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A Methodological Model for Life-Based Design

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Abstract

Technology should exist for bringing added value to people's life, thus improving itsquality. Technology design, therefore,ought toconsider human-technology interaction (HTI) in a much larger context than that of technology use. Comprehension of people’s lives should be the real starting point of the design. In addition, we need to have well-grounded design methods and tools, which can make good use ofour investigations of life and applythis knowledge to the design work. Life-Based Design (LBD) is a multi-dimensional and holistic approach, which integratesHTI design issues with the concepts inhuman life sciences and calls attention to a careful analysis of people’s forms of life. This paper outlines a methodological model forLife-Based Design. Themodel has four main phases: form-of-life analysis, concept design, fit-for-life design and innovation design. Itcovers the main steps in designing concepts, which can be used in technical design.

Keywords: concept design, innovation, interaction design,human-centred design, life-based design

1. Introduction

Technology design has for long been dominated by natural scientific thinking. For this reason, the design research has only recently called systematic attention to the issues of front-end design and human dimension of technology. The definitions of design have been based on the concepts of "user need" and "user requirements" as well as natural scientific thinking, which allow designers to construct technical artefacts (Beakley, Evans and Keats 1986; Dieter and Schmidt 2009; Lindemann 2005; Pahl, Beitz, Feldhusen and Groete 2007; Ulrich and Eppinger 2007). Consequently, engineering design has been much more product orientedthan user or human oriented.

However, technologies – when understood as combinations of human action and the technical artefacts or systems in use – are always designed for people, to be used for improving the quality of their everyday life (Leikas 2009; Saariluoma and Leikas 2010). Therefore, technologies can make sense only in human and social contexts. Since technology design thus entails also a human dimension, it is essential to rethink the nature of early designstagesinhuman-technology interaction (HTI). When designinghuman-technology interaction, i.e., the human dimension of technologies, it is quite natural to take the concepts of the humanlife sciences into use. Concentrating only on natural scientific concepts, theories and methods easily makes the human-technology interaction design rest only on intuitive conceptions and assumptions of humanactions and human life.

In general, HTI designers' thinking is biased inthe absence of the elements of life. Most of HTI design paradigms, such as "human factors", "ergonomics" and "usability engineering",areintended to guarantee smooth and unproblematic *use of systems and services* (Crandall, Klein and Hoffman 2006; Karwowski 2006; Nielsen 1993; Noyes, 2001; Rosson and Carroll 2002; Vickens andHollands 2000).In this traditional design thinking, the technology determines the way and the operations that have to be carried out in order to complete tasks to achieve the goals. Hence, the usage of technology is assessed in terms of*efficiency* and *accuracy* and other similar attributes (Nielsen 1993; Rasmussen 1986; Vickens and Hollands 2000). User interfaces with their input and operation models are still designed in this technology-driven way, although the input modes and the feedback systems, i.e., tasks and the "push buttons", may have been designed from the point of view of people (Crandall, Klein and Hoffman 2006; Olsen 1998; see also collections by Jenkins, Stanton, Salomone and Walker 2009; Rasmussen, Pejtersen and Goodstein 1994; Schraagen, Chipman and Shalin 2000).

Traditionally, people have been tacitly or explicitly expectedto form integratedsystems with machines. From this point of view, it is actually the machines that define what people can do (Henry 1998; Hollnagel 2006; Olsen 1998). The International Ergonomics Association defines human factors (ergonomics) as a discipline that "optimizes human well-being and overall system performance" (IEA 2009). According to Noyes, (2001, p. xi) human factors seeks to "maximise safety, efficiency and comfort by shaping the design and operation of the technology to the physical and technological capabilities and social needs of the user". In a sense, this technology-driven design can, of course, be seen as a logical way to approach human-technology interaction problems, as it usually brings out also a set of human-centredissuestoHTI-design. However, these issuesseldom provide a sufficient basis for a successful design.

For example, in a technology-driven sense, using a microwave oven presupposes turning two different knobs in the right positions. When people use the oven, they can interact with it bythiswell-defined way and make the oven operate the way they had anticipated. However, consideringonly this common interactive system level it would not be possible to know what the oven is used for. We have learnt to use itforheating food or beverages of different kinds or for thawing frozen food, among other uses. The quality of food determines theheating time and the temperature required. These types of decisions go beyond the immediate technology-driven use of agiven artefact. Forus,human beings, the desired goalmust be known, i.e., what the oven is used for,to enable us to feed in the right parameters. Further, in relation to all technologies, there are two different aspects of technology use: reasoned (optimal) and immediate (suboptimal).

Luckily, analysing human issues has gradually gainedmore prominencein the HTI-design discourse. Additional dimensions forHTI-designhave beensearched, for example, from such topicsas *social experience and culture*(Aykin, Qaet-Faslem and Milewski 2006; Sclove 2006; Winner 2006),*organization* (Dettinger and Smith 2006; Rosenberg 2004), *safety* (Wishart 2004; Zimolong and Elke 2006),*security* (Ruighaver, Maynard and Chang 2006), *ethics* (Hongladarom and Ess 1997; Winston and Edelbach 2006), and *aesthetics andpleasure*(Bertelsen, Petersen and Pold 2004;Hassenzahl 2004; Jordan 2000; Norman 2004; Tractinsky, Katz and Ikar2000). Instead of considering people as extensions of artefacts and systems, human-centred thinking examines peopleas users who wish to exploit and take advantage of technologies, use themsafely, organize their work around them and even gain pleasure from using themin their everyday life (Jordan 2000; Leikas and Saariluoma 2008; Leikas 2009; Norman 2004; Saariluoma and Leikas 2010). This means that the traditional view of adapting people to technology (Vickens and Hollands2000)isgradually being replacedwith design issues that better reflect human needs in terms of user experience (Abowd,MynattandRodden 2002; Law, Roto, Hassenzahl, Vermeeren and Kort 2009).

Despite of the recent shift of focus to user experience, the current HTI research concentrates still very much on *usage situations*. As such it provides no concepts that would make it possible to study the real needs that arise from the contents of people’s life and that could be metwith the help of technology. To ensure that we haveproducts that satisfy user’s needs, an analysis of people’s lives and living conditions is needed (Leikas 2009; Saariluoma and Leikas 2010). Even more, we need clear conceptualizations and methodological processes thatdescribe how to apply this knowledge in technology design.

This paper outlinesan alternative and complementary way to understand HTI design and especially its methodological procedures, which begin with the analysis of human life phenomena. In design thinking, instead of focusing on how to use technologies or why people like or dislike their use, we are interested in asking *what* people use or wish to use technologies *for*.

2. From Competence of Use to Quality of Life

The classical HTI-perspective (ISO 1998; 1999; 2000; 2008) does not fully cover the users’ role as human beings and individuals who, instead of executing mechanical actions, want to determine the goals oftheir own activity and their own life. In the deepest sense, the goal and the focus of technology design should be in enhancing the quality of life forpeople. The traditional usability attributes, such as efficiency and effectiveness, have little to do with this aim, as they do not connect technology to life, i.e., to the real needs, desires and goals that arise from the contents of people’s life. In HTI-research the importance of these goals has been recognized, but still no systematic procedural and conceptual approaches have been developed in contrasttotraditional engineering. This is a consequence of the limited power of expression of the natural scientific concepts in formulating the questions of everyday life (Brentano 1874/1973; Radnitsky 1970; Saariluoma 1997, for power of expression).

Fundamentally, quality of life (QoL) is investigated as a basic issue in philosophy about good life (Plato 601d-602a; Nussbaum and Sen 1993). During the last decades this issue has been studied in other sciences as well, and the term QoL has been used as a social scientific index of the relative well-being of whole populations(King and Napa 1998, Saarni 2008). Nowadays QoL is more individualized, and a vast range of methods measuring quality of life has emerged. For example, wealth, health and social relations have all been found to be prime determinants of subjective QoL (Gilhooly, Gilhooly and Bowling 2005). According to WHO (1994), quality of life is a person’s position in life perceived in the context of the culture and value system where (s)he lives and in relation to her or his goals, expectations, standards and concerns.

If technology is to enhance QoL for people, it needs to mediate the relationships between the important factors of life - such as wealth, health and social relations - and QoL (Gilhooly, Gilhooly and Jones 2009). To improve people'squality of life, technology should not exist for itself, but rather for bringing added value to people'sdaily life(Artz 1996; Cockton 2008;Mesthene 2003).This is the key to consumer satisfaction. Developers should understand how people can and wish to live with technology, not only how they use it. Traditional technical design paradigms only tacitly address the issues of good life. Natural science conceptsdo not reflect the socio-cultural and physiological determinants of good life. For example, issues such as hopes, values, lifestyles and mentalities do not belong to the scope of natural sciences.

Values, both personal and social, play a significant role in user acceptance and consumer satisfaction (Allen and Ng 1999; Bochini,Garzotto andPaolini2008; Friedman and Kahn 2003; Friedman, Kahnand Borning2006; Jurison 2000; Kujala and Väänänen-Vainio-Mattila 2009; Mackie 2007). For example, Redström (2001) discusses practical applications (originally introduced by PaulssonandPaulsson, 1957) and their use, which the designer has to acknowledge, i.e., practical use, social use, and aesthetical use. It is a question of practical use when we, e.g., use a saw to cut timber or when we use a boat to cross a lake. Depending on the model, the boat can also have a strong symbolic value in social use, especially if it is a motor or a sailing boat. Social use concerns the symbolic values that different artefacts have in social contexts, in other words, the roles that things play in our social and personal life (Redström 2001; Scanlon 1993; Schwartz 1992). An example of this might be the usage of a tie in different occasions. For some people, it is a symbol of respect for the occasion, whereas for some it might be a negative sign depictinga social class. The third form of use, aesthetical use, concerns reflective use, e.g., using a product because of its beauty(Bertelsen, Petersen, and Pold, 2004; Hassenzahl 2004; Tractinsky, Katz andIkar2000). In a way, aesthetical use goes beyond both practical and social use, as it concerns our most immediate use of any product and is steered by our immediate perception of things in terms of likes and dislikes.

In the light of what has been said above, theaim of HTI design should be to consider human-technology interaction in a context that is much broader than that of technology use. In addition to the physical usage environment, the impact, for example, of users' psychological and social environments should be taken into account (Leikas 2009; Saariluoma and Oulasvirta 2010; Winston and Edelbach 2006).Also the issues of technology ethics are becoming increasingly important here (Albrechtslund 2007; Bowen 2009;Bynum and Rogerson 2004; Cairns and Thimbleby2003; Floridi 2010; Hongladarom and Ess 2007; Winston and Edelbach 2006). This calls for a holistic consideration of the problem at hand, without necessarily getting off the ground with technology first and foremost in mind as the primary solution.

On these grounds, it seems inevitable that it is the time to call more attention to the analysis of the role of designed technologies in human life. It is not sufficient that we concentrate on immediate usage situations and set aside the wider question of what a technology is actually used for. We should ask what we could learn from answeringthe question of *‘what for*’ about the requirements for the technology under design. If the design of new products and services is based merely on the usage and the analysis of immediate use situations, i.e., goals, tasks and operations of the system, and providing the user the capability and know-how to access the technology, the users – and the society as a whole - will never get the full benefit from the innovations of technology. Instead of designing for how users should behave when they use technology, we should concentrate on designing for what people actually want to achieve, what is important for their well-being and what they wish to do in their life and why. We should also focus on the benefits, needs, motives and goals of people instead of merely concentrating on the issues of ‘hows’ and 'likes', such as ‘usability’ and ‘user satisfaction’.Therefore, instead of relying only on natural sciences,whichare not really interested in values and goodness of life but only on ‘*what is’* and thus do not give a sufficient basis for examining the issue of *‘what for’*, we should try to find a more holistic approach to design. Here, we shall move on to define the scientific basisfor Life-Based Design(Leikas 2009, Saariluoma and Leikas 2010).

3. Life-Based Design

Life-based design (LBD) is intended to be a multi-dimensional approach which emphasises the importance of understanding people’s lives (forms of life, values and circumstances) as a basis for the creation ofdesign ideas and for concept design. LBDis concerned abouthow to incorporate new technologies to everyday life and how to derive design goals from human research, based on the analysis of everyday life. A holistic approach means that, fundamentally, all design issues in LBD are biologically, psychologically and socio-culturally motivated(Figure 1). The main component of LBD is to discover information about forms of life, values and people’s actions. This information that is gathered in the very first stage of the design process is then efficiently entered into the design with the help of technology-supported actions (Leikas 2009; Saariluoma and Leikas 2010).

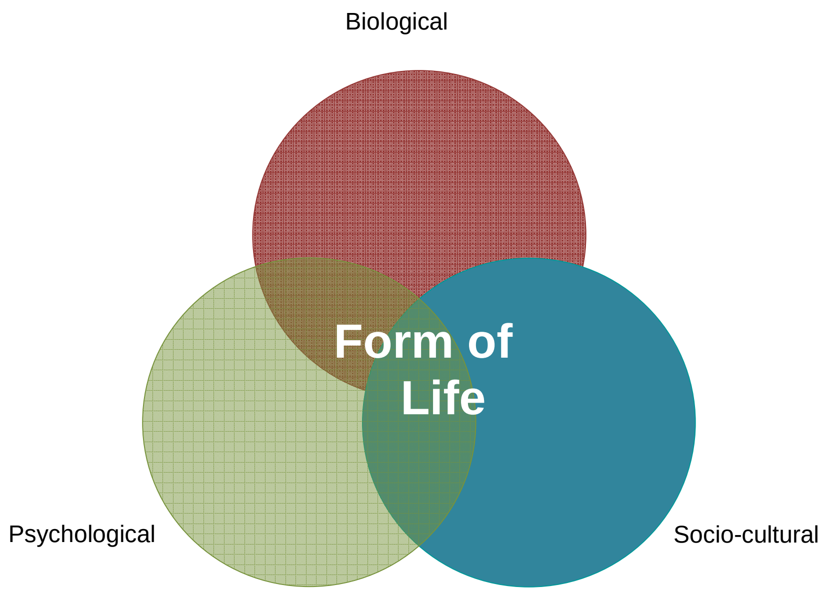

Figure1. Global explanatory frameworks for the Form of Life.

The only way to truly understand and design the human-technology interaction is to bring knowledge of the diversity of users’ life and genuine needs in it to the product design. Here we have to take the life and the sciences investigating life as the starting point (Abowd,Mynatt and Rodden 2002). Quite simply, this means that human-technology interaction design should be able to perceive, analyse and designtechnology through the knowledge of human life sciences in order to improve people’s life with the help of new technologies.

When designing for the quality of life, we have to understand what is relevant for people. Relevance in respect to technology can be made visible through values and meanings that people have in their everyday life. These in turn become visible in different contexts. To understand these contexts and to be able to design value in them, we have to understand different regularities of forms of life (LeikasandSaariluoma 2008; Leikas 2009). A '*Form of life*' refers to any system of rule-following actions carried out by people. Our everyday life is constructed by different forms of life, which affect significantly our goals in life. We participate in forms of life through sharing the rules and regularities that are included in them.

The concept 'form of life' originates from Wittgenstein's (1958;1964) philosophy (Hanfling 2002). By it,Wittgenstein refers to any circle or context of linguistic actions. One can say that people who follow the regularities, actions and practices of language games embedded to some form of life actually participate in that particular form of life.All of us,when using language, participate in anunlimited number of different forms of life, and we can extend the concept from language use to any kinds of human activities.

A form of life can be a hobby, such as motor cycling or being a soccer fan. It can also be an activity, profession or family status, including enjoyingretirement in the sunny Southor being a medical doctor, a grandmother or a metal engineer. These forms of life all have their own rules and regularities andcan explain what these people do when they participate in those forms of life.

There arecountless forms of life around us. We follow their regularities, and these regularities give a sense to our actions. Individual deeds and practices make sense only in the context of a form of life. The same practice may have a different meaning in different forms of life. Kneeling in front of a child is a different act from kneeling to pray. In the former, we may be showing intimacy or dressinga child, in the latter we mightbeshowing our respect to Allah and participatingin a Muslim wayoflife;in the former we need no compass, in the latter we can use technology to aid our orientationand to locate Mecca.

Forms of life have a specific role in designing technologies. Oncewe are able to analyse forms of life and their structureofrule-following actions, we can innovate technologies, which may aid people in their action and practices. We may say that rule-following actions have their meaning in a form of life. Accordingly, it is the rule-following actions and their goals which give a meaning to technological ideas, and consequently, to designing technologies.

As explained above, the need for a technology makes sense in a form of life and its regular actions. Forms of life explain why our deeds have certaingoals. Technologies make sense when they aid us in reaching some goal of (everyday)life. What these goals of life are can best be seen in the context of a form of life. For this reason, it is vital to have a clear understanding of the structure, functional relations and contents of the forms of life for which we design technologies.

4. Human Life Sciences in Life-Based Design

Many sciences and research directions concern human life (Figure 2). Accordingly, we call them human life sciences, i.e., sciences that work on the different aspects of human life.Here wewill present these research areas in a very compact form,beginning with human biology. By this term we refer to all the paradigms of biological and related research, which focus on people. Examples of such research areas can be found in many forms of ecology (e.g., Berkes and Turner 2006; Young 1974), human ethology (e.g., Eibel-Eibelsfeldt 1989), physiology, anatomy or neuroscience, (e.g., Corr 2006) and even in many issues of medicine andhealth care (e.g., Coiera 2009; Eysenbach 2001).

The second dimension of human life sciences is based on psychology and philosophy of mind, i.e., research on people as individuals and the general laws conducting people's behaviour (e.g., Kosslyn and Rosenberg 2003). This does not only refer to cognitive aspects of mind but to all of psychology (Saariluoma and Oulasvirta 2010). Again, there can be found many related disciplines, such as education, ergonomics and social psychology (e.g., Brown 2000; Karwowski 2006; Nolen 2009).

Sociology, cultural research and the related disciplines form their own cluster of human life sciences (e.g., Argyle 1990; Geertz 1973; Giddens 1984, 1987). In this cluster we can find such research disciplines as social and cultural anthropology, ethnography,gerontology, linguistics and semiotics, as well as many issues that are usually associatedwith art, literature and film research. They all focus on human experience and the systems of social behaviour. We have also many interdisciplinary fields of learning which are relevant in Life-Based Design. Action theory, management, and organizational science may serve here as examples(Bannon 1991; Bannonand Bødker1991; Kaptelinin1996; Kuutti 1996; Nardi 1996)

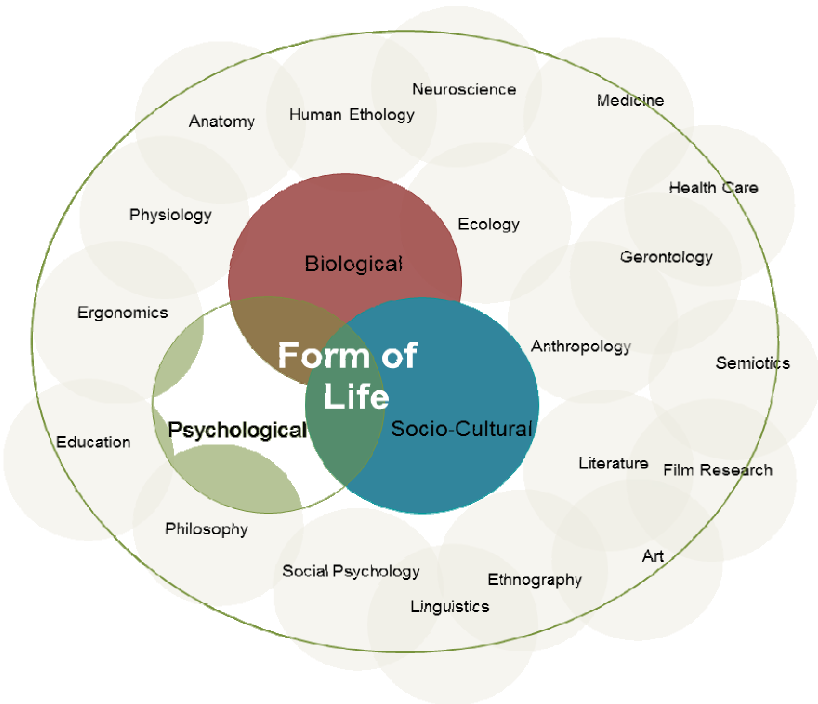

Figure 2. Human life sciences in Life-Based Design

These research fields all have something to say about human life. They also provide methods, concepts, paradigms, models and theories, which may prove relevant in setting, asking and solving design questions. Indeed, all of these disciplines can play their part in specific types of human-technology interaction design processes.

Human life sciences can have two essential roles in the design of technical artefacts and systems. Firstly, they can play arole similar to that of natural sciences in other disciplines. By this we mean that the concepts of human life sciences can be used to open up design issues, in search for clarity with the problems and solutions. Secondly, they can also be used for explanatory design, i.e., in arguing why some solution in the design is better than some other and why it should be implemented.

5. The Practice of Life-Based Design

It is important to see that design is a form of thinking that is different from that inscience.

One could say that design and science represent different stances for improving human life. Whilescience is about revealing how things are in the world, design focuses on how they *should* be (Saariluoma 2010). This means that we can use the results and paradigms of science in design to support our thinking, andin order to design something we have to combine numerous pieces of information into a working whole. In this sense, design is construction, and science can be used to solve particular questions.The knowledge inone field of researchis seldom sufficient enough in design. This is why we have to think holistically in design.

In design science, the discussion on the scientific status of processes and the right procedures has been central for some time. Simon (1969) argues that design is a science of its own kind. It belongs to 'sciences of artificial', of which other typical examples aremedicine, architecture, law, business research, and engineering (March and Smith 1995). The character of design, as its own particular way of thinking, has since been supported by many (Hevner, March and Park 2004; Iivari 2007; March and Smith 1995; March and Storey 2008). The core issue has been that design methodology is a description of a reasonable procedure, which can be used to reach the design goals in some area. In the following, we describe the procedure of Life-Based Design.

LBD consists of four differentphases, which guide the designers' thinking along the design process. The process begins with the analysis of a form of life and endsby clarifyingthe way new technologies can be incorporated as working innovations to life. These four phases do not have to be absolutely sequential, but they can be parallelin the iterative design process.

The four main phases of Life-Based Design are: 1) Form-of-Life Analysis, 2) Concept Design and Design Requirements, 3) Fit-for-Life Design, and 4) Innovation Design (Figure 3).

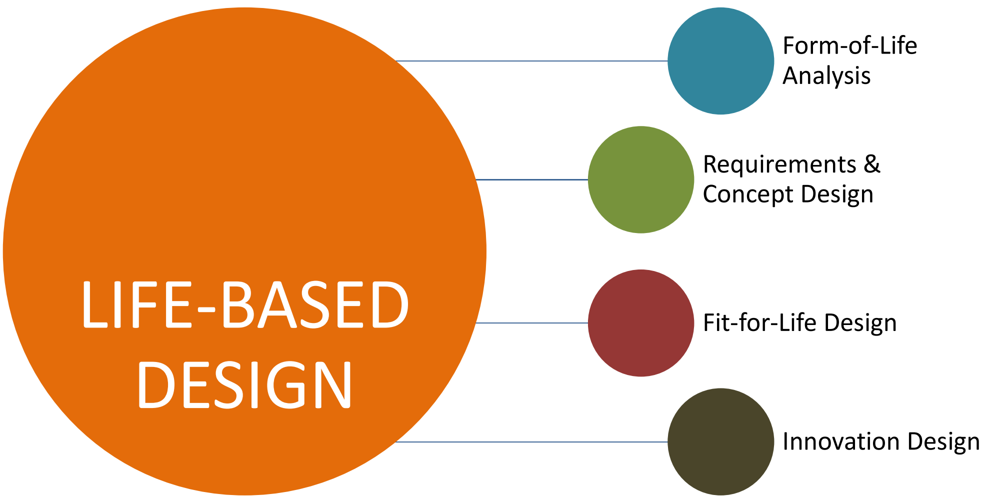

Figure3. The main phases of Life-Based Design.

The first phase, ***Form-of-Life Analysis***, begins with ananalysis of the particular form of lifethe designers are interested in. This may, for example, be 'living in a senior home'. The outcome of this phase is*human requirements*, i.e.,a description of the rule-following actions and practices typical to this form of life. This includes a definition of design goals and explication of design-relevant problems, as well as analysis of typical actors, contexts and relevant characteristic actions, and an understanding of why they are connected to each other as they are. The general goal is to get a clear idea about what the properties of the particular form of life are. This phase also entails analysis of the factors, which explain the regularities of a form of life.For example, neural illnesses may make it difficult for people to live independently in old age. The material given can be taken as the standpoint of design activity.

In the ***Concept Design and Design Requirements***phase, the designers define the particular problems they like to solve and the role of technology in achieving action goals.This means defining what the technology is used for. The outcome of this phase is a definition of technology-supported actions fora product or service concept. In this phase, the designers also begin to outline what the supposed technologies could be like. They generate prototypes of the relevant new technologies. They also explain how these technologies can be linkedto the problems. This means definition of the forms and role of technologies in everyday life. This refers also to the way new technologies can be implemented. Thus, the actual user and technical requirements are defined in thisphase.

The***Fit-for-Life Design*** phaseis critical. It illustrates the logic to enhance the quality of life of users and investigates whetherthe new ideas really fit for theirlife. In other words,itexamines the benefit the users can get from the developed solutions andthe impact the solutions haveto the quality of life. The outcome of this analysis can lead to improvements in and modifications of the product ideas. Thus the process has aniterative nature, which istraditional in HTI-design (ISO 1999; 2008).

The ***Innovation Design*** phaseincorporates the new technology in human life settings. This phase entails activities, which can transform the new ideas into everyday products. In addition to producinggood ideas and making agood design,it is essential to ensure that the product is really used by people in their life. This is why innovation diffusion processes are a vital part of Life-Based Design.

The overall characterization above has presentedthe Life-Based Design methodology as a model of four partially iteratively overlapping processes. They are all needed when new products or services for life are being designed. We will proceed now by systematically introducingthemain questions characteristic to respective phases.

6. Analysing Forms of Life

Form of life is the core concept in Life-Based Design, as it is used to separate relevant areas of life under scrutiny to design technologies for these particular life settings. In the design, it is difficult to think life as a whole. Instead, we have to abstract definable parts of it. This can be done by positing the specific area of life that we are interested in by defining it as a “form of life”. This kind of abstraction of the research focus is a common procedure in science. For example, a chemist may be interested in the properties of molecules. However, before it is possible to proceed with the research, it is necessary to definewhetherthe research topic concerns hydrogen or sodium chloride. Similarly, when a form of life is studied, it has to be posited first. Whereaschemists can be interested in pentane molecules instead of some other molecules, a life-based designer can find soccer fans' form of life as the standpoint for the technology to be developed. Researchers in both of those areas have to posit their topics in a similar manner. With the help of a form of life analysis, it is possible to define differentproblem areas in human life.For example, it is a totally different thing to design for young and sporty people than for retired active seniors. The user groups as well as their forms of life differ in many ways. This is why it is necessary to first select the relevant life settings we are interested in.

A form of life can entail a number of interconnected and relatively regular deeds and actions characteristic to thatparticular form of life. For example, runners train daily and follow the relevant media to get more information about running. They travel to competitions and talk about runningwith each other.To get to know and understand this information, which is relevantto the runners’ form of life, we have to extract itsmajor regularities and other properties. This means that we have to find out what kinds of activitiespeople normally engage inwhen they participate in this form of life. We have to discoverthe life settings and the major explanatory factsand value structures in them. This taskisreferred to as the analysis of the selected form of life.

It would be easy to start searching for life design solutions inthe basic higher-level issues such as work, leisure time and well-being. However, these higher-level themes do not yet carry us far in understanding the real needs of people and the explanatory issues behind them. This is why we have to examine the specific form of life and,with the help of it,find additional concepts to consider, such as what kinds of socio-cultural contexts people participate in, what kinds of actions are relevant to these contexts and what kind of biological and psychological factors are related to these actions (Leikas and Saariluoma 2008; Leikas 2009; Saariluoma and Leikas 2010).

A form of life is composed of different *facts*, i.e., different situations of life that people live in, and *values* that people share. The facts can be, e.g., illness, wealth or poverty, youth or old age, being a student or an enterprise leader. These are facts of life that make understandable the kinds of everyday contexts people live in and the kinds of *real* needs that arise from these contexts. Along with values that people follow, these facts can be used for designing meaningful services for people's needs. Most importantly, understanding these facts makes it possible to create added value for people and thus improve their quality of life. With the help of the forms-of-life concept, we can focus our design on opening possibilities instead of merely solving problems.

The next step is to define the design goals. This means that we have to figure out what people need in their life and how technologies could really improve their life. For example, while traditional surgery can result inbadly healing wounds, modern surgery with new technologies makes it possible for the patients to get out from the hospital the very same day they areoperated instead of having to lie there for weeks. The innovators of new methods understood the problem of human suffering and created new ideas, which includedope rating patients with minimally-invasive surgery so that only small woundswould beinflicted. The design goal was fixed to the form of life of the patient (and surgery as well), and the created solution made the life of the patients, and also the personnel, essentially better.

Developing any idea requires that numerous side problems must be solved before the core idea really works. Also in Life-Based Design, it is essential to extract all the design-relevant,human-based problems, to define possible problematic side issues and put them under scrutiny. Along with an idea about the actions relevant to the design, it is equally necessaryto have a realistic idea about the potential users or actors and their properties, such as education, age, gender or technology skills, as well as the technology already in use. This knowledge is essential in solving many design problems, and for this reason it is important to collect it as a part of analysingaparticular form of life.
Similarly, we have to have sufficient information about the context of use. This includesboth physical and social conditions. Thus, we have to be aware of, e.g.,whetherthe use of the product or service takes place inside, outside, in sunshine or when it is raining. We also have to understand what kinds of social relations are activated before, after and when using the technology.

The analysis of the form of life should generate the *human requirements*for the product or service. This is the information, whichexplains the *why's*and *what for's,* and it should guide the design process from the beginning to the very end. The human requirements definehow people's life in a specific form of life should be improved. They are based on the methods and results of human life sciences and create the basis for the design by introducing the design theme they support. However, theydo not define the technological concepts, which could be used in answering the defined goals of aspecific form of life. These goals are called 'design (user) requirements', and areillustrated in the next chapter.

The main questions of the analysis of the forms of life are summarised in Figure4below.

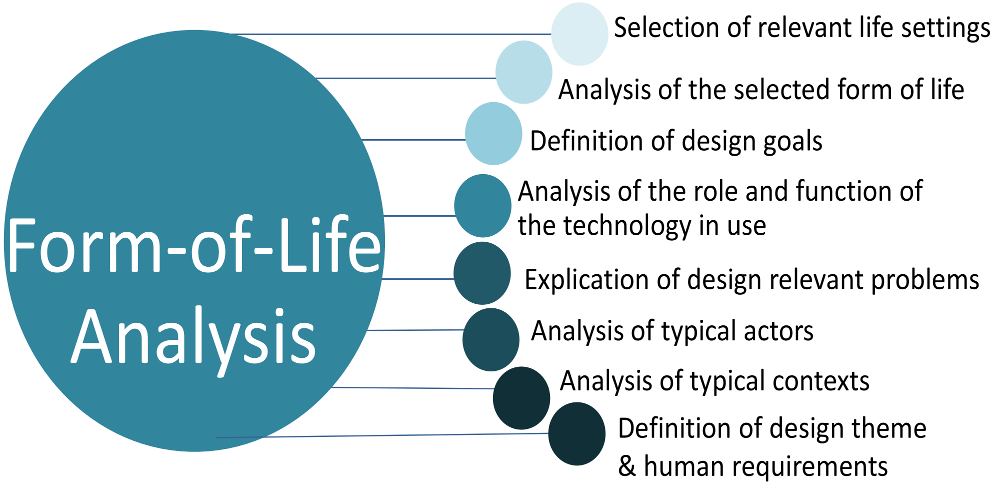

Figure 4. The main questions of the form-of-life analysis.

Thesummary gives an overview of the processThe questionsgivean idea about what should be done, but they should not be followed slavishly.The goal is to generate a sufficiently detailed "Human Requirements Report" for the concept design.

7. Concept Design and Design (User) Requirements

The second phasein the LBD framework is concept design and the generation of the actual design requirements. This phase produces a *definition of technology-supported actions in a product or service concept*. It introduces the role of technology in achieving action goals based on the knowledge collected by analysing the topical form of life.

In our earlier example about minimally-invasive surgery, it was necessary to develop laparoscopic tools and endoscopes that would make it possible to avoid inflicting large wounds in patients' bodies. Thus the core requirements lead to the development ofsuitable tools for filling the main requirement of minimal invasiveness in this particular case. In terms of rule-following actions, penetration to the focus area of the body is still necessary, but the way it is executed could be essentially changed.

The essential parts of the concept design phase consist of ideation and reflection, and elaboration of the selected solution. To give another example, in the case of a navigation device, the designers have to find a suitable angle for presenting visual information. They have to ask whether the bird eye perspective is more suitable than the map perspective. They also have to solve what kind of augmented information is required.

In addition, and congruent with the ISO standards, this concept design phase carries out user interface design as well as usability and user experience studies. This may include, e.g.,deciding whether touse fixed or mobile technology and general purpose or special devices for realizing aparticular design goal. Consequently, this entails the use oftraditional usability engineering processes as a part of Life-Based Design (Leikas 2009), together with proper knowledge of potential users and use contexts.

The concept design phase ends up with technical design and implementation. Here the designers generate mock-ups and prototypes using the kind of technologies that should be able to reach the design goals as well asmake it possible for theusers to reach their life goals.

The main questions of the concept design phase are summarized in Figure 5below.

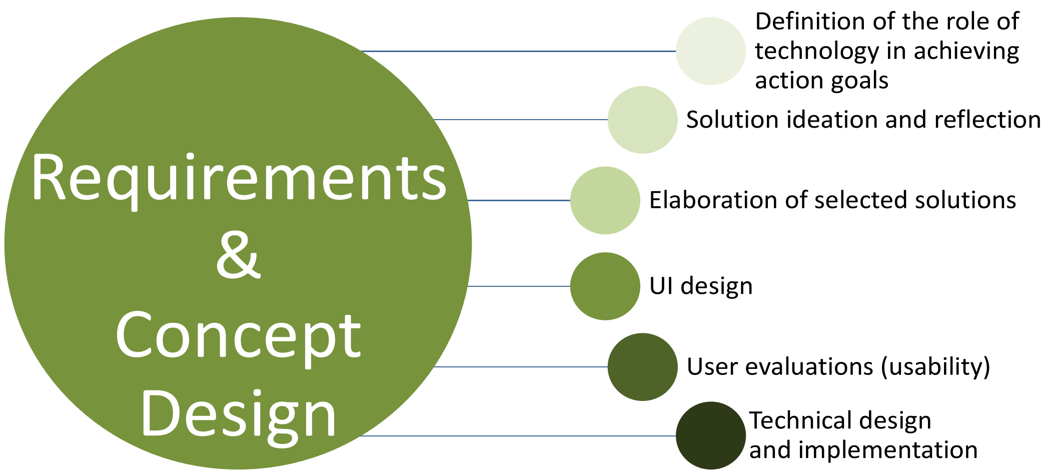

Figure 5. The main questions of concept design and design requirements.

The final outcome of the concept design phase is a definition of the technological concept - which can be also expressed e.g., in a form of a model, a mock-up or a prototype - and a description abouthow people shall use it in their lives.This presupposes a(user)requirements specification for the implementation. Therefore, the process also provides the logic of how the future technology will be part of the users' everyday life.

8. Fit-for-Life Design

Concept design and design requirements enable the designers to solve the defined problems. In Life-Based Design, the core challenge is to improve the quality of life of the users. This is why it is essential to test the fit for life of the generated new ideas and technologies, in other words the meaningfulness of the concept in people's lives. Thus,fit-for-life design aims at reassuring that the design outcome fits seamlessly in the form of life of the target users and enhances the quality of life.This is afundamental phase in the LBD framework as it *illustrates the logic to enhance the quality of life*.

This process reassures that the developed prototypeis the best possible way to improve the quality of life in agiven context. This analysis is mostly forgotten in the design processes. It stresses the importance of coming back to the human requirements defined in the form-of-life analysisand reflecting upon them as well as defining and removing the barriers for implementation. Should there be any problems in fitting the outcome to the form of life, the prototype should be refined in accordance withthe requirements. Only in this way it is possible to ensure that the outcome really has a genuine role in the life of the users. As an example, we may be designing a grocery service that would deliverhome the food that the customer has ordered, for example,byusing the Internet or a smart phone. Technologically, the service may work perfectly,and the user interface may be ofhigh usability. However, if the designershave not been able to solve how the groceries can stay cool outside the door if the client happens to be away fromhome by the time of delivery, the service will not fit for the form of life of the target user.Another example could be a service designed for sending greetings to friends. It may work fine foran ordinary day, but the designers should also consider people's forms of life and their need to send, e.g., Merry Christmas or Happy New Year greetings. If millions of people have the need to send Happy New Year greetings at the same time by using the same system or service, the service may become overloaded. This should be considered in the form-of-life analysis, and theinformation should be brought to fit-for-life design. These two examples illustrate how a proper analysis of a form of life and people's actions in it form the very basis for fit-for-life design.

Technology design facilitates the emergence of countless possibilities on which to build our future world. The goal of Life-Based Design is to improve the quality of life. *Ethical evaluation* of design solutions is thus a natural part of fit-for-life design. As ethics defineswhat can be considered as 'good of man', ethical analysis may help in exploring from whose perspective and by what kind of choices it could be possible to generate an increase of goodness and develop products with high value in improving the quality of life. The questions that should be underlined are, for example: who can and may use technology?on what terms?and, what would be the ethical and practical consequences of this usage?(Bynum and Rogerson 2004; Cochrane 1997; Stahl 2008; Warwick and Cerqui 2005).

The main questions of the fit-for-life design are summarized in Figure 6below.

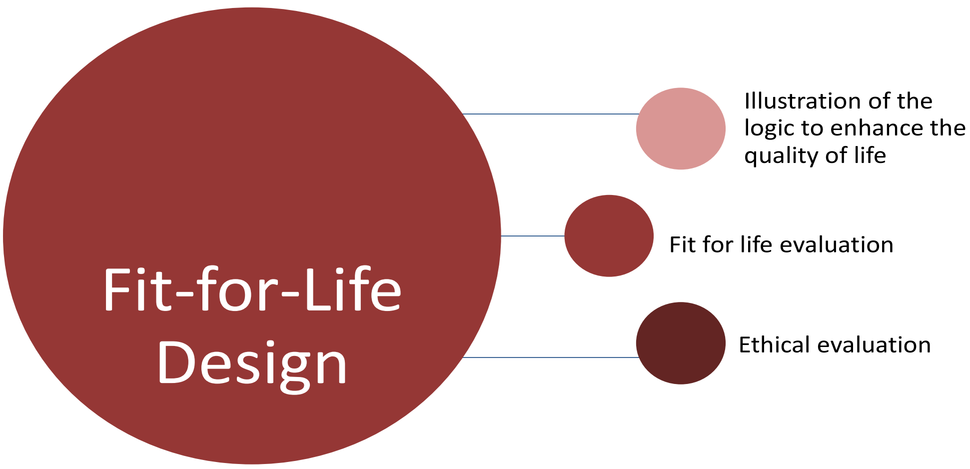

Figure6. The main questions of the fit-for-life design.

The final outcome of the fit-for-life design is assuring and demonstrating the meaningfulness of the concept in terms of fit for the selected form of life and enhancement of quality of life.

9. Innovation Design

The innovation design phase introduces *a procedure for incorporating the new technology in human life settings and exporting the design outcome into general use.* Innovation management in human-technology interaction has become a crucial strategic component of many enterprises today. The main difference between innovation and design is that innovation processes should, from the very beginning, be connected to real life. Therefore, LBD is a natural tool for developing technological ideas into innovations.

In LBD, it is importantto solve how to instantiate new technologies into people's daily life. When technologies are designed to increase the quality of life, they can become innovationswhen they are really used by people. To make something an innovation, it is important to *create usage cultures* for design outcomes. To ensure that people really get what they wish forfrom the technologiesguiding and training are needed. Thismay evencall forsophisticated educational programs. Without skilled users there can be no use cultures. A use culture means also that users have a role for technology in their life (Rousi, Leikas, Saariluoma and Ylikauppila 2011). Thus, the users should know how the quality of their lives could be improvedwith the help of the new technologies available for them.

Innovation design includes *definitions of the infrastructure (social and technical), a marketing plan, and service and auxiliary activity*. These are methods of conveying the message to the users about the benefits from using the technologies. Marketing can consist merely ofraising curiosity byPR-methods and publicity, but it may also mean extensive campaigns in media. Finally, this phase of the LBD model illustrates *the technology life cycle*. This includes issues such as how to answer the demands of sustainable development, instructions for disposal of the product, and even an introduction of the next product generation.The main questions of innovation design are summarised in Figure 7 below.

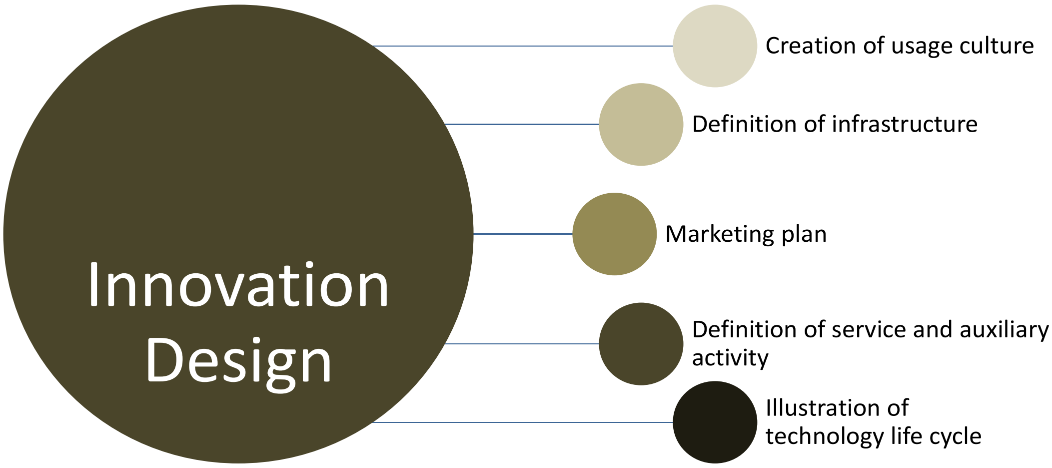

Figure 7. The main questions of innovation design.

The outcome of theinnovation design process is a product, which has found its users,or atleast a clear plan of how this goal can be reached. Without active innovation design, this vital part of Life-Based Design would be a random process.

10. Discussion

The re-thinking of human-technology interaction design is important now as technology development is focusing more and more on services. The design of service concepts, if any, has to be carried out with a much broader design approach than what the traditional approaches to human-technology interaction design can offer. Life-Based Design, the main features of which have been outlined here, is a new, advanced way of carrying out front-enddesign, as it combines the concepts of life-sciences and design of information society.

Life-Based Design (Leikas 2009; SaariluomaandLeikas 2010) brings in new concepts, questions, research paradigms and perspectives in the design discourse. The main challenge is in the quality of life of people, and the main goal to replace technical intuitions about future information society with well-grounded social, philosophical, psychological and humanistic facts.

Life-Based Design shiftsthus the focus from technology, i.e., technical artefacts and systems (Simon 1969; Ulrich and Eppinger 2007), to designing good life. Here, technologies should be seen in the context of life. It should be considered from the very beginning how they are intended to support and advance the forms of life of people. Hence,the main question is what is needed in life rather than asking how technologies should be used. With the former, we will beable to developatrue user-friendly information society and, with the latter, in the worst case, we have to suffer from poor solutions.All technological ideas can be created by the ‘human needs’ requirement, but not all technical solutions can be justified in terms of the benefits of good life.

Design is always a discourse. For this reason, it would not make sense to claim that the traditional technical design is not essential. Of course, technical design makes it possible for us to reach the goals of our lives easier. It is a necessary but not a sufficient precondition for effective improvement of life by means of technologies. However, we do not actually have an alternative to incorporating human research into technical design discourse. It has to become an essential part of technology design with all its skills, concepts and knowledge.

Life-Based Design is a seriously thinkable and practical enough approach for meeting the human demands of the information society. It emphasizes that the technology design is not only about techniques and artefacts;it is essentially about designing for human life to improve its quality. One may even say that the core idea of Life-Based Design is to design the life itself and not just devices, systems, artefacts, products or other techniques. This is why we need the concepts of human life sciences in the design. This is why the model of Life-Based Design is worth further developing.

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