New technology should complement old and familiar devices, not replace them.

No feedback from the system

In interface design for computer software there are numerous of rules for interaction that has been developed since computers started to have visual displays. One of the great improvements in interaction design was the Graphic User Interface along with the Desktop metaphor and WYSIWYG (what you see is what you get) rule. One of the cornerstones of the GUI is to receive immediate, continuous feedback on your actions. Ubiquitous computing is getting rid of visual displays and graphic interfaces, but what is worse; it also gets rid of control and feedback.

Consider this excerpt from Birgitta:

"It was very hot in August and we always slept with the balcony door open, so when we went to bed and pressed the Good-night button there was a voice telling you "The balcony door is open" and then you could either close the door or press the button again to make her stop. But sometimes she would go on saying" the balcony door is open" with this machine voice, even thought you, pressed the button. And if the Guide-light went on in the middle of the night this horrible woman would go on "the balcony door is open… the balcony door is open…" The light was one thing but this voice! Once I said, "I strangle her!" It was driving me crazy!"

The voice is there as a reminder, to press the button once more is to acknowledge that the information has been received and that it is ok. But even though Birgitta presses the Good-night button the voice does not stop. And when the guide light accidentally goes on in the middle in the night the voice starts again, it really drove Birgitta mad. This exemplifies a serious problem in the flats interface: The lack of interfaces makes it impossible to communicate with or understand the system. There is no alternative way to make the voice or light stop for Bertil and Birgitta. No interface means no interaction, comprehension or control of the system. Buttons are pressed with no effect and there is no indication on why it does not acknowledge the command. In Peter's kitchen there were no indication why electricity was gone or how to get it back. When the water disappeared for Bertil and Birgitta there were no feedback from system until the day after when they received an email.

– Non-existent interface and no feedback from the system make communication impossible

Technical Support – or not

Birgitta was quite disappointed with the technical support.
"Some of the people that come here have a very patronising attitude. It's like they don't believe you. Sometimes it works and sometimes it doesn't. "It can't be like that, you have to understand that" they say. But it is like that! I have worked with PC in my work since 1981, I am not at all a beginner…but they think that just because you're an old lady you don't understand anything…"

Other occupants are also dissatisfied with the support, broken things take long time to repair or replace, they have a patronising attitude and step in and out the apartments without concern for the people who live there. Different areas of responsibility between electricity, telephone network and various computer networks are not clear.

The only one that likes support is Patrik who vividly describes the malfunctions in the flat and happily demonstrates remote functions and yelling alarms. I ask him how he feels about the problems:

" *Well, the guys that come are alright. They work here a whole day and when I get back from my work I ask them "have you fixed it?"" Noo… they go on, nothing works..." And then they've been here a whole day. (Laughs) First it worked, then it was disconnected, something with the computer so they put everything in this closet, then nothing worked…so they had to do it all over again...totally worthless…"*

For Patrik living in Kvarbo is a thrill. The more things that does not work the better. He is unhappy about having to move because he does not want to go back to his old flat, and he tries to use the malfunctions as an argument to stay longer. He has no problem with the support because he does not put pressure on them.

Birgitta on the other hand is not cognitively disabled and expects the flat to function. She is particularly frustrated when she is not believed by the support or they treat her condescending. She is used to computers and to understand technical functions.

–Technical support has to be seen as an integrated part of the system and user experience.

Conclusions

The main motivation behind this study was to evaluate the users experience and make recommendations regarding design of future initiatives in supportive technologies for the home. The study has focused on interaction, understanding and social fit of the system. From the interviews we have seen a number of typical situations and been able to draw conclusions from them.

A typical breakdown situation is characterised by:

–Something strange and unpredictable happens; there is a lack of adequate support and a random or unexpected solution.

The relation between different parts of the system is unclear, and it is not clear what has taken place or why. Technical support is unable to help out. It would advisable if the system itself communicated to the user why something had happened and how to deal it.

–Sensor based technology and implicit input often forces new behaviours in daily activities instead of supporting the old ones.

Implicit input is regarded as a way for computer technology to support everyday practices. The study shows that sensor based technology tends to be unreliable and that predicted behaviour does not fit. Thereby it forces users to change existing routines and violates the very idea with sensor-based input.

–To replace old and familiar technology with new is a cause for confusion and distress.

Handling old and familiar devices is something that people can do even if they are forgetful or suffer from dementia. New devices in contrast are very difficult to learn to use. Therefore, new technology should try to use metaphors and interaction rules from well-known artefacts. New artefacts should never replace old and familiar devices, only complement these.

–Non-existent interface and no feedback from the system make communication impossible.

Numerous examples given by the users in Kvarbo show that the technology does not work or is malfunctioning. But there is nothing in the system that supports troubleshooting or control for occupants or caregivers. There is not even a reset button! When there is no feedback it is very difficult to know if a command has been acknowledged, or for that case, to remember what it was good for. If the relation between action and result is obscure, it is very difficult to make a mental model of how

the system works. For cognitively disabled it can be impossible. Therefore, interaction has to be clear, understandable and with proper feedback.

–It can be difficult to distinguish own mistake from malfunctioning technology.

Whether you blame the system or yourself for problems is usually related to self-image. A person with low self-confidence is more likely to blame himself than a person with high confidence. A person with bad memory and limited learning resources might simply "forget" that there were any problems at all. Or they might think "it should be like that" and accept the faults without questioning them.

–Technical support has to be seen as an integrated part of the system and user experience

IT-aided care is developed to help us cope with decreasing staff in home help and care services. In the future we will have nobody there to help us with daily practices but instead a range of support people repairing and controlling the machines that are there to help us. But technical support in the home is different from the workplace. Form this study we have learned that users are dissatisfied with support. Providers of home health services need to take into account that support has to be treated as an integrated part of the system and user experience.

Suggestions for design

A smart and caring home is there to give support, provide comfort and safety for its occupants. The technology resides in the background and is not noted by the occupant. But when something goes wrong, the action and the technology associated with it are fore grounded. Invisibility in use only appears with something very familiar and well known. To achieve this familiarity the artefact has to behave in a predictable and meaningful way.

Based on the findings in the study I argue that Norman's design concepts such as affordance and creating a mental model for the artefact is even more important for disabled people than for normal.

Meaning is central here. If you do not know why you are doing something, and if you do not see a result, it is almost impossible to learn. The Good-night button was easy to learn for the users in Kvarbo. It turned off lamps and electricity and thus gave immediate feedback on the action. The Good-by button on the front door on the other hand, was very diffi-

cult to understand. It did also turn lamps and electricity off and it turned on burglary alarm, but the users did not see any of this since they were outside the flat. The action did not result in any perceptible events and was therefore difficult to grasp. The motivation for the action was not clear.

In interface design for computer software there are numerous rules for interaction that have been developed since computers started to have visual displays. One of the great improvements in interaction design was the Graphic User Interface along with the Desktop metaphor. One of the cornerstones of the GUI is to receive immediate, continuous feedback on your actions. Ubiquitous computing is getting rid of visual displays and graphic interfaces, but what is worse; it also gets rid of control and feedback.

Based on the case studies I suggest four basic considerations for design of ubiquitous systems.

Design for understanding of system
Design for detecting and managing errors
Design for disabling of system parts
Design for alternative coping

Design for *understanding* means to enable users to create a mental model of the artefact in Norman's sense. The mental model should support interaction and understanding of the artefact, and help to predict its behaviour. Understanding is facilitated if metaphors from other well-known products are used. When we experience a product as intuitive it means that we recognise its design from other products.[6]

Design for *detecting* and *managing* errors means that problems should be expected to happen. If the home is a computer, then it is likely to hang up like a computer once in a while and it will need a restart. The artefact should communicate why it makes certain decisions. If the water is turned off, there has to be a message about it.

Design for *disabling* of system parts means that should be possible to turn off a troubling artefact of function without disrupting a whole lot of other things. For example one should be able to disconnect the stove alarm without disconnecting the electricity in the kitchen.

Design for *alternative* coping of means that there should be ways act

6 A Blackler et. al. "Intuitive use of products". Durling & Shackleton, eds, *Common Ground*. DRS conference, UK, 2002.

the normal way. For example use a normal key and not only electronic keys. A recommendation is therefore that appliances are not tightly coupled with each other, but rather freestanding and linear in the construction.

What's wrong with the Smart home?

A report from The Institute for Future Studies concludes that the development of technology aided care in the home has not been successful.[7] In spite of technical know how and a large future market, development and research initiatives have been few and fragmented. The report concludes that both caregivers and technology providers have been slow and there is a lack of dialogue between the operators. Other causes are the fragmented organization of caregivers and lack of standards in IT-systems.

The reason for the problems in Kvarbo are many, one of them a lack of dialogue between the different IT-providers another the recession in the IT-business and a lack of understanding of the complexity of everyday life. The troubling technology has made the user testing ambiguous and provides a both humorous and problematic background to the project. Testing new and complex technology in live settings require accuracy, persistency and a methodical mind. This was certainly not the case with the users and seemingly not with the support team either. Forgetful and slightly confused people are not an ideal partner for beta testing IT-technology. But since this is the target group for IT-aided care in the home, developers and financers have to take that into account. To make large scale examples like Kvarbo work developers have to be extremely cautious that the technical system works smoothly. The study points at a lack of user perspective from technical developers and support personnel. Simplicity, robustness, control and ease of use have to be guiding principles for everybody involved in the development. It shows that user issues are far from a natural and integrated part in system development.

A statement made by managing director at the company responsible for the IT-installations supports this conclusion. He argues that the reason for the troubling technology is because the users could not handle it well enough. "*The level of technology has been too complex for this group of users, they should have had a simpler system*".

For the management, the problem with the IT-installations is appar-

7 Anna Essén, 2003, ibid.

ently caused by this category of exceptionally dizzy and forgetful groups of users. The manager seem to forget that this was the inclusion criteria for the user group and therefore fundamental in the evaluation, and that "normal" accompanying family members experience even more problems than their forgetful spouses. He admits that the system should have been more adapted to the user but not that there were any problem with the system per se.

Charles Perrow[8] notices that complex and tightly coupled systems are likely to go wrong in an unforeseen way that is not mentioned in a manual. Linear and self-standing technical systems do also go wrong but error detection and managing is much easier. While often blamed, human error is usually not the cause of accidents in complex systems.

One of Weiser's main arguments was that computers would "weave themselves into the fabric of everyday life until they are indistinguishable from it."[9] This was certainly the goal for the installations in Kvarbo, but the examples given here show that it often resulted in the opposite. I am not arguing that computers should not weave themselves into everyday life, but this will not be achieved by removing means of interaction. It is also doubtful whether sensor technology and implicit input is the right way to go. As we have discussed here, implicit input is difficult to achieve while at the same time retaining feedback and control.

Making IT artefacts pervade the home in an invisible manner is an understandable but problematic ambition. While we do not want our homes to be filled with "ugly technology", as some users describe it, we still do not want the computer installations to be inaccessible and invisible power structures. For elderly, absentminded and disabled (and most likely, for the rest of us too) the demand of clear mental models, reliable feedback and interaction is crucial. Domestic life is complex, in flux and differs between individuals. To reallu support everyday behaviour we need systems that can be adapted to meet different need and changing behavoiur. I still believe that technology has a large potential for increased well-being and support in the home, but before that there are a many interaction and design problems that needs to be solved.

8 Charles Perrow, *Normal Accidents*, Basic Books, New York 1984.
9 Mark Wesier, 1991, Ibid.

5.2 Case:The Photo Messager

The Photo Messager is a product for supporting and enhancing telecommunication and facilitate the handling of incoming telephone messages. It helps people with concentration and memory problem to easily maintain telephone contact with friends and family. This case study will describe the development of four prototypes of the Photo Messager and the results of the evaluation by users and a focus group.

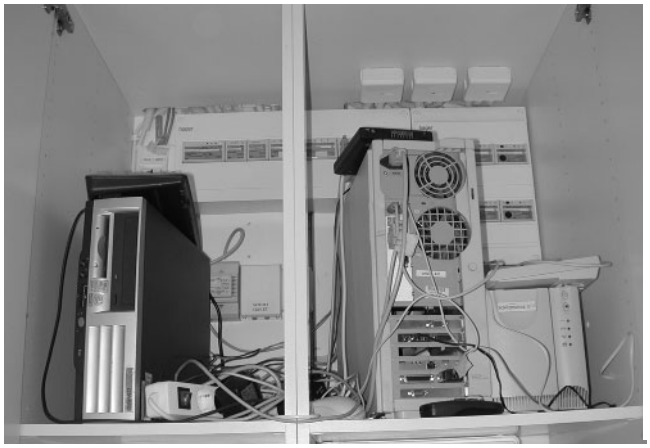
Keeping in touch with friends and family is crucial for our mental well-being. Studies show that many elderly and disabled have difficulties handling ordinary answering machines; at the same time this group of people has a large need for safe and easy telephone contact. The main goal with the project is to support emotional communication and social awareness by augmenting well-known artefacts with computer technology. A conscious ambition was to make the whole product fully visible, simple to handle and yet unobtrusive.

Research background

Ubiquitous computing in the home seems to mean that all the wardrobes are full of computers.

The research background for this project is to be found in two main areas: ubiquitous computing and home health care.

The objective of ubiquitous computing (Ubicomp) as first described by Mark Weiser, is that computer technology should "weave themselves into the fabric of everyday life."[10] This is disussed more elaborately in section 4.2. Ubiquitous computing suggests implicit input and sensors that anticipate and remember users behaviour. As we have seen in the previous case study "Living in ubiquitous confusion" this is ambition is not achieved easily. Instead of supporting familiar routines the system often expects another behaviour and appears unpredictable. The lack of normal interfaces or even turnoff buttons makes interaction and control problematic. Though the basic ambition of ubiquitous computing, to computerise everyday artefacts, is still valid, we need to re-examine the



10 Mark Weiser , 1991, ibid

means by which it is done. Interaction with IT-artefacts without conventional interface has to be extremely graspable and self-evident in order not to create confusion. We argue that new interface solutions have to be introduced with caution and only in combination with familiar interaction principles. The product has to be viewed as a whole where the overall design and interaction metaphors are analogous.

The other research background is in home health care that has emerged as a growing field in the last decade. The guiding idea is that chronically ill and elderly shall be able to remain living in their home, instead of in institutions, with the help of IT-aided support. One important function of that is to keep in touch with family and care personnel in a simple manner. It is important for children of elderly parents to know that their mothers and fathers are safe and feel well and the children want to know immediately if a crisis appear. The research project "Aging in place" at Georgia Institute of Technology[13] aims at developing support for elderly to remain in their home. They have for example developed a digital family portrait, to support peace of mind of family members, with icons on the frame representing the state of the portrayed person. The Casablanca project[14] has identified social communication for the home as a central research area. They have developed several prototypes for asynchronous and simple communication between family members. The Smart studio has worked with several projects on emotional communication and awareness. The 6th sense project[15] investigates remote presence with lamps that light up if a relative is present in a remote apartment.

The first concptual sketch of the Photo Messager.

In Sweden there exist several attempts to facilitate communication for disabled, mostly by using Internet or live video. One drawback with these prototypes is that they are too complicate to learn for many elderly or

11 Belotti et al. "Making sense of sensing system: five questions for designers and researchens". *Proc. of CHI '02*, ACM Press 2002.
12 P. Tolmie et.al, "Unremarkable computing" *Proc. of CHI '02*, ACM Press 2002.
13 Mynatt et.al. "Increasing Opportunities for Aging in Place". *Proc. of CUU'00*, ACM Press 2000.
14 Hindus et.al. "Casablanca: designing social communication devices for the home". *Proc. of CHI '01,* ACM press 2001.

chronically ill. Live video contact with hospital and health care centres has a large potential but the technology is still not reliable enough to implement in real residences.

Common problems with most of the research described above are that the prototypes have not been tested outside laboratories. Inspired by the projects we wanted to design an appliance that supported awareness and communication but with such simple technology that we could actually build it and have people test it for a longer period. Concepts and lab tests are useful for a start but we believed that the time has come to see how these ideas would be received in a real life situation.

Technology has the potential to facilitate our everyday life and increase well-being, in a range of areas. But when technology develops and becomes more complex there is a risk that large groups in society cannot use it. The so-called "digital divide" i.e. the difference between those that have access to new technology and those that "end up outside" grow. That is why research needs to focus on the needs of weak groups such as disabled, children and elderly. Sweden has a long tradition of product design for disabled but this regards mostly practical aids such as can-openers, knife handles and walking sticks. Information and communication Technology (ICT) has the potential to increase the individual's ability for independence, communication and control, but often contributes to the opposite. Information technology today is mainly introduced for applications that support and facilitate work and where the main criteria are effectiveness and rationality. To develop ICT for the home demands other quality norms such as simplicity, safety and meaningful presence.

Project background

The Photo Messager was a result from the Virus project (see section 4.4) that looked at general ill-health problems and how these could be prevented by IT-support in the home. Virus was done in cooperation with Kvarbo that aimed at developing products that made it possible to remain living in your home even after you became old or disabled. Kvarbo resulted in two experimental flats that were equipped with a range of IT-aided support to enable "Staying in place". The flats would be tested by users during two years and evaluated by Danderyd Hospital. The inclusion criteria for the user group were acquired cognitive disorders, i.e. brain dam-

15 Tollmar & Persson, "Understanding Remote Presence" *Proc. of Nordichi '02*, ACM Press 2002.

age, usually as a result of traffic accidents or stroke. The Photo Messager seemed particularly appropriate for this group of people since they had a bad short-term memory and sometimes physical impairments and thus problems handling ordinary telephone equipments.

Smart Studio/interactive Institute developed the Photo Messager in co-operation with Frontyard AB. The Knowledge Foundation supported it financially.

Goal and research questions

The project goal was to develop four prototypes that could be tested in the homes by people with cognitive disabilities and by "ordinary" families with large communication needs for example where family members lived in different places. Questions we wanted to be answered were:

Does the Photo Messager facilitate handling of telephone messages?
Does the Photo Messager facilitate calling?
Does the Photo Messager affect telephone communication?
What is most appreciated?
How is the use experienced?
Are there any problems or comments?

The purpose was to receive feedback on the design for further development and to understand communication needs. The product development was not regarded as research per se, but a means to make user testing possible.

The goal of this project was to create a product that was more comprehensible and easy manoeuvred than an ordinary product without having to make something that looked like an "ugly handicap aid".[16] We wanted to support everyday routines and augment existing and well-known artefacts in the home with new functions and an interface that was clearly visible and gave proper feedback.

Design and Dvelopment

The initial idea for the Photo Messager appeared in a discussion about how IT-artefacts could be designed to include emotional communication and support social awareness. We discussed information overload and how to distinguish between emails and telephone calls that were of emotional significance, from those that were less important or just trasch. On

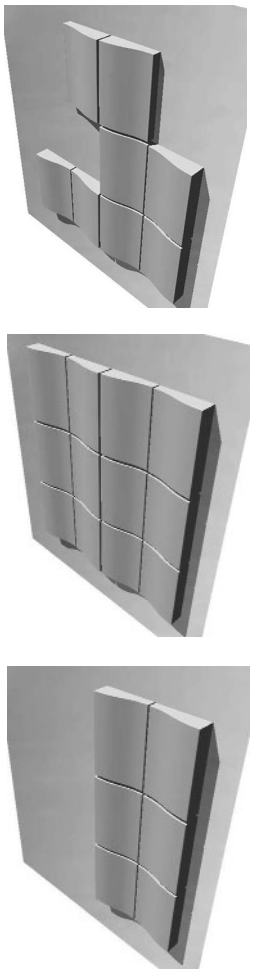
16 This was a recurrent comment from the people interviewed in the Virus project.

an answering machine the messages appear in a long row, in order to find out whom they are from, you have to listen through the whole lot. Were there any ways to select messages from some people from the rest? We were also disturbed about the anonymity and impersonality of emails as opposed to letters. Could we bring some personal flavour to impersonal technology? One idea was to have a photo appear on the screen if you had an email from a friend. But we also wanted to "break the screen barrier" and do something that could be touched and handled physically. Another ambition was to do something that was technically simple so that it could be built and tested by users. Many ideas in this area are so technically complex that they remain just concepts.

We observed that many people have photographs of friends and relatives in their homes. Suddenly the idea appeared to connect telephone calls to photos of friends and family, and to have these flash if some of them had left a message. We thought that this function would be useful for both elderly and families with many children or parents living apart. Many of the people we had talked to were irritated of being disturbed at dinner by telephone calls from salespeople or Gallup polls. One of the basic ideas was therefore to include a "peace button" that blocked all telephone calls except from those on the pictures. We called the concept The Photo Messager, it was included in the Virus project and presented to the project financers.

When the concept was selected for implementation, the real design work started. To get an idea of where and how people placed their telephones in the home we made some quick "probes".[17] People were given a camera and asked to take pictures of telephones and notice boards in their home. The researchers in the group also took pictures in as many homes they could. The results showed that telephones in living rooms often were placed on a sofa table or on the windowsill next to flowers and decorative objects. In the hall, study or kitchen, however, the telephones where often placed on the wall or a shelf next to piles of paper, notice boards or list of telephone numbers. It seemed like telephones in these areas were used more for rational and effective reasons. Telephones, photos and notices were often placed close to each other and the idea to combine them therefore seemed reasonable.

17 W Gaver & H Martin, "Alternatives: Exploring Information Appliances thorugh Conceptual Design proposals", *Proc. CHI '00*, ACM Press, 2000



The idea was to make a design that could be arranged in different ways.

We also noticed that there was not much space in people's homes, particularly shelves or benches were crowded. The walls appeared to be the most free and self-evident space for a Photo Messager. We therefore decided to make a wall-hanged piece.

The Photo Messager was thought to consist of buttons with transparent covers, where pictures or photos could be put. Behind the pictures there would be lamps that could flash in different frequencies and strengths. Inspiration for the design came mainly from notice boards but also from tiles in different shades and angles that could be assembled to various patterns and placed very tightly to the wall. Due to technical reasons the prototype had to be made thicker than we initially had imagined. Unfortunately we also had to leave the "peace-button" out since we could not solve it technically.

After discussions with occupational therapists that often programmed telephones for disabled we decided to have six buttons, five for external numbers and one for everybody else. The size of the buttons were made to fit ordinary photos of 10x15 cm. One important feature was the switch that made the Photo Messager look slightly like a lamp or a domestic appliance, and that clearly signalled that it could be turned off.

Description

The final design consists of six large "buttons" in clear plastic with pictures of the people you wish to call most often. Behind the buttons are lamps that make the pictures light up or flash. The buttons are programmed to dial the phone-number of the person represented and a telephone number display registers who is calling. To call up any of these people you simply press their picture. When one of those people calls you, her/his picture flashes. During the call the picture shine with a steady light. If you were not at home when the person called, the picture glows, and if there is a message the picture flashes in slow frequency. When you get home a quick glance will reveal if anybody has called or left a message. To listen to the message, you simply press the picture and the message is played. To erase the message you press once during, or a few seconds after, the message is played.

There is a built in loudspeaker that plays the messages. Recording of outgoing messages is done via the phone. The Photo Messager can be connected to any telephone. The initial prototype was connected to a PC were the programming of telephone numbers took place. The program-

ming was very easy and was done either by us or the occupational therapist.

The Photo Messager makes it easy to:

Call up to six pre-decided numbers
Listen to incoming messages
See who is calling
Remember who you are talking to
Remember who you might call in an emergency situation
See if anyone has called or left a message

Technical Development

The prototype was made with a microprocessor that controlled the lamps and a separate PC with the programming functions and voicemail. Each button had three lamps that could be controlled separately to achieve different intensity of light.

The company Frontyard was responsible for software development and the Smart studio for hardware, product design, prototype building and evaluation. Despite the relatively simple construction the technical development was troublesome; the software was unstable, reaction times were long and the software had to be redone three times. Staff from Frontyard were exchanged and fired due to the economical recession and finally the company went bankrupt before the prototype was finished. Another obstacle was the complex computer and telephone network in Kvarbo that interfered with the Photo Messager and made installation problematic.

Finally one prototype was installed in each of the Kvarbo flat and worked fairly well, but the other two could only be made working in our research lab. Therefore we could not test the prototypes in "normal" homes as we had wished to. The prototypes were installed in Kvarbo flats while six households lived there, but this evaluation only reports on the first two.

Evaluation with users

The evaluation was done in two ways. Firstly: interviews with two households in Kvarbo that had used one prototype each during ten weeks. Secondly: A focus group consisting of eight experts in handicap aids, occupational therapy and design that met and discussed the prototype. The interviews were recorded, written down and analysed. Here

follows a summary of the evaluation and a conclusion. (For a full description of the evaluation see the report).[18]

Kvarbo experimental flats

The first household in Kvarbo consisted of Kristoffer, 29, who lived there alone. He has a lighter brain damage since an accident and has memory problems. His prototype has been working well.

Here is an excerpt from the interview with Kristoffer.

–If you compare to your old answering machine what do you think?

–This one is easier. You see right away if somebody has called or not.

–How do you feel if the buttons are flashing?

–Its nice when you open the door and see that somebody has called. With Telia's (answering machine) there could be 20 messages sometimes because I did not think of listening to them. Once my cousin was cross at me because he had left me 15 messages but I hadn't listened to them for a month…

–Would you like to have one at your home?

–Yes, that would be good since I am not so good at checking answering machines. So now I have more contact with dad and the cousins since you see that they called and then you call back. It's more natural to keep in touch.

From the interview it is clear that the Photo Messager helps Kristoffer and that he has more contact with his family. He is reminded to listen to messages and to call back.

The second household was Eva and Johan. They are about 40 years old and were injured in a traffic accident. Eva's speech is impaired and she uses a wheelchair. Both have problems with short-term memory. The Photo Messager is mainly aimed at Eva since she at is home during the days and has difficulties using ordinary phones. Eva finds the Photo Messager easy to use. She demonstrates how to call up, listen to a message and to erase. Eva is reluctant to new routines.

–Is this easier to use than your old answering machine?

Eva – *No*

Johan – (looks at Eva) *A problem for Eva and me is that we are very dependent on routines and we have difficulties learning new things. A week ago Eva tried to call my mobile and did not think about the Photo Messager and was fiddling with the ordinary phone. But it's good when you get home and it's*

18 Sara Ilstedt Hjelm, *Projekt Fotosvararen*, Report to the Knowledge foundation, Dnr 2001/0118

flashing. Because it used to be a terrible nagging on my account to make Eva remember to listen to the answering machine…it's good that it is flashing and you can see that there is a message. And large buttons with the most important numbers are really good.

–What do you think about the size?

Eva – *Too big*

Johan–*Good I think, because it should be easy to handle. I think that remote controls and all those things are too tiny and muddy for Eva. But half the size would be OK. It would be good with a built in microphone in the frame. It would be nice for Eva not to lift a receiver if she just wants to say something short.*

In spite of her difficulties to handle normal phones and answering machines, Eva does not think she needs a Photo Messager. She is usually helped by an assistant to dial numbers when Johan is not at home. Ann Granquist, occupational therapist from Danderyd hospital and responsible for the evaluation, comments:

–Eva calls easier with the Photo Messager. She does not have to remember numbers or to dial them. But she does not really understand that herself. I can see that it helps her and so does her partner.

–Is it good for disabled people to see who is calling?

–It is good for Eva since she has problems to talk. Then she knows if she can answer the phone or not. Otherwise she lets the answering machine start. Eva does not think she needs the Photo Messager herself, but I have observed that the first thing she does when she gets home is to roll over and see if somebody has called. If somebody has called then she gets very happy.

This account shows how important familiar routines are for disabled persons and how difficult it is the get used to new products. It also brings up the question on how reliable interviews are for adequate information. In this case we have the observations by the occupational therapist that shows another view. Another surprising anecdote came much later. When Eva and Johan were leaving Kvarbo to move home, Eva requested a Photo Messager to their flat to be used as an emergency telephone.

The focus group

To complement the user study with a broader view, we also put together a focus group consisting of eight experts in the area:
Ann Granquist, Occupational therapist, Danderyd Hospital
Bosse Westerlund, Industrial Designer, Centre for user-oriented IT Design (CID) KTH
Anders Torberger, Managing Director Polycom AB, development of communication aids
Katarina Brun, Swedish Handicap Institute
Anders Bond, Psychologist, The National Association for Persons with Intellectual Disability
Lotta Ahlquist, "Klara mera" Centre for intellectual aids
Lena Haber, "Klara mera" Centre for intellectual aids
Ulrika Junell, Occupational therapist and Industrial designer

The focus group thought that the Photo Messager was suitable for the following target groups:

- Brain damaged with a bad memory
- Dementia in an early stage, particularly if they can keep the old telephone
- Light to medium intellectually disabled
- Severely intellectually disabled if you integrate a microphone
- Mentally ill who need to know who is calling
- Physically disabled
- Children, with or without disabilities
- Possibly youths with disabilities, with reservation that they might find it look too much like an aid.

Some general comments from the focus group:

It is important to have feedback on all actions. When you press a button or erase there should be sound feedback.

Some target groups would benefit from an integrated microphone.

For a single person the number of pictures are adequate but a family would need more. It would be good with a flexible design so that size and numbers of pictures could be altered.

The design is found attractive. It is important that the things you have at home are beautiful and fits in. Many people will not have "ugly aids" even if the function is good.

Pictures instead of numbers are good. Some disabled can recognize numbers but not too many, it takes time; you get nervous and do not dare to answer.

Youths are very sensitive on things that are different and remind that somebody in the home is disabled. They want to have the same things as everybody else. There is a risk that the Photo Messager is experienced as an aid and you do not want that.

You can work a lot with sounds and rhythms on lights or signals. Intellectually disabled often have a very developed musicality which can be used for interaction design.

Most people find the Photo Messager too large. Half the size would be enough. At the same time it is important that it suits physically disabled.

Robustness is extremely important. It has to be reliable and work all the time, otherwise it is very confusing. This applies for all groups that suffers from dementia or are cognitively, mentally and intellectually disabled.

Conclusion of evaluation

The evaluation was very useful for understanding the possibilities and limitations of the Photo Messager and gave useful information to Polycom for their further development of the product.

Positive qualities were:

- Nice to see directly when somebody has called or left a message
- Good to be reminded to listen to incoming messages
- Good to be reminded of whom to call
- Good to see who is calling, some are afraid to answer if they do not know who is calling
- Some categories benefit from easy calling up
- Images are easier to remember and create emotional contact
- Looks attractive

Negative aspects were:

- Too large, should be smaller and more flexible in size
- Could be experienced as a handicap aid and thereby stigmatising
- Have to be robust to be trustworthy
- Most functions already exist in other products
- Price, will probably be expensive

Summarising the view we can draw the conclusion that the Photo Messager has potential to become a useful tool to many categories of dis-

abled. Both households in Kvarbo think that it facilitates contact. Johan was very positive and Eva's reluctance was slowly changing. A disadvantage is the price and a risk to be seen as a handicap aid. A larger target group would lower the price and make it more natural to use for disabled. One possibility is to market the product for families with small children and separate family members.

The evaluation can help us answer to the questions that was made initially:

• Does the Photo Messager facilitate handling of telephone messages?

Yes, particularly that the user is reminded to listen to messages

• Does the Photo Messager facilitate calling?

Yes, particularly for absentminded and physically impaired

• Is telephone communication in the home affected by the Photo Messager?

It makes you call more often and listen to messages quicker

• What is most appreciated?

The most positive is that it flashes welcoming when you get home. It can be used easily in emergency situations.

• How is the use experienced?

Easy to learn, intuitive

• Are there any problems or comments?

See above

Discussion and further work

So far the Photo Messager has turned out to be a successful project. The results of the evaluation were mostly positive and the product has met a lot of interest. In April 2004, is Polycom AB launching a new smaller version with a built in computer and the future will show how successful it will become on the market.

For us in the research team it has been pleasing to see that our ideas to make a product for social communication and awareness using simple technologies like photographs and the telephone network has proven successful. There is obviously a need for improvement of old and common appliances like answering machines. In a time of economical recession, basic needs that support familiar routines are more valid than expensive, prestige projects. Good ideas does not necessarily have to be implemented in complex technology. At the same time the Photo Messager was a result of Virus, a forward looking and explorative research project that did not

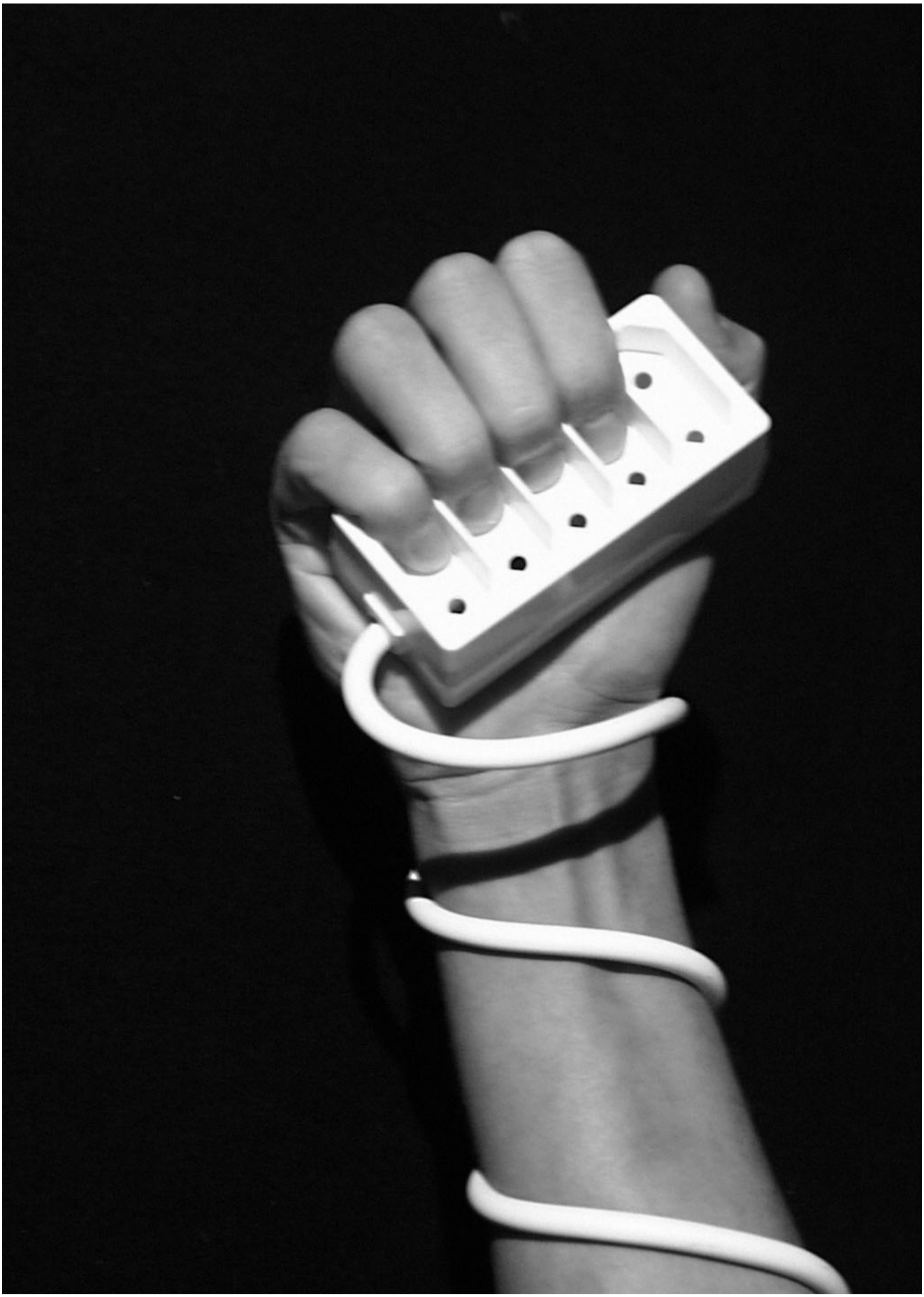
conform to normal Smart homes, which mainly consist of remote controls and alarms. The Photo Messager was inspired by concepts in awareness and emotional communication such as Sixth sense lamp[19] and Casablanca projects[20]. Though imaginative and inspiring, a problem with these projects are that they very rarely go beyond the conceptual stage or a few hours testing by users in the lab. Some of them, like the Digital family portrait,[20] have been very difficult to interpret by the users and it is doubtful if they will ever have practical use.

The use and interaction of the Photo Messager is so simple to learn and understand that even people with learning problems and bad memory can remember how to handle it. This suggests that the users quickly construct a valid mental model[21] of how the product functions.

Our aim was to use information technology to make a useful tool, to support emotional communication and awareness, without abandoning control and comprehension. In contrast to the ideas of implicit input in ubiquitous computing we believe that technical artefacts above all should be comprehensible, manageable and meaningful.

19 Tollmar & Persson, "Understanding Remote Presence", *Proc. of Nordichi '02*, ACM Press 2002
20 Hindus et.al. "Casablanca: designing social communication devices for the home". *Proc. of CHI '01*, ACM press 2001
21 Donal Norman, *The Psychology of Everyday Things*, Basic Books, New York,1988.

Chapter 6
Towards a new agenda for Design



Towards a new agenda for Design

This work started with an ambition to better understand the relation between health, design and society. I was intrigued by the fact that we create a world of artefacts that makes us stressed, unhappy and physically immobile. I wanted to find out the fundamental factors that are required to create a world that promotes well-being rather than creates stress and what role design plays in this part.

We create our reality in the form of actual material structures consisting of buildings, products, workplaces and homes. These artefacts are on one level a reflection of ourselves; we have created them and we understand ourselves through them. Together with immaterial artefacts like political systems, educational systems, healthcare and culture, they create our society. At the same time the totality of these material and immaterial artefacts forms the conditions of our everyday life.

The theme of this dissertation is *the design IT artefacts for increased well-being in the home*. The goal has been to provide a better understanding of the relation between design and health, and to offer tools that allow us to design for increased well-being. The context for the investigation has been the home, and various research initiatives in Smart homes and IT-supported care. I wanted to find out how these initiatives worked in practice and what conclusions could be drawn for future work.

The central questions have been:

- Is there a relation between well-being and design?
- Why do we create a world that makes us ill?
- What characterises the home as a context for new technology?
- How can interaction design promote well-being?
- What are the implications for design practice?

The fields of departure for this work are industrial design and human-computer interaction (HCI). These two areas are coming increasingly closer to each other as more computer technology is integrated into everyday products and housing. The research questions are based in the problems that meet the practicing designer and aims at contributing to the development of the design professions. The ambition has been to contribute to this development with both critical analysis and concrete cases studies.

This work should also be regarded as a contribution to the discussion about design-oriented research and the role of design research in HCI. Before I give an account of the results I would therefore like to make some remarks about the relation between the design practice and the more academic HCI discipline.

6.1 Practice versus Theory

When I started my research I had the ambition to unite theory and practice. I regarded design mainly as a practical field, with the potential of being enriched and developed when met with theory. My education until then had been strictly divided between theoretical subjects pursued at the university and practical subjects pursued at art and design schools. I looked forward to the possibility of researching the meeting between these diametrically opposed areas, to be the reflecting practitioner in the spirit of Schön.[1]

In the beginning of the work I was very frustrated that I was unable to unite the two fields. I was either absorbed in a design project, consumed with questions about function, form, technology, user groups and needs, or I was absorbed in theory, pouring through thick books laden with technical terms, writing about and feverishly pondering the validity and inner relations of the different theories discussed.

Eventually I realized that reflection in action does not at all describe a "new" sort of designer that unites theory and practice. On the contrary, it is the way designers actually work (something that Schön also says, but I had missed in my dichotomist thinking).

Theoretical subjects, on the other hand, were far from being only theory; they are in fact their own practice, where theories are developed, dis-

1 Donald Schön, *The Reflective Practitioner, How Professionals Think in Action,* Basic Book, New York 1983.

cussed and compared in exactly the same way that the designer develops and compares artefacts. Both theoretical and practical activities thus contain both theory and practice.

That they cannot be done at the same time does not mean they could not have the same goal in a longer perspective. In other words: it is difficult to shop for food and prepare it at the same time, but both activities have the overall goal of allowing us to eat.

As Schön has pointed out, design work is pursued in a dialectic between sketching, reflecting and discussing. The process may be seen as a discussion between the situation and the designer, where the surrounding factors, the context and the user requirements are a part of the dialogue. Design work is not only practical and tacit. Other aspects, having to do with general ideas and concepts, are explicit and verbal, i.e. theoretical.

Writing a text is a part of doing theoretical work, but it is also a kind of practice. One does not learn to write only by following a logical argument. The text shall also feel right, have the right tone, fit into its context – in other words, both the rhetoric and the aesthetic must be convincing. Sometimes the form is more important than or equally as important as the content. Form and rhetoric are areas of knowledge that are implicit and difficult to express. They are mastered by reading and writing academic texts over a long period of time. When we "imitate" a certain tone, we must develop an ability to recognize and recreate what we have learned. In this way we learn to become sensitive to small nuances in the differences between various texts or concepts. In the same way, the designer develops a feeling for various differences in aesthetics that can be difficult to express explicitly, but instead is felt "in the gut."

Theory/practice is one of those dichotomies that have left a deep impression in our time. Like the dichotomies man/woman and culture/nature, they colour our way of seeing and interpreting reality. These conceptual orderings control our thinking to the extent that we "read in" these dichotomies also where they do not belong. In this way our world view is continually confirmed through these personal experiences. An HCI researcher once related how he had worked with a graphic designer to create a virtual meeting place in a computer-generated three-dimensional milieu. The designer had moved around some of the architectural elements in the image, and when the HCI researcher asked why, she answered: It works better. The HCI researcher used this in a lecture as an example of how designers work with "tacit" knowledge, i.e. that they do

not use explicit arguments. For anyone with even a modest education in spatial questions, the change the designer made was completely natural and fully possible to express verbally. That she did not do so may have been because she did not think it was worth the effort to describe something that is so obvious.

Imagine instead that a designer studies a programmer who is writing a program. The programmer moves a bit of code from one place to another. The designer asks why. How does the programmer answer? Probably he says something like "It works better there." Does this mean that programming is a tacit practice? Yes, you may answer. But it may also mean that the programmer does not feel like explaining to a layman exactly why he did what he did. One more example: a researcher moves a bit of text from one paragraph to another. The designer asks why and the researcher answers: It works better there. The designer concludes that research is a tacit knowledge that cannot be expressed verbally. Or? With this anecdote I wish to show that it is an advantage when the tacit knowledge of practice is verbalised by someone who knows the field. In this way we reduce the risk of being misunderstood or misinterpreted. It also shows how guided our thinking is by these built-in dualities.

Designers usually start from a vague idea that is realised in a dialogue with the situation and the material at hand, while conventional research (ideally) start from an explicit plan that is subsequently implemented. In conventional research the final result of the work is not an artefact but the paper presented at a conference. Therefore researchers need to make the project explicit during the work. For conventional art and design there are no such requirements of a post-product reflection. The artefact itself and how it is received by the users/audience is the main goal. But when designers become researchers and researchers designers these habits, ambitions and conventions are destabilized. Designers are forced to reflect about their practice and researchers to be more materially concrete. The Brainball case also shows some of the difficulties in combining a typical design practice with a reflective approach. Reflecting–on–action is not possible while acting; it needs distance, analogues and concepts that can be used on the practice. To develop tools for such a reflection is part of an agenda in design oriented or design based research. Donald Schön remarks that you have to do something before you can understand it. This is a good argument for professional designers to get involved in research and for HCI researchers to get involved in design.

The view is sometimes presented that the goal of design is to produce an artefact while the goal for research is to produce knowledge[2]. But knowledge is not something immaterial floating around in space. It needs to take a concrete form to be understood by humans, usually in the form of a report or a conference paper –which are artefacts. Knowledge is always situated and exists in a certain context of use. The goal of design is not to create "any" product but achieve a certain goal with this product. The product is thus informed by knowledge and embodies knowledge (in ergonomic, aesthetics, technology) just as much as a conference paper does. The knowledge embedded in the artefact, the paper or the product, are however not readily available to anybody. It requires a certain pre-knowledge of the subject and knowledge about how to "read" and interpret the artefact. Understanding is facilitated by certain common rules and norms about how to materialise the content, that is shared by everybody working in the area. The Graphic User Interface is such a shared form. It creates a common norm for how information is presented and structured. I would therefore argue that "knowledge" is the result of a design process just as other products.

Knowledge/artefact and theory/practice are dichotomies that have left deep imprints in modern society. They form our way to understand reality and are aligned with a cluster of symbolic attributes. Introducing designers to research might change this relation.

6.2 Answering the Research Questions

In this section I will try to answer the research questions posed in the beginning with the help from the theory and analyses made in the dissertation.

The investigation started from a general ambition to better understand the relation between health and artefacts from a design perspective. This is a very broad ambition, too broad, some of you say. I do not argue that I can give any full answer. I hope, however, that I can make some outlines on the map and that future work in this area will fill in the details.

2 Daniel Fällman, "Design-oriented Human-Computer Interaction", *Proc. of CHI '03*, ACM Press 2003.

Is there a relation between well-being and design?

The answer is yes, in a number of different ways.

On a general level design contributes to the forming of the entire material setting of our lifes. The artefacts around us affect our behaviour by enabling some actions and hinder others. Some of these actions contribute to increase ill-health, other to increased well-being.

The most obvious is that artefacts affect our physical health by being more or less well adapted to our physical prerequisites and needs. Today we see how monotonous work and lack of physical activity results in back problems, insomnia and cardiac diseases. But artefacts also affect us mentally, which was shown in the survey in the introduction. Some artefacts caused stress and irritation while some made us calm and feel well. Stress was coupled to lack of control, powerlessness and visual and audible noise. Relaxation was closely related to routines and activities that were done just for the pleasure of it. It was mostly *situations* that created stress or relaxation, but in many cases artefacts were also associated with these conditions. Telephones and computers were experienced as the most stressing objects, whereas music, books, sofas, kitchen tools and beautiful things were relaxing. It was clear that IT was a common reason for stress, and that this was due to both the demands that were associated with the artefacts and the concrete technical problems that appeared.

While the well-known and familiar is supportive and creates safety, the new is challenging and demanding. Large changes that we cannot control or influence are likely to lead to stress. Karin Johannison[3] describes how working conditions in the beginning of the 20th century were miserable, leading to tuberculosis, rheumatism, silicosis and poisoning. But those who worked with new technologies such as electricity, telegraphy and steam engines suffered mainly from neurosis, overstrain and neural diseases. These were the technologies that signalled the break of modern times. There is much to suggest that the same applies to information and communication technologies today.

What are the typical public health problems today and how do they relate to artefacts?

The investigation that was made in the Virus project pointed at two simultaneous trends in contemporary health picture. One large trend was *mental overload*, resulting in stress, insomnia, mental problems, stroke,

3 Karin Johannisson, *Kroppens tunna skal*, Norstedts förlag, Stockholm, 1997. page 228.

etc. The other was *physical inactivity*, which causes back problems, insomnia, cardiac diseases and osteoporosis.

So we seem to have created a world that on the one hand has "liberated" us from physical activity, and on the other hand creates mental overload and stress. When we looked at existing initiatives in IT-support for the home, we realised that no products addressed these general health issues. On the contrary, the product on offer were likely to enhance the negative health trend by affording even less physical activity, as well as overly complex control and entertainment systems. In the Virus project we tried to change this trend by suggesting design solutions that would stimulate movement, enhance relaxation and facilitate social contact.

Why do we create a world that make us ill?

By using social action theory we can try to answer this question. Berger and Luckmann[4] describe how reality is a social construction that is built up by human actions. When human actions are repeated more and more often, they are no longer perceived as individual actions but as occurring in a pattern. Typified actions become *Institutions* that no longer have a connection to individual actions. Institutions provide people with patterns for actions, create social control and security and make actions outside the institutions appear as less self-evident. Institutions become over time released from their origin and become objective facts – a cogent reality. In this way social roles are created that become objective or intersubjective phenomena in society. Over time these roles become part of history and acquire a historic existence. The original intentions behind the actions are *externalised* into roles that acquire an objective character. *Reification* is the understanding of human phenomenon as things. The objectified reality disconnects from its human origin and appears as a thing or a natural phenomenon. The contradiction then appears that human beings regard themselves as a product of these things rather than its originator. In this way we can understand how something that is made by us at the same time can appear as separated from us. *Internalisation* describes the process where objectified reality returns to the individual via socialisation. This is when we internalise beliefs and behaviours as our own. Reality maintenance is an ongoing process to keep our world-view

4 Berger and Luckmann, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*, Penguin, London 1966

coherent and meaningful. Everything around us helps to maintain our everyday world: conversations, work, routines and, not the least, artefacts.

When objects are mass produced, their meanings acquire a legitimacy that goes beyond the individual to the general. Individual actions, the intentions behind the design, are externalised into objective reality. The road there is short, much shorter than the one needed for groups of people to form a social pattern. In this way coincidences, improvisations, and short-term needs can become materialised reality through mass production and electronic dissemination.

Following Stolterman[5] I would argue that artefacts could be seen as social actors that influence and interact with us in much the same way as human beings. When a product enters the life world it possesses a certain register of characteristics and affords certain types of actions. If we regard artefacts as social actors then our view of the interaction between artefacts and people will change. The world of artefacts becomes a social world and the interplay between artefact/ individual resembles the interplay between the social world and the individual. Designers tend to look at the interaction between the product and the individual user but forget that these products form our whole material world. We now live in a *society* of products that creates its own living conditions. We might therefore look at social science to understand this interplay.

This investigation points at a new way to look at artefacts as social actors in an interactive life world. In this perspective, use becomes a dialogue and a cooperation with the artefact. Design work becomes a careful guidance into being where the focus is the *interplay* between the artefact and its social environment. Stress and ill-health is a sign that there is an unbalance in the interplay. Well-being on the other hand results as a balance between the artificial world and the individual.

What characterises the home as a context for new technology?

During the last decade new technology has entered the home in an extensive way. These changes have been accompanied by ideological discussions and political choices. Technology would replace servants, make household work more efficient and enable both parents to be employed.

5 Erik Stolterman, *Designarbetets dolda rationalitet, en studie av metodik och praktik inom systemutveckling.* Dissertation, Umeå University 1991.

Today we are facing the threat of a disappearing health care system and an elderly population, and the argument goes that technology will solve that too.

Many feministic researchers have pointed at the puzzling phenomenon that technology seems to reproduce the existing division of labour and inequality between the sexes. The power structures at hand are invisible and very difficult to change. The extensive ill-health we can see today among women between 30-49 points to the problem that technology in fact did not replace servants. Combining fulltime work with family and children is a heavy commitment.

The home as a context for new technology is different from the working place in many ways. Technology in the home should subordinate to domestic routines, needs and aesthetics. Homes are, unlike working places, not built to accommodate crowds of computers, cables and technical support. Therefore ubiquitous computing, the idea of invisible and non-obtrusive computing seems particularly appropriate for domestic environments. Mark Weiser[6] argues that truly useful technologies are the ones that disappear. Instead of having single computers or personal digital assistants, computer technology should "weave themselves into the fabric of everyday life until they are indistinguishable from it."

The ambition to make computer technology invisible is however not unproblematic. How can you interact with something invisible? How will you get feedback and influence decisions when you have no interface? These questions are even more important since this new technology is aimed at the disabled and elderly.

Design is a powerful tool that allows values and cultural codes to be materialised into factual objects, thereby making them a "natural" part of the world. How feasible is it to make technology invisible in order for us to accept it? In gender theory there is the idea of the double invisibility [7] [8] that can be used to understand some implications of invisibility:

The dominating culture becomes invisible because it is the natural, self-evident, normality above interests of gender, class and others.

A culture in opposition becomes invisible because it gets less room in the public space and appears as vague, indistinct and temporary.

6 Mark Weiser, "The Computer for the 21st Century", *Scientific American*, vol 265, no 3, sept 1991.
7 Maria Uden, *Women technically speaking,* Dissertation, University of Lulea, 1990.
8 Louise Waldén, *Genom symaskinens nalsoga*. Carlssons förlag. Stockholm 1990.

By applying the theory of the double invisibility to ubiquitous computing, the suggestion to massively penetrate the world with invisible computer technology, appears as a way to normalise, naturalise and reify computer and information technology. The invisibility creates a power position where it is nearly impossible to criticise or change the prevailing system.

Something hidden or invisible will not only exercise power, it will also be impossible to understand and interact with. A breakdown situation requires that we can communicate to solve the problem. Instead of hiding computer technology we should use the power of design to visualise and express this complex issue. Gender theory also points at possible ways to act – to visualise the vague and make relative the self-evident.

What are the implications for design practice?

The origin of most artefacts that create our material world is beyond the individual's memory or experience, and has therefore become institutionalised. Artefacts are typifications, common sense interpretations, knowledge "at hand" that constitute a taken for granted model of the world. Without them, the world would appear as completely unstructured and chaotic. In that sense artefacts help us to structure and make sense of the world.

But artefacts may also objectify obsolete, contradictory or dysfunctional patterns. Even if they make us unwell, they are perceived as natural catastrophes rather than human products, and therefore impossible to change.

If we regard artefacts as social actors forming a social world of artefacts that we are a part of, then it is close at hand to look at coping theories to understand the relation between artefacts and people.

The demand – control – support model developed by Theorell and Karazek[9] shows how important control and support is to handle strains. High demands at work can be coped with, and even regarded positive if the individual at the same time can influence decisions at work. But working places with high demands, low control and low support are shown to cause stress and ill-health. These ideas can be successfully applied on artefacts. In the Kvarbo flats there were very little means to con-

9 Karazek and Theorell, *Healthy Work: Stress, productivity and the reconstruction of Working life,* New York, Basic Books, 1990.

trol the system if something went wrong and a the support team was a failure. Complex systems have to enable a high level of control and provide a good technical support that helps users when problems appear.

Antonovsky[10] argues for a *salutogenic* approach that looks for the causes of health, as opposed to the *patogenic* approach, which merely identifies the causes of disease. He uses three concept, comprehensibility, manageability and meaningfulness, to describe important aspects of how we perceive life. To succeed in coping with stressors we must first believe that we *understand* the problem, and then that we have the *resources* needed to manage the problem. But most important is our *motivation* which Antonovsky calls meaningfulness. It is striking how well Antonovsky's concepts are applicable on our world of artefacts: we optimise our chances for a successful interaction with an artefact if we believe that (1) we can *understand* the artefacts; (2) that we have at our disposal the *resources* that are needed to handle it; and (3) if we *wish* to cope with the artefact.

Meaningfulness is about our motivation to do something. On a basic level it is connected to the results of our actions. If the action gets a result, preferably in the way we wished, our motivation is increased. But if the action does not have an intended result, or if nothing happens at all, then our motivation decreases. Finally the action loses its content and is regarded as without meaning. If the action is tied to something emotionally important, the feeling of meaninglessness might spread to comprise the whole life and result in burnout and depression.

For the cognitively impaired a direct feedback on actions is central to keep up motivation. It was very difficult for inhabitants in the Kvarbo flats to understand what the Goodbye look did and to remember to activate it when leaving the flat. Even if they repeatedly were explained that it turned off electricity, water and lamps and turned on alarms, they could not *grasp* it. People with normal cognitive ability naturally grasp abstract relations more easily, but essentially the same applies to us. Without feedback the meaning disappears.

Inspired by Antonovsky, a salutogenic approach to design aims at identifying and strengthening the factors that make us handle adversaries. That means to create artefacts that form a world which is comprehensible, manageable and meaningful.

10 Aaron Antonovsky, *Unraveling the mystery of health, how people manage stress and stay well*, Jossey-Bass, London, 1987.

When we design an artefact we form the physical and mental *meeting* between the object and the human being. By looking, touching, hearing and trying this physical *gestaltning* (form) we create an image, a mental model, of this artefact and how it works. When we interact with it we get feedback that in turn deepens the insight and develops the mental model. When we encounter a new object we study and try the artefacts carefully. Gradually we become more used to it. It might become a well-known tool we often use, at hand when we need it, and a natural part of everyday life. It becomes invisible in use.

With the inclusion of computer technology artefacts become more complex. It takes a longer time to get to know them well and learn all the functions. Complex objects tend to malfunction more often in a way that is unforeseen. We will have to learn how to handle technical problems, error messages and unexpected results. IT-artefacts can be configured, be self-learning, and adapt themselves to our behaviour. In that sense they become more similar to living creatures.

Artefacts can be seen as social actors and our interplay with artefacts resembles our interplay with humans, here is much knowledge to be found within psychology and the social sciences. But we can also use our everyday knowledge about human communication and transfer that to artefacts. One basic condition in human communication is that we need feedback on communicative acts. If we receive no response the communication fails. We want to recognise ourselves in others and have our experiences confirmed. Communication is facilitated by common cultural background. It is crucial that we understand the other person and believe that she understands us. Some predictability in behaviour, as well as clarity and feedback, facilitate communication.

My conclusion is that these factors are just as important in human-artefact interaction as in human-human interaction. If we design an artefact with the goal that it should be like a well-functioning person, chances are better that it will work well. If we on the other hand design complex systems that are not visible, do not give feedback or require a special "language," there is a great risk that interaction will break down.

What implication does this have for our question?

People that grow up or work in environments where they cannot influence decisions, with high demands and low control, are likely to become ill. But people that spend time in environments were they receive feedback, support and can control their own situation stay well.

How can interaction design promote well-being?

In interface design for computer software there are numerous rules for interaction that have been developed since computers started to have visual displays. One of the great improvements in interaction design was the Graphic User Interface (GUI) along with the desktop metaphor. One of the cornerstones of the GUI is direct manipulation: to receive immediate, continuous feedback on your actions. Ubiquitous computing is getting rid of visual displays and graphic interfaces, but what is worse, it also gets rid of control and feedback.

Based on the case studies in chapter 5, I suggest three basic considerations for design of ubiquitous systems:

- Design for *understanding* a system
- Design for *detecting* and *managing* errors
- Design for *disabling* a system
- Design for *alternative* coping

Design for understanding means to enable users to create a mental model of the artefact in Norman's sense. The mental model should support interaction and understanding of the artefact, and help to predict its behaviour. Understanding is facilitated if metaphors from other well-known products are used. When we experience a product as intuitive it means that we recognise its design from other products.[11]

Design for detecting and managing errors means that problems should be expected to happen. If the home is a computer, then it is likely to hang up like a computer now and then and will need a restart. The artefact should communicate why it makes certain decisions. If the water is turned off, there has to be a message about it.

Design for disabling a system means that it should be possible to turn off a troubling artefact without disrupting a whole lot of other things. For example one should be able to disconnect the stove alarm without disconnecting the electricity in the whole kitchen.

Design for alternative coping means that there should be ways to act the normal way. For example there ought to be a normal key that complements electronic keys. A recommendation is therefore that appliances are not tightly coupled with each other, but rather freestanding and linear in the construction.

11 A Blackler et.al. "Intuitive use of products". Durling & Shackleton, eds, *Common Ground.* DRS conference 2002, UK.

If we get rid of screens and graphical interfaces we need to find new metaphors for interaction. We can look at human communication, how we address, show attention, give feedback and create confidence. But we should not forget "ordinary" artefacts such as for example door handles, pictures, keys, locks and windows. New artefacts can have a "family resemblance"[12] with old artefacts and follow the same social rules even if they are different in function.

Interaction can be made graspable in simple ways with light, sound and tactile feedback. Sound and music have a large potential for feedback and communication, especially for the disabled, which was discussed in the evaluation of the Photo Messager. You can have various sounds or jingles to signal different kinds of feedback, what needs to be done, or who is calling.

Studies show that products are experienced as "intuitive" in use, if they remind us about another product that we are well acquainted with. When we meet something new, comprehension facilitated if the new artefact uses well-known metaphors, operations, or rules of interaction.

Some artefacts have a large amount of redundancy, i.e. they are repeated so often that use and identity cannot be mistaken. These artefacts can gain from a greater freedom in the expression. Chairs, clothes and personal belongings are used just as much to express identity as to keep us warm or to sit on. Here is space for esthetical exploration and critical design. But artefacts that are new and ambiguous, which do not have well-known rules for interaction and use, should in a higher degree apply familiar metaphors and mental models.

This must not be confused with attempts to hide technology in a well-known product, as inthe case with the radio piano or the Internet fridge. It means that models or metaphors for interaction can be found in our everyday life. To transform this raw model into a working product is the expertise of the practising designer.

The Photo Messager is one example of how to do this: the product is new but it borrowed form, content and handling from other items in the home. Precisely this combination of photos and function did not exist before, but the idea with photos, to remind about family and friends, was embodied in the Photo Messager. Further, the Photo Messager can be

12 Pelle Ehn and Morten Kyng, "Cardboard computers: Mocking-it-up or hand on the future". In Greenbaum and Kyng (eds), *Design at Work*, Hillsdale, NJ: Lawrence Earlbaum Ass. 1991.

turned off, it is not coupled to any other artefacts and it was regarded as a positive contribution in the home environment.

6.3 Some final words

There are some comprehensive conclusions that can be made from this material. The first is that the artefact can be seen as a social actor and design as creating the basic conditions for the interplay between the artefact and the environment. If something goes wrong in this interplay the result is an unbalance that might lead to ill-health. In order to understand and create conditions for a good interplay, design practitioners should benefit from looking at social sciences and psychology.

Looking at the artefact as a social actor may guide us as to how interaction should be designed. Influence, support and meaning are some central concepts. With new, obscure technology it becomes more important to support recognition and routines than to enable a multitude of functions. This becomes particularly central in domestic use and in IT-support for the disabled and elderly.

All these artefacts, now social actors, form together a society of artefacts that co-exist in much the same way as human beings. Artefacts make patterns, become institutions and contribute to maintain and construct our social reality. A social world of things appears where we may feel as strangers, even though we are in fact its originators. Design practitioners, and others that form our world, have an important task in designing new artefacts that do not reproduce obsolete or dysfunctional typifications.

The large interest for design today points at a transition from a society characterized by discoveries within natural sciences to a society formed by people. Design becomes central in shaping a good future. A future where the world of artefacts help us cope with problems by being comprehensible, manageable and meaningful.

If research is to concern itself not only with evaluations and general laws, but also with suggestions and practical examples of future lives – then design becomes a central practice in research. In this endeavour we need a larger cooperation with practitioners from social and technical sciences, the humanities and design.

We have seen how essential meaningfulness in for our well-being.

Design is basically an activity to make sense of the world. Disparate and meaningless parts are formed to a meaningful whole. A meaningful product has emotional sustainablity and is therefore something we like to livfe with longer. A narrative is usually described as a depiction of a series of events, connected causally and chronologically in a meaningful way. Narrative aims at creating comprehensibility and meaning from chaos. In the same way design is a way of making sense; from a range of wishes and requirements a working solution appears, embodied in a physical artefact.

In that sense design is a basic human activity. Just like communication, it is also a human necessity – the origin of our survival and prosperity as humans. If storytelling is regarded as a form of design, then we design all the time, it is only the material that changes. The goal is to change the world to something better, to create meaning and comprehension. The potential to influence and improve one's living condition is thereby a fundamental need for humans and something that enhances well-being.

This investigation points at a new agenda for design research and design practice. An agenda were designers become actively involved in understanding and shaping the conditions for our artificial world. A design agenda that includes HCI, social science and technical development and where human well-being is the main objective. In this agenda there are several areas that needs to be further understood and developed that I have not been able to fully investigate in this study. Here are for example interaction design versus explicit and implicit input, gender issues in home health care, and aesthetics as meaning-making. In these areas my belief is that a design-oriented reserach will play an important role.

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