A Publication of Design For All Institute of India January 2013 Vol-8 No-1

Design for All

Design Research and Practice:
A Norwegian Perspective

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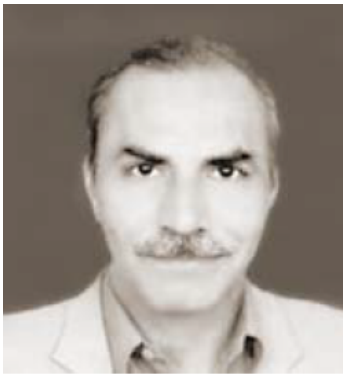
Norwegian University of Science and Technology
-
Department of Product Design 2012

Chairman's Desk:



Dr. Sunil Bhatia

It is great pleasure for us that we have successfully completed our 8th year of monthly publication and this is our inaugural issue of our declared 'A year 2013 dedicated to student Designers '. Why are we successful and appreciated by the world by all sections of people is mystery for design communities and we believe it is some divine power that is guiding and goading us to keep the work of selfless service at free of cost of disseminating the information and in return enjoy the privilege of blessings of readers, contributors that never allow us to miss single monthly issue since the day of inception of this publication. Where we are at present is the result of the blessings of our well-wishers who are silently praying for our success and their help from time to time is the strength to meet the challenges of any crises. I just vividly recall the day when I ventured into this publication and was unaware of associated responsibilities of publication. I wasn't aware about dos and don'ts and we did blunder and missed various opportunities that fell on our way of progress to take this publication to new heights. But international design communities never expressed their attitude of 'perfectionist' and appreciated our commitment, sincerity and they ignore our minor mistakes. We are thankful to them who have made our

publication a true international and apologize to those to whom our unintentional actions have hurt. Our conscience & intentions are clear and as recipients in many occasions we have feelings that it is most painful act for anyone and it is reason that hurting is not our philosophy. I was unknown to international design communities but sincere guidance from President of EIDD Mr. Pete Kercher, Prof Richard Duncan of North Carolina State University, timely association with Imma Bonet of Design For All Foundation and Prof Jim Sandhu made us what we are at present. Our success story is mystery for us and we are surprised what makes us to enter in 8th year of publication. I believe I was destined to work for this social movement and thrust with the responsibilities to provide a platform to facilitate to those who wish to be part of this social movement. Mysterious power that has helped us, taken us out of any crises , warns us any eventuality is store in future and made us stronger to meet the challenges of publications, is still guiding us and we feel morally stronger to give proper momentum to this social movement with more vigorous energy . That force has never let down us rather made our publication year by year stronger and respected by Design communities and under this obligation our monthly publication are focusing for social benefits under moral binding. It is my belief that selfless services get recognition sooner or later. We never exhibit any discrimination and welcome all who so ever with no commercial mind set wishes to share something without consideration of commercial return for the benefits of mankind. We do not know how long and how far our journey will continue and I request that some individuals or institutes should come forward and hold the baton as we exchange in relay race. Individual is too small. Movements are

run & controlled by the boards of dedicated & devoted people who are selfless & determined.

Life is full of hardship and on a few occasions we encounter happiness and in general we live with miseries. There is no other go for us. Miseries, failures and pains are our true companion, philosopher & guide and we learn a lot as against to our happiness, success & good times. Failure helps us to understand many possibilities of the life. Success story pushes the life of an individual in a different direction and closes other possibilities. It opens gates of happiness & comfort. We rarely pick up and go against the odd if we are comfortably placed. Failure makes us to understand the art of living along with strong desire of searching new objectives. Failure has its own associated pains and these are inescapable. Pain may be physical or psychological or social. A person who has never seen elevator and his first encounter generates various pains. When he finds other people including children are using with comfort as if they are playing with toy, that triggers his social pain. 'If I fall, people around me will laugh?' The social embarrassment generates pain under psychological pain.' I might hurt if I fall and it might prove reason of my death.' He experiences his physical strength is vanishing, body parts are no more under his control and mind is blank. 'How will I manage elevator? These pains are associated with every products/ services and with due course of time person overcomes and feel comfortable with it. Modern Designers are overcoming these pains by using 'emotion design'. Basic emotions are universal and our social, culture and political factors are reason of shaping it. Reason of success of iPod is even child can operate with such ease that any adult feels if he can why not me? That motivates him to operate and succeed in overcoming the initial pain.

Role of pain in design is significant and it sets the boundary of functions and help in interface. When we emphasize on that products/services should function with ease & comfort without taxing human being that reminds us to eliminate associated pain factors and introduce as much flexibility as much we can. Flexibilities increase life cycle of the products. Result of this exercise is bound to be excellent and it will be accepted by majority. The basic philosophy of Universal Design is based on that pain should not be experienced by users. What is the role of pain in design? To understand the pain we should understand the human anatomy and its capability to bear pain. 'Pain has limit but person does not have limit.' Average functions are misleading because every individual has different level of stress and strain. Stress of any machine is how much a machine can take the processing load at particular time. For example one computer is attached with many input devices and if simultaneously at particular time all connected devices are submitting their own data and computer process the few and rejects inputs of others devices, the ratio of success and failure is stress of the machine. Too much instructions to man can surface his stress. Why do we design 8 hours of working in a day and atleast a complete day of rest in a week? Reason is body has limitations and beyond this people experiences pains and that directly affects his outputs & performance. Machine also works under stress as man is. This indicates that while designing we should know the stress of device as well of man. Pain tolerance presents a problem. The desired outcome is to make that pain go away by some brilliant method of our designing. We should take care that we lessen their pain and tried to eliminate completely without creating any more additional pain. It is my experience unless and until designers be

subjected to pain until then they cannot design better solutions. Through an analysis of the interactions between the human body and the products the designer is designing should surpass every human being's body limitations and that design will be accepted by all. Only design that serves the objectives with ease & comfort is good design. When designers fail to design according to limitations of human body , they ultimately designed for creating as not only creating weapons instead of tools, becoming the causers of pain to other human beings, and thus embodying pain.

Why do we experience pain? Is it because of age our organs lose their vitality and if we exert more than particular limit feeling of pain generates. Is it because of injuries? Is it matter do not turn out as expected the reason of pain? Pain is a private and subjective experience of an individual but the pain unites the mankind. The real problem comes when its affects are not uniform and same degree of pain creates different level of change in behavior. There are many reasons of pain but we are focusing only those which are associated with design. If our eyes can see at maximum of 120^0 wide angle and if we design the product that need 210^0degree that will be pain in the neck and eyes will not perform what optimally it can perform if it is design according to eyes capability. An auto driver focuses on what is ahead to move forward for avoiding accidents. There is chance that accident may happen if someone hits from the back. To keep an eye on rear designers have introduced concave mirror at different places so that drivers can look at the rear situations not at the cost of chances of meeting accidents while moving forward & without taxing his eyes. It has come to the design because pain was the guiding force. If a person has stamina of holding of some elements and we design beyond it, will be painful act for him. To lift

beyond what a human can the designers have designed pulleys, fork lifter and cranes etc.? Pain indicates what the limitation of a human being. Imagine a world where human is not experiencing pain then nature of solution will be altogether different what we are designing at present. Pain has given us varieties of solutions and forgo that might be better than what we are using. Other side pain proves to be another constraint while designing the products/ services.

Best part of the men is that they experiment with pain and try to overcome. A little carelessness may invite injuries and may prove fatal or even reason of our deaths. Distraction is our basic character and it proves as one of the reason of carelessness. It means no one can pain. Beauty is that every human is designer and allows them to develop various solutions based on available resources. Ancient man has invented cotton for stopping the blood for helping the natural clotting. Design of anesthesia is a result to overcome the pain. I believe last process of evolution in man was he succeeded in standing on his feet and it was possible because of experimentation with pain. It is inbuilt character of human that he experiment with pain and tries to win over. Man might have felt pain while thought to stand for catching or grabbing or whatever may be reason. His body might have experienced pain because of limitations of movement of organs and gradually he has overcome by experimentation and succeeded in standing. It might have happen to other animals but they live with pain, succumb to pain and never have mechanism to overcome the pain by design.

Man has capability who can dare to challenge the pain and finds the reasons, effects and look for solutions. The experience of pain appears universality and it might prove one of the best tools to view various aspects of human life. Pain, crucially, is unpleasant and

motivational and it is one of the dynamos of the progress of human. It can be awful; and it drives us to action. This is the reason that I say that pain is a good for mankind and has been taken a little from human and in return has given a lot. Pain is the reason of enmity, war, makes a few sensitive toward other's pain and has produced person with golden heart like Mother Teresa. Pain is the reason of artificial intoxication by alcohols, narcotics etc. Pain has use & abuse both attributes. Design of torture is nothing but generating maximum pain to the person is one kind of abuse. It is the objectification of pain. Torture becomes pain in its purest sense; not only is pain felt in the body, but the torture victim is also psychologically damaged by the acute awareness that his or her body is being violated. Pain can be helpful in diagnosing a problem. Pain indicates where damage is being done to the body or is about to take place. Pain is a warning system. Pain is a complicated area of inquiry. It is quite difficult to say that pain is inherently bad when it helps preserve the appearance and health of the human body. If someone wishes to hit by sword, stone or any scab and/or bruise with sharp weapons he knows by hitting neck he may die or hitting other body parts pain will generates that has thought to find the solution for cut or control the flow of pouring out blood . Pain is the center of formulation of all types of laws and punishments in this world .Even divine power are also inflicting pain to punish if an individual has not performed as power was wishing. Design of Plaster is part of management of pain for fractured bone. Design of needle in injection is such that administering drug it gives minimum pain. Is it possible that pain could actually be good? Yes indeed. "Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such

damage" Pain motivates the individual to withdraw from damaging situations, to protect a damaged body part while it heals, and to avoid similar experiences in the future. In order to grow and appreciate the joys of life, one must be able to endure and live through the pain. Pain is the ultimate creator or strength and is the tool used to develop induce growth of mankind.

Our special thanks to Prof Martina Keitsch for accepting our invitation of Guest Editor of inaugural issue of 8th year of publication and motivated her students to be part of this special issue and expressed her complete commitment ,dedication & sincerity in bringing out this special issue . Her philosophy is clearly reflected & visible in this issue from cover to the last page. Mr. Jonas Asheim and Mr. Anders Kjøllesdal has done justified work as Guest Editor and invited the authors whose design reflect the excellent knowledge and understanding of Norwegian philosophy

Every nerve that can thrill with pleasure, can also agonize with pain.

HORACE MANN, A Few Thoughts for a Young Man

With regards

Dr. Sunil Bhatia

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A year 2013 dedicated to young designers

February 2013 Vol-8 No-2

Assistant Professor Dr Gaurav Rehaja of IIT- Roorkee will supervise this special issue

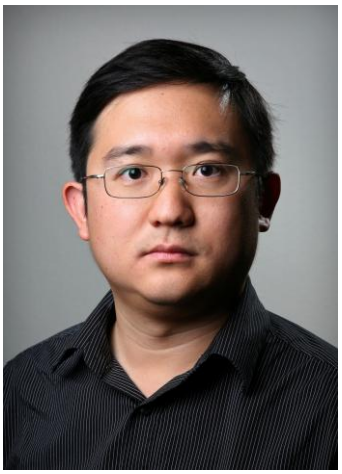
March 2013 Vol-8 No-3

Dr. Debkumar Chakrabarti, PhD. Professor and Head Department of Design, INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI, IIT Assam, INDIA will supervise works of his students of undergraduate/ post graduate and Guest Editor will be Aditya Ponnada, a fourth year student of Bachelor of Design program.

April 2013 Vol-8 No-4

Professor Rachna Khare, PhD (Architecture-Fulbright Scholar), Coordinator Doctoral Programme , Center for Human Centric Research (CHCR) School of Planning and Architecture Sports Complex, MANIT Campus, Bhopal, Madhya Pradesh (M.P.), INDIA will supervise her students to bring out special issue. Mr. Piyush Verma and Ms .Deepshikha Sinha will be the Guest Editor.

May 2013 Vol-8 No-5



Dr. Kenneth Joh is an Assistant Professor in the Department of Landscape Architecture and Urban Planning at Texas A&M University, Program Coordinator of the Graduate Certificate Program in Transportation Planning, and an Assistant Research Scientist at the Texas Transportation Institute. He will be the Guest Editor of this special issue

July 2013 Vol-8 No-7

Christian Guellerin is president of Cumulus, the International Association of Universities and Schools of Design, Art and Media since 2007. The organization counts 178 establishments in 44 countries. He is also the executive director of the Ecole de design Nantes Atlantique, which trains professionals to create and innovate for socio-economic development, with an interface between technology, economics, and the sciences. Today they're expanding to China and India. He writes on design and pedagogy. He will act as philosopher & guide for this special issue and students of different streams will participate in this special issue.

August 2013 Vol-8 No-8

Dr. Antika Sawadsri PhD in Architecture, Planning and Landscape University of Newcastle upon Tyne, UK. Lecturer, School of Interior-Architectural Design (2004-present) Faculty of Architecture King Mongkut's Institute of Technology Ladkrabang (KMITL) Thailand will supervise this special issue of student designers.

September 2013 Vol-8 No-9

"Inclusive Tourism: international perspectives, accessibility and inclusion in the Brazilian tourism" is topic suggested by Prof Regina Cohen Pro-Access Group - Federal University of Rio de Janeiro and she will be Guest Editor.

Content of January 2013 Vol-8 No-1

Other regular features

Guest Editorial:

Design Research and Practice from a Norwegian Perspective

Martina Keitsch, Jonas Asheim, Anders Kjøllesdal



Design is often associated with making good looking, expensive products. However, designers and design researchers with their creative and analytical skills can also contribute to better access to education and participation in local communities and thereby promote changes towards social innovation as a crucial part of advancing a sustainable, inclusive development.

In Norway, social issues such as sustainable lifestyles, equality and universal access were relatively early integrated in design education and curricula and this brought forth a number of alternative ways to investigate and validate design research and practice. It produced in fact some ways of doing design which are quite in line with today's inclusive design approaches. For example integrative approaches such as user participation have been practiced and discussed in Norway since the 1970ies within the professional design and planning communities (Bratteteig and Bjerknes 1995).

The idea creating- and hermeneutic potential of the design process is in Norway today emphasized by different authors. Especially popular is the discursive and communicative role of design, which is applied through interaction and participatory- and service design concepts e.g. with help of empirical studies, ethnography and discourse analysis (Gulliksen 2006). Further, a lot of emphasis is devoted to design for sustainability and wellbeing and - connected to these – the design of ecologically- sound, assistive and life-quality enhancing products and services.

The following special issue presents student papers from the Department of Product Design at the Norwegian University of Science and Technology which reflect some of the concepts above. The papers are based on a student assignment in a Master course at the department. The aim of this Master course is to extend the knowledge about scientific and theoretical approaches used in product design research. In the assignment the students should 1) Choose, define and refine a topic for further scientific study, 2) Use scientific research methodologies related to product design research, 3) Select, review and interpret relevant literature, and deriving implications for future research, 4) Write a scientific review paper in English.

The papers presented in this special issue are selected by their focus on sustainable and inclusive design theories, methodologies and results. They are divided in three thematic areas which consist of the following contributions:

1. Theory and practice of sustainable design:

- *Considering Time in Design: Re-evaluating the conception of a sustainable material culture* by Emil Khoury

- *Design for sustainable behavior* by Anna Karine Lunna

2. Inclusive design and aid design:

- *Guidelines to Inclusive Design for the Hearing Impaired* by Torhild Nornes Hove.

- *Rethinking Rain: Bridging the gap between disaster relief and development work with domestic rainwater harvesting systems* by Christoffer Sæther Sørensen

3. Design for well-being and open access:

- *Designing the Hospital Soundscape* by Mari Skatvold - *Open Design* by Audun Ask Blaker

The papers represent a well-developed curriculum routine at the Department of Product design, in terms of topics as well as in terms of expertise and argumentation.

The majority of design students prefer workshop activities to theory reflections, however their aspiration to practice can be a starting point for entering theory discussions and also helping them back, scaffolding activities that enable movements between different stages of the experiential learning cycle (Keitsch/Hjort 2012). Writing theses papers enable students to engage with the material in meaningful way, growing a range of skills, and seeing the value and practical implications of a relationship between design research and design practice.

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Emil Khoury

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Basic qualification: Master of Science in Industrial design Norwegian University of Science and Technology

Experience: Currently freelance designer and illustrator at Skurktur

Considering Time in Design

Re-evaluating the conception of a sustainable material culture

Emil Khoury
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ABSTRACT

In industrialized societies, we refer to the term consumption as the act of acquiring and using products and services to meet human needs. As a vast amount of products are effectively dumped on landfills, needlessly recycled or stashed away in attics long before their functional lifetime has come to an end, we clearly have reasons to wonder whether or not the stuff that we surround ourselves with really is helping us to fulfill our needs. Strategic approaches to better and more sustainable design solutions have in recent years gained a lot of attention within the design industry. Despite this, mainstream product design still seems to follow the dictates of marketers who are more concerned with making easily saleable products than ones that can support the fulfillment of genuine needs over time.

This article explores the conception of our material culture, and suggests the acknowledgement of time as an important aspect of sustainable product development. Presented like a list of ingredients rather than a specific recipe for the ideal design framework, the

paper seeks to provide the young designer with a basis for reflection on the properties and perception of time, and evidently to encourage conscious considerations of time in the product design process. Through the embracement of time, designers stand a better chance to conceive and promote a material culture that cherish successful ways of meeting needs through enduring and meaningful product experiences.

KEYWORDS

Needs, consumption, planned obsolescence, sustainability, durability, slow design, product lifetime optimization, ecoliteracy, secular time, sacred time, time in design, wabi-sabi, ageing, super normal, good design.

1. INTRODUCTION

In current form, mainstream product design revolves around problem based activities – the matter of finding the preferred solutions to given problems. From the early 20th century to the present day, the world has witnessed how the exponential growth of industrialized mass production has changed nearly every aspect of modern society and, to a great extent, also the environment. As a result, it has become evident that this development is not only concerned with problems related to our own species, but the surroundings world as well. This view has in recent years been commonly expressed through the field of design, particularly in attention to the production of solutions that promote more efficient ways of using materials and energy, pollute less and are easier to recycle – products referred to as safer, cleaner or greener. Although the implementation of such designs seemingly is a necessary part of

a healthy and stable product development, it is important to note that these ideas cannot be considered as sustainable solutions unless they also allow a healthy development to continue over a prolonged period. Hence, *time* is clearly a fundamental part of the equation.

This article presents the notion of sustainability in the light of our perception of time, and suggests the understanding of time-related aspects as an essential element of the product design practice. The goal of this article is not to define a new framework or a set of specific design strategies for considerations of time, but rather to serve as a basis for reflection on how time relates to both the field of design and, in a larger context, the material world. In this sense, the aspects of time do not represent a new stage of the design process, but are something that the designer should consider throughout the course of development.

The concept of sustainability and sustainable approaches to product design are widely debated in current scientific design literature. Although the subtitle of this paper indicates a reevaluation of sustainability, it is not within the scope of the article to map or decipher every aspect of it. Instead, the article focuses on the notion of sustainability in correlation with the understanding of human needs and time in design. The discussion starts off with an introduction to the current state and structure of the consumer society. This part seeks to present the conflicting relationship between meeting human needs and profiting from the sales of products. Part 3 reflects upon the definition and meaning of sustainability, and links these aspects to the notion of durability. Part 4 sees the introduction to our perception of time, and reviews

the topics of the two preceding parts from a cultural point of view. The relationship between products and the properties of time is then discussed thoroughly in part 5 under the title "time in design". In closing, part 6 briefly reviews the notion of time in design in the light of the designer's responsibility.

2. THE STATUS OF THE PRESENT

2.1 Abundant needs

People are consumers. Even though the use of such a statement in most cases would imply a negative meaning, there's no way around the fact that the very fundament of our existence is based on consumption. At the most basic level this refers to the intake of food and water, but nutrition alone does not count for all of our consumption. In order to navigate in modern day society, the consumer relies on the ability to identify and process a vast amount of data through the use of tools and appliances. Consider for instance the significant role of online communication via e-mail; estimates for 2010 shows that that the total amount of (non-spam) messages sent per day was more than 32 billion on a worldwide basis [Focus Editors, 2011]. With regard to the sheer amount of information we digest, consumption seems, as Chapman puts it, not only to serve as a descriptive term for of our way of life, but as an implication of life itself [Chapman, 2005].

We understand consumption as "the process of acquiring and using goods and services to meet one's needs" [Leonard, 2010, p.147]. From a psychological point of view, the classification of needs forms the basis for understanding and mapping how, what, when and why we consume – collectively referred to as consumer behaviour. In

Maslow's renowned pyramid model needs are arranged in a hierarchy of five main groups with some needs taking precedence over others (see figure 1) [Wikipedia c]. The bottom of the pyramid represents the most fundamental level of needs; the physiological factors that our bodies cannot function without, such as food, water and clean air to breathe. This is followed by the need for safety, which covers the security of one's body, health and environment. The next three levels; social, self-esteem and self-actualizing needs describe sets of what we might consider as acquired needs. These include, among others, the need for love, respect and the ability to express our uniqueness as individuals.

Figure 1: Maslow's Hierarchy of Needs.

Although the pyramid model might suggest what people in a specific (physical or psychological) environment likely will pursue on behalf

of their needs, its suggestions alone are not universally valid. The example of people jeopardizing their fundamental needs in order to fight for higher level needs such as solidarity or freedom of expression, indicates that other aspects also should be taken into consideration. In terms of consumer behaviour, Hofstetter refers to how additional notations such as boredom or habit might influence people's decision to acquire stuff, and that the real world scenario likely is more accurately portrayed as a procedural model with dynamic processing of context and needs as opposed to the hierarchical having-doing-being model [Hofstetter, 2003].

An interesting aspect of need in this sense is the classification between what we genuinely do need and what we, on the other hand, just want. Needs and desires are relative to both context and environment, and are not easily identified in terms of moral. Chapman illustrates this problem as follows: When a vacuum cleaner stops working or is damaged beyond repair, it's by western conventions morally accepted to buy a new one. Acquiring two or several more vacuum cleaners would, on the other hand, be considered as an immoral action since the premise (in this case) is that you only *need* one. Yet, people living in tribal communities (or in undeveloped countries) will likely do just fine without any at all [Chapman, 2005]. This fact, not only raises the question of whose concept of moral our premises of needs should be based on, but also whether or not it is possible at all to clearly make a distinction between need and desire on behalf of such premises.

Considering that the current population of our planet soon will pass the 7 billion mark, Thorpe believes that finding the answers to such

questions would be close to impossible [Thorpe, 2007]. Even so, she does point to other aspects of need and desire that might be of importance to our understanding of the two terms and their relation to consumption. Since human needs only describe the underlying motivations for consumption, they leave it up to the consumers themselves to choose *how* these needs should be met. As an example, the need for water makes no distinction between drinking bottled water or water from the tap. The need is met as long as we quench our thirst. Thorpe also points to an issue that often seems left out of the discussion; the relation between needs and time [Thorpe, 2007]. Human needs are by definition exclusively linked to our requirements as individuals, thereby framing the needs within the individual's lifetime. In that sense, your needs are not concerned with the needs of those outside your own life, like the needs of past or future generations.

As for the perception of consumer behaviour, society has become increasingly aware that our current ways of extracting, using and discarding resources are moving at a pace that is far greater than what the Earth can sustain. Over the past three decades one third of the Earth's resources have been depleted [Leonard, 2010], and "over 90 percent of what's taken out of the ground today become waste within only three months" [Chapman, 2005, p.8]. As a quantitative example: an UNEP (2006) study estimates that 20-50 million tons of electronic equipment is thrown away worldwide every year [Park, 2010, p.79]. Some predictions suggest that the expanding knowledge and awareness of the finite nature of our planet is steering the western lifestyle toward a "waste not, want not mentality" [Steffen, 2006]. Sadly, hard facts state that we still

seek to meet our higher level needs through shopping – spending more money on more stuff and replacing fully functional products with new ones [Leonard, 2010].

Although the vast amount of stuff that we surround ourselves with indeed is causing significant damage to the environment, it's not necessarily the stuff itself that is the main problem. As an important part of the motivation behind consumption is based on human needs, it seems reasonable to assume that the previously noted ambiguity of need and desire likely is diluting the consumer's ability to make morally, and thereby environmentally, sound decisions. This implies both difficulty and uncertainty in terms of identifying what an environmentally friendly product or service really is, and thereby also adding confusion to the decision of selecting one over the other. This situation is pictured by Baum as the consumer being a hunter who is never able to tell if he has caught the prey, only suspect that he has not [Bauman, 2006] – a notion that has clear analogy to how the advertisement business is fuelled by consumer confusion.

2.2 Marketing obsolescence

"There are professions more harmful than industrial design, but only a very few of them" [Papanek, 1971, p.1]. These are the opening words of Victor Papanek's book "Design for the Real World", which point to the fact that designers too often end up producing work based on capitalistic market premises rather than people's genuine needs. Detailed reports on market economy will be left out of this article, but an illustration of Leonard's "Work, Watch, Spend Treadmill" is presented in Figure 2 for the purpose of portraying the key process of consumer capitalism.

Figure 2: The "Work, Watch, Spend Treadmill".

As Hamilton argues; "Modern consumer capitalism will flourish as long as what people desire outpaces what they have. It is thus vital to the reproduction of the system that individuals are constantly made to feel dissatisfied with what they have" [Hamilton, 2004, p.79]. This fact is exactly what Figure 2 illustrates – we spend most of our days at work to earn an income, and then tiredly return home to the couch from where TV commercials tell us that our current state of living is not good enough, and persuade us into buying more stuff that we allegedly need. In the weekends we do what we are told and spend our money at shopping malls, only to find ourselves having to work even more to be able to afford the new batch of stuff introduced by next week's advertisements. And so the cycle continues, at least from a simplified point of view. The implications of this loop of desire and disappointment will be further discussed in terms of human well-being in section 4.2. The following part of this section will serve as an introduction to product obsolescence – a

term that might prove Papanek's statement just as relevant today as it was 40 years ago.

In relation to the product industry, obsolescence first rose in prominence with the introduction of planned obsolescence in the 1920s and 30s. The concept of planned obsolescence basically deals with strategic ways of "assigning death dates to specific consumer products" – at which time the products would require replacements, without considering the their actual (working) conditions [Leonard, 2010, p.161]. This idea gained currency as an answer to the problems of overproduction, which at that time was referred to as "America's most troubling social evil", by revitalizing consumer demand in saturated markets and thereby contributing to economic growth [Burns 2010, p.42]. In other words, planned obsolescence is a way to keep the treadmill in Figure 2 turning. Credited by many for popularizing the term, industrial designer Brook Stevens explained planned obsolescence as "instilling in the buyer the desire to own something a little newer, a little better, a little sooner than is necessary" [Leonard, 2010, p.161]. A historical example related to planned obsolescence is that of the Phoebus cartel, who sought to bring the expected lifetime of light bulbs far below what was possible to achieve in manufacturing. During the 1940s the cartel managed to cap the standard for lifetime at 1000 hours, a standard that still is preserved for incandescent light bulbs today. This being 500 hours less than what Thomas Edison's light bulb of 1880 managed to perform, and also immensely inferior to one of Adolphe Chaillet which has proven to provide over 100 years of service [Dannorizer, 2010]

It's obvious that many of today's products, especially among consumer electronics, are put together using cheap design solutions, which results in shortened product lifespan. Brian Burns argues that, even if this seems to be the case, "it should not be assumed that such products are planned and marketed in the continuation of the philosophy of Brooks Stevens" as the issues around obsolescence today are of a greater complexity than they were in the 20th century [Burns, 2010, p.43]. As to portray this, Burns categorizes obsolescence into four modes; aesthetic, social, technological and economic obsolescence.

2.3 The four modes of obsolescence

Aesthetic obsolescence embodies two components; the first one refers to the physical "wear and tear" (i.e. scratches, cracks, deformations, etc) that affects both the product's surface and material. This component also encompasses what Cooper defines as "absolute obsolescence" – the point of which a product is broken as a result of rough use, natural degradation or a combination of both [Cooper, 2010, p.16]. The other component of aesthetic obsolescence relates to the temporality and rapid changes of fashion and styles, in which objects won't really become obsolete at all; we'll just perceive them as becoming so when they no longer are a part of latest trend.

The social mode, also existing within the borders of so-called "perceived obsolescence" [Leonard, 2010, p.162], consists of two components that respond to sociocultural changes in society. The first one describes products that people simply stop using; some in the response to increased awareness related to, for instance, health

or environment, others simply due to boredom. Obsolescence as a result of changes in law and legislations represents the second component of the social mode. Examples of such products include hazardous and toxic children's toys, among others. Considering the increased restrictions on smoking in several countries, the ashtray might in the not so far future also represent a product of this mode.

When a functioning product is pushed out of the marked due to changes in technology, the product is considered to have become technological obsolete. This mode of obsolescence is easily identified with the replacement of electronic appliances, with new models mostly becoming smaller and lighter in physical form, yet faster and more powerful in terms of performance than that of its predecessors. The last century witnessed a huge range of electronics becoming technological obsolete including products such as the CRT Monitor, VHS and MiniDisk.

The last mode of obsolescence is related to the economic expenses of keeping a product in use, and often occurs when the cost of repair, maintenance, reuse or upgrade is too much to be justified by the manufacturer or the consumer [Burns, 2010, p.49]. Again, the world of electronics holds several good examples. As Park refers, the price of consumer electronics has long been following a deflationary trend while the cost of repair work has been increasing [Park, 2010, p.80]. The first fact is mainly a result of companies externalizing their costs, while the high labour cost of western societies constitutes a significant part of the actual price of getting something repaired [Leonard, 2010]. Although you may be able to fix a broken product yourself, the scarcity of spare parts might in many cases

make DIY repairs impractical to carry out. Handymen have, in the process of picking apart electronics, most likely also encountered screw head recesses (such as those in Figure 3) or other features that require special tools to be unscrewed or opened.

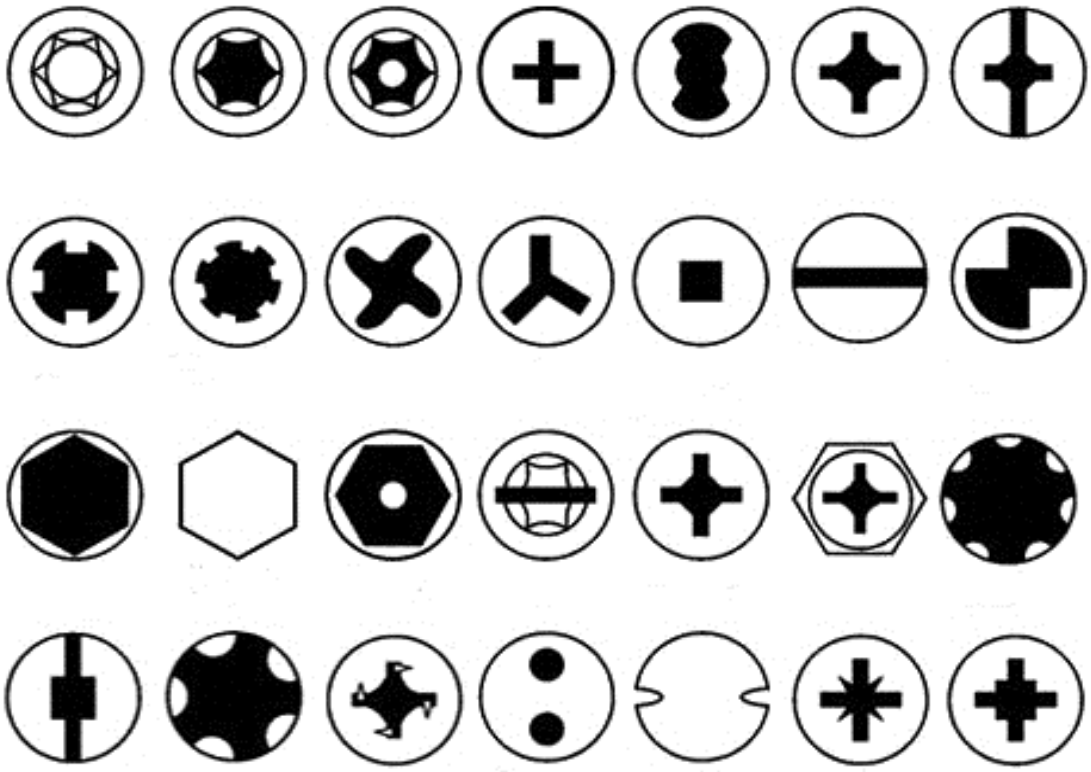

Figure 3: A sample of screw head recesses.

On one side, the manufacturer might state that such constraining properties are implemented for the purpose of allowing parts to be put together efficiently during production, protecting vital parts of the product or secure its warranty, but as they limit the possibility of self-repair it can also be argued that they rather encourage consumers to throw stuff away when it breaks. Why bother with the effort of getting your old mobile phone repaired when it's cheaper to buy a new and even better one anyway?

It's apparent that the ephemeral nature of products cannot be explained only by looking at factors directly concerned with the products themselves. The role of social and economic influences, for instance, should also be taken into account. The philosophy that seeks to adapt industrial production with respect to such factors is known as sustainable design. The coming section will look further into the discipline of sustainability and question its close relations to the industry, that on so many levels elevates "throw-away consumerism" as the key to progress.

Before the discussion is taken any further, it should be pointed out that critique of the consumer society is not necessarily an expression of anti-materialism. Part 4 will further discuss the importance of material objects in terms of meaning and value, and show how needs and time can be manifested in the physical form.

3. SUSTAINABILITY

The term sustainability deals with the capacity to endure, and is often described with the Brundtland Commission's definition on sustainable development: "Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs" [Hofstetter, 2003, p.5]. This definition relies on a comprehensive understanding of needs related to environmental, social and economic aspects. The complexity of this manner has made the questions of which set of rules designers and the corporate world should play by in order to produce sustainable solutions, a much-debated topic. It is not within the scope of this article to give a complete overview of every approach

to sustainability, but we will here list a few of the more predominant frameworks to provide an insight into the current perception of the term.

3.1 Sustainability frameworks

Life Cycle Analysis (LCA) is a technique for assessing the environmental impact associated with the different stages of a product's life (i.e. from the extraction of materials to disposal/recycling). The framework relies entirely on quantitative data and is therefore considered to provide the best depiction of results with any degree of accuracy [Shedroff, 2009]. Despite being powerful as an exacting approach, LCA is criticized for suffering from several methodological drawbacks. LCA mainly focuses on environmental factors and does not adequately address social or economical aspects, something that leaves a fundamental problem unaddressed: the short lifetime of products [Verbeek and Kockelkoren, 1998]. Also, as LCA is mainly a tool for analysing the final impact of fully specified products, it makes it difficult to adequately perform in the conceptual stages of the design process.

Instead of seeing the product's lifespan as a road from "cradle to grave", such as in LCA-thinking, the Cradle to Cradle (C2C) framework is constructed in the light of natural metabolism where the concept of waste is completely removed from the equation. In such a system the expelled materials of one organism constitute food for another, thereby letting the process resemble a closed cycle [Braungart and McDonough, 2009]. Following this idea, the framework encourages elimination of toxic materials, use of natural energy such as solar power, and reutilization of materials through separate material streams for technical and biological materials,

enabling "upcycling" as opposed to "downcylcing" (the first term describes the remanufacturing of materials that are able to retain their quality despite being recycled, the other term deals with recycling into lower forms). Although recognizing sustainability as a local phenomenon, and stating to prefer ecological properties such as biodegradability in designs, the C2C framework first and foremost prioritises effect and efficiency, and is not too concerned whether a material or process is "natural" or not [Shedroff, 2009], [Braungart and McDonough, 2009]. As with LCA, C2C is primarily involved with problems related to the environment, and does not fully discuss financial or social aspects of sustainability.

Biomimicry is another approach that takes its inspiration from nature and natural processes. By its definition, Biomimicry strives to include nature as "model, mentor and measure" for design solutions [AskNature, 2008]. The underlying mantra of Biomimicry is that "life creates conditions conductive to life", something that is stressed through design for self-assembly, resilience and healing, and timed degradation among other principles [Benyus, 2007]. Biomimicry, in its current form, doesn't suggest a tool set as much as it represents a source of inspiration and a model for environmentally sustainable solutions, and should therefore be implemented to the design process accordingly [Shedroff, 2009].

As indicated, the concept of sustainability is associated with several other factors than just the ones directly related to the impact of products and services. Considering this, critique of environmentally focused frameworks, such as those mentioned above, should be taken seriously. Chapman argues that the majority of current

sustainable design methodologies lack philosophical depth and "do not actually attend to the root causes of the problems we face, instead focusing almost primarily on solutions that attend to the after effects of our wasteful and glossy existence [Chapman, 2005, p.170]. This point of view is also shared by others who argue that strategies for eco-efficiency might backfire; by justifying and increasing consumption and thereby hampering the potential improvements of eco-efficiency [Hofstetter, 2003]. So where should one begin to get to the real problems? The first question should probably be directed towards our economic system.

3.2 Sustainable economies

According to Lietaer, today's capitalistic system has a structural flaw that seems to contradict production of sustainable solutions [Lietaer, 2009]. To illustrate his argument, Lietaer compares our economic system with a natural ecosystem in terms of how they value the importance of efficiency and resilience (represented in Figure 4.1 and 4.2 by the letters E and R respectively).

Figure 4.1: Balance in natural system.

Figure 4.2: (Im)balance in our economic system

In a sustainable system the weight between the two variables is balanced. This meaning that the importance of throughput does not outweigh the system's ability to adapt and endure within an environment (or vice versa), as depicted in Figure 4.1 for the case of the ecosystem. In Figure 4.2 on the other hand, it is obvious that the seesaw won't stay balanced. As the value of durability is clearly outweighed by the large focus on efficiency in this figure, it seems by Lietaer's premises reasonable to consider our economic system as unsustainable.

In the attempt of getting around this structural problem, theoreticians have in recent years proposed several ideas for new or modified economic models that make interesting alternatives to the current one. This includes, among others, Hawken's concept of Natural Capitalism; a business model that reassesses the value of human and natural resources [Hawken et al. 2009], the inflation-resistant and tradebased global currency named "Terra" [Lietaer, 2001], and the concept of gift-based economies [Eisenstein, 2011]. Among the frameworks that challenge the capitalistic idea of progress and growth there is especially one that relates directly to the product design discipline. This concept is called Slow Design, and is manifested in the idea of designing to slow down human, economic and resource use metabolism. In doing so, the framework

seeks to shift our focus from material objects towards cultural experience, well-being and learning, all on a much more local scale [Copper, 2010, p.139 and p.150].

Considering that true sustainability seemingly will only become possible in a society that has gone beyond economic growth, pushing the design industry towards framework such as Slow Design seems to be a step in the right direction [Hamilton, 2004]. As for the chances of Slow Design to succeed as a beneficial framework in practice, Fuad-Luke points to the success of earlier attempts of incorporating Slow-principles to industry such as through the movements Slow Food and Slow Cities [Fuad-Luke, 2002]. The main activities of Slow-movements is expressed through activism rooted in the strong belief that economic interest, in the coming time, will gather around the elements of society that best can satisfy the full spectrum of human needs [Fuad-Luke, 2002]. Although implementation of such a framework might seems feasible, Slow Design will, as with all forms of activism, be worthless without the collective force of the people behind it. The great role of responsibility that, in this sense, is left in the hands of consumers has been little debated in recent literature. Section 4.1 will revisit this topic from a cultural point of view, and further points to its importance in the understanding of sustainability.

3.3 Product durability

Decisions that seek to slow down the pace, at which products are used, thrown away and replaced, are commonly referred to as "product lifetime optimization strategies". The notion of lifetime optimization can be divided into two parts; the first encompassing

strategies to extend the lifetime of products while the other part focuses on intensifying the actual use or service life of products [Vezzoli and Manzini, 2008]. Even though these two parts give separate meanings to the understanding of a product's lifetime, the difference between them is not consistently pointed out in scientific literature. The decision to prolong the lifetime of a product by enhancing its structural or material qualities might be a good idea if the problem is that it easily breaks.

In cases where a product for instance suffers from technological obsolescence, enhanced durability will understandably not prevent the product from being tucked away in people's attics. As of this, it should be understood that "making a product last long" is significantly different from "making a long lasting product" [Van Hinte, 2004]. Table 1 summarizes a list of different design strategies for optimizing product durability, including design for high quality, possible upgrades and repair, among others.

Figure 5: Dieter Rams' 620 chair by Vitsæ

The British furniture company Vitsæ can be used as an example of a business that seemingly gives great attention to optimising product durability. With its ethos "Living better, with less that lasts longer" Vitsæ has clearly taken the step in a direction different to that of many renowned furniture companies such as IKEA [Vitsæ, n.d.]. The 620 chair (see Figure 5), designed by Dieter Rams, is an example of this. The chair is part of a kit consisting of interchangeable parts that allow repositioning, customisation (such as adding a head restraint, or combining several chairs into a sofa) and the possibility of repair. On the topic of maintenance, it can also be mentioned that Vitsæ offers touch-up paint for some of their products as an alternative to the physical replacement of parts [Vitsæ, n.d.].

Despite being presented as feasible strategies, tactics to prolong product life spans are often not practically implemented in the product design process [Park, 2010]. When an economic system seemingly links the highest profitable reward to material consumption, it's not too hard to imagine that the idea of extending products' lifetimes may be perceived as a rather unfavourable financial decision – a decision that within the current economic framework often seems rejected in fear of locking both industry (and society) in a stock of inefficiency. In fact, it would appear that the urge to make products last longer, yet obsolete quicker, actually presents us with a paradox.

3.4 A term with thinned down meaning?

First of all, sustainability is by no means a bad concept! But it does seem to suffer from a couple of drawbacks. One of the problems with sustainability in design today is the perception that it's purely

mechanic (analysing carbon impact, toxicity etc) and, like Western medicine, mostly symptom-focused [Sacks, 2010], [Chapman, 2005]. This is though not true for every sustainability framework (such as for instance Slow Design), but it does imply some deception in the current focus of what sustainability really is. Take for instance recycling, which is promoted as far more important than the initiatives to reduce or reuse [Shedroff, 2009]. From what has been discussed so far, it's clear that recycling alone is not a one-stop solution to either sustainable design or consumption, but rather a step that should be evaluated when reuse fails or is undesired [Shedroff, 2009], [Vitsæ, n.d.]. From this uneven focus follows another problem; if sustainability is perceived as no more than the assessment of recycling, it will fail to respond to the real problems and thereby run the risk of "turning into a passing trend rather than a deep cultural shift that really makes sustainability sustainable" [Chapman and Gant, 2007, p.13]. An example of this is so-called Nu-Austerity furniture that utilises driftwood and other salvaged materials for both structural and aesthetical purposes [Raymon and Franklin, 2006]. Acquiring furniture that is made of scrapped rather than virgin materials is probably a good thing, but does such a sole focus on re-use and material efficiency make furniture more durable or sustainable in the long run?

Each sustainability framework does, in some form or another, suggest which ideal features a product or service should display in order to be considered sustainable. This provides a long checklist that might come in handy when thinking about the problems, but gives sustainability a rather extensive meaning as a term – this fact has been pointed out as a source of confusion and by several voices

within the design field. Some even argue that the term sustainability may be too vast to be of any real value at all [Chapman and Gant, 2007]. Another argument against the term states that most people cannot relate to the word "sustainability" as it lacks emotional connection to our lives by not appealing to values or meaning [Chochinov, 2009]. The coming sections will have a closer look at such emotional factors – at first, in the relation durability.

3.5 Emotionally durable

In the field of design, the word durability is often just cited in relation to the physical attributes of products. But as advocated by theorists and visionaries of several disciplines, the optimization of product lifetime is also highly dependent on whether or not we as users are given the opportunity to relate to, express meaning through or embed value in our products [Chapman, 2005], [Eisenstein, 2011], [Hamilton, 2004], [Koskinen and Niinimäki, 2011], [Mugge, 2009], [Van Hinte, 2004]. This can be manifested through, for instance, physical changes in the product or free space for user personalization. An often-cited example is the steady accumulation of patina in those "hard-to-let-go-off" pair of denim jeans – portraying the age of a long and loyal life or simply smelling of last night's party. Creative touches such as bleached areas, splatter of paint or tears that expose bare knees, are all familiar means of jeans customization that further can enhance the narrative value of the garment [Chapman, 2005]. A full list of strategies that seek to transcend obsolescence by strengthening the emotional durability of products is presented in Table 2. The outcome of such strategies is in much literature referred to as "emotional attachment", a term that implies a real emotional relationship

between humans and products. "Occasionally, strong empathic bonds are formed between subject and object, forging practically inseparable unions" [Chapman, 2005, p.69]. In the continuation of this statement, Mugge suggests that designers "only through a throughout understanding of these emotional relationships can create products that bring about favourable emotional responses during ownership" [Mugge, 2009, p.475].

If we return to the example with that precious pair of jeans, it seems, to an extent, reasonable to say that some form of emotional attachment is involved in the connection between the owner and the garment. Although this might be the case, it is not necessarily what designers should strive to achieve. Van Hinte argues that "emotional attachment" is a misleading term as emotion hardly ever is involved in the interaction between people and objects. "Understanding", he suggests, is as a more accurate notion [Van Hinte, 2004, p.351]. As opposed to ultimately seeking emotional attachment between humans and products, shouldn't designers rather strive to broaden our understanding of products, and focus on enhancing the emotional bond between Time in Design 11 people instead? This question will later be explored in relation to the concept of time, but for now let's briefly look at the concept of shared use, a strategy also encompassed by the definition of emotional durability (see Table 2).

"On my street, every family possesses a lawnmower that is used perhaps ten hours per summer. Most families have their own hedge clippers, their own power tools, and their own cars. Because they are unused most of the time, most of these things are superfluous"

[Eisenstein, 2011, p.27]. Integrated and organized systems of sharing do not only hold the potential of reducing the amount of products we feel the need to own, but also provide room for occasional interaction and socialization among the members of a community. The attentive reader might recall that Slow Design has a great focus on the local and socio-cultural benefits of design. Sharing is therefore considered an important theme for the design work surrounding this framework [Fuad- Luke, 2010, p.145]. As the majority of modern society puts great effort on the articulation of personal meaning and identity through ownership of material goods, sharing is understandably not the easiest strategy to implement. In the discussion of the move from ownership- to sharing based solutions, Fuad-Luke identifies four systems as visualised in Figure 6 [Fuad-Luke, 2010, p.149]. The system described in relation to the Slow Design framework is marked in the figure as "cooperative sharing".

Product Service System (PSS) is a somewhat related concept that encompasses tool hiring and leasing, both being systems where ownership is not a prerequisite to obtain the specific function of a product (see Figure 6). The essence of the PSS is to make services out of products. In many cases this means partly or fully replacing physical products with human labour, something that potentially can give a greater attention to human expertise, knowledge and communication. Although so-called transmaterialization might contribute positively to environmental or economic feasibility, it does not necessarily make a service fundamentally sustainable [Mont, 2008], [Shedroff, 2009]. Another feature of the PSS is that it, in current form, essentially takes charge of every aspect of

sustainability related to the service's lifecycle. It's argued that this promotes durability as a lucrative strategic approach for the industry. But at the same time the user is left with little or no personal responsibility of impacts, and is therefore not required to neither know nor care about whether the service he uses is sustainable or not.

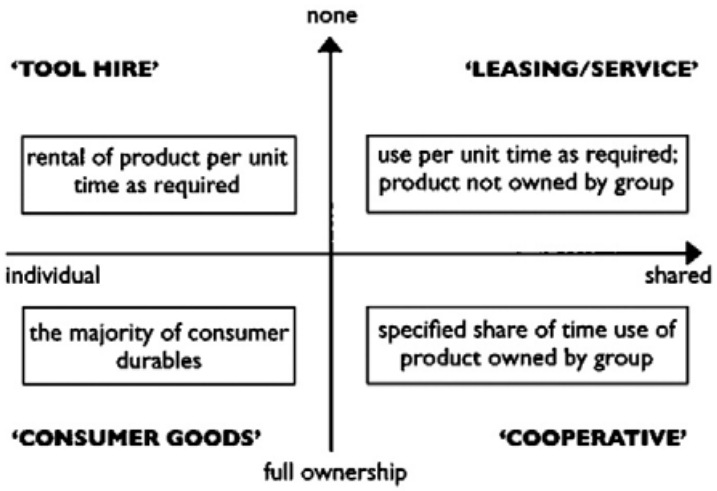

Figure 6: From ownership to sharing

On behalf of what we've discussed so far, there seem to be reasons to believe that sustainability in its current form is not worth much, neither as a term nor a real practice, unless people understand what it means and how it relates to themselves as consumers. In a broader sense this implies that today's "environmental crisis is not only a technological problem, but a cultural problem as well" [Verbeek and Kockelkoren, 1998, p.28]. The next part of the article will explore the cultural implications for sustainability, focusing on man's relation to himself and to his natural surroundings.

Although focusing on different aspects of sustainability, current frameworks should not be considered as separate approaches, but

rather as tools that, despite varying degrees of integrity, can assist the design process on the path to more sustainable solutions [Shedroff, 2009]. Designers should also keep this in mind for future frameworks, which likely will emerge as hybrids of current approaches. On the notion of durability, the reader might wonder why usability is left out of the discussion. Aspects of usability are indeed related to lifetime optimization and thus crucial for the decision to keep a product in use. As usability already is a well-established and integrated part of the design discipline, it has intentionally been omitted from the main discussion to narrow the thematic scope of the article.

4. CULTURE

We've up to this point looked at how the perception of human needs is related to consumerism in the western world, and further at strategies for defying the prodigal conduct that seems to permeate the life in such societies. These themes are clearly reflected in the manifestations of our intellectual achievements, our culture, but have so far not been discussed in the context of nature and time.

4.1 Nature and the concept of time

"For the animal, child, or hunter-gatherer, time is essentially infinite. Today its monetization has subjected it, like the rest, to scarcity" [Eisenstein, 2011, p.31].

In a world where "time is money", the majority of industry will constantly strive for improvements in efficiency; optimizing the different stages of manufacturing and homogenizing both products and production to make more at a faster pace. Accordingly our interaction with the material world is also coloured by a sense of

urgency. We're constantly multitasking, giving each individual task only the tiniest bit of our attention in order to keep up with the rapid flow of information that literally is accessible at the tip of our fingers. Lead astray by the empty promises of the marketing world, our perception of time seems stuck in a somewhat maniacal sense of the present that embraces nothing but "ME, HERE, right NOW". As previously discussed, many ideas for slowing down our rapid pace are currently emerging in several disciplines. Therefore, the pervasive properties of this "nowness" might be somewhat exaggerated. Still, several theorists are sceptical towards the fact that we place a greater value on time, even though we seem to have less and less of it, and claim that it disconnects us from nature [Griffiths, 2000], [Thackara, 2005], [Thorpe, 2007]. One example is how the life in cities runs at a non-stop pace, independent of the natural cycles, but always punctual to maintain the 24-hour service of comfort and convenience. Griffiths argues that modernity's obsessive measurements of time, not only alienates us from nature, but time itself; separating us from the actual experience of time, such as our bodies' natural rhythms [Griffiths, 2000]. In cities light pollution, the obtrusive exposure to artificial light, is among the main contributors to this. Medical sources states that "less than one hour of exposure to excessive light can produce as much as a 50 percent reduction in circulating levels of melatonin, an compound providing the key signals for the maintenance of circadian rhythms... Changes in melatonin releases have been implicated in coronary heart diseases, oxidative stress, decreased immune function and cancer in humans and animals" [Nevara & Nelson, 2007, p.317-19]. Seemingly, the modern perception of time is not only separating us from nature, but also threatening our health.

In indigenous and tribal communities nature and natural time often have profound relations to aspects of people's existence, being the seasonal relation to the harvest or the characterization of time by starscapes and lunar processes. The Bajau Laut for instance, who reside in the coral seas between Borneo, Sulawesi and the Philippines, measure the passage of time by the rhythm of the tides rather than minutes and hours [BBC, 2011]. The reason for bringing the Bajau Laut into the discussion is though not to impose the suggestion of abandoning modern life in favour of a complete return to natural time but rather to ask if it's possible to find beneficial ways to embrace the human-nature relationship in the light of our current evolutionary standpoint.

In nature, time serves a strategically important role for the maintenance of the environment's self-sustaining ability. More specifically ecosystems use the balance between fast and slow to create resiliency, i.e. adjust to change. At a large scale, things generally happen slowly (e.g. the formation of a forest), while at a smaller scale processes are usually faster (e.g. the lifespan of a mayfly). "In any shock to the ecosystem, the fast parts respond quickly, allowing the slow parts to "ignore" the shock and maintain the continuity of the system" [Thorpe, 2007, p.50]. Thus indicating that rapidity and growth should not be perceived as fundamentally negative for a system. Backing examples from the modern world include the growing access to the Internet along with our ability to find, view and share information. Likewise, slowing down is not always the most sustainable solution. In parts of the world where people are suffering because their basic needs are unfulfilled,

slowing down might not (yet) be a healthy option. The design challenge today is not to slow everything down, but to encourage a holistic approach to design that will support the rhythms of both slow and fast moves, or in other words; to design for the right time. [Thackara, 2005]

"Man is a part of a system that both is constant and changeable. In order to support the conditions for life in a specific place, we first need to understand and respect this place"[1] [Norberg-Schultz, 1992, p.7]. This notion points back to the problem of sustainability losing its meaning when it's not understood in the relation to our natural surroundings. The term ecological literacy, often called "ecoliteracy", refers to a person's general knowledge of the ecosphere, and the ecological understanding of his or her local bioregion [Thorpe, 2007]. The latter means the knowledge of a region's boundaries and key characteristics, including its native animals and plants, the final destination of your garbage, and the path of your drinking water etc. Today the sequential measurements of clockwork are contributing to a secularization of the perception of time. Secular time is highly chronological, temporal, linear and unidirectional, making time of the past rather irrelevant and condensing the present to nothing but a fleeting moment [Van Hinte, 2004], [Walker, 2006]. Within the framework of such a conception of time, little room is left for acknowledging the more cyclic time scales predominating in nature, thus revealing the answer to why people in general seem to have little problem identifying corporate

[1] ***Author's translation***

brands by their logos, but struggle to name tree species by the characteristics of their leaves [Thorpe, 2007].

With its potential to eliminate the illusion of man as an entity separated from nature, improvements in ecological literacy might be an important step towards the realization of ideas embodied in the sustainability frameworks we discussed earlier. From the local perspective it appears that sustainability, as Fuller puts it, "is not a crisis of resources, but a crisis of knowledge" [Glasrock, 1974]. On a globalized level however, the prevailing conditions of different geographical areas might make a certain practice seem "sustainable" in one area, but destructive in the other. Thus making the scenario substantially more complex on a global scale. Even so, time theory is clearly of prominent relevance to environmental practices on both the personal and political level. It is also closely related to the more social practices of our kind, and is thereby pertinent for our well-being.

4.2 Human well-being

"The age of plenty is an age of emptiness – we have unlimited reach to anything in the world, yet we miss out on what's closest to us." [Irrisari, 2010].

The term well-being is used to describe what is indefinitely good for people, including the notions of happiness, health and prosperity. In the continuation of the relation between needs and consumption (discussed in part 2), well-being can be said to occur when our needs are constructively and successfully satisfied. In modern societies, this is mainly a question of fulfilling so-called higher level needs. As most of these needs are related to our emotions and

intellectual selves, they are highly dependant on our own introspective efforts to develop abilities that can help us pursue meaningful relationships and ideas throughout time. According to several comprehensive studies, the more people seek external ways of satisfying higher level needs, such as through material wealth, the less likely they are to have their actual needs met [Thorpe, 2007]. As the educated reader already might know, this fact is not really a new discovery. Teachings of all the five major religions do, along with words of wisdom from both ancient and contemporary cultures, state the exact same; those who engage in a "life of less" will evidently live the most meaningful and satisfied lives according to their values [Hofstetter, 2003], [Leonard, 2010], [Shedroff, 2009], [Thorpe, 2007].

Knowing that fast-pace consumerism, and the momentary sense of time that comes attached to it doesn't make us happier, it seems rather counter-intuitive that the quality of our lives is measured by materialistic and quantifiable terms. Today, a country's Gross Domestic Product (GDP) per capita is the most commonly used economic indicator for the quality of life. The problem is that "GDP doesn't distinguish between economic activities that make life better and those that make it worse", nor is it concerned with activities that don't involve monetary transactions [Leonard, 2010, p.243]. So, if we cook for our neighbours, take turns to watch each others kids or help each other out in any other voluntary way instead of using commoditized alternatives, GDP will essentially go down; telling us that we're worse off when we in fact are building closer and more healthier communities [Eisenstein, 2011]. Alternatives to the GDP per capita measurement include the Genuine Progress Indicator

(GPI) and the Happy Planet Index (HPI) among others, but these will not be further discussed in this article. Although such alternative indexes arguably won't provide perfect measurements of well-being, they might encourage political meanings to gravitate towards a new form of social and economic vision that values "quality of life, rather than quantity of stuff" [Schor, 2005, p.48].

If you are to pursue and engage in meaningful activities, you surely need to devote some of your time to it. Out of several domains of wellbeing, Hofstetter points to leisure as the most essential aspect of life satisfaction [Hofstetter, 2003]. According to long-term studies of the work hours of working-age persons in several different countries, " the annual hours of work have been increasing for a large fraction (perhaps the majority) of the population in the most affluent parts of the world [Schor, 2005, p.42]. These findings suggest a counterweight to the somewhat widespread futuristic (and highly debated) idea that decreased workload is a permanent feature of technologic improvement or, more generally speaking, an evident result of economic growth. Enhanced technology and more efficient means of production could certainly allow workers to take more time off. But as our current money system rewards higher speed and increased growth, it is more likely that the workers are asked to work just as much and produce more stuff.

Allegedly, hunter-gatherers of the later parts of the Middle Stone Age (around 50,000 years ago) only had to work about two or three hours a day to meet their subsistence needs. Most of their time was spent collectively in the acts of ritual and social character such as storytelling or cave wall painting [P.M. 1985]. Again, returning to

more primitive states of condition is neither a wish nor an option. Even so, considering that out of the last four hundred generations of humans, only five or six has lived in fast-paced technological culture, we might in fact have a lot to learn from rethinking our relation to nature –a reassessment in which nature and natural time are perceived as substantially more connected parts of culture as they shapes us on both psychological and physical levels [Thorpe, 2007]. Further can "reflection on how we think about time be useful in revealing how we conceive and create our material world, and can lead to other ways of considering the design of functional objects" [Walker, 2006, p.140].

5. TIME IN DESIGN

The term "time in design" is borrowed from the Eternally Yours Foundation (1995-2005), a Dutch design ensemble that sought to disseminate knowledge of long-term thinking and sustainability through the exploration of quality, endurance, and fast and slow design [Muis, 2006, p.277]. As a step further into the realm of Eternally Yours, this part of the article will explore these themes thoroughly by relating the practice of design to the deeper connections between our psychological being and the concept of time. Accordingly, we may here refer to "time in design" as the understanding of how deep considerations of nature, time and communication can be embedded in artifacts that enhance human well-being. In sections 5.1 –5.3 we'll continue the discussion of this concept in relation to three different qualities of time: as a reflection of the past, as a natural process, and as an embracement of the eternal now.

Before we proceed, let's take a moment to dwell on how the predominant part of the developed world views time. In section 4.1 we described our current sense of time as secular; utilitarian and temporal, quantifiable by the ticking of clocks and experienced in a sequential manner. In a world where time is perceived as secular, the concept of eternity will generally mean a very long time. According to Walker, this is a misconception. The true interpretation of it, he says, sees eternity as encompassing all time –past, present and future. Eternity means the eternal now, the enduring present that exists beyond time [Walker, 2006, p.142]. This interpretation of eternity forms the basis of what Walker defines as sacred time. In contrast to secular time, sacred time embraces the cyclic nature of time and employs symbolic and poetic modes of expression to convey metaphysical meaning [Walker, 2006]. Based on the previous discussion of durability (in section 3.3 and 3.5) it seems that we, in order to approach a more enduring and meaningful material culture, must provide greater room for the articulation of human value and meaning through the objects we surround ourselves with. In order to allow this to happen, both secular and sacred time must essentially be acknowledged as equally important facets of our lives. "However, over the past century it is clear that in the field of product design and manufacturing the overwhelming emphasis has been on the utilitarian priorities of business expansion and economic growth"[Walker, 2006, p.146]. The result of this lack of balance is evident: an excess of non-durable consumer goods that offers little room for expressing ideas of higher or spiritual understanding.

"Technologies and new materials may improve performance and design; they may bring things up to date and occasionally innovate, but the *experience of living with an object* seems to have cheapened" [2][Morrison, 2002, p.42-43]. This statement points to a consequential symptom of an exclusively secular perception of time: the reduction of material value. Value, in this case, does not refer to the costs of materials, but rather to the perceived value of material objects in our everyday lives. Along with an increased rate of mass-produced, generic commodities, our focus has shifted from the products themselves, to only the ideas that these embody. It's the function that a product fulfills that matters, the material object itself is, generally speaking, hardly relevant anymore [Verbeek and Kockelkoren, 1998]. Hamilton shares a somewhat similar view stating that "it's not the physical properties of the goods that are being consumed, but the style, attitude and the image associated with the products. The products themselves are redundant" [Hamilton, 2004, p.97]. As an example, let's look at the Apple iPhone, one of the most popular smartphones on today's market. It seems likely to assume that those who own an iPhone do so because they to some extent identify with its image (e.g. the high-tech finesse, simplicity, usability etc.). Through the process of use, the owner may surely find the smartphone's functionality to be of great convenience. However, any contentment found within the features of the iPhone will primarily relate to the phone's image and not to the owner's *specific unit*. We can picture this differently by imagining the following scenario: If your iPhone breaks and you're given a new one (assume it's covered by its warranty), no harm is suffered as long as you're able to retrieve the data from your old

[2] ***Emphasis added***

phone (through a backup that is stored elsewhere). This implies that, other than being the mere means that provide you the access to the phone's functionality, the material manifestation of your phone have in fact no real intrinsic or independent value for you as a consumer [Arendt, 1982].

In relation to the design practice, one of the big questions seem to be how the designer can work to support a more stable balance between secular and sacred notions of time. In relation to their work on sustainable clothing, Koskinen and Niinimäki present a framework that embodies several important aspects of needs, durability and time [Koskinen and Niinimäki, 2011].

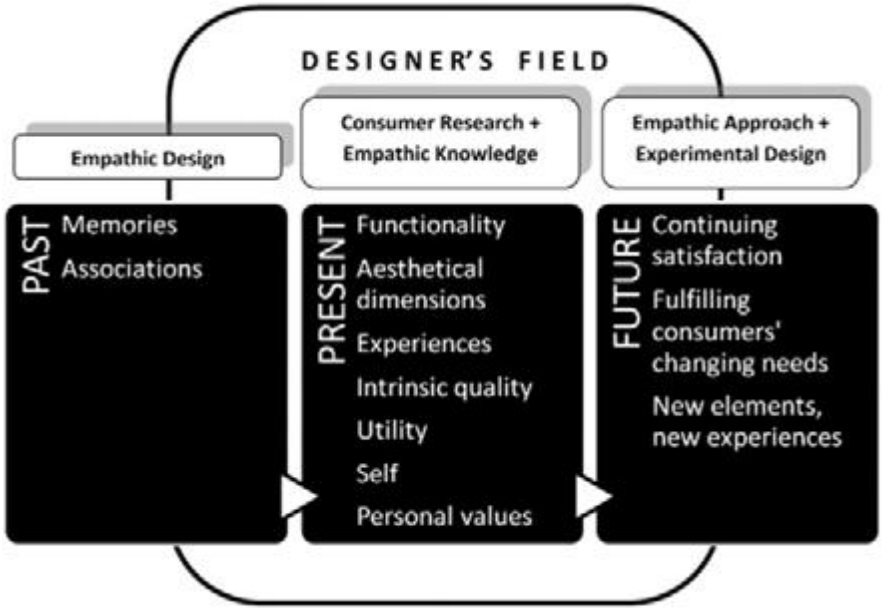

Figure 7: Framework for sustainable product relationships

As illustrated in Figure 7, the framework connects parts of past, present and future time to the field of design, thereby introducing elements of sacred time to the design process. Over the next few

sections we'll look more specifically at some aspects of "time in design" that potentially could be relevant for the formation of more specific strategies for such a framework.

5.1. Time as a reflection of the past – the lost qualities of design

Everything has an essence, but that essence is not necessarily intelligible to people. To access this essence, we must engage in "a painstaking effort to think through still more primarily what was primarily thought" [Heidegger, 1977, p.327].

Past time has many qualities; it relates to several aspects of our mental selves through memories, associations and knowledge. When speaking of the past time of products, an interesting notion is to what extent the former history of an object might affect the way it's currently perceived or used. In past communities common objects often served as talismans that embodied a greater sense of meaning, such as family ties or knowledge of a craft [Thorpe, 2007]. With modern society revolving around the fast paced consumption of convenient commodities, the bridge to the past, through our everyday products, seem to have narrowed. Both designers and consumers alike might therefore find reason to compare and inquire into which benefits we gain from the use of modern-day products and which qualities we seemingly have lost.

Charm represents one of characteristic that modern products seem to lack. To illustrate this point, Chapman refers to a citation on the relationship between man and his pet. "One of the greatest pleasure of owning a dog is its stupidity. What greater joy is there than

throwing a ball and watching him run after it until he realizes that you never let go? Or the way you can say anything at all to him, and as long as you use the right tone, he'll wag his tail regardless" [Chapman, 2005, p.49]. Such character and allure is hardly ever found in new products today as they are mostly designed and engineered to be as smart, precise and sterile as utterly possible. This struggle for predictable and flawless results has, since the coming of its age, represented a kind of unwritten law for the means of mass production. In handmade or customized products, on the other hand, there is generally a greater room for roughness and error, and thereby also possible surprises that can unfold as layers of narrative (see point 3a of Table 2).

In relation to mass production, the absence of distinction among products represents another lost quality. The identical repetition of mass produced goods leave behind a cloned sense of experience that that seem to make it easier for consumers to loose commitment to products. Despite this, it should be pointed out that mass production does not necessarily always result in the loss of a product's character. Much of Dutch designer Hella Jongerius' work, for instance, is centred on the idea of individuality; she makes products that seek to defy the appearance of mass production despite being mass-produced [Schouwenber, 2011]. Similar examples can also be found in product categories related to retro, re-use, or DIY-culture, but we will for the sake of limiting the scope of the article not bring such examples into this discussion.

Other categories of lost qualities include, as emphasized by Matthews, lost involvement and lost breathing space [Matthews,

2009]. The former involves deeper sensorial dimensions, preservation and transmission of knowledge, and describes how a lack of human participation in the use of modern processing tools may devalue both end result and experience of use. This point could on a general level refer to how for instance the digitalization of many services, such as the act of buying a train ticket, are limiting the interaction between strangers and therefore (theoretically speaking) also our sense of community. It could also be understood in the sense of devalued human product interaction. The convenience of present day products rarely requires users to get involved with anything but their obvious functionality. Cars (and other motorized vehicles) are among the last few things today of which we actually are willing to devote our time and effort to "look under their hood" [Matthews, 2009]. The argument that design suffers from a loss of breathing space derives from the overemphasized importance of immediacy in our lives. New solutions are almost solely made to do the job faster or more efficient than its predecessor; every micro pause is eliminated for the sake of instant convenience. Isn't it annoying when your browser uses three seconds to load instead of one? With little patience there will be little pause for thought, rigour and reflection, something that not only may raise the chance of serious mistakes, but also threaten to abolish the idea of anticipation [Watson, 2010].

5.2 Time as a natural process – beauty in decay

When speaking of time as a natural process, the idea of change is obviously an important factor. In a sense, the pace of natural change could also be considered as a lost quality. We've previously mentioned how excessive exposure to artificial lighting affects the

natural rhythm of the body, but you can probably list several other products or appliances that we also use to defy or control natural change in our lives. A familiar example is the regulation of temperature with heaters and air conditioners. In this section however, "the natural process of time" will mainly refer to physical change in products, such as through maintenance and wear.

For the modern product, the passing of time generally implies something negative: a derogatory manifestation of life coming to an end. As consumers we're continuously exposed to the rather dubious idea that our stuff will serve us best only when they are new and untouched – that the appearance of our products must maintain the virgin look and feel of something fresh out of the box. "The truth is that consumer products are 'new' only for a very brief moment when they are first removed from the packaging, but spend the great majority of their useful lives as 'used' products in the process of decay" [Labesque, 2011]. Chapman describes the initial phase of newness that takes place after a new product is acquired as "the honeymoon period". After the early stages of passionate subject-object relationship have passed and conditions of use return to normal, the product must still prove able to serve as a loyal companion [Chapman, 2005, p.63]. As discussed earlier, this is the part of "the story of desire and disappointment" (see Figure 2) in which many products suffer the fate of early obsolescence – something that evidently result in products being thrown away. In the process where products change over time, ungraceful ageing is a clear precursor to waste. Still, an embracement of the idea of ageing is not very common within the field of mainstream product design.

Wabi-sabi is a Japanese concept of aesthetic that is quite related to the previously defined realm of nature and sacred perception of time. As noted by Koren, the words "wabi" and "sabi" do not easily translate as their meanings have gradually changed over the course of history. The original meaning of "wabi" referred to the cheerless and dispirited emotional misery of living alone in nature. "Sabi" was originally used to describe something chill, lean or withered. Today, the words suggest a greater sense of positive aesthetic value, and are considered to be more or less parallel in terms of meaning. In general, wabi-sabi can be described as "the beauty of things imperfect, impermanent and incomplete. It's a beauty of things modest and humble and of things unconventional" [Koren, 1994, p.7].

The concept of wabi-sabi is rather comprehensive; it encompasses an integrated approach to both spiritual and metaphysical sense of knowledge and value, a state of mind, sense of morality, and materiality [Koren, 1994]. We will here concentrate on aspects that relate to the material qualities of objects. Koren presents seven key characteristics of things wabisabi: They are susceptible to influence of change by natural processes, earthy, irregular, simple, intimate, unpretentious and murky [Koren, 1994]. The first suggest that wabi-sabi objects are expressions of time; that they show a strong inherent character, a recorded history, of exposure to the forces of nature. Such processes may give objects an earthy looking appearance with rugged, coarse or unrefined characteristics. The irregularity of wabi-sabi objects, meaning the acceptance for oddity and distortions of form, is also related to this earthy sense of appearance. As of this, the degradation and contamination of wabi-

sabi objects represent a stark contrast to the western assumption of purity as a sign of rich expression. Simplicity, "the state of grace arrived at by a sober, modest and heartfelt intelligence", forms the core essence of character of all things wabi-sabi [Koren, 1994, p.72].

In the wabi-sabi universe nothingness marks the ultimate stage of simplicity and also the ultimate stage of tranquility. We can here again point to the differences between eastern and western philosophies. As Chapman argues "It takes supreme confidence and intelligence (of people in modern consumer societies) to not say and not do; yet this is frequently perceived as inertia and time wasting. To find beauty in nothingness and the tranquility of negative space is a true gift" [Chapman, 2005, p.156]. The next two characteristics are closely related to this perception of simplicity. An object is considered intimate when it's small, compact, quiet and inward-oriented. Intimate qualities "inspire a reaction of the physical distance between one thing and another; between people and things" [Koren, 1994, p.67]. In this sense wabi-sabi objects are also unpretentious, they appear humble and in coexistence with their surroundings, and are not demanding to be the centre of attention. These sort of non selfcentred characteristics are also predominant in Buddhist concepts, such as in "The Three Marks of Existence" [Wikipedia, a]. As a more careful examination reveals that in fact several ideas of wabi-sabi derive from Buddhist teachings, it isprobably not too absurd to consider such objectsas material representations of the religion. Lastly,wabi-sabi objects have a "vague, blurry or attenuated quality" that can be described as murky, both in terms of colour and appearance [Koren, 1994, p.71]. These characteristics also encompass the depth and richness in the shapes of darkness and shadow. As Tanizaki points out in his

contemplation on Japanese aesthetics; "...only in dim half-light is the true beauty of Japanese lacquer ware revealed" [Tanizaki, 2001, p.13].

The perception of beauty is clearly relevant to this discussion, but it's not within the article's scope to attain any greater philosophical depth of this topic. Nevertheless, when reflecting back over the past few sections we might see the recognition of beauty in ageing and decay as an essential step towards the acknowledgement of the complete cycle of nature and the qualities of sacred time. In a sense, we might even consider this acknowledgement as a fundamental aspect of eco literacy. However, for this part of the discussion it seems more relevant to contemplate the relation between the understanding of beauty and the practice of design.

When thinking of wabi-sabi aesthetic in design, people would probably envisage craftsmanship as the most apparent (and probably also the most appropriate) medium of expression. In the world of handicraft, the maker is an artist with the potential to embody poetic expressions in his work. The work of a craftsman can therefore provide rich narratives of both its materials, maker and cultural ways of use, or as Pye says it, serve as a "tangible link to the past" [Pye, 1995, p.84]. Although the strive for perfect materiality in the greater parts of industrial production seemingly limits the means of such expression, individual production characteristics alone don't necessarily form a strong point of subject-object relationship. As van Hinte notifies "the difference in affective value between industrially made products and hand-made ones is a romantic cliché" [Van Hinte, 2004, p.83]. However, the main point here is that expressions through craftsmanship,

especially in terms of wabi-sabi aesthetics, in fact seem to fit very well with the strategies for lifetime optimization (as listed in Table 1 and 2), and therefore hold the potential to enhance durability and defy obsolescence. This demonstrates that even though the frail nature of wabi-sabi objects might seem to contradict improvements in quality, we can still understand that something that is not perfect still can be perfectly functioning [Yanagi, 1989].

The last two sections of the article have emphasized aspects of past time, the weathered and the old – even so, this do not imply an affection for nostalgic design, but is rather a preference for objects that anticipate the process of ageing. As Chapman assures, "this is not to say that everything should be made out of wood and denim", nor is it a suggestion that all objects should be handmade or need to look and feel like they're old [Chapman, 2005, p.136]. Instead, it constitutes a request for products to embrace, rather than resist time – to embody a sense of future nostalgia [Van Hinte, 2004].

"At present, product ageing is dealt with in deeply genre-specific terms and therefore remains cautiously sequestered from the bulk of mainstream design... When ageing concentrates rather than dilutes the gestalt (...), we can see that the transformative nuance of decay can be utilized by designers to great effect, ensuring that products are free to age and evolve gently through the course of time, rather than falling ruthlessly out of favour the moment their glossy façades of newness begin to peel away" [Chapman, 2005, p.130-33]. However, ageing I understandably not always a positive or desired consequence of time. When we are hungry, we need fresh and edible food, and when it's cold we need a shelter that can withstand the forces of nature. If our products change in unpleasant ways or unfold into detrimental results, they can no longer be considered as

neither durable nor sustainable. In order prevent the arise such faulty outcomes, the objects need to be understood in the context of an evolving relationship with the user.

5.3 Time as the eternal now – the good product

The truth of art must not be pure correctness, to which the so-called imitation of nature is limited, but the exterior must be consonant with an interior, which is consonant with itself and precisely as a result is able to reveal itself as itself on the outside" [Kemp and Ueki-Polet, 2009, p.21]. The German philosopher Hegel speaks in these words of the problematic relationship between form and content, which seemingly is a question of honesty. If a product reveals it self as something different than what it initially presented itself to be, it surely has a greater chance of becoming obsolete. As indicated in earlier sections, much of the blame lies in the structure of our current economic system, which have made the production and marketing of deceitful products profitable. Still, we understand that telling the truth is an essential key to successful product design. For a subject-object relationship to surpass Chapman's honeymoon period, products cannot suppress their past, be untruthful in the present of use or deny their future. The truly good product is honest in the eternal now.

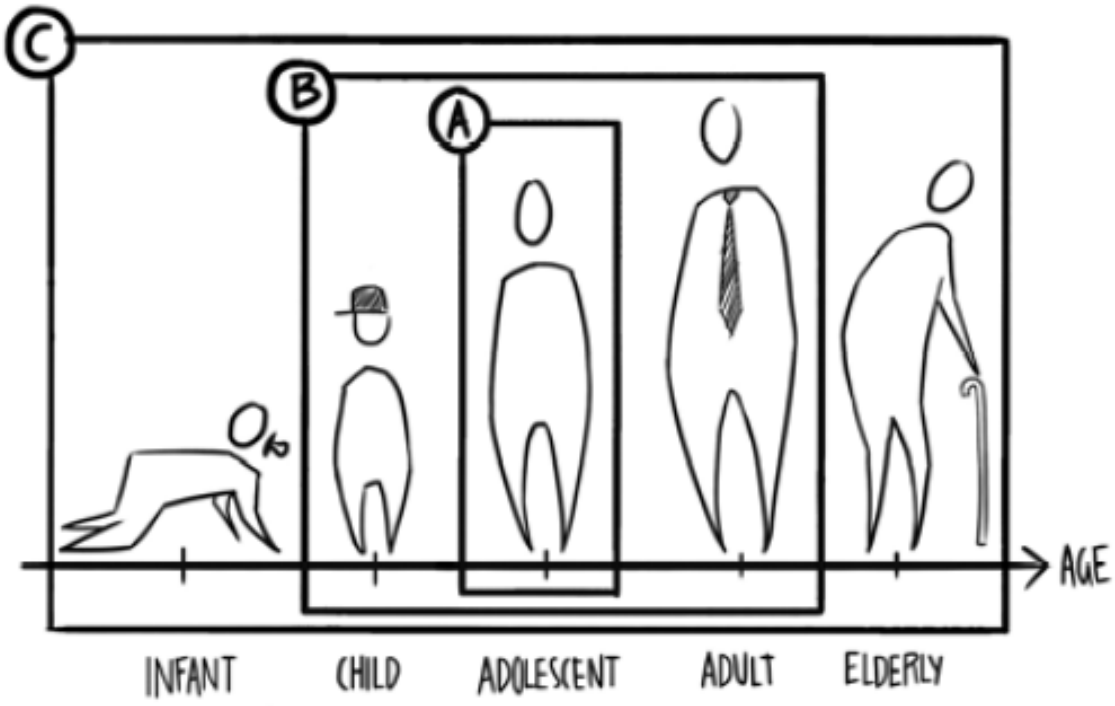

Figure 8: The lifetime of products

"Western society ignores and hates death, treating the old nudging near to it with dislike and scorn; the miserable moribund are 'the elderly', not for instance 'the elders'. It seems slightly perverse that we are devaluing old age at the point when people, in the West at any rate, are living longer and longer" [Griffiths, 2000, p.261]. Although Griffiths' statement might be somewhat bold and not necessarily compatible with our individual feelings, it points to the interesting coincidence of how we perceive the lifespan of most modern products. For the sake of understanding, consider for a moment the lifetime of a product portrayed as the lifetime of a person. Figure 8 illustrates this as five stages of a product's life, ranging from infancy to old age.

The greater part of all products we surround ourselves with, such as those smartphones from a few sections back, are shiny and

pristine at the moment of purchase, but will sooner than later degrade and quickly turn aesthetically, socially, technologically or economically obsolete. Such short-lived products are design to function and last only through the stage of "adolescence" (marked by box A in figure 8) – when the products' youthful appearances are at their prime and the their images are easy to sell. As such products show little or no ability to evolve or adapt to change; they are likely to suffer a sudden demise. Products within the borders of box B, on the other hand, are slightly more suited for evolving relationships with the user. Many tools or instruments, for instance, require an initial time of adaption through use before they'll provide a good grip for the hand or give the right sound when played (evolving form "child" to "adolescent"). Other products might allow upgrades or add-ons to improve functionality and make them better, or more "mature". The reader might probably think of several other examples that fit into this category of products, but finding objects that embody every single lifetime stage encompassed by box C is rather difficult.

Although it's not really a product in the normal sense, a (house) plant such as a bonsai tree (pictured in Figure 9) may, if grown from a sprout, be a suitable example for this category. While such a tree grows, the owner might through watering and other kinds of treatment observe and learn how the plant best can thrive in its environment. During the later stages of the tree's life, he might even decide to apply different techniques such as leaf trimming or wiring to influence how the tree grows, and to assure it will age gracefully [Wikipedia, b]. Due to the fact that plants are not part of what we consider to be usable objects, and that they must be kept under

supervision in order to survive, this example doesn't accurately render the character of the products encompassed by box C. Still, our example does indicate what kind of subject-object relationships products that embrace time as the eternal now might offer, and how these in the greater context might benefit both the environment and us.

Figure 9: A bonsai tree

A question that may arise from this section's illustrative depiction of the good product is how such an object can be identified. On this topic, Morrison writes; "I realised that certain less noticeable objects could over time become the object of daily choice by virtue of charm, stealth and efficiency" [Morrison, 2002, p.42-43]. The objects Morrison refers to are those that have been reduced to cultural archetypes. In this context, an archetype is a product that resembles a typical example of that specific product. We can also understand this with the following example: The corkscrew archetype is the kind of corkscrew that is as much of a corkscrew as a corkscrew can be – stripped down to the material representation of the fundamental essence of a corkscrew. Understandably, such products are therefore fundamentally normal. The phenomenon

Super Normal, coined by Morrison and his Japanese colleague Fukasawa, deals with objects that are designed to resemble this essence of the normal, and embodies a design philosophy that is rather different than that of mainstream design [Fukasawa and Morrison, 2007]. Rooted in the idea that it is the process of use and not the process of formation that bring out the quality of an object, Super Normal disavows the formalistic, gimmicky and conceptual approaches to design. As Morrison justifies: "Nine times out of ten you're better off with an ordinary corkscrew than a designer corkscrew just because ordinary corkscrews know what they are doing" [McGuirk, 2009, p.53].

Figure 10: A sample of Super Normal objects

Figure 10 presents a sample of the objects that Morrison and Fukasawa regard as being Super Normal [Fukasawa and Morrison, 2007]. When considering the above notions of how this category of products is defined, one might at first glance think of these objects as results of purely functionalistic or minimalistic approaches to

design. As the Super Normal design strive to find the "normal within normal", it's evident that both functionality and simplicity will serve as essential ingredients of the materialized results.

Though, what separates the phenomenon from such ideas is the fact that it also embraces the realm of the eternal now. "Super Normal is a place outside time and space... (it) defines the inevitable form that results from lengthy use of a thing... It is about how things work in relation to our living with them... The more we use a good object, the more we are able to appreciate its qualities, and we may discover its beauty not just in how it ages but in how we age with it" [Fukasawa and Morrison, 2007, p.99-111].

Objects that allow the formation of lifelong subject-object relationships will allow full play for narratives to unfold alongside knowledge or memories that might help us to retain some of the lost qualities of design. But if our products are to serve more like blank, workable canvases rather than fragile images of virginity, they must show honesty towards consumers and prove reliable as companions that encourage an introspective focus on the products themselves. As we've already seen, the latter is not the case for the greater parts of our material world, which emphasize on convenience and instant functionality before the experience of use over time. In relation to the topic of good products, focusing on the objects themselves can be understood as a vital aspect of (sustainable) design. According to Arendt, the attempt to return to the things themselves also serves a greater role for ability to perceive, and to navigate through the tangible world of matter [Arendt, 1982].

In the light of the current form of mainstream design practice, the maker's ego is probably one of the more threatening challenges in the task of designing the "realization of what's good in normal". As Morrison argues, many products today suffer from influence of the designer's ego, which might replace some of the objects' usefulness and even their ability to behave naturally [Morrison, 1996]. Considering that the marketing of both Morrison's and Fukasawa's designs are almost solely grounded in their fame and signature, one might find reason to question whether or not their products really find their way into everyday settings of use as Super Normal objects or end up as nick-nack in "designer homes". Regardless of the truth might be, it seems reasonable to state that the notion of Super Normal proposes an interesting approach to the consideration of time in design. The conflicting terms between marketing and the practice of design also raise another question: Where are the boundaries of the designer's responsibility? Several principles for design, especially Rams' Ten Commandments (presented in Table 3) summarize many of the key aspects discussed in this article and might therefore serve as helpful guides to the practice of good design [Kemp and Ueki-Polet, 2009]. Yet, few of these principles speak of which specific role the designer should enter in order to achieve this. The next part of this article will briefly touch upon some aspects of responsibility in order to relate time in design to the broader context.

6. THE RESPONSIBILITY OF DESIGN

"Design (at least the main part of it) has become a lazy and somewhat cosmetic practice that erodes consumer consciousness to nurture promiscuous cultures of more, more and yet more" [Chapman and Gant, 2007, p.4]. Based on the earlier discussions in

this article, we might to some extent find reasons to agree with Chapman – meanwhile we know that smaller sections of the design field (both on the official and nonprofit level) are working toward the implementation of different approaches and strategies that may steer development in a different direction. The questions remain though: Who will be guiding us through this age of transition? How much responsibility rests on the shoulders of designers? First of all, it is probably wise to limit the ambitions of each individual approach. As van Hinte describes, the purpose of the Eternally Yours Foundation is not to fully ensure that everyone's lives are re-organized in a way that can support life for generations to come. "All it wants to do is to try to find ways of turning down the noise of production and consumption by giving more attention to product quality, and by looking for different emphasis in economy that may contribute to establishing some of the conditions needed for a sustainable world" [Van Hinte, 2004, p.49]. As a first step along the way, this is probably also a suitable ambition for designers when they consider the aspects of time in design. Secondly, we should keep in mind that there is likely more than one answer to the question of responsibility. We should therefore not look for one universal truth, but rather ask: "In what ways could design help connect us to the past while also being mindful of the future?" [Thorpe, 2007, p.164].

6.1 The designer's role

"As I get older, I begin to see that designing is really about seeing, hearing, thinking and understanding at a higher level" [Ma, 2004]. It seems evident that one of the more important tasks of designers today is to see the elements of sustainability approaches, lifetime

optimization strategies and considerations of time as codependent elements of the greater whole, rather than individual one-stop procedures that will foster better product design solutions. In order to ensure this understanding, we might need to revitalize the idea of design in a way that designers no longer act as pushers that make what the market wants, but what the market should want [Thorpe, 2007], [Grawe, 2009]. Thorpe divides the challenge into three systems of change: policy, behaviour and technology [Thorpe, 2007].

In the system of policy, designers must represent economic "actors" that shape and respond to policies. Designers might not have strong political or economic powers themselves, but can surely influence decisions of such character indirectly through people's behaviour. Good design encourages the user to make the right decision –the handle on your coffee mug tells you to grab it and thereby makes you able to enjoy the warm brew without burning your fingers [Thorpe, 2007]. Good designs do "not only provoke astonishment, but challenge one to reflect on general expectations, codes of behaviour as well as the referential context of firmly established notions, and to review traditional fixations" [Somewhat Different, 2005]. An example of this could be products that enhance eco literacy. The third system of change deals with designers' ability to explore, invent or apply new technologies that can promote long-term sustainability.

In summary, the role of designers is clearly not to inhibit consumption, but rather to act as facilitators who'll guide the consumer towards the use of sustainable products that can satisfy their needs and provide fulfilling experiences –"Encouraging people

to pursue a rich life instead of a life of riches" [Hamilton, 2004, p.xvi].

6.2 Intuition, reason, head and heart

When speaking of a revitalization of the idea of design, we cannot forget about the actual codes of the practice itself. The overly emphasized strive for innovation, for instance, is one aspect that seemingly might conflict with the above notions of change. If the practice of design is to embrace the sacred qualities of time, it must first acknowledge that the law of balance between fast and slow systems in nature also apply to the material world. In this sense, the good product is therefore not necessarily grounded in the most original and exciting idea, but is rather the solution that best is in balance with both its role and designated environment – Faulty products and services might call for innovation, while evolution should assure that good products remain relevant.

Product lifetime is another notion related to the balance between fast and slow elements of time. Although the discussion of products in this article has revolved around the slower aspects of time, designers should by no means dismiss the whole idea (and great importance) of ephemeral design. If we were obligated to form comprehensive relationships with every product we needed or simply wanted to use, human life would likely have become rather inconvenient – Just think of all the things you interact with throughout the course of an ordinary day. Some objects simply serve us best when their lives are short, but if designers are to assure that they don't end up in piles of waste, such products must be intentionally planned for obsolescence and not unwillingly suffer from it [Burns, 2010]. If designers keep this in mind, design of

ephemeral products might not only provide us with healthier forms of convenience and efficiency but also promote a more sustainable technological development. This implies that strategic approaches grounded in nature's conception of waste, such as those derived from Biomimicry or C2C, seemingly will be of greater importance for the future design of impermanent solutions.

The understanding of time, for instance in relation to the beauty of wabi-sabi, is not easily conveyed through utilitarian means of expression or the words of language. Therefore, the main problem of considering time in design is likely much more an issue of practical implementation than a question of theoretical understanding. A part of the problem might relate to the fact that our intuitive modes of expression do not easily translate with the tools of industrial production, which only speak the language of numbers and measurements. As Albert Einstein once said; "It would be possible to describe absolutely everything scientifically, but it would make no sense. It would be without meaning, as if you described a Beethoven symphony as a variation of wave pressure" [Clark, 1984, p.243]. Certainly, the design of good objects does indeed require a logic sense of understanding. However, embodying spiritual or higher sense of meaning and value in such products cannot solely derive from a focus on knowledge, but must rather result from both planning and intuition – a balanced reasoning of both the head and heart.

7. CONCLUSION

"We purchase more products, but they bring us less joy. We move constantly, and even faster, but lack a destination. We congregate densely in cities, but yearn for a sense of community" [Van Hinte

and Bakker, 1999, p.2]. Is this the sad truth of our current way of living? Based on individual experiences, we will likely have different opinions on whether or not this statement gives a correct depiction of our lives. As a collective whole it's on the other hand rather evident that our present pace of consumption is unhealthy for both the environment and for us. In the struggle to conceive and develop more sustainable solutions, designers are currently deploying strategic approaches of several different sustainability frameworks. However, as many of these frameworks are criticized for not attending to the underlying causes of the problems we face, the confidence in sustainability as a term seem to have weakened – the impression left behind is that, despite their efforts, designers still continue to "supply growth-dependent economies with novelties for our ever-more-insatiable appetites" [McGuirk, 2011]. As this seems to be the case, why do we still keep making things? Don't we surround ourselves with enough stuff already?

Although the vast amount of material objects, that we so recklessly use and throw away today, indeed is contributing to the trashing of our planet, the act of consumption itself (which in fact is natural) is not really what we should blame. Instead of trying to prevent consumption, designers should rather think of better and safer ways to go about it. This includes designing for successful ways of meeting genuine human needs, optimizing the lifetime of products, and encouraging a greater focus towards the products themselves. As all these processes are closely connected to time and our perception of it, shouldn't designers to a greater extent consider the implications of such aspects when they decide what, how and why things should be made?

Time in design describes a holistic understanding of how deeper considerations of the interplay between people, nature and time can contribute to a better and more meaningful material culture. Contrary to many of the more symptom focused approaches to sustainability, considerations of time in design suggest striving for "good" design rather than the promotion of solutions that are "less bad". This state of affair would seem to call for a fundamental reassessment of mainstream product design, but as Leonard eagerly reminds us; "We can't transform the system of stuff unless we transform the way we think" [Leonard, 2010, p.103]. As the current speed of modern society leaves little room for thought and reflection, slowing down may be the first step towards a collective re-wiring of our perception of wellbeing and time. Such an enhanced sense of ecological literacy could aid societies in the transit from a mentality where affluence is measured by the production and consumption of goods to a more conscious state of being, which avoids irrelevant choices and instead values solutions that are better to live with.

Although several ideas of leaning towards such a transition are present in circles of both product designers, economists and others, sustainable design remains to this day an unresolved topic. However, we should not be disheartened by its complexity or the lack of viable answers. Change often comes in small steps, which is okay as long as we're heading in the right direction.

LIFETIME OPTIMIZATION: PRODUCT DURABILITY
1. High Quality – designing for reliability, resistance to abrasion and wear in terms of material selection, design and manufacturing. **2. Scripting – devising scripts for products to modify or guide user behaviour.** **3. Piggybacking – renew or enhance functionality of a product through the addition of a secondary device or component.** **4. Silent Performers – designing for silently operating products that only require user attention when they fail (such as smoke detectors and ceiling fans).** **5. Reassignment – designing for re-use of products, as their original function or with potentially new purposes (such as re-programming or DIY-customization).** **6. Upgrading and Adaptability – designing for flexibility in terms of product compatibility and use configuration.** **7a. Reparability – facilitating repair, maintenance and assembly/disassembly with an eye to consumer, manufacturer and retailer.** **7b. Transparency - designing comprehensible objects that people can learn how to repair and maintain.**

Table 1: Lifetime Optimization Strategies – Product Durability

LIFETIME OPTIMIZATION: EMOTIONAL DURABILITY
1. Graceful Ageing – designing to allow aesthetic degradation and patina of wear to enhance product value and quality through use and the passing of time (Graceful Ageing can this sense also be associated with the strategy of High Quality in Table 1). **2a. Signs – embodying self-expression, identity and the reflection of individual values in products.** **2b. Personalization – stimulating "irreplaceability" by allowing customization and creation of highly unique and personal products (including everything from manufacturer's customization to the true personalization possibilities and symbol of accomplishment from DIY self-design-making).** **3a. Layers of narrative – embodying multi-layered narrative experiences that allow interwoven narratives to be simultaneously recognized and revealed through exploration and discovery.**

3b. Co-design –perceiving the user as a co-producer of narratives, rather than a passive observer. **3c. Pace - adjusting speed and slowness to which narrative experiences unfold (through adaption of for instance access or frequency of use).** **4. Shared use – designing to simulate social contact through use of products.** **5. Luxury Products – designing high-end, premium positioned products that seeks to defy aesthetical, social, technological and/or economical obsolescence (including limited editions, handmade objects etc)** **6. Perfumed products – embedding odours, sounds or tactile properties to stimulate and encourage product related memories.**

Table 2: Lifetime Optimization Strategies – Emotional Durability

DIETER RAMS' TEN COMMANDMENTS OF GOOD DESIGN
1. Good design is innovative. **2. Good design makes a product useful.** **3. Good design is aesthetic.** **4. Good design helps a product to be understood.** **5. Good design is unobtrusive.** **6. Good design is honest.** **7. Good design is durable.** **8. Good design is consistent to the last detail.** **9. Good design is environmentally friendly.** **10. Good design is as little design as possible**

Table 3: Dieter Ram's Ten Commandments of Good Design

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Design for sustainable behaviour

A shift from user centred to user participation

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ABSTRACT

HCI is a field where usability and user centred design has deep roots. The designer's role has been seen as an impartial facilitator for easy, effective and enjoyable interaction between human and product.

Sustainable design, on the other hand, has previously had a strong bias towards the manufacturer's side, working with improvements in production, materials and ease of recycling. It is now recognised that user's behaviour plays an equally important role when it comes to reducing emission and energy consumption. Design for sustainable behaviour can be seen as a merging field between HCI and sustainable design that works to influence the interaction between users and products for a better environmental outcome. This article will give a thorough picture of design methods within this field. I will also discuss whether or not a user centred design process can lead to innovative and sustainable products/services. A shift from a user centred design process to user-participation is suggested, as this can be helpful for identifying the conditions for consumer adoption.

KEYWORDS: sustainable design, HCI, design thinking, user centred, mobile phone

1. INTRODUCTION

As a field, HCI have a special focus on usability and studying users' behaviour during the use phase. It is common to include end-users in both research and development of the product/system, ensuring the company to meet user needs and, when done correctly, create an effective, enjoyable, easy and interesting interaction. Sustainable design has on the other hand had an orientation towards production, materials and purchase behaviour on one side, and discarding behaviour and reuse of materials and components on the other side. Though designers working with sustainability often claim to take a lifecycle perspective, the use phase has often been limited to consider just the environmental performance of the product. Now designers have started to look into how making the user more efficient might be just as effective when it comes to reducing the use-impact. At the same time HCI has also started to look into sustainability, and thus designers from both fields are now working with design for sustainable behaviour. In this article I will look at design methods that are used within this field, and discuss two issues regarding which method are the most adequate for sustainable change within this field:

1) Should we focus on designing for behavioural change or is it better to make products and systems that adapts to the users' behaviour and habits?

2) Can a user centred design process be sustainable, or do we need someone (the designer) to take the "unpleasant" choices for us?

In the end I will argue why I think a shift from user centred design to user-participation can be helpful when designing for

sustainability; leading to more desired, acceptable and suitable products and services.

2. DEFINITIONS

2.1 Definition of sustainable design In 1987 The World Commission on Environment and Development defined sustainable development as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." [1] This definition will obviously have a different meaning to different people, but the fundamental idea is clear: to manage the earth's resources in such a way that it is ecologically sustainable over time, given the continued evolution of technology, and maintenance or improvement in the quality of life for people throughout the world.[2] In light of this definition, sustainable design can be seen as the design of physical objects and services that aims for sustainable development, with an emphasis on environmental, economic and social concerns.

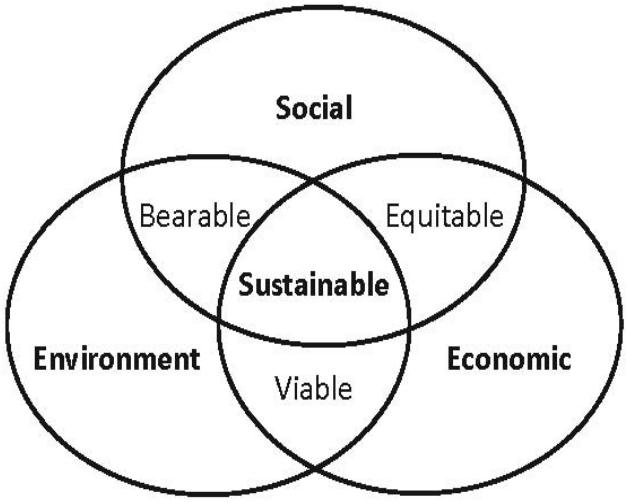

Figure 1: Sustainable development

There is no sharp distinction between environmental, social and economic sustainability, and all three domains overlap massively, and depend on each other.[4,13] This article will not try to set boundaries between the different aspects, but the main emphasis will be on the product's environmental impact.

Environmental sustainability can be defined as "the maintenance of natural capital" [3], and regards the use of renewable and nonrenewable resources and the pollution and waste assimilation throughout the life-cycle of the product/service. Although the focus is on the environmental aspects, this will be done without neglecting or compromising with the other aspects of sustainability.

Design for environmental sustainability have traditionally had a strong bias towards materials and technology, rather than focusing on more people centred aspects. [12] Sustainable design has been about how to lower impact by using less, and the right kind of materials, making the product easy to disassemble and easy to recycle. Other areas of focus have been making the product durable, modular, easy to repair, energy efficient and upgradeable.

Some traditional eco-design principles is mentioned in the table below.

- ***Low impact materials***
- ***Avoid hazardous materials***
- ***Cleaner production processes***
- ***Minimize choice and quantity of materials***
- ***Efficient distribution***
- ***Energy (and water) efficiency***
- ***Optimized Long lifespan***

- ***Design for disassembly***
- ***Waste minimisation***

Table 1: Eco-design strategies

In many ways one can say that traditional sustainable design have been more about technical improvements that can be "engineered out", and thus the territory of scientists, engineers and technologists, rather than product design and marketing.[14] When it comes to studying user behaviour, the main focus has been on purchase and discarding behaviour, and less about how the user interact with the product during use.

2.2 Definition of HCI

HCI is an acronym for Human-Computer Interaction, and is a discipline concerned with the design, implementation and evaluation of interactive computing systems for human use.[5] HCI includes desktop systems as well as embedded systems in all kinds of devices. The term "computer" must not limit our vision to regard just PCs and the interface of these. HCI can be found almost everywhere around us, and includes everything from the use of mobile phones, remote controls and DVD-players to taking out money from a cash machine or buying a train ticket on a ticket machine. Although the user interface is the primary element between users and computer systems, HCI is a larger discipline that does not only include the design of screens and menus.[6] HCI also deals with the reasoning for building functionality into the system, the consequences of using the system over time, the effect it has on the individual, group and society, and how to make these systems easy, interesting, efficient, effective, safe and enjoyable to use.[6][7]

3. Sustainable HCI

"As a field, HCI is largely oriented to the generation of short-lived consumer products and to the support of enhanced productivity. Both goals sustain an ethos of constant consumption."[8]

E-waste is the fastest growing category of waste in the EU, and grows about three times faster than the rate of normal household waste.[21] As consumption grows, to radically reduce resource use is becoming increasingly important. Whereas improvements in material use and production is crucial to reach a more sustainable development, influencing consumption patterns, how long people keep their products and what they do with them in the end-of-life phase holds the potential for more far-reaching savings.[16] In this article I have therefore put a special emphasis on the human-related aspects of sustainable design in HCI.

Both product design, technological development, the expansion into new areas of use and effort and costs of repair versus replacement all contribute to an increasingly rapid replacement and reduction of product lifespans. In addition there is a seemingly unstoppable attraction to new and novel products among the customers. [19] Since so many factors point to the direction of a unsustainable development, design for sustainability becomes an increasingly interesting, demanding and not least necessary task.

4. Design For Susainable Behaviour

Designing for sustainability is not just about designing products and systems, but to influence how these products and systems are used.[20] The increased focus on the environmental impact coming from how the users interact with the product, has led designers from

both the HCI and the eco-design field to look at how they can influence this interaction. Studying research in this field shows there are different views on how to approach the task.

5.1 Adapting products to users' behaviour

One option is functionality matching, which means to adapt the product to people's existing behaviour, and thereby get a better match between desired functionality and delivered functionality.[22] Functionality matching tries to minimize negative side effects, such as unnecessary energy consumption, trough creating a product better adapted to the human behaviour and not implying a behavioural change. By taking this approach you can normalize sustainability, and make it become something people do without reflecting upon it. The sustainable action becomes invisible to the user, and does not require them to make a conscious or deliberate decision to act differently to how they intended.[20] This approach clearly has both positive and negative consequences. The control to predict the outcome is given to the designer, and thereby makes it easier to ensure a sustainable result. It is a way of making sustainability effortless, and may therefore work well for those who are not motivated to do sustainable actions elsewhere. Positive experience with a sustainable product, for instance improved usability or saving money, may lead to greater acceptance of other sustainable products, also by those who are initially sceptical.

On the other hand it can be frustrating for a thoughtful user.[23] As functionality matching tries to adapt to an existing behaviour, it insinuates there exists a standard behaviour as a basis for your design. It is a well-known fact that user behaviour is as diverse as users themselves, and thus a lot of people will not fit into this

stereotypical behaviour. For the thoughtful user, functionality matching can feel like being forced. Trying to satisfy the largest possible number of people with one solution may also implicate that in reality one cannot have large changes, and hence limited environmental benefits. In this way functional matching becomes a way of "green washing" your product, when in reality there is potential for larger improvements in e.g. design for sustainable behaviour. Also, if the user is not aware of the sustainable benefit from their behaviour, it will not lead to positive side effects when considering their interaction with other products.

5.2 Design for behavioural change

An alternative to accommodating existing behaviour is modeling users, in order to make their behavior more sustainable. By taking this approach designers implement some guidelines or "scripts" into the product, in order to persuade, guide, steer or force the user to desired behaviour.[22]

Since the approach imply a change in peoples existing behaviour, one can say the difference from functionality matching lies in making the customer aware and in control of the change.Forced functionality/automaton is the exception, where the product is stll in control, but where the user is very much aware of being steered to certain behaviour.

How a user experiences influence is very individual, and will depend on both on the user's personality and the situation in which the influence is exerted. One cannot say that one solution will be suitable for every occasion, or for every person. It is important to

gain knowledge about users' behavioral pattern and motivation, but also the context your product will be in.

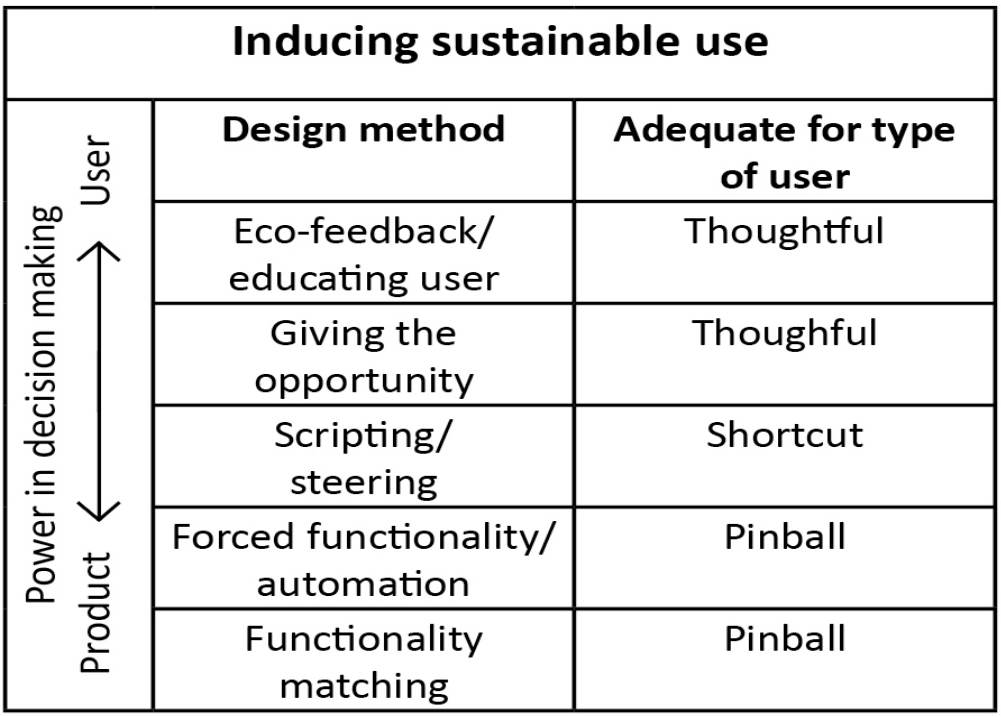

Figure 2: Inducing sustainable use

There will be physical, social, cultural and emotional aspects that affect how your product is experienced. In order to identify what type of influence and strategies that will be most effective, it is important to understand the relationship between collective and individual concerns and whether they conflict or coincide. The power of design lies in it's potential to bridge these concerns.[23]

5.3 Design for pinball users

Dan Lockton, a designer known for his work with "design with Intent", talks about three types of users; the pinball, the shortcut and the thoughtful. Designing for the pinball user you assume your users not to reflect much upon their behaviour, beyond basic reflex

responses.[24] In order to make their behaviour change the affordances of the system are designed so that only a certain behaviour can occur, hence the term forced functionality. The designer exerts a strong form of influence, which restrict users from doing undesired behaviour, and leave the decision to the product.

Thinking of the user in this way might seem a little harsh, but also when looking at it from a user centred point of view, it is not always a negative approach. It is often an acceptable approach in public and institutional domains [23], especially when it comes to safety issues and mistake proofing in situations where the consequence elsewhere can be fatal. It can also be a way of saving the user for unnecessary effort and thoughts, for instance if their concentration is required for other actions.

Designs for pinball users are more common in design for social sustainability than environmental sustainability. You also find that it often involves legislation or is implemented through government action. It can be a very restrictive way to influence, and therefore requires authority to be applied.[25] Examples of this forced functionality can be speed bumps on roads near schools and kindergartens, safety system in cars that makes skidding impossible or light bulbs that turns of if there haven't been movement in the room for a while. Forced functionality is often associated with automaton or sensors that detect the user's pattern of behaviour, and therefore can respond to it in an intelligent way.

In cases where it is a common agreement or a law that ensures the collective concerns are more important than individual freedom, forced functionality will most likely be accepted and seen as a good thing. But what is best for the collective, and thus on average also

for the individual, will not always be experienced this way by the single user, and can easily be overruled by other conflicting concerns.[23] If collective and individual goals collide, forced functionality can be experienced as intruding to the individual. By forcing behavioural change you have the risk of provoking significant reactance. [24] In worst case, a bad experience can lead to rejection of the product and an increased skepticism to other sustainable products. In this way what was initially planned to ensure a sustainable outcome can in reality lead to more unsustainable behaviour.

How the user experience the product is an important factor in the user's motivation to alter his or her behaviour.[23] A distinction between discouragement of undesired behaviour and encouragement of desired behaviour can be useful. Although guilt has previously been suggested as a motivation to make consumers behave in a more ecologically responsible manner [25], there is now a increasing recognition that guilt is not a sufficient motivator to change behaviour.[18] Encourage of desired behaviour, rather than a discouragement of undesired behaviour, can lead to a more satisfying experience. If the user change his/her behaviour as a result of interaction with coercive design such as forced functionality, they will most likely regard it as a reaction to the influence, and thus externally motivated.[23] A more implicit way to change behaviour, for instance by scripting or eco-feedback, might on the other hand lead users to feel they change behaviour due to internal motivation.

5.4 Scripting

The term scripting was introduced by Madeline Akrich in 1992 to describe the user manuals that are embodied in a product.[17] She highlighted the importance of distinguishing between the values inscribed by the designer and the values a user perceive, and to constantly evaluate the relationship between "the world inscribed in the object and the world described by its displacement."[17] Bruno Latour describes how scripts work in the relationship between designers, products and users as inscriptions, prescriptions and subscriptions. Inscriptions here describes the designer's intended effect on user behaviour, prescriptions are the actions a product allows the user to perform, and subscriptions describes how the user understands and handles these scripts. [15] In order for the user to gain motivation for behavioural change it is important that a individual concern is addressed. For instance; for a washing machine with eco-wash as a default setting the inscribed message might be "use Eco wash to save energy and water", while for the user, the main motivation will be "use eco-wash to save money". As Tromp et.al. States: "... a product can comply with collective concerns and can mediate the corresponding desired behaviour by addressing individual concerns in product use." [23]

5.5 Design for shortcut users

When designing for shortcut users you assume their primary interest is getting things done as easy, fast and effortless as possible.[24] As long as they don't experience any usability problems or a mismatch between their desires and the product's performance they will continue to use what is perceived as the easiest alternative. Because of this, scripting, steering and default settings often work well with

shortcut users. As a designer you assume your users to make decisions based on intuitive judgments and habits, and that they will recognize and respond to simple patterns and guidelines you design into the product. [24] The shortcut user is not necessary looking for the best way of doing something, but a way that works well enough. [10] It is therefore your opportunity as a designer to give them an easy access to a sustainable way of acting. It is a clear potential to steer and manipulate the shortcut user into a behaviour they elsewhere would not have choose for themselves.[24] When you influence is also of high importance. It is crucial that steering, information, feedback and reminders are given in real time, in order to alter their behaviour.

5.6 Design for thoughtful users

When you design for thoughtful users, you picture them to reflect upon what they are doing and why. Because they are analytic and reasonable, they are open for changing their behaviour if they are met with reasoned arguments.[24] One can say that instead of steering the thoughtful user, you are educating him. By giving users information and feedback about their behaviour and how this affect the world around them, they can make reasonable choices about changing their behaviour themselves. Eco-feedback and giving the user possible solutions for change are design methods that are suitable for the thoughtful user. As with shortcut user, it is also here important that information is given in real time, in order for the user to better see the link between his or her behaviour and the environmental consequences. Lilley et.al. questions the success of educational interventions in creating sustained behavioural change. [18] The failure, they say, may come from designers focusing on a

macro level, which many users cannot relate to emotionally or practically. There are few individuals that possess the ability to link global issues to their own behaviour, and it can therefore be difficult to realise the importance of a change in lifestyle and behaviour. It is therefore of high importance that information given to the consumer is clear and presented in an appropriate level to ensure understanding, and above all, it has to be relevant to the individual.[18] In addition the information has to be followed by clear suggestions on how they can change, in order to enable them to actions, not apathy.

As Dan Lockton states; most people want to picture themselves as thoughtful users.[24] If this had been the case it would have been good news for designers working with sustainable behaviour. The truth is, most people may act in this way only in cases where they experience that the addressed problem is of high personal relevance. Also, people are too complex to be characterized by only one of these behavioral patterns. We can all be both pinballs, shortcuts or thoughtful users, depending on the situation, the personal relevance of the problem and also how we experience the influence we are faced with.

5.7 Experiencing influence

Hassenzahl and Tractnsky describe user experience as "a consequence of a user's internal state, the characteristics of the design system and the context within which the interaction occurs."[9] In their article Design for socially responsible behaviour [23] Tromp, Hekkert and Verbeek worked with a classification of influence, based on intended user experience. They describe four

diferent ways to experience influence with basis on the dimensions salience and force. (see Figure 3)

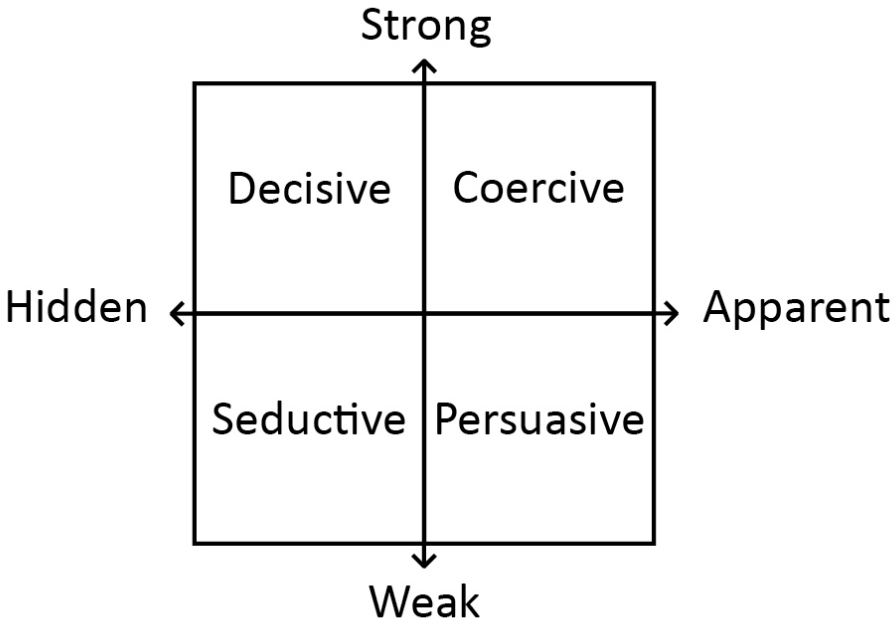

Figure 3: Four types of influence

The reason for putting a special emphasis on how influence is experienced is because this plays an important role in the effectiveness of the design intervention. To each influence they have made a set of strategies a designer can apply, and then focused on the relationship between the product, human behaviour and the implication of the behaviour, in order to clarify when and why to apply each strategy.

Coercive influence is strong and explicit, and can be related to forced functionality/automaton in Figure 2. It makes the user aware he or she is forced to certain behaviour, and examples of strategies are:

- **Make the behaviour a necessary activity to make use of the product function.**

• Make unacceptable user behaviour visible (shame).

• Create a perceivable barrier for undesired behaviour. Because of the power that lies in coercive influence, it is adequate to use when collective and individual concerns conflict, but only in public domains and when there is an agreement that the collective concern is more important than individual freedom. In private domains it is only acceptable to use this influence if the individual goals are in line with the collective. Persuasive influence is weak and explicit. The user is aware of the influence, but can decide for himself whether or not he wants to change as a reaction to it. If the user choose to change it is most likely experienced as a combination of inner and outer motivation. Examples of persuasive influence are:

• Provide users with arguments for specific behaviour.

• Suggest actions.

• Trigger different motivations for the same behaviour.

Persuasive influence can be linked to design for the thoughtful user, and eco-feedback and giving the opportunity in Figure 2. It is best applied when collective and individual goals correspond, and when collective concerns can easily be identified or experienced as a individual concern. As Lilley et.al also discuss, persuasive influence can fail to crete a sustained behavioural change. If the persuasive influence focuses on long-term implications, they can easily be overruled if they conflict with short-term maters. It is therefore highly important to address the short-term wins in order to keep the user motivated. Seductive influence is weak and implicit. This means the user may not be aware he is influenced, and a change in behaviour due to this infuence will most probably be regarded as

internally motivated. Examples of strategies for seductive influence are:

• Elicit emotions to trigger tendencies.

• Activate physiological processes to induce behaviour.

• Create optimal conditions for specific behaviour.

Seductive influence can be related to design for the thoughtful user, and giving the opportunity in Figure 2. As said, this is a weak form of influence, and is adequate in situations where there is inappropriate to use enforcement or explicit arguments. (E.g. campaigns to make people drive collective instead of taking their car.) Decisive influence is strong and implicit, and can be linked to design for shortcut and pinball users, and scripting and forced functionality in Figure 2.

The user might recognize he is forced to certain behaviour, but may not recognize the regulation as a intentional influence from the designer. Examples of strategies for decisive influence are:

• Trigger human tendencies for automatic behavioural responses.

• Make the desired behaviour the only possible behaviour to perform.

Decisive influence can be very powerful, at least if one makes the desired behaviour the only one possible. As discussed in design for pinball users, the application of such force may be limited, as it is not appropriate in private domains unless concerns coincide.

As Tromp et.al also admits, these strategies cannot been taken as absolute facts, that will guarantee that the user experience a particular type of influence. But the better you know your user, their

motivation and identify the context of the concern you want to address, the greater is the change of succeeding in creating the experience you want. Nevertheless, in the end it is not the designers intention but the users experience that will determine what kind of influence is exerted.[23]

Design method	Collective and individual concerns conflict	Collective and individual concerns are in line
Coercive	x	
Decisive	x	x
Seductive	x	x
Persuasive		x

Figure 4: When is each influence adequate to use.

6. Must the User Centred Design Process Be Rethough?

Robert Vergant describes a user centred design process as a way to create innovations by starting from the user, getting a good understanding of their current behaviour, needs and wishes, by for example thorough analysis of how they use existing products.[27] Donald Norman describes the mantra of the design research community as "Study people. Discover hidden, unmet needs. Fulfill those needs, and leap ahead of the competition."[28] And as he states, this research field is an important provider of knowledge for understanding human behaviour. It has led us to a greater understanding of users and how to satisfy their needs and demands that are indisputable valuable for creating better products.

But both Norman and Vergant questions if a user centred process is the most adequate when designing for innovation and sustainable outcome. By using Robert Vergant's own words: "User centred innovations have helped conduct us into an unsustainable world. The reason is sustainability is not embedded in the anthropology of our existng culture, society and economy."[27]

His proposal is that there are only forward looking, executives, designers and policy makers that can manage to introduce sustainable innovations, and that we need to step back from our current approach dominated by users' needs and existing behaviour, in order to envision new scenarios. This, he says, can create products and services that are both attractive, sustainable and profitable.

Dan Lockton also discuss if it can still be called "user centred design" as such, when the designer aim to change users' behaviour, rather than accommodating it. In his opinion, when the design change correspond with what users wants to achieve, it is still very much user centred design, whether enabling, motivating or constraining.[29] His opinion is that this is the best form of user-centred design, as it both support users' goals, but while transforming behaviour for a more sustainable outcome.

But what happens in the situations where user's goals and environmental concerns do not coincide? By taking a user centred approach it is easy to hide behind the fact that your solutions have become the way they are to support user's needs. Robert Fabricant sense a discomfort in the HCI community to influence behaviour, and that the user centred approach lead designers to feel the best design

allows users to fulfill their own goals, free from interventions from the designer. [26]

7. Conclusion

My opinion is that we as designers have both a great opportunity and a responsibility to shape the future and our society. If we want a sustainable development, the idea of a designer as a somehow unbiased person that only answers to users' needs and manufacturers demands must be rethought. I think Robert Fabricant raises a very interesting question when he asks: "If we, as a community, are not willing to invest some effort and yes, exert some influence, through the products and services we design, then exactly how will these changes come about?" [26]

As an answer I want to pose the question "is design ever neutral?" Are we not always exerting some kind of influence through the products and systems we create? But maybe most important, if we come to terms with the fact that we need to use our position to create some meaningful changes; how should this be done?

Part of the problem today is that sustainability doesn't have a voice of its own in the design process. Unless it is demanded through legislation or someone sees a potential for extra profit or increased sales, it is hard to drive the sustainable agenda as a designer. What in reality should be seen as a serious individual concern among all of us, may be hard to relate to, as long as it is not affecting us directly. This, I think, is where design has its biggest potential when it comes to design for sustainable behaviour. Design holds the potential to address these collective concerns, through the products and services we make.

Yes, we need a fundamental change, but one cannot expect this change to come by itself. We need laws that support a sustainable development. We need clear directions and goals, and clear sanctions if laws are not followed. Environmental legislation will set the standard for how companies can operate, and probably lead to products, services and systems that are both environmentally friendly and profitable. But on the way getting there, the designer's job is to make the road as smooth, enjoyable and meaningful as possible. It will be our task to transform sustainability from something you do for the good of humanity, into a meaningful activity for each one of us. We have to take our task as shapers of the future seriously, and yes, as Fabricant says; exert some influence in order to bring about meaningful changes.

That being said; if you want to become the voice of sustainability, and if you want to be heard, you first of all have to learn how to listen carefully. By shifting from a user centred design process to user involvement, you have the opportunity not only to fulfill user's needs, but doing it with a sustainable agenda in mind. When designing for change in people's behaviour, no matter if it is in their consumption pattern, the way they use their products or how they handle them in the end of life phase, involving them in this changing process should be the first step on the way. By involving the users in the creation of sustainable innovations, there is a bigger chance of acceptance and adoption of your solutions. Even though a thorough study of users and their behaviour can give you a picture of their needs and wishes, users are experts on their own lives, and should be treated as such. If you want to help them change their behaviour and lifestyle, they are the ones who can guide you to find out how

these solutions can fit into their lives. In this area I think users are a under-utilized resource.

It is a great opportunity not only to gain insight in their needs and wishes, but also in the physical, cognitive, social, cultural and emotional factors that affects how they experience the interaction with their products. To say it in Kumar's words: "If you manage to build innovations around peoples experiences, you can shift focus from products that people use, to what those people do – their behaviour, activities and motivations." To see behind the first obvious wishes and needs of your customers by constantly asking why people act the way they do , can help you create innovations that is not just better for the environment, but also for the user.

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Guidelines to Inclusive Design for the Hearing Impaired

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ABSTRACT

Designers, architects and decision makers pay little attention to the challenges and needs relating to hearing impairments. This is partly because it is an "invisible" impairment. Moreover, existing Norwegian standards are not good enough, thus making it difficult to create good requirement specifications when designing to include the hearing impaired in today's society. However, there is an increasing focus on inclusive design, and also on people with hearing impairments.

The research for this article seeked guidelines that include people with a hearing impairment. There are different kinds of hearing impairments, and people experience many different challenges and have various needs. This is a complex situation, and what is challenging for one person is not necessarily challenging for another. However, some guidelines can be put forward, that are positive for both people with a hearing impairment and those without. These can for example be good lighting, low background noise and clear signage.

It is concluded that today's guidelines are not complete and often fall to short. They miss important elements such as the need for visual alarms, and there is also a lack of quantitative requirements when it comes to inclusive design for the hearing impaired.

This article is aimed at industrial designers, architects and others that are involved in creating or making decisions on products, services, buildings and the spaces around us.

KEYWORDS: Hearing impairments, hearing loss, guidelines, inclusive design, universal design, assistive technologies, user involvement, people centred design

1. INTRODUCTION

There is an increasing focus on improving life quality and accessibility for people who have an impairment. Universal design, inclusive design and design for all are different terms, however with more or less the same focus - designing for the greatest extent of users possible.

For the visually and locomotive impaired, many of the challenges are quite obvious. Attention has been paid to improve life quality and accessibility for people with these impairments. Contrary to this, hearing impaired people seem to be easier to forget. They are able to climb the stairs to the university, and they can see the packaging of the products in the super market. Still, they encounter difficult incidents every day. The audio solutions implemented in today's society are also often discriminating for people who are hearing impaired.

According to HLF (Hørselshemmedes Landsforbund, The Norwegian Association of the Hard of Hearing) there are almost 700 000 hearing impaired people in Norway today.[1] This is the biggest group of impaired people in Norway[2] and about 200 000 use hearing aid(s).[3] From Norway's total population of 4 902 724[4]

this means that approximately 14% of Norway's population are hearing impaired, and 4% use a hearing aid.

In Norway, hundreds of young people permanently injure their hearing every year.[5] It is also common to experience reduced hearing ability from the age of 50.[6] Hence, most people will at some point encounter the difficulties of being hearing impaired, or knowing someone who is. By 2015 WHO estimate that there will be 1,1 billion people with a hearing impairment. This is approximately 16% of the world's population.[7]

Rocchesso et al claim that "Times are mature to think about sound as one of the main design dimensions of the environments in which we live and work. That means overcoming the sound-asnoise cultural barrier and promoting a sound-asinformation attitude."[8] Furthermore, they believe that when functionalities in a product are not apparent through the physical form or other visible indicators, sound can reveal these functionalities.[8] The internet used to be only text and pictures, but today an increasing amount of information is provided through different media. A video where the most important element is the reporter talking in the background, and there are no subtitles, will exclude people with a hearing impairment. This is what Daniel M. Berry, who has a hearing loss, fears when in his article he states that "I personally would prefer that computers stay with entirely textual and graphical interfaces."[9]

Standard Norway states that poor accessibility often is caused by the lack of quantitative requirements in requirement specifications. This may be due to lack of knowledge about how accessibility can be

incorporated into the development of for example web sites, and lack of knowledge of how to assure the quality of accessibility in the design process.[10]

This article aims to help designers, architects and decision makers understand the importance of having the hearing impaired users in mind when designing. It provides an overview of different hearing impairments, and the accompanying challenges, needs and existing solutions. It also intends to encourage designers and architects to include people with a hearing impairment in user tests.

1.1 The structure of the article

Section two introduces four different kinds of hearing impairments. In section three the challenges that people with a hearing impairment are facing are looked into. Their needs are explained in section four. Further, section five presents different existing solutions in terms of assistive technologies, alarms, acoustics and visual information. Section six looks upon the guidelines of today regarding their focus, what is proposed, and if they are used. Finally, some thoughts on user involvement are put forward in section seven.

1.2 Research methodology

The research has mainly focused on literature from 2000 and onwards. Older literature has been considered out-of-date as the focus on and hence development in the area has seen major changes in the recent years.

The different search terms have been "hearing impaired", "impairment", "hearing loss", "inclusive design", "universal design",

"guidelines", "design", "design for all", "user testing", a combination of these and the equivalent of Norwegian terms.

It was also necessary to contact organisations and companies focusing on people with hearing impairments, to establish if any guidelines on inclusive design for the hearing impaired existed.

2. HEARING IMPAIRMENTS

In this section the different kinds of hearing impairments are introduced. Waller and Clarkson define hearing as the ability to discriminate specific tones or speech from ambient noise and to tell where the sounds are coming from. This is a sensory capability.[11] It is important to understand that there are different kinds of hearing impairments, and people experience many different challenges and have various needs.

Phonak claims that only one third of people with a hearing impairment are elderly adults, thus most are of the age of school children, students and the work force. At the same time more and more young people experience a hearing loss, mainly due to high noise levels and listening to too loud music. Studies show that only one in five people who could make good use of a hearing aid are actually using one. People with a hearing loss normally wait in average 10 years before doing something about it.[7]

Skogen and Losnegård claim that being hearing impaired is a hidden handicap, and is still prejudiced against.[12] The term "deaf and dumb" is not accepted anymore. However, as people with a hearing impairment sometimes struggle to comprehend what is being said they risk being perceived as dumb. It is also known that many people with a hearing impairment try to hide their hearing loss, for

example by covering the hearing aid(s) with their hair. This could be due to the fear of non-impaired peoples' preconceptions.

2.1 Hard of hearing

Several studies show that of those people with a hearing loss, about 65% have a mild loss, 30% have a moderate loss and 5% a severe loss.[7] It is possible to be born hard of hearing, but it is also common to experience a hearing loss when ageing. See figure 1 for definition of the different losses. It is also possible to get a hearing loss at a specific frequency. This could for example be caused by a constant background noise at the work place, or from listening to a lot of music playing at the same frequency.

Many people with a hearing loss have problems hearing the higher frequencies. This makes it difficult to differentiate "s" and "f". This also explains why it can be easier to comprehend male over female voices.

2.2 Deaf

The Norwegian Association for the Deaf states that deafness can be looked upon in two different ways. Medically, people who have a hearing loss which is so profound that to comprehend speech is difficult even with a hearing aid or cochlea implant (CI) are referred to as deaf. However, there are people who identify themselves as deaf, but still have parts of their hearing left. Thus, it is culturally determined who is deaf, not the amount of loss in dB.[13]

Deaf people mostly communicate through sign language[13], and this is their mother tongue. Be aware that compared to Norwegian language it has a different grammar. Further, it is not an

international language, and therefore each country has its own sign language. Even so, many of the signs are similar, so when travelling it is to a certain extent possible to communicate. This is because the signs are often based on natural gestures.

2.3 Tinnitus

The regional centre for the deaf-blind at Skådalen Resource Centre explains tinnitus as an experience of a sound that does not disappear. Different Guidelines

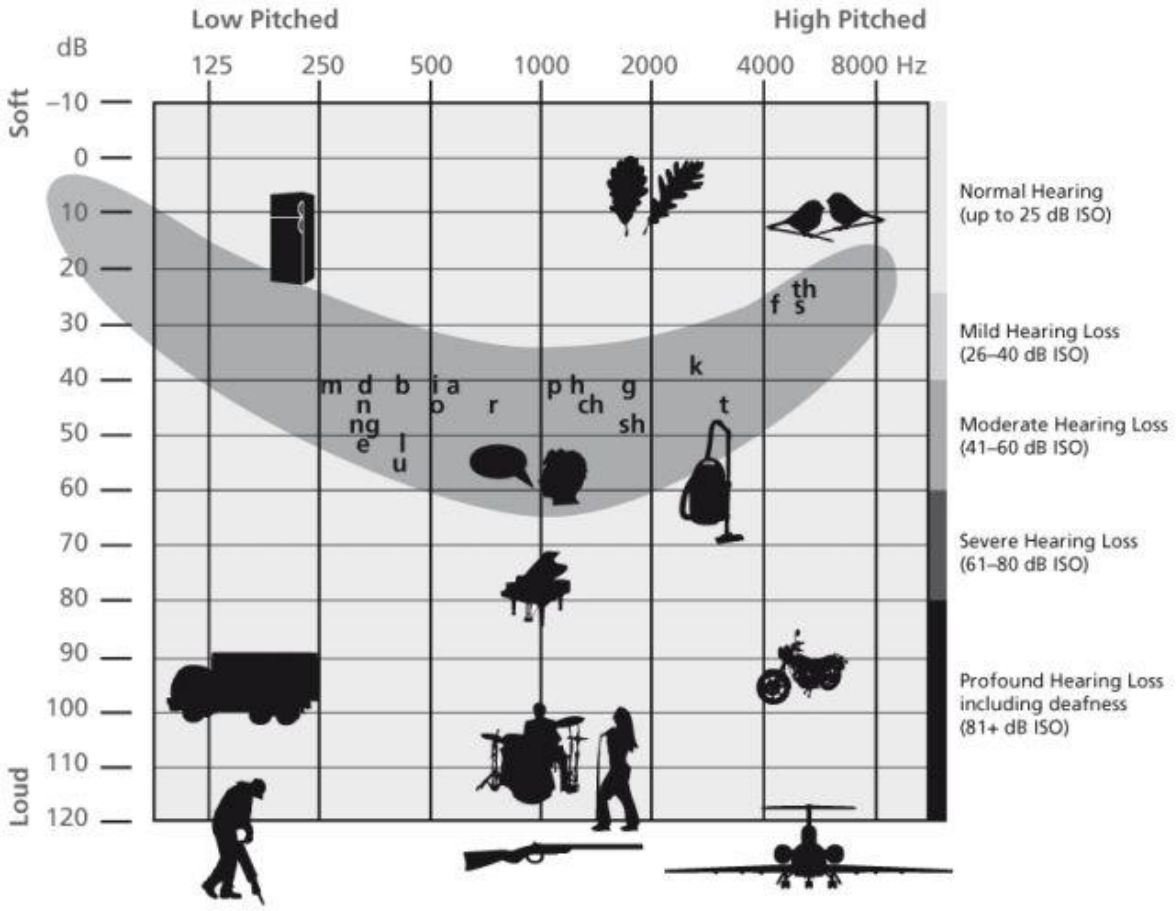

Figure 1: Hearing Loss

Different Guidelines individuals hear different sounds, like whistling, ringing, hammering or thundering with varying intensity. The sounds can develop over time, and loud sounds can come suddenly. They can be constant or fluctuating, and present in one or both ears.[14]

Tinnitus is normally caused by illness or injury in the inner ear.[14] This could be due to exposure of constant noise, or a shorter influence of loud sound. Concerts with a high volume or gun shots can be examples of this. To cope with tinnitus there exist exercises on relaxation, information and focus techniques and sound stimulation with a low background sound. There exists different aids that amplify the sound from the surroundings and make noise so that the person with tinnitus is not forced to listen to the tinnitus.[14]

2.4 Menière

HLF states that Menière disease can be recognized by strong and sudden dizziness attacks, sound distortion, the feeling of having your ears pop, or tinnitus. About 40 000 people have Menière disease or similar symptoms in Norway.[3]

3. CHALLLENGES

Clarkson et al presents sound detection, speech discrimination and sound localisation as challenges for people with a hearing impairment. Sound detection is the ability to detect beeps, tones and other sound output from various products. Speech discrimination is the ability to detect and understand speech in quiet and noisy environments. Sound localisation is the ability to tell which direction a sound is coming from.[15]

3.1 Physical Consequences

According to Skogen and Losnegård the hearing impaired listener can hear sounds fainter or differently than normal, can hear parts of what is being said, and can become hypersensitive to loud sounds.[12] Luck states that loss of balance is a common problem

for those with a hearing impairment.[16] Other physical consequences can be tiredness, exhaustion, headaches, dizziness and stress.[17]

3.2 Social Consequences

Even with a hearing loss which is not too profound, one can experience difficulties in groups where several people speak at the same time. A lot of background noise will also make it more difficult to discriminate speech.[13] Olaussen states that even with a hearing aid one is not "normal", and does not necessarily hear everything. This might lead to a fear of becoming revealed, or the feeling of being inadequate.[2] Because of hearing impairments people also experience communication issues. This can again lead to conflicts due to misunderstandings.

Berry states that: "What I hate the most is Interactive Voice Response (IVR), namely the automatic, recording-directed menu selection regime that is so common these days when one calls an institution."[9] This shows that some of the solutions today are excluding people with a hearing impairment. If there was an individual at the other end of the tube, it would be possible to ask for information to be repeated or rephrased.

Another issue for hearing impaired people is knowing whether they should stop working and be involved when new people arrive in a space. One of the test persons in Luck's studies comments that: "It is often difficult to concentrate when there are many activities within a room. It is easier to concentrate when there are just 1 or 2 people within a room, perhaps we need areas for sole working."[16] This statement explains why many people with a hearing impairment

choose isolation. It can be tiresome to all the time worry if other people are trying to communicate with you. This takes up a lot of energy, and corresponds well with Olaussen comment on the fear of becoming revealed.

3.3 Aesthetics

Bodil Ravneberg claims that aesthetics and design is underestimated when it comes to the development of technical aids. The design of the aids is significant for the hearing impaireds' self-understanding and identification. Furthermore, the aesthetics can result in the technical aid being used or not. There are examples of visual alarms based on light that has been dismounted because the user was not satisfied with the shape. This indicates that a lack of aesthetic focus can result in dramatic consequences.[18]

3.4 Language

Hearing impaired people often struggle to follow conversations between more people, and they also do not pick up "free" words and information like non-impaired people. As a consequence, hearing impaired people often have a minor vocabulary than non-impaired listeners.[12] For many profoundly hearing impaired people sign language would be their mother tongue. Therefore, a written language appears as a second language, and thus more complicated to understand.

Gappa and Nordbrock found in their studies that 67% of the hearing impaired users would prefer only 1-3 lines per text block in the design of web sites. They also point out that all jargon should be explained in a glossary, preferably also available in sign language for deaf and hearing impaired people. Furthermore, they notice that

web pages requiring extensive reading can be hard to follow for hearing-impaired users. Therefore, it can be helpful to have short sentences that include only one idea. Also sentences formulated in active rather than passive voice are easier to understand. [19]

4. NEEDS

4.1 Good Lighting

The visual impressions are enhanced when you have poor hearing. Therefore, hearing impaired people use their eyes to a greater extent than others to collect information.[20] As a support to understanding speech, it is crucial for people with a hearing impairment to be able to read the lips of the person whom one is talking with.[21] Consequently, it is important to be positioned so that one is not blinded by any light, while the person talking is well-lighted.

4.2 Low Background Noise

As mentioned earlier, a lot of background noise will make it more difficult to discriminate speech.[13] Thus, architecture that provides good acoustics would be of great benefit. Also, it is more likely that a big room filled with people will be noisier than a smaller room. Hence, smaller rooms would often be preferred by people with a hearing impairment.

To limit sounds created by other individuals is important. This could be teaching children in school to speak one at a time or to put protection on the legs of chairs to reduce noise when moving chairs.
Visual noise can be disturbing for people with a hearing impairment. As they use their eyes much more to follow what is happening around them, visual noise can have a negative impact on their

concentration.[22] Hence, to reduce this disturbance a shielded room, or the ability to shield working areas can be efficient.

4.3 Aesthetics

Ravneberg states that young people with a hearing impairment are not necessarily concerned about the hearing aid being skin coloured. However, they will often use it as a means of expressing their identity. Thus, a technical aid that satisfy the user's aesthetic taste can make it easier to identify with the impairment in a positive way.[18]

The wheel chair that traditionally has been associated with a medical understanding of impairment, related to illness, injury, defect, passivity and dependence is one of Ravneberg's examples. Ultra light, high-tech and smart designer chairs give people a different identity, and it disengages the chair from the medical connection.[18]

5. SOLUTIONS

Looking upon current assistive technologies, Naess and Ortsland found that they can be stigmatising as they often embody a "neutral" or "for all" aesthetic. [23] Furthermore, solutions for people with a hearing impairment might be a challenge for others, such as people with a locomotive impairment or allergy. Øderud and Kvam points out that a carpet on the floor would have a positive impact on the noise level for the hearing impaired, but could become challenging for others.[24]

5.1 Assistive Technologies

There exist several assistive technologies for people with a hearing impairment. However, this needs to be installed, looked after and people need training in operating them. The systems can also be costly to install in an existing building. As the technologies like for example t-coil loop is not standard everywhere, it needs to be clearly marked when available. In this way the hearing impaired person can use the technology when needing it. The resources beneath are the most common resources available (in Norway). Other technical aids also exist, like the "Cushion Loop" which is designed for home use.

Hearing Aid - Hearing aids are the most common assistive technology.[22] However, they amplify the background noise indiscriminately, and hence are least effective in noisy environments.[15] Further, they have limited usability with distances exceeding two meters.[25] Nevertheless, they make it possible for people to make use of t-coil loops, FM- and IR-transmitters. In this way they can make audio information that would otherwise not be accessible possible to get hold of.

Cochlea Implant - A cochlea implant is an advanced form of hearing aid[14], but functions quite similarly.[22] After such a surgery, deaf people can hear sounds, but have to learn to hear through exercising.

T-coil loop - Induction or T-coil loops transmit sound directly to a hearing aid. When set to receive only this signal background noise will be eliminated.[15] The person with the hearing impairment can

adjust the volume of the sound output on the hearing aid. This can be useful when watching television as it is not necessary to turn up the volume for the hearing impaired person to listen. If putting both hearing aids to t-coil setting, this means completely shutting out all other sound. However, on some hearing aids there is a mixed setting, combining the sound from the t-coil and the surroundings. Some hearing aid users also put one hearing aid to t-coil setting, while leaving the other to the normal setting. In this way it is possible to hear if someone is trying to make contact. A problematic aspect with this system is that a t-coil loop may interfere with other nearby loops if not installed correctly.

Loudspeaker - A loudspeaker amplifies the sound from the most important sound source. This is a good solution for people with a smaller hearing loss.[22] Especially for all the people with a hearing impairment, who are not using a hearing aid, it can be essential with loudspeakers to be able to comprehend for example a speech.

FM transmitter - An FM transmitter is a speech amplifier that consists of a small microphone which the speaker can put around its neck, and a receiver to put directly onto the hearing aid (microlink) or connected to the hearing aid through a mini loop. The intention of the system is to transfer the speaker's voice with a minimum of noise to the hearing impaired listener.[21] However, if this system is used in a noisy room, the microphone will also pick up these sounds, and send them to the receiver. In rooms where a t-coil loop is not installed this system can be used. [22]

IR transmitter - With an IR transmitter the sound is transferred from the sender to the receiver through infrared light. The system

will not interfere with similar nearby systems. An IR transmitter works with hearing aids and can be used instead of a t-coil loop. [26]

5.2 Warning Installations

As sound can be difficult or impossible to perceive for the hearing impaired, alternative means of signalling is used. A blinker lamp notifies the hearing impaired by light instead of sound. To awake and notify hearing impaired people there are also vibrators that are connected to the alarm clock, door bell and smoke detector.[21] When travelling, a vibrating alarm clock might be available on request. However, this implies exposing the impairment.

A Norwegian newspaper points to an example of a deaf person staying in a hotel with only auditory alarms, who did not wake up when the fire alarm sounded. As the staff failed to remember him, he did not evacuate the building like the rest of the guests. [27] This shows how fatal not having alternative alarm methods can be.

5.3 Visual Information

If the hearing sense is reduced, it is important that visual information is available. For example, clear signage can be very helpful for the hearing impaired, as one does not need to ask others for directions. Moreover, clear signage is not only positive for the hearing impaired, but also visually impaired and nonimpaired people. Thus, good conditions for people with a visual impairment can be good conditions for people with a hearing impairment.[28]

As sign language is the mother tongue for many profoundly hearing impaired, it could be useful for them if more sign interpretations

were made accessible through video. This could be sign interpretations on screens presenting information in public areas or media files on web sites.

As previously mentioned, loss of balance can be an effect of a hearing impairment. By implementing strong horizontal features or horizontal bands of tiling within spaces this can easily be assisted.[16]

5.4 Acoustics

According to HLF it is possible to improve the acoustics in a room by putting up roofing sheets that deaden the noise. Increased uses of textiles and thick curtains also have an effect. Putting tennis balls or wheels on chairs or table legs reduces potential noise tremendously. Integrated wall absorbers will also create a silent space. A soft cover on the floor will limit sound, also from the floor above.[22] All these actions will reduce background noise, and hence improving the conditions for both hearing impaired and nonimpaired people. Teachers with a hearing impaired student in their class report that the improved acoustics and the use of technical equipment in the classroom are of benefit to everyone. Their working conditions are also better.[22]

6. GUIDELINES

In much of the design literature regarding inclusive design [29, 30, 31, 32] we find little or no guidelines on what to keep in mind when designing for people with a hearing impairment. The most thorough introduction to user capabilities was found in the book Inclusive design toolkit by Clarkson et al. They provide information on vision,

hearing, thinking, communication, locomotion, reach&stretch and dexterity.

6.1 Focus

Both in Norway and internationally, stricter laws are introduced when it comes to universal design, accessibility and anti-discrimination.[33]

HLF has made five short videos to inform about
acoustics, lighting, universal design, visual information, pedagogics, technical aids and the benefits for everyone of good sound. These videos are accessible at www.godlydiskolen.no, and thus available for a wide audience. They provide important information about necessary adjustments to include children with a hearing impairment in the school environment.[34] Furthermore, HLF has created a guide for accessibility that looks upon how to create an accessible society for people with a hearing impairment. Information about accessibility to buildings, public transport, hotels, culture, the public health service, schools, universities and kindergartens is provided. Furthermore, there is focus on acoustics and alarm signals.[35]

The Norwegian Directory of Health provides two relevant brochures, namely "Hotels for all" and "Restaurants for all". They focus on guests with visual, locomotive and hearing impairments and allergies or asthma. The brochures give a quick overview of which areas that can be problematic for the different groups, and what it is important to improve.[36]

The Norwegian Directory of Health has also put up the web site www.ingenhindring.shdir.no. There are examples of good products and architecture, and there is also possible to see a video of a specific case through the eyes of a person with a hearing impairment. When it comes to the products presented, it is mainly the mobile phone, the internet and signs with symbols that are relevant in terms of hearing impairments. The examples of good architecture emphasize the use of t-coil, but there are in general no comments on the acoustics. However, it is mentioned once when looking at the universally designed home.[37]

The Norwegian Design Council provides careful guidelines of how to user test, and writes about lead users and focus groups. However, there are no specific guidelines on what is important to keep in mind if user testing a hearing impaired person, or that focus groups might not be a suitable solution for this user group.

"Unge funksjonshemmede" has put out some practical ideas for inclusion.[38] As this is an organization that is working to include young people in society, they do not provide quantitative guidelines on buildings or products. Their focus is on how to create inclusive meetings and activities. Even if the main target group is young people, many of the guidelines are important for everyone with a hearing impairment. If followed, it will most likely also create a better meeting atmosphere for others. It can also be seen as good communication guidelines. Hence, many of the points can act as a guide to be read before user testing people with a hearing impairment. The organization work to influence politicians. However, it is not clear how they distribute the information on the web site, or

if they work toward other areas. Are designers or architects aware of the organization, the web site's existence or the guidelines provided? This will be discussed later in the article.

6.2 Design Guidance

The seven principles of universal design[39] are as follows:

1. Equitable Use

2. Flexibility in Use

3. Simple and Intuitive Use

4. Perceptible Information

5. Tolerance for Error

6. Low Physical Effort

7. Size and Space for Approach and Use

There are also 29 associated guidelines. However, these are very general sentences like "This product can be used without hearing.". Hence, using these principles extra knowledge about the needs of people with a hearing impairment will be necessary to evaluate products considering this group.

Persad and Langdon provide a good introduction in their chapter on hearing in the book Inclusive design toolkit.[15] They look upon the physical description of the ear, the major hearing functions, and the environmental context. Furthermore, the following design guidance is put forward:

· Provide adjustable volume levels where possible, failing that, ensure sufficient loudness for the ambient noise level.

· Ensure that the frequencies of beeps and tones are within the range 800 to 1000 Hz in order to maximise the number of people able to detect them.

· Use natural recorded speech in preference to synthesised speech, and avoid high pitch speech.

· Use intonation, an appropriate word rate and clear pronunciation to help speech recognition.

· Think about assisting those with hearing impairments by supplementing information through visual or tactile means, with due consideration for information overload.

· Think about enabling the user to customise the tone and volume of auditory outputs.

· Consider using sounds that contain multiple frequencies to help people determine where the sound is coming from.

· Think about providing inductive couplings to assist communication with hearing aids.

· Contemplate sound reflection and reverberation when designing environments and spaces.

· Ensure that systems that transmit and reproduce speech do so with sufficient clarity.

Persad and Langdon also suggest that if speech output is interesting, a male voice should be used as it generally is of lower pitch and is within the range of hearing.[15] They also comment that sound localisation is important when interacting with products that warn the user or indicate where they are utilizing sound. Lights, motion or vibration can also assist in localizing a product.[15] However, there is no emphasis placed on the needs of people with a hearing impairment when it comes to lighting conditions or acoustics. On the other hand, when focusing on the environmental context, they (Persad and Langdon) claim that increased

reverberation affects people of all abilities, but affects those with reduced hearing ability to a greater extent.[15]

Laberg et al. have created a booklet that focuses on how to create and situate a self service machine that should be accessible for all.[40] Below are the ideas that are of most importance for the hearing impaired user:

· It is better to position a machine against a wall than placing it in the middle of the room. It will make it easier for hearing impaired people to comprehend auditive feedback.
· If the machine is situated in a noisy environment, like a train station, it should be carefully shielded against the noise. This is even more important if the user is dependent upon auditive feedback.
· It should be clearly indicated (on the machine) if it is possible to use the t-coil loop.
· If privacy is not protected in any other way, it must be possible to connect headphones to the machine.

In the back of the same guide there is a list with checkpoints to control if the machine is easy to find, access, and use. This list includes relevant questions to assure that the machine is also possible to use for people with a hearing impairment.

Standard Norway states that the Norwegian standards NS 11001 -1 and NS 11001-2 have planners and designers as their main target group. The standards are focused around five themes; locomotion, vision, hearing, cognitive ability and environment. The conditions related to locomotion are mostly measurable. There is also a lot of good documentation and deepening on visually impairment. The remaining themes are at the moment lacking agreed criteria as a

basis for norm setting. In the standards this is solved partly with requirements that can be documented and partly with recommendations.[41]

The existing standard on acoustics, NS 8175, is being revised to see if any criteria need to be changed when taking universal design into account. The current limits do not cover the need for speech recognition, sense of direction, and communication for visually and hearing impaired. Other kind of acoustic criteria, including criteria related to deck to ceiling height, are being discussed.[41]

6.3 Application

According to studies of Hall and Imrie many designers were assuming a knowledge and understanding of environmental issues for disabled people which they did not have.[42] Hølmebakk also discovered in her interviews that architects claiming they fully grasp the concept of universal design appeared to seldom think of people with a hearing or visual impairment. There seem to be less consciousness among architects when it comes to the non-visual elements such as acoustics and tactility. For them accessibility and universal design is connected to wheel chair users and their requirements to area and different levels.[43]

Gill states that even though the World Wide Web Consortium's Web Accessibility Initiative (W3CWAI) guidelines are very well known, they are not frequently applied. A number of web sites are inaccessible; hence the guidelines are widely ignored by commercial organisations.[44]

6.4 Alternatives to Audio Colour

Chan and Ng states that international guidelines and standards are available for designers to follow when using colours (ISO 3864-1: 2002; ANSI Z535.1-2002). However, cultural and geographical factors may affect designer preferences and user perceptions for colours.[45]

Chan and Ng further claims that for memory coding and message recognition colour is particularly useful.[45] This corresponds with the studies of Gappa and Nordbrock where they found that 100% of the hearing impaired users understood colour coding as helpful in order to highlight key information and differentiate between different types of information. 100% also stated graphics, and in some cases video clips, to be very important to facilitate comprehension of the information presented on a web page.[19] The subway in Fukuoka City in Japan is a good example of the use of colour coding in big scale as every station on the line has its own colour. This simplifies the transport also for the hearing impaired travellers as they are not dependent on hearing the name of the station over the calling system, or reading the name of each station.[46]

Chan and Ng also found that people associate different alerting colours, flash rates and flashing modes with different levels of danger. The red flashing light was perceived as the most effective hazard warning colour, with yellow and blue warning lights indicative of less hazardous situations.[45]

Light

When focusing on self service machines Laberg et al. states that it should be a minimum of 400lux lighting at the control panel and on

all information provided. In some cases external/local lighting is sufficient, but this needs to be considered in each case. If there is not sufficient lighting, additional lights need to be installed in the machine.[40]

Laberg et al. also provide guidelines on the use of light as a guiding tool. They propose that light diodes can be implemented to show that a button or area is active, and to show where the next action is going to take place. Furthermore, a constant light can show a continuous situation and a flashing light a new situation or warning.[40] Thackray and Touchstone found that flashing was superior to colour alone in attracting attention to objects in a display.[45] Moreover, Chan and Ng found that the faster the flash rate, the greater is the hazard perceived. A flash rate of 240fpm (flash per minute) was the most effective.[45]

Vibration

Luck states from her studies that for people with a hearing impairment vibration is important as an alerting mechanism for movement such as when someone is approaching.[16] Tactile feedback can also be of benefit for everyone. Studies by Hogan, Brewster and Johnson or Chang and O'Sullivan indicate that touch feedback in touch screens both increases productivity and make products easier to use. Additionally, user experiences are more satisfying. They added consistent sets of audio/tactile feedback to touch screen visual buttons, and hence demonstrated that both the users' preconceptions of how the button should feel and sound was met, and also the perceived quality of the button was improved.[47]

7. USER INVOLVEMENT IN THE DESIGN PROCESS

Irene Olaussen did her doctoral thesis on the interaction between people with a hearing impairment, technologies and the surroundings. Olaussen states in an interview that user involvement is often used when looking upon the cosmetic part of the hearing aid. According to several big producers of hearing aids the users are seldom included in the problem definition phase. Olaussen claims that if the focus was put more on the users' social challenges, and not the technological possibilities, one might discover that the technology is not always and necessarily the solution for people with a hearing impairment.[2]

7.1 User Testing

Eikhaug et al. claim that involving lead users in the design process can be very useful. Lead users are people who demand more from a product, system, service or environment and therefore challenge it in ways beyond that of the average mainstream user.[46] However, as people with a hearing impairment can have difficulties understanding and communicating, special care has to be taken when carrying through a user test. Berry expresses that it is important to remember to face the person, and not to cover one's lips.[9] Eikhaug et al also suggest that group interviews are not suitable for those with poor hearing.[46]

Who to test

If it is a product which is not only going to be operated by a person with a hearing loss, it is important to user test other relevant users as well. It could for example be people working in a conference centre who have to know how to check and operate the t-coil

system. Adults taking care of children using hearing aids also need to be capable of monitoring the hearing aid.

7.2 Impairment Simulators

At www.sansetap.no[48] the hearing simulator gives an impression of how it is to experience only speech, speech with background noise or music with a moderate or severe hearing loss compared to non-impaired hearing. There is also a hearing aid simulator which indicates how sound is perceived by people using a hearing aid. It clearly shows that the sound picture is not the same as for people with nonimpaired hearing. This web site is aimed at employees working with elderly people, and relatives to elderly with a vision or hearing loss.[6] Similarly, research within Cambridge University has developed software that can simulate a variety of vision and hearing impairments. These simulators are available on www.inclusivedesigntoolkit.com. To simulate hearing conditions such as the natural deterioration caused with ageing an audio file is modified. In this way it is possible to compare different sounds and see how they are affected by the loss. The effect of the ambient background noise can also be appreciated.[15] The simulators are intended to reinforce the need for bringing real users into the design process, and are thus not a substitute for working with real users. Hosking et al. claims that used correctly, these can open people's eyes to the reality of capability loss.[49]

8. DISCUSSION

Hearing impairments are very complex, and it is therefore difficult to create a complete overview of which solutions that satisfy which needs. A solution that is essential for one person might be superfluous for another. However, solutions and guidelines on noise

reduction, lighting and visual information are of benefit for everyone, and essential for many hearing impaired. Table 1 provides an insight into the needs of people with a hearing impairment, why they have these needs and suggestions to how these needs can be met. The table is not complete, but can act as a starting point for designers and architects. Quantitative requirements that can tell what vague guidance like "good" lighting signify, is lacking.

There exists, more or less, thorough information on which challenges people with hearing impairments meet, and what to do to improve different conditions. However, different organisations provide information focusing on diverse areas. It is therefore questionable how easily accessible this information is. With more than 10 different web sites [1, 5, 6, 7, 13, 22, 33, 37, 38, 50, 51] and numerous brochures and books [11, 12, 20, 21, 24, 28, 33, 35, 36, 40, 46, 52, 53, 54, 55] with guidelines, experiences, news, videos, simulators, etc. it is a labyrinth to manoeuvre through all the information. Is it clear to whom the different sources of information is directed to? How are new web sites or brochures made known? Is information concerning people with a hearing impairment only distributed within the "hearing impaired's community"? Is it possible that the information is not reaching the right or necessary people? Are the employees at design offices aware of the needs of hearing impaired people? Is information targeted at designers? What do designers perceive as the needs of people with a hearing impairment, and are these perceptions correct? These are some of many questions that can be asked.

Should it be the designer's duty to know about every challenge met by any person at any time? Can it be expected that designers look

for information they might not even know exist? Or should it be the task of the different organisations to make sure everybody knows about the information they provide? Both these solutions seem unattainable because there are so many impairments to focus on, and it would be a huge task for someone to make a list of all designers, architects, decision makers and others that might find the information useful. The politicians might introduce laws and guidance on how they would like to see the society. Should they also be responsible for making sure information is reaching everyone? As seen from table 1 there are not only solutions linked to design, but also architecture plays an important role. Hence, one should not think that all challenges can be solved through product design. By providing laws and regulations on inclusive design the government demands a shift in focus from designers, architects and decision makers. However, this also calls for detailed quantitative requirements.

Being hearing impaired does not only mean that sound cannot be heard, but additional challenges and hence needs, which may not be obvious for others, also follow. This is why the awareness among designers and architects is so important. If a product is only considered on the basis of whether it can be used if no sound is heard or not, it gives no indication on how appropriate the product will be for people with a hearing impairment. This is because they might run into problems which are not directly connected to the sense of hearing. For example, a product that does not provide auditory output may still be challenging to use if the visual feedback is text with unfamiliar words.

NEED	WHY	HOW
Noise reduction	Speech discrimination	Reduce reverberation; suitable floor covering, wall absorbers, roofing sheets, textiles, furniture.
	Sound detection	Choose frequency between 800-1000Hz
	Sound localisation	Use sounds which contain multiple frequencies. Consider using light, motion or vibration.
	Visual noise	Remove objects that may reflect light, remove distracting elements from the line of sight , shield areas for concentration
Good lighting	Lip-reading	Avoid blinding, people talking should be well-lit
Visual information	Eyes take in a lot of information	Light, flash, colour, clear signage, icons, illustrations, graphics, sign interpretations
Tactile information	Cannot hear	Vibration in place of sound
Easy language	Minor vocabulary	Short sentences, small text blocks, use activ voice
Identity	Avoid generalisation	Design, user involvement
Adapted architecture	Loss of balance Dizziness	Strong horizontal features, hand rails
Facilitation of communi-cation	Who's talking?	Face people when talking, do not cover your lips, talk one at a time, avoid high pitched speech
Assistive technologies	To hear better	Hearing aid, CI, T-coil loop, FM/IR transmitter, Loudspeaker

Table 1: Needs of people with a hearing impairment

If inclusive design thinking is brought into the education, designers will have a wider knowledge on challenges met by people with different impairments. Through people centred design it can also be

avoided that wrong assumptions are made about the challenges encountered by people with impairment. It is therefore important to observe and include users in the design process. In this way the information otherwise provided at web sites and in brochures will be seen and learned by the designer himself, thus it is not essential to search for information. According to Martin Bontoft in IDEO empathic research give more inspiration. This supports the idea that user testing is a sensible approach to inclusive design. If designers are brought in at the start of a project, a different, and possibly better, result may be achieved due to the methods used.

When developing new buildings, services and products it is important to include the users from the beginning. Many people are not aware of the challenges and needs people with a hearing impairment are facing, and thus it is of even greater importance to include these users in the design process. With users covering different needs one will discover useful contributions.

It was stated that the videos accessible at www.godlydiskolen.no are available for a wide audience. It might be true that the web site is accessible for everyone with internet access, but is it well-known? Do designers know about its existence? If so, do they remember to look at the videos when necessary? It is believed that due to the lack of knowledge of the challenges met by people with a hearing impairment, designers have not sought this information and thus are not aware of the web site's existence.

Some years ago, people with a handicap needed special equipment or were excluded from social events. Today there is more focus on the products and surroundings, and to lower the barrier for

accessibility. Why is it then, that people with a hearing loss are still excluded from social events because the surroundings are unbearable? As an example the reverberation can be too high in many assembly rooms. When many people are gathered in the same room, this often leads to a lot of background noise, which makes it difficult for the hearing impaired to discriminate speech, and it can also be very tiresome. As it may be more difficult for restaurants to clean a carpet than a floor, the allergy friendly solution without a carpet is often chosen. The floor covering may also contribute to the restaurant's atmosphere, making the owners reluctant to change it. This leads to a worsening of the situation for people with a hearing impairment as the noise from chairs being moved in and out is not reduced.

Many solutions that may contribute to better life quality for people with a hearing impairment already exist. Hence, it is often a question of implementing them. In existing buildings or services this change might be costly, but if the solutions are considered from the start in the design process it should not become much more expensive compared to not including them. It will be more costly having to change the surroundings or add technology at a later stage if decreed by law.

Good acoustics is important for people with a hearing impairment, and it creates a good environment for others to reside in. However, what is good acoustics? There is a Norwegian standard for acoustics, though it is currently being revised by experts as the latest requirements are not sufficient for the hearing impaired. The acoustics in a room do not depend entirely on the material used, but

can also change depending on what kind of curtains, if any, you put up, and what kind of furniture is put into the room. This complicates the system of how and when to check the acoustics.

Özcan and Van Egmond states that consequential sounds are emitted by products as a result of their functioning.[56] Many hearing impaired people will not be able to hear these sounds. As a result they cannot, and will not, act in the expected way if a machine is producing a non-intentional sound, a sound that for non-impaired people would indicate that something is wrong with the machine. Do we need new guidelines for the use of sound, to ensure that future designs will not exclude hearing impaired users? If the awareness around different challenges for people with a hearing impairment is raised, and they are included in the design process, it is likely that less solutions will exclude the hearing impaired.

Some solutions are brilliant, and highly appreciated by many people. The now so common mobile phone that offers volume adjustment, vibration options and the possibility to send text messages is useful for people with a hearing impairment in many ways. The alert signal can be adjusted to a level that is perceived by the user, or replaced by vibration if this is preferred. The text message option has also been popular, and facilitated the flirting for young people. Additionally, the mobile phone is useful for people impaired by a noisy work environment or at a concert. Through the screen it is possible to see who is calling, and to have a text message conversation. Another success is the chat functions offered by some online banks and shops. By offering this service one may contact the company in writing, and receive an immediate response. Many

people do not fancy talking on the phone with strangers, hence this is a much appreciated solution.

As there are hundreds of young people becoming hearing impaired in Norway every year, does this mean that too little is done in terms of reducing the risk of obtaining this impairment? Can designers and architects contribute through their designs? If noisy machines are isolated in a work environment, this would most likely lead to better working conditions and reduce the possibility of workers losing the ability to hear sounds in the frequency range of the noise. It is a challenge for designers to create products that provide enough sound for users to understand that the product functions or there is a malfunction, and to design for less disturbance and annoyance. However, designers have the possibility to make hearing protection more attractive to use.

The fact that it has mainly been focused upon Norwegian web sites and brochures providing information and guidelines can be seen as a limitation that can have affected the study. However, the article search has been internationally directed.

There are not many articles focusing on design and the hearing impaired. Therefore, there are many areas where further research would be of interest. Looking upon interfaces attention can be paid to how light can act as guidance for the hearing impaired, to facilitate their use of interfaces. Moreover, what will be the problems and effects of conscious implementation of audio and light in user interfaces in public spaces? How different colours of light and its rhythm will provide different effects for people with a hearing

impairment can also be interesting to look upon. Information on this topic can be useful when for example developing visual alarms.

It would be interesting to know why existing solutions like information screens are not always implemented. Is it solely because of the cost of buying and installing the extra equipment? Or do people in the board rooms not have enough knowledge about hearing impairments? Or are the existing solutions not well enough developed in terms of aesthetics or functionality?

Why is it that we have water proof watches and water proof digital cameras, but not water proof hearing aids? Is it too costly to produce – not beneficial to develop? As many people with a hearing loss become practically deaf when removing the hearing aids to go for a swim, one would think that a demand exists.

The Norwegian Association of the Hard of Hearing is the world's biggest organisation for people with a hearing impairment. This may also be a reason to question what the conditions are like for people with a hearing impairment in other countries. What are their rights? What kind of assistive technologies are accessible? How are they included in the surrounding society?

9. CONCLUSIONS

There exist a lot of general information and advices regarding people with hearing impairments. However, it is provided by many different organizations, mainly governmental and interest groups, and thus to be found on various web sites and in several brochures. This makes the situation a bit chaotic, and it might be difficult for designers to know when all necessary aspects are taken into account.

Furthermore, several of the books and reports on universal design have clearly focused mainly on people with a locomotive impairment when evaluating buildings and outdoor areas.

As there are few quantitative requirements concerning the needs of people with a hearing impairment available, and existing Norwegian standards are not good enough it is difficult to create good requirement specifications. This can to a certain extent explain why there is a lack of complete guidelines when it comes to inclusive design for the hearing impaired. However, it is also due to less attention to "invisible" impairments.

Instead of believing and having opinions on issues for disabled people, it is better to run user tests and find out. There exist a lot of design literature that speaks warmly of user testing and methods to include users, but it was not found design literature providing information on which considerations that needs to be taken when carrying out user tests with people with a hearing impairment.

This article shows that there has been little focus on the challenges and needs relating to hearing impairments. It provides designers, architects and decision makers with an introduction to what it means being hearing impaired, what solutions exist today, and some guidance on user involvement. There is also focus placed on guidelines that can be found when designing for the hearing impaired in mind, though making designers aware of the shortcomings.

It is time to provide a set of proper guidelines to include also the hearing impaired in what is to be the universally designed society of our future.

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Rethinking Rain

Bridging the gap between disaster relief and development work with domestic rainwater harvesting systems

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ABSTRACT

With inspiration from the Rethink Relief (RR) design workshop 2011, this article challenges the traditional thinking of designing domestic rainwater harvesting systems for poorer countries. Rethink Relief is a new initiative by freethinkers within design for development and disaster relief, with the goal to build a bridge between disaster aid and long term development work. Domestic rainwater harvesting techniques in sub Saharan areas is the selected focus area. A literature review is used to show a need for interdisciplinary approaches, focusing on beyond technical specifications. Industrial design methodology from the RR is used as a foundation to gather a new perspective on related literature concerning water supply for domestic use. Building on these findings, a suggested strategy for designing low cost rainwater harvesting systems, accessible by small entry level investments is presented. The article concludes with a call for a design tool that can bridge relief and development in this

area; something that will provide access to safe drinking water for all.

KEYWORDS: domestic rainwater harvesting, design for BoP, low--cost and low entry-level investment solutions, potable water, rethink relief.

1. INTRODUCTION

About 1.1 billion people do not have reasonable access to safe drinking water.

About 1.1 billion people have an income of less than US$1 a day.

…These are usually the same people.

David Brett Martinson

RR started up in 2011 at the University of Technology in Delft with a design workshop lasting 5 days, gathering professionals from a wide range. A majority of the participants had background in industrial design. Also present were professions related to disaster relief and development represented by Doctors Without Borders, different engineers and aid workers, including outstanding individuals and entrepreneurs from beneficiary communities. The aim of this workshop is to build a gap between disaster relief and development work, thereby filling the aid vacuum following disaster relief operations. One of the project topics resulting this intensive workshop was a problem definition regarding the supply of potable water on a household scale for low income communities in semi-arid zones. This is the source of motivation for this article.

Water is a prerequisite for sustaining life. The consequences of not having access to potable water are clear for all, but less clear are the surrounding ripple effects. Rainwater has been a well tried and tested source of potable water throughout time. Used in combination with other means of harvesting water, rain can provide sufficient water in all but the most arid zones. For people living under the poverty line, advanced technology and cost intensive water supply systems are out of reach (Martinson 2007, Nega and Kimeu 2002). Ironically, according to studies, solutions with these properties are often the systems that agencies or governments try to implement, amongst other reasons thanks to the flare and PR value of such installations (Gould and Petersen 1999).

Cheap, easily accessible, simple irrigation systems, with an expected product life of only one season, exists. An important question is why there are no similar products for the purpose of rainwater harvesting (RWH). By first glance, it is unclear why cost intensive storage solutions are the preferred approach when those in need seldom have the economy to finance such installations. Existing beliefs and opinions surrounding RWH will be explained.

RR made the contrast of relief work and long term development clear for its participants. This involves a challenge of providing products applicable in both settings, or the choice to better managing both stages separately. One of the organizers, Amy Smith from D---Lab at MIT, lectured on how to design for affordability, for re---use and even how to plan for failure. These theories are used in argumentation throughout this article, and creating the foundation of a rethought

approach to RWH. According to the RR workshop, there is a real need for bridging disaster relief and long---term development work. It is of great practical importance to investigate the applicability of this design strategy combined with RWH. To turn this into a tangible project, a strategy for designing a flexible domestic RWH system is suggested. It is necessary to investigate the viability of such a solution to materialize the design theory behind the RR workshop, and to justify such an approach.

1.1 Scope and methodology

This is a review article with the intention of shedding light on why RWH is considered only as a last option for water collection in those rural settings where people live below the poverty line. The article will illuminate the possibility of creating a modular, expandable and flexible rainwater harvesting system, accessible by a small first time investment.

Using the findings and discussions that took place at the RR workshop, this article will provide a new perspective to traditional thinking, linking the provided design strategies from RR with common practice related to domestic rainwater harvesting (DRWH). Tim Brown's Change By Design (2009) and Andre Liem's Managing the industrial design process (2006) provide definitions of terminology regarding design methodology and the design process. Theory presented in RR is chosen as the backbone for the following analysis to investigate its viability when applied on the selected problem area.

To be showed is that a combination of a top down and bottom up way of working towards a sustainable solution is less present. A strong focus is put on technical literature, as the majority of literature on RWH has this approach. This is done to investigate if the represented literature provide a broad enough perspective on the topic. Some consideration will be taken to social, political and economic aspects, but not to a large extent, hence this would be far out of the scope of a simple review article. The importance of related topics is illuminated through the selected literature. Literature regarding RWH is found through selecting works based on high number of citations in related articles. Thomas and Martinson (2007) as well as Martinson (2007) are sources for many thoughts in this article. They present an updated and comprehensive literature from the last decade, concerning roof water harvesting in humid equatorial climates. Gould and Petersen (1999) is one of the most quoted writings on general RWH from the 90's. Heeks (1995) provided a summary of the current state of the art, including theory and applications for technologies suited for developing countries. From the 80's Pacey and Cullins (1986) dominates the quotations in connected articles on this subject.

Sub Saharan Africa is chosen as the intended application area. Lessons learned here are applicable to some extent in more arid zones, and other geographic areas.

A background will be provided in the first chapters and an explanation of RR philosophy. Next follows a general overview on RWH along with new developments in this field. The chapter about design for affordability presents some strategies to

bridge the gap. Chapter five organizes the literature included in this review, and presents findings based on this. In the following discussion the article is tied together, presenting the suggested strategy on how to continue further work. A conclusion will give final arguments.

2 Rethinking Relief-Bridging the Gap

RR illustrated the value of bringing together people with different experiences. Relief workers, doctors without borders, engineers, industrial designers to pioneers and outstanding members of communities from developing countries. Combining professions in a team demonstrated the general applicability of design thinking. "Design thinking is a way of seeing the world and approaching constraints that is holistic, interdisciplinary and inspiring." (Ivy Ross, VP of marketing, The Gap, commenting on Brown 2009). Throughout the conference there was a focus on "The idea of designing products in an integrated manner such that low---cost, entry---level offerings create wealth quickly for customers has applications…" (Brown 2009) in a large amount of settings. Integrated thinking as it is named by Tim Brown, refers to the ability to "…know how to widen the scope of issues salient to the problem". This stands in contrast to a more sequential and isolated problem solving approach, applying only one model at a time (Brown 2009).

The described gap is the aid vacuum following disaster relief operations and leading into prolonged development. Large amount of resources and initiatives are wasted when agencies and governments don't cooperate. Efforts are not planned with a wider perspective, instead on a project to project perspective.

Interagency cooperation is more of an exception than common practice (RR conference 2011)

2.1 Project "Let it Rain"

One team at the RR workshop got involved with the challenge of low entry level investment RWH systems apparently not existing for rural communities. High quality water without the need of advanced filtering is unavailable since existing low-cost solutions require in general some sort of funding or government support if to be made available to people of poorer resources. Gulu, Uganda was used as a starting point, utilizing one of the team member's inside knowledge about the current status.

When studying the Gulu area (Figure 1,2,3,4), thatched roofs are shown to be popular amongst many families. This presents a challenge, as they are less suitable for RWH because of low runoff coefficient and how the grass affects water quality. Tarpaulins have been used for covering roofs, but this has a negative effect on the thatched roof's abilities for ventilation. Instead tarpaulins ended up being used in submerged water tanks (Gould 1999). When protected from UV rays, the durability of the lining is greatly enhanced.

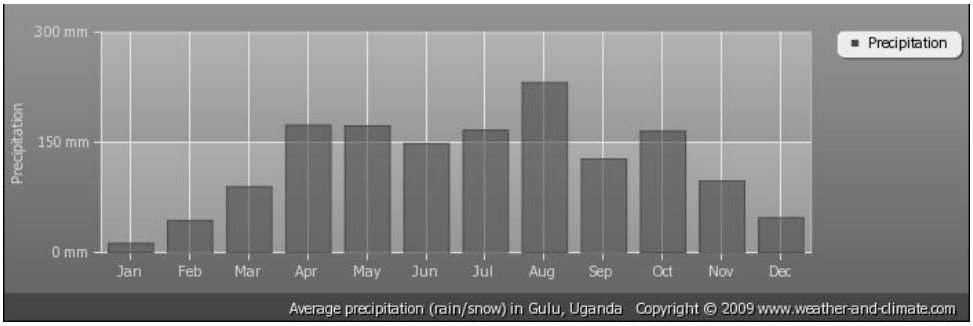

Figure 1: Total precipitation is on average 1503 L per m^2

One of the main water sources is shown in Figure 4. The situation in Gulu was an inspiration for investigating the actual existence of tangible solutions to this problem. This project became as well the inspiration behind this article, providing a connection to a real world situation. The project was named "Let it Rain".

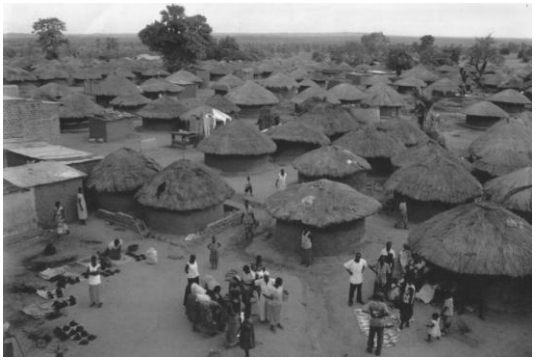

Figure 2: Typical housing situation, Gulu, Uganda

Figure 3: Roofs are removed because of a fire

Figure 4: Waiting line at water collection point, note the amount of plastic Jerry cans

2.2 Bridging the gap with RWH and disaster relief tents

Disaster relief agencies bring with them more resources than their equipment and personnel alone. Potential for building material comes in the form of packaging, for example with the crates Doctors Without Borders utilize. Design without Borders have created an emergency shelter (Christiansen 2011) with the purpose of better utilizing resources made available by aid organizations, and bridging disaster relief and development.

The tents delivered by many disaster relief agencies can, with a small amount of modification, be aimed at RWH. A simple gutter system and some sort of container are all that is standing in the way (Thomas and Martinson 2007). Tarpaulins are widely distributed and accessible, and can provide a clean surface for gathering rainwater in addition to the tents. Care need to be taken, as the material can degrade from exposure to UV light. With simple RWH (Figure 5) systems a family can add to their potable water access provided traditionally by a capacity blown distribution point and take part in enhancing the level of hygiene throughout a camp. In combination with modified relief tents this provides an initial start of an expandable DRWH system, bridging the gap between relief and long term development.

Figure 5: RWH in its simplest form

3 Background on water for Domestic Supply & Harvesting

In the aftermath of the workshop, it became apparent that further studies on the topic RWH was necessary to decide on the viability of the Let it Rain project.

Water is used in a household for numerous tasks, these include drinking, cooking, house cleaning, washing of clothes and personal hygiene, flushing of toilets and cleaning of utilities. Outside the house, tasks include irrigation of plants, feeding of livestock and general maintenance. In the industrialized world this water is traditionally made available through piping systems for a monthly fee including sanitation services. The water has usually acceptable quality and relatively low cost. Still in many cities it is necessary to acquire drinking water from other sources, as the tap water can have too low a quality or undesirable taste.

Potable or drinking water is water clean enough for consumption, with low risk to human physique both on a long and short term basis (Martinson 2007). A large proportion of the world's population do not have access to water of this quality, and rely upon more or less contaminated water sources. If potable water is accessible it might often be located at impractical distances (500m +) and results in countless of working hours being spent (Gould and Petersen 1999, Mati et al.2007) on just transporting water every day.

At the extremes, people with low income in arid zones can be forced to survive on as little as 5 L per day (Gould and Petersen 1999) This is the bare minimum of what a grown

adult need to sustain basic body functions and the most basic sanitary needs. Daily human consumption should be above certain limits considering climate and level of activity. In accordance to WHO the amount available per capita per day should be at least 20 L (WHO 2008). This includes potable water for drinking, cooking and general hygiene. Other household related usage does not require the same level of water quality. The extended water consumption of a normal family of 4 or 5 people is therefore quite high, but when only looking at the amount of potable water needed for basic sanitary needs the figure is a lot lower.

The ripple effect of having family members indisposed because of water related health issues can become substantial. With a family member in hospital, others in the family will have to attend to the patient. Now more of the children in the family who before had available time for school, if any, will have to spend their time on chores as gathering of water and more (private communication with David Okelo, 26th of October 2011 at RR). When the women of a family in rural areas can save time on an activity as water gathering, valuable time can be spent with taking care of children and other important tasks which otherwise would have to be neglected, and even the possibility of a well-deserved brake (Gould and Petersen 1999).

3.1 Roof water harvesting

RWH can be done in a numerous amount of ways, from as simple as in Uganda, using banana leaves as gutters when collecting from trees, to as sophisticated as utilizing pumps and

advanced filters (Thomas and Martinson 2007). Key elements are a suitable catchment area, gutters to channel the rain and a storage device. Roof catchment systems have clear benefits over other rainwater harvesting techniques when applied to DRWH (Gould 1999 ++).

A comprehensive mapping of the potential of RWH technology in Africa (Mati et al, 2007) gives an overview in selected countries in Africa. Roofwater harvesting is further advocated by this study.

The origin of RWH is not known precisely, but this technology has probably its roots from the Middle East and Asia, starting several thousand years ago. At the beginning of the 20th century rainwater harvesting was a generally accepted practice in large parts of the world where different ways of harvesting water where used, based on old techniques. During the middle of the 20th century a rise in groundwater exploitation took place. Along with improvements in pumping technology and dam construction, this led to a decreasing focus on rainwater as a potent source of easily accessible water (Gould and Petersen 1999). Population growth and unsustainable exploitation of traditional water sources have made surface and ground water less available. As a result it has become necessary to revive old craftsmanship.

Grass and thatched roofs has earlier dominated roofs in rural settlements, but during the last 30-40 years roofing materials better suited for RWH are more widely spread, making DRWH more applicable (Gould and Petersen 1999).Corrugated metal sheets and other non-organic materials ensures less

degradation of water quality. Ferrocement based tanks have become popular and provides an effective tank solution of lower cost. Important developments as these are giving RWH a sort of renaissance in our time.

3.2 Supply and storage of rainwater

The supply of a system is calculated by following formula (Gould and Petersen 1999):

Supply = Rainfall x Area x Coefficient (runoff)

The runoff coefficient explains the amount of water going to waste because of evaporation or other reasons depending on the catchment surface. Typical coefficient for corrugated iron is0.8, which makes this one of the most efficient surfaces normally available. A standard roof size of 30m2 shown in the case study of Gulu, Uganda will be sufficient to provide a family of five with potable water, given average precipitation, suitable storage and sound rationing management. Please refer to Gould (1999) for detailed calculations. Martinson (2007) provide recommendations on tank size based on supply strategy and climate situation. Sound water management in this case implements that the high quality water is used only for covering vital needs for consumption and basic hygiene. A total supply requires tanks too large to remain economical viable (Thomas and Martinson 2007).

Conventional storage designs include:

- **Big tanks -10m^3 and more, often in ferrocement**
- **Brick tanks**

- **Plastic - all sizes**
- **Thai jars and similar constructions, 1-3 m^3**
- **Small tanks - clay, metal**
- **Small bottles. Different material, clay, terracotta, plastic, metal (jerry)**
- **Oil drums**
- **Numerous designs for underground storage, with a popular low cost alternative being the tarpaulin design.**

For further studies and details on the different solutions it is referred to Gould and Petersen (1999) for a general overview at the state of the art of DRWH and Martinson (2007) on low--cost solutions for domestic supply, along with an updated handbook by Thomas and Martinson (2007). These works provide a comprehensive and updated perspective on DRWH.

3.3 Applicability of RWH

In situations where traditional piping systems fail or become unstable due to capacity problems, RWH is suitable to complement the water harvesting capacity. RWH provides a practical emergency supply in case of disasters, rendering existing water supply useless or insufficient (Gould and Petersen 1999). In dry seasons RWH can provide an important addition to the households water supply but will seldom be sufficient for a total supply (Martinson 2007). Drought with a duration of six months will put great demands on storage capacity and rationing management, and especially here is a combination of other water sources necessary. If good quality surface and groundwater are available in rural

settings provides a good addition to water sources as to ensure reliability of having potable water available at all times.

3.4 Security regarding drinking rainwater

RWH systems providing good quality of water fail when exposed to secondary contamination before consumption (Gould 1999 A).What is perceived as sufficient water quality and personal hygiene can differ from what is demanded. Rainwater has throughout history been a reliable source of high quality drinking water. Studies show that rainwater can be a good source of potable water (Gould 1999 A, Martinson 2007). Mechanisms such as a first flush system greatly enhances the water quality with no more than a couple of liters flushed through.

The most simple systems collect water through an open drum or jar, often in the form as the well known 200L oil drum. In certain climates this leaves room for growth of algae and mosquito breeding. The latter can contribute to problems in a larger scale if allowed to develop. For safety it is important with closed containers, not letting in light for protection from insects, with regard to vector borne diseases.

3.5 Social aspects

To claim that there are more than meets the eye involved when implementing DRWH systems is hardly an understatement. Examples can be made of projects failing utterly even though the presence of sturdy financing and sound technical solutions (Gould and Petersen 1999). Experiences from the field cannot stress enough that community involvement is key along with governmental or agency support. Where projects solely led with

a regional perspective, without influence by or considerations to local desires and customs, great problems arise in the aftermath of installation regarding maintenance and proper use.

When implementing water projects other benefits may follow, such as increased awareness of health issues, general improvement of hygiene and sanitation, making it hard to decide the benefit of quality versus quantity (Gould and Petersen 1999). The value of small incremental changes in a community can be of equal importance as introduction of new technology. Amy Smith from RR, is suggesting to create technologies and products that not necessary makes changes to the composition of the local societies. Small steps creates more sustainable progress, and rather aiding someone to become farmers instead of poor farmers is a good place to start (Amy Smith, TEDtalk September 2011). Gender roles within a family is a central topic and closely related to water harvesting, concerning which family member's daily routine being directly affected by a new project. When agencies implement projects, social education is of great importance.

4 Design for affordability

When living on less than 2$ a day, buying equipment for about 60$ can be seen as affordable. In reality RWH systems within the low-cost segment can cost 100$ (Martinson 2007). Micro loans, funding from outside or a combination are appearing to be the only ways of achieving DRWH in low income communities. Down payment through saving the expenses paid when using existing sources as buying water, then paying this amount for the equipment after the down payment time is

over, is one amongst other ways to reach the goal of water for all.

A farmer might buy a smaller system that can only cover half of the field, and halfway through the day go out and move the drip lines. This is a normal procedure when recourses are scarce, but not competitive in the industrialized world (Smith 2005). When designing for performance and durability, features can be added, improving these qualities In a design for affordability setting, cost will put tough constrains on this. Important aspects along with designing for affordability are design for failure and design for reuse (Smith 2005)[3]

4.1 Product examples

Several innovative designs exist, but in general few of them challenge the traditional way of harvesting water. Thomas and Martinson (2007) draw the conclusions that existing designs can be greatly improved from a cost perspective, with lowering the quality of the tanks. Gould and Peterson (1999) warn about pushing this approach too far, as failure of larger tank designs can have fatal consequences. Design for affordability is truly a demanding discipline.

The Rain Cycle System[4] is expandable and flexible, but can truly be said to be but out of reach, with starting prices from 799$. Some new design concepts (Figure 6) are appearing throughout the design community in entries for BoP design

[3] ***Lecture notes provide further discussions on these topics***
[4] ***by Rainwater Harvesting, Inc. Information gathered at 25th of November from http://www.rainwatercollecting.com/find-a-system/the-raincycle.html***

contests, but still it appears not to exist tangible solutions for providing affordable systems that can be expanded.

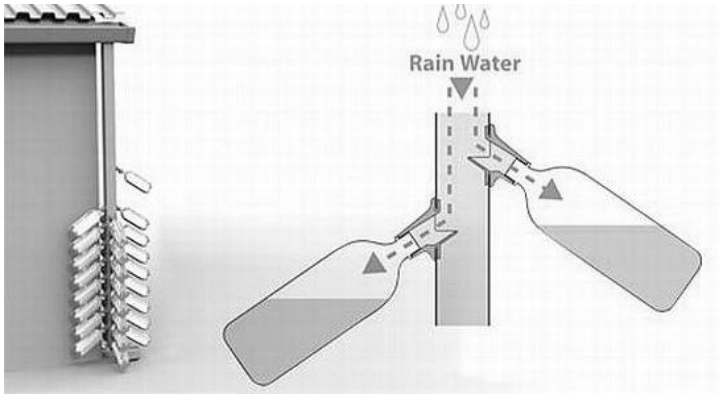

Figure 6: The RainDrops concept of Evan Gant

The irrigation system from IDE(India) (Figure 7,8) shows an interesting way of thinking when designing for affordability. When creating products for developing countries, different criteria must be put into consideration when deciding the balance between cost of materials, manufacturing and effectiveness in use. Labor comes with a low price, while materials and production capabilities are of a lesser availability and of a greater cost (Smith 2005)

Figure 7: The IDE drip irrigation system with 20L plastic bag as water source

Figure 8: $2.50 IDE--India Affordable Drip Irrigation Technologies (ADITI) "Family Nutrition"

Other example of a product designed for affordability is the water purification bag (Sodis report 2005). Using UV rays, water can be purified in a short a time as two hours. However, such innovations, Smith insisted, do not eliminate the need for governments to provide clean water. Why should those who make $1 to $2 a day be required to purify their own water?, she questioned. The water purification bags are, she acknowledged, a "transition technology." Smith also upturned the old saw about "teaching a man to fish" with these caveats: "Unless there's no river nearby"; "Until the fishing pole breaks"; and "Maybe you should ask if he likes fish."[5]

5 FINDINGS

Common for all literature reviewed is a strong focus on technology, seldom going beyond this to search for solutions. Amy Smith, representing recent, innovative approaches on

[5] ***3 quotes gathered at 25th of November from: http://web.mit.edu/newsoffice/2007/smith-talk.html***

design for both relief and long term development, is less present with literature, but interviews or published lectures provide some source material.

In general the technical viability of DRWH is thoroughly documented. Agreed upon is also that the rate of success is strongly connected to integration of locals in projects. Some literature like Gould (1999 A) and Martinson (2007) argue that first flush systems along with proper maintenance are sufficient for providing acceptable and safe water, rendering chemical filters redundant. Peter Varbanets et al. (2008) advocates the strength of a dual based water supply system, where different degrees of water quality are provided for different purposes, such as consumption or irrigation. This is backed up by Gould as well as Martinson, who claims that RWH systems are seldom efficient if used as the sole source of water.

Big tanks seem to be the preferred solution when deciding storage size. This is connected with the general impression of large scale benefits. Studies show that size is not always a good thing (Martinson 2007). Smaller tanks can be cost effective, with regard to construction, usage/utilization ratio and ease of maintenance. A smaller tank will get filled and emptied more often, where a large tank might only reach its full potential once a year at its best. Smaller tanks are easier to construct. The successful Thai jar is a good example (Gould and Peterson 1999) of a smaller tank with successful design. In general it may be observed that large ferrocement tanks is the preferred low cost solution when implementing large scale systems, as well as on a domestic scale. Many tank

designs are intended to provide total water supply. Small, expandable, low cost solutions are rather more a suggestion from Thomas and Martinson (2007) than a design observed in the field. The approach on low cost systems is not uniform, as Nega and Kimeu (2002) focuses solely on submerged storage solutions, arguing this being more cost effective. Thomas and Martionson (2007) agree that above ground tanks can be more expensive, but have advantages in ease of maintenance, while under ground tanks present several challenges, such as detecting leaks or failures. Thai jars are held as a successful and popular over ground design.

Some designs can be said to be of low-cost, but in common for most designs are the need of outside funding or governmental aid to start up a RWH projects. Design principles presented by Amy Smith are not common practice. Without good alternatives where people living below the poverty line are able to invest little by little for a RWH system, the likelihood of this technology being generally available is a small one. Some loaning mechanisms have been proven effective, but this still relies on governmental interference. For making more people self sustained it is a dire need of further studies and development on an affordable system. The sustainability of an expandable system is provided in research documentations, given that a suitable piping system is developed.

A trend showing an increase in systems aimed at domestic management is present (Gould and Peterson 1999, Martinson 2007, Mwenge Kahinda et al. 2007, Nega adnd Kimeu 2002, Peter-Varbanets et al. 2008) Problems experienced with earlier community based projects are a strong reason for the

skepticism in communities, and represent a challenge to overcome when trying to start up new DRWH projects (Martinson 2007). Maintenance and cleaning is less of a problem when responsibility lies within the families (Gould and Peterson 1999)

5.1 Modular and expandable system of storing water

An expandable system has the advantage of instantaneously start up possibilities as the first investment would be within acceptable price range even at low income communities. When experiencing local disasters such as a fire, the water supply might easily be transported for salvaging or even to be used for firefighting. Within the house, smaller containers provide the flexibility if there is a shortage of space, as the cans can be distributed to where space is available.

5.2 The piglet system providing distribution at point of use

For an expandable system to work, there is a need to provide an affordable piping system connecting several containers. As described in Thomas and Martinson (2007) they accomplished to produce a system connecting several jerry cans during field tests of various low cost designs. The weakness here was the vulnerability of the system of having one can left out when put to use other places.

A piglet system distributes water from one source to several locations (Amy Smith, RR conference 2011), in a way as the name of the system suggests. The added value of a system like this comes when the piping system is expanded.

The point of distribution is in many cases crucial for the success of RWH systems. Local sanitary conditions can endanger the otherwise high level of quality of the water. Water gets easily contaminated from the point of storage to the point of consumption. (Gould and Petersen 1999) A piglet system with distribution throughout the dwelling directly to the point of consumption is a way of removing some of this risk. A crude foot pump may provide the pressure needed for distributing the water inside of the living quarters.

6 DISCUSSION

The following discussion will address how technology aimed literature fails to utilize the potential in RWH. The trends of current literature has been structured on how it agrees, differs and in what areas the opinions in literature deviates from common practice. The aim of this chapter is to tie up the selected background material and present arguments on how using design when bridging the gap between relief and development can help creating a tangible solution for RWH, that will not become a reality with the traditional approach. The viability of a low-cost, expandable DRWH system is presented as a result on conclusions from the literature review, coupled with the design thinking of design for affordability, discussed in the RR conference.

When paired with other sources of water harvesting RWH can ease the pressure on existing supply chains, and provide security to unstable or unsecure sources of water. The environmental effect of domestic RWH is negligible. The general view amongst professionals in the water supplying

industry is that RWH is a cost intensive activity (Gould 1999). This view is largely based on the misconception and miscalculations presented when assessments are being done by NGO's and governments. When agencies provide calculations on RWH, it is planned to be the sole providing water method, thereby demanding rather large and expensive tank designs. The storage facilities is the cost intensive element of RWH, and greatly affects if DRWH is economically viable. The definition in low-cost storage is relative, when considering price per stored liter versus total construction cost (Thomas and Martinson 2007). This dilemma is a good explanation of why low-cost systems are considered cost effective while in reality being unavailable for poor income communities! RWH is often looked upon as a last resort, where other water sources are either unpractical, contaminated or inaccessible. The water quality is expected to be lower as well as the taste, but on the contrary the reality is the other way around. Rainwater is when gathered in a sensible way, of good taste and free of most chemical pollutions, and to be viewed as on a comparable level of water quality coming from groundwater collected at wells. There are strong differences in between perception and reality regarding RWH.

6.1 Sustainability of low-cost expandable piglet systems

As presented in Martinson (2007), several jerry cans or other forms of a water containment can successfully be connected by an arrangement of pipes or tubes. This will ensure improved water quality as the water reaches the final container. One challenge is to develop the tubing system so that the setup is

not vulnerable of misplacing or forgetting to replace one container. Jerry cans can be of a high cost, if not present already in the household. Other traditional products such as terracotta or clay pots or even crude plastic bags, covered in jute for protection can work. It is advisable that further studies on a system such as this in connection with the piglet system, is undertaken. This provides the flexibility and simplicity of use and maintenance as traditional large scale tanks fail to provide. With flexibility provided by a design as this, tubing technology provided at camps or local distribution points can be used, given easy operation. In this way, some bridging between a disaster relief situation and long-term development can be done.

With internal water distribution on a domestic scale, one can assure to a greater extent or motivate for better and more sensible usage of the high quality rainwater. When distributed from an outside container, the water might easily be used for other purposes, leading to the same problems in drought periods as before implementation. When water is distributed directly to the point of use, it is easier to ensure that water is not contaminated between storage and consumption, which is normally a trouble area giving DRWH a poor reputation in many occasions. With a closed system, it is less tempting to mix rainwater with water from other sources, as this might compromise the water quality.

6.2 Equipment provided in disaster relief having long term development effects

Education about RWH and hygiene can be made in camp situations, and knowledge will then be transferred to a development situation when returning to villages after an evacuation. Components and knowledge necessary to start with DRWH are then available when the process of rebuilding old homes start. This follows the thinking of "Design Uten Grenser" (Christiansen 2011). Less complex and temporary solutions become transferred into a more stable and long term construction, utilizing all available resources at all stages. As shown in a project implemented in real life from Design Without Borders, there can come great effects of bridging the efforts of these two worlds of aid. An enormous amount of recourses and material is put to waste, an a aid vacuum arises between these two stages. If design of equipment and processes are done with each other in mind, improved effect of invested resources and time will be the outcome. The concept of using DRWH in the disaster relief context is one of those ideas bridging the two situations. With tents prepared for RWH, and the provision of simple utilities making this accessible, families become more self sustained, and less dependent on water deliveries, as relief camps seldom have good access to good quality surface or groundwater sources.

6.3 Self-sustaining kits, and boxes

The strength of disaster relief is the fact that deployment occur ideally within 24 hours of an event. This requires kits and equipment that does not need other inputs to be in full effect when deployed. Time is of the essence. In developing stages after a disaster, time is available and focus is put on utilizing local

entrepreneurship to strengthen local economy and to build local expertise. Kits of equipment that can be expanded at later stages fulfills these requirements for both situations. ShelterBox is an organization providing a kit for survival after a disaster, and provides a foundation for bridging the gap of relief and development. The ShelterBox kit concept is however strongly focused at the relief stage.[6]

6.4 The application of low entry level investment systems

Farmers in industrialized countries in the need of agricultural irrigation invest in systems meant lasting for a decade. In low income communities these investments will rarely be available. What a farmer needs is a solution he can buy with available money, that puts him better prepared for the next season, and will in the future give him the opportunity to expand. Products and technologies suited for micro finance and micro enterprise is desirable goal (A. Smith, TED talk 2006), as this can help people living below the poverty line climb above it.

6.5 Combining a top down and bottom up approach

Local decision makers must be involved, as to gain acceptance in the local community. Projects need grass root support as well as backing from investors, NGO's, agencies and central government. In some literature (Gould and Petersen this way of thinking is present. 1999) this way of thinking is present. Important questions to resolve before engaging any project is

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[6] Information gathered at 29.11.2011 from http://www.shelterbox.org

who the beneficiaries are and what they had before. No area is the same, and technology suited for one location might end up with failure at other sites. The importance of talking to locals to find out hidden problems cannot be stressed enough.

7 CONCLUSIONS

This article has showed that small scale, flexible systems can be a viable approach on DRWH. In general they are viewed upon as a complex solution, but there is a potential of changing this. Complexity is normally leading to a risk of contaminating water. For a system of this type to receive a consensus within this field of study, it is necessary to demonstrate its efficiency at different communities, rather than provide arguments for its supposed brilliance. The necessity of field testing is of undisputed importance, supported throughout reviewed literature.

As a result of the article review, the importance of social studies became apparent. For the success of a DRWH project, the focus must be on so many other things than just the technical aspect. An otherwise sound design might end up as useless when not adapted and suited for each specific situation. The need for a holistic approach is clear. The bridging of disaster relief and long-term development work is shown to have desirable results as to provide sustainable solutions to a challenge as supplying water to all. With the industrial design profession working as a binding material in the matrix of experts and other professions, innovative and otherwise unreachable solutions become available. A strong tendency to restrain from thinking outside the box, and in this

case the large tank, is clearly present. On the bright side, initiatives for discovering low-cost alternatives on existing practices are out there.

The feasibility of a smaller and flexible DRWH system is of great practical importance. This approach will be unsuitable of replacing all of a family's water demand, but can make DRWH accessible to those who live on a low income, and greatly improve the amount of potable water available at any given time in wet seasons. When sufficiently expanded, this setup can provide a manageable and low level maintenance storage system for shorter dry seasons, where before there was no alternative than spending the better part of a day on something as simple as gathering water.

Providing available water of good quality to all is one of those challenges with often the most basic and simple solutions, but such a challenge is still hard to counter and with an almost imaginable effect if tackled. RR provided a platform to build on to provide new ways of working towards this goal. To conclude this article it is stated that tools facilitating interdisciplinary design teams using a holistic approach is necessary to tackle the challenges we are obliged to solve. Such tools are called upon to enable more people to climb above the poverty line.

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Designing the Hospital Soundscape

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ABSTRACT

Sound can affect our expectations, interactions and emotions related to products. It can also affect performance, pain perception and general well-being. Sound can provide information, pleasure and satisfaction but it can also be a source of confusion, annoyance and disappointment. This paper identifies some sound related issues related to pa4ent safety and adverse events in the hospital setting and the sound design approaches that can be used to solve them. A large part of medical technology relies on alarms to keep patient safe, but as the sheer number of devices and alarms increases the technology that is intended to keep us safe can have the opposite effect. Sound is often close to ignored in the industrial design process, and designers need to understand the potential of sound, for both good and evil. This is a review paper which seeks to give an overview the basic aspects of sound and perception and further define soundscape, sonification and product sound from an industrial design perspective, and how sound design can be a tool in increasing patient safety and quality of care in modern hospitals.

KEYWORDS: Sound, psychoacoustics, sound design, product sound, soundscapes, auditory display, sonification, noise, hospital, health care, patient safety,

1. INTRODUCTION

Humans are visual creatures but we still base much of our communication on sound. Our ability to hear, interpret and act based on auditory impressions not only affects our relationships with each other but also how we relate to objects and our surroundings. Sound can provide information, pleasure and satisfaction but it can also be a source of confusion, annoyance and disappointment.

Despite sound's powerful potential, this side of design receives little attention, and the result, as stated by Donald Norman, is that `[...] the sounds of everyday things annoy many while pleasing few.'[1] In the hospitals setting the effects of sound can be far more adverse and result in pa4ent injury or even death. Alarms are among the top ten health technology hazards[2]. Noise pollu4on is present in the average modern hospital, and can lead to anxiety, heightened pain percep4on and prolonged convalescence for patients[3], as well as reduced clinician performance, efficiency and accuracy. The amount of technology number of alarm reliant devices in the hospital setting is likely to keep increasing in the future, and alarm hazards and noise pollu4on issues are equally likely to remain a serious problem unless appropriate actions are taken to prevent it.

This review paper explores sound related challenges in the hospital settings and sound design can be used as a part of

the strategy for tackling these problems. Part two gives an introduction to the hospital setting and issues in patient safety. The basic terms of sound and percep4on are explained in part three while soundscaping, sonification and product sound are defined from a product design perspective in part four. The final part of the paper revolves around how the techniques and approaches in part four can be used to solve some of the issues raised in part two.

2. The Hazards of Hospital Care

Health care in general and hospital care in particular can be categorised as a high-hazard industry[4]. Like aviation and nuclear power production it has the power to kill and maim, but unlike avia4on and nuclear power it appears to be less successful in preventing this from happening[4].

2.1 A Brief Introduction to Hospital Complexity

The hospital presents the most complex safety challenge of any modern day activity, and understanding which factors contribute to this complexity is a key element in making them safer. The first source of complexity is the human body. Aeroplanes and nuclear reactors are usually in good working condition when they are in service, while the average hospital patient is not. To further add to the complexity, medical treatment is based on probabilities. Two patients with the same symptoms can have very different diseases and two patients given the same treatment can have very different outcomes. Determining a diagnosis and appropriate treatment is based on accumulated knowledge on what usually works best.

A broad array of diagnostic and therapeutic technologies have been developed to improve the probabilities, but sometimes they add to the complexity rather than improve the situation. This is particularly true in some settings such as the operating theatre or in intensive care units where the sheer amount of different devices and interactions in use at the same time give rise to unimagined interactions.

Finally, hospitals have a very different organisational structure compared to other high-hazard industries, in terms of relationship[5], structure and leadership[6]. Several different specialists and departments can be involved in the treatment of a single patient, potentially creating an equally high number of gaps where errors can occur. Handling the complex relationships becomes more challenging still in a system that is traditionally committed to individual autonomy and where the formal leadership structure can share few similarities with the actual one[6].

2.2 Errors, Accidents and Patient Safety

In 1999 the US Institute of Medicine (IOM) published a report[7] that dramatically called patient safety to attention. The report estimated that as many as 98000 people die from medical errors in the US each year. Similar reports from several other countries followed in its wake, all contribu4ng to the increasing concern regarding adverse events in health care. Patient safety is a complex field that in simple terms relates to avoiding, preven4ng and ameliorating adverse events that are the results of errors, deviations and accidents[8]. It is often confused with the term quality of care but although they share some of the same fields of interest, the two are not the same. However,

improving patient safety is an important part of improving health care quality[9].The rude awakening caused by the IOM's report led to an avalanche of pointed fingers, identified causes and suggested strategies for a better future. Hospital complexity alone cannot explain why so many die or are injured at the hands of those who are meant to save them. Health care has a tradition of expecting individuals not to make mistakes and then punish them when they do[10], a practice long since abandoned in other, safer industries. In addition to changing the attitudes towards errors and accidents, health care also needs to implement the correct strategies to build a safer health care system.

2.3 Strategies for Safety

Several strategies for safety have been proposed and implemented, some more successful than others [11-14]. An increased use of technology in modern hospitals is both desirable and inevitable, not only in a patient safety perspective. Although implementing more medical technology is purely based on good intentions, it can have some unintended and unexpected consequences.

Health care has grown to become dependent on medical device alarms, and patient rooms without any kind of monitoring devices are becoming few and far apart. The sounds created by all these devices add to an already sound intensive environment, where separating the signals from the noise is rapidly becoming a serious challenge.

Alarm hazards is rated as one of the most serious threats to patient safety in a medical technology perspective[2]. A large part of medical technology relies on alarms to keep patients

safe but without proper design the alarm systems on these devices can be an annoyance at best, and a source of adverse events at worst.

Alarm fatigue is one of the most important factors related to alarm induced adverse events [15-17]. Alarm fatigue is used to describe a situation where staff become overwhelmed by the sheer number of alarms. This can lead to alarm desensitisation, which in turn can lead to staff muting or turning off alarms or adjusting them beyond the safe range for a particular patient in an attempt to reduce the number of alarms. Between 85% and 99,4% of alarms have been determined to be false positives in papers published in recent years [18-20].

Another important alarm hazard is the actual sound created by the various devices. It can be hard, and in some cases impossible, for staff to recognise the urgency level of an alarm, and the clinical situation can be inconsistent with the perceived urgency level[21]. The number of different alarm sounds create an impossible challenge. The average individual has trouble learning more than six different simple alarm signals[22], and even experienced clinicians have trouble iden4fying all the alarms related to complex hospital care[22].

Many current strategies for dealing with alarm hazards give very little attention to the actual sound aspects of hospital care. The main focus is management; schooling staff in correct use of alarm thresholds, establishing alarm response priorities and responsibilities and implementing technology solutions to ensure alarm notifications reach the right caregivers[23].

Alarm hazards are not the only sound related issues in modern hospitals. Noise pollution is present across the institutions, creating unpleasant environments that can affect patient safety and progress, as well as clinician productivity and well-being[3]. Can focusing on the hospital soundscape have posi4ve effects for both patients and staff? To answer this question we need to know a little more about sound, percep4on and sound design.

3. SOUND AND PERCEPTION

The acoustical detectors in our brains are packed into an area smaller than a pea. They can respond a thousand times faster than visual photoreceptors and enable us to quickly respond to new s4muli, especially those that we cannot immediately see24. Humans are very visual creatures but much of our communica4on is mediated through the auditory system.

In this sec4on the basic terms related to sound, hearing and percep4on are explained to form a foundation for further discussion.

3.1 Acoustics

The study of acoustics deals with how mechanical waves are generated, propagated and received. Sound can be defined as a mechanical wave that is an oscillation of pressure transmitted through a solid, liquid or gas, that is perceived through the auditory system. As far as acousticians are concerned, the four major features of sound are waveform, phase, amplitude and frequency. Acoustics is not limited to music and architecture, but covers a vast field including ultrasound, SONAR, noise control and seismology[25].

Pure tones based on a single wave are extremely rare in nature, and in our auditory system the inner ear acts as a sort of auditory prism, decomposing complex sounds into a myriad of cons4tuent sounds[24].

3.2 Psychoacoustics

Still, we all know that waveform, phase, amplitude and frequency is not all there is to a sound. Psychoacoustics is the study of the psychological and physiological responses associated with sound, and does a little bit more when it comes to explaining why some sounds are better than others.

We perceive sounds as different from each other because they have different pitch, loudness and timbre. Pitch is associated with frequency and can be described as how high or low a sound is. Loudness correlates to the amplitude, or the physical strength of a sound.

Timbre describes the tone quality or tone colour, or in other words that which makes sounds different without being either pitch or loudness26. Timbre is very important for sound percep4on but we are not very good at describing what it is.

3.3 Everyday Listening, Music and Genre Sounds.

Everyday listening, music and genre sounds are three approaches to explaining sound that are different but closely related. Everyday listening concerns hearing sounds related to their sources, music involves how sounds can be combined while genre sounds are musical or everyday sounds that are closely associated with a given event.

Gaver defines everyday listening as the experience of hearing sound related their sources. Unlike musical listening, where you focus on the pitch, loudness and timbre, everyday listening is about identifying the source of the sound. Is it coming from something hard or soft? Does it bounce or break? Is it threatening or harmless?

Localisation in terms of direction and distance is another aspect of everyday listening, which at the same time is related to psychoacoustics. On the one hand it is a perceptual problem that has been investigated thoroughly by psychoacous4cians, but the ability to localise a sound and identify the environment from which it comes from is clearly related to everyday listening.

Our ability to calculate the distance of a sound depends on several different cues. To some degree amplitude and loudness play a part in determining the distance, but other factors such as reverberation and whether or not we know the sound complicate the matter. A final factor that affects our perception of distance is the spectral content of a sound, but there is little experimental evidence that this factor strongly affects our distance perception[27].

Where distance only requires one ear, our percep4on of direc4on is based on having a full pair. Sound waves produced by a source travel different paths to each ear (see figure 1), and thus giving two cues that we use to calculate direc4on. The first is the time delay and the second is the intensity difference. These two cues alone are not enough to determine the direction of a sound. The final clue to where a sound

comes from is the filtering that occurs as the sounds pass over our outer ears[27].

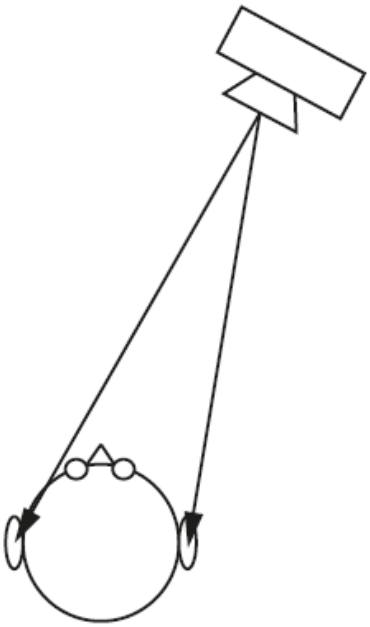

Figure 1: Sound travels along different paths to our ears (adapted from Gaver[27]).

Music is structured at many different levels which can be manipulated to express complex emotions in a relatively short interval. Rhythm can be used to convey a sense of urgency or excitement, harmonic structures can make a piece of music sound happy or sad.

Genre sounds are strongly associated with an event, not because the event itself causes them but because they have been linked to that event over time. They are a result of design and cultural standardisation. A consequence of increased globalisation is that we share a vast array of genre sounds but many are still culturally specific and they are generally hard to parameterise.

3.4 Sound Versus Noise

Noise is unwanted sound, a definition that indicates a certain subjectivity. Sound becomes noise when it is unwanted, objectionable, interferes with work tasks, impairs verbal communication or prevents sleep. At this point it becomes clear that avoiding noise generation is difficult, if not to say impossible.

If we, against all odds, have managed to agree that a particular sound is in fact noise, the degree of annoyance is further subjective and personal. Acoustic variables such as pitch and loudness in addition to non-acoustic variables such as perceived control, noise sensitivity and attitude toward the source are important factors in explaining variance in noise annoyance[28].

Noise can cause ill-health in several ways and it can also have a negative effect on performance. The nature of the noise affects the effect of it. 'Irrelevant speech', as in unrelated conversations in your surroundings, can impair mental tasks much more than non-speech noise. Furthermore, noise has more than just immediate effects on performance, which is impaired for a long time after the noise has stopped[29].

Besides all the adverse effects on our health and performance, there is also evidence that noise may reduce helping behaviour, increase aggression and reduce the processing of social cues[29]. The subjective nature of noise makes it difficult to eliminate but attention to what influences our experience of noise can be very useful.

3.5 Sound and Emotion

In addi4on to the aforemen4oned factors, emotion also affects whether we perceive a sound as pleasant or noisy. Listening involves the whole brain, not just the auditory system.

Sounds trigger percep4on, action, cognition and emotion. The emotional impact is related to pitch, rhythm and harmony, but also to expectation, memory and recognition[1]. The emotional connotations we have to a sound will affect the way we perceive it. A boiling kettle can for some give a posi4ve reaction to the sound, based on the anticipation of a cup of tea, while it for others can be no more than another annoying noise.

Some aspects of sound and music are universal while other vary substan4ally between cultures. Minor keys are close to universal when it comes to signifying melancholy or sadness, but some emo4onal responses are dependent upon previous knowledge.

4. SOUND DESIGN

Establishing a taxonomy of sound design is no easy and straight forward task as many of the terms are being used without any unified defini4on. This section seeks to define and clarify the terms soundscape, auditory display, sonifica4on and product sound from a design perspec4ve and suggest a taxonomy based on these definitions.

4.1 Soundscapes

The purely etymological meaning of soundscape is sound occurring over an area. The term is used in several different disciplines and has been given a wide range of meanings. It can refer to all the sounds that are present in the environment, both natural sounds and those created by humans[30]. It can also refer to a performance of sounds that create an illusion of being in a particular environment or that contains found sounds from an acoustic environment.

The earliest use of the term soundscape was by Southworth, an urban planner who described how the acoustic properties of cities helped people relate to certain areas in 1969[31], and it was further developed by Schafer, who attempted to find a more positive approach to studying environmental sounds than the dominating anti-noise view. He described the three main elements of a soundscape: keynote, soundmark and sound signals. The keynote is the ever present background sound that is rarely given active attention. In cities this is often traffic, inside the standard office building it is the ventilation system. Soundmarks are location specific sound such as a church bell tower or the office coffee machine. Sound signals are sounds placed in our perceptional foreground, sounds that engage active listening such as alarms and other warning devices[32]. The term has since been claimed by several different areas of human activity and come to represent anything from artistic sound installations to the everyday sounds of an office environment.

From a designer's point of view the most applicable definition is that a soundscape is an environment of sound which focuses on how the individual or society perceives and

understands it[33], a definition that places soundscapes at the top of our taxonomy. By creating a balanced soundscape which maximises informative and pleasing sounds while minimising uninformative and unwanted sounds the aim is to create a balanced soundscape that promotes active listening.

Informative Sounds

The property of being meaningful might not only depend on different activities, but on, for example, how far from its origin an acoustic event is propagated.

The eventual meaningfulness of sounds also depends on other sounds in the present soundscape. The sound signal of a mobile phone can be informative if there are only a few phones in the immediate environment, but it can also be uninformative if there are many phones around and it is difficult to say which one is calling.

Pleasing Sounds

Whether or not a sound is pleasant depends largely on its psychoacoustic properties. Increased loudness, sharpness and roughness contribute to make a sound less pleasant, while increased tonalness will make it more pleasant.

Particular spectral features, so called 1/f noise or pink noise, are present in most types of music. These features are very common in the natural environment, and research shows that music that imitates this is found to be more pleasing[34].

4.2 Sonification - Converting Information Into Sound

Sonification is defined as a technique that uses data or information as an input and generates sound signals, given that the generated sound reflects objective properties, the transformation is systematic and the sound can be reproduced given identical data and interactions[35]. An auditory display is a system that uses sonification as a way to generate and structure sound, and this system also includes the technical elements that are required to generate sound waves, the user context and the application context. This means that it is the sonifica4on that is a part of the soundscape, not the auditory display.

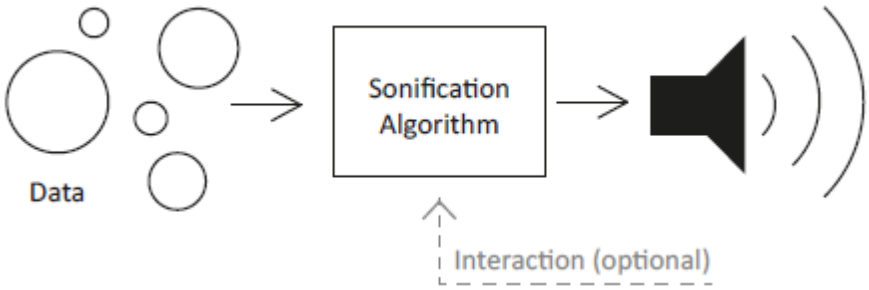

Figure 2: The general structure of sonification **(adapted from Hermann[35]).**

Audification is the most direct form of auditory display, and is based on directly transla4ng data values into sound. Although this is a relatively simple approach it makes a number of useful data properties directly available to the human ear, the variance of data through sound level, the data set size through duration[36]. The Geiger counter is probably the most successful example of this sonification technique[37]. However, due to simplicity, audification is not suitable for all kinds of data, and depending on the data the generated sounds might not be all that pleasing to the ear.

Parameter-mapping represents a potentially more pleasing and more flexible method of tailoring sonifications to the human ear. This method of sonification uses and underlying instrument sound and maps each data point into the parameters of it, in other words 'the data play an instrument'[35]. Both the underlying sound and the data-to-parameter mapping can be adjusted to the requirements of the particular data analysis task. Although this provides significantly more flexibility, the resulting sonification can be difficult to interpret without knowledge of the employed mapping.

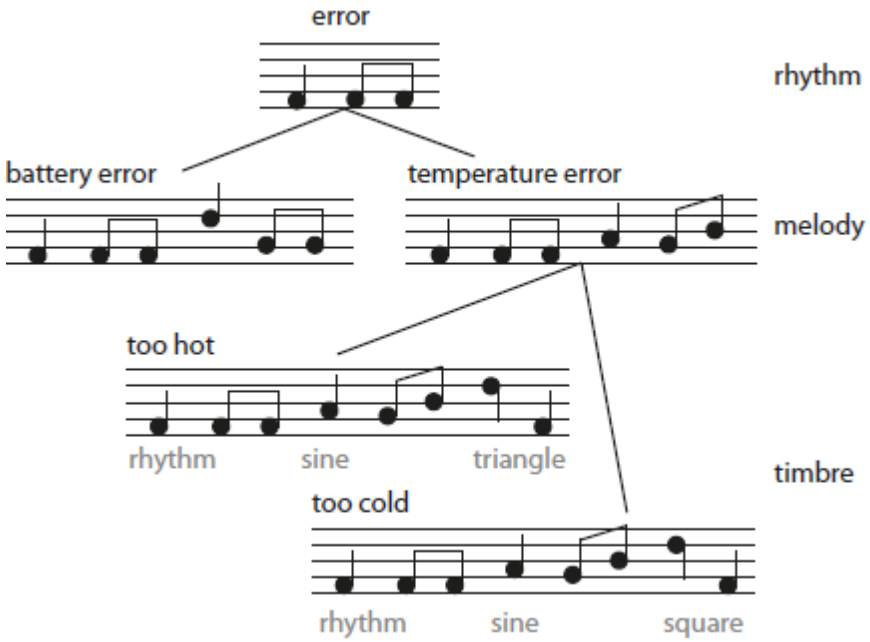

Figure 3. A family of error messages built as a hierarchy where each subordinate level is distinguished by a new musical parameter (adapted from Gaver [27]).

Audification and parameter-mapping focus on using sound to understand data. Sound can also be used to create auditory messages that can be recognised and used in isolation to

convey meaning[36]. The word earcon is a pun on the more well-known icon (eye-con), and an earcon is a motive, a short recognisable melody that represents a message or event. Families of earcons can be constructed as a hierarchy in which earcons at each subordinate level is distinguished by a new musical parameter[27], much in the same way words are used to construct a sentence[36], see figure 3.

Auditory icons have the same purpose as earcons, but use everyday sounds instead of musical one. The musical sounds used by earcons require learning to understand their messages, whereas auditory icons take advantage of metaphorical or iconic mappings between the sound and what they represent. This use of everyday sounds can be less demanding than musical listening required by earcons, but it can also be perceived as less pleasant27. The nature of auditory icons also makes them harder to create and manipulate, and for some messages it can be difficult or even impossible to find and adequate sound paLern36. Auditory icons can be expanded by controlling the parameters of the sound, makingthem more flexible while preserving understandability.

These sonification techniques can be very useful in the appropriate context, but they also have some limitations. With the exception of parameter-mapping they cannot be used for complex, highly dimensional data sets. Auditory icons and earcons have traditionally been seen as competing concept but they can be used to complement each other. If used with care, auditory display can make a valuable contribution to our environment but they can also be nothing more than noise.

4.3 Product Sound and Design

Van Egmond defines product sound as being sounds that are produced by industrial products, cars and user interfaces. Within product sounds we dis4nguish between consequen4al and inten4onal sounds(38). Consequen4al sounds are a result of moving parts whereas inten4onal sounds have been added deliberately[38]. From this follows that sonification can be categorised as a part of intentional sounds, but it is important to remember that not all intentional sounds can be called sonifications.

Intentional and consequential sounds are designed and experienced differently, but both of these can be to a certain extent be designed in a way that they would evoke exactly the preferred experience. Sound can influence user expectations and emotions, satisfaction and attachment, purchase decisions and preferences[39], and should be considered throughout the design process. Sounds should not only be pleasant in psychoacous4cal terms but should also fit the product. A sports car with a motor that sounds like a sewing machine or doors that close with soft thud will never invoke the desired experience.

We use sound to identify context and context to identify sound. A coffee maker has a particular sound that we recognise as kitchen related, while mixers, hairdryers and vacuum cleaners have a general drone that require knowledge of context to be identified.

It should come as no surprise that the product sound design examples that spring to mind are often related to cars. This is maybe the area where sound has received the most attention,

but hopefully the huge field that is sound will come to be appreciated within all aspects of product design.

5. DISCUSSION

Patient safety and adverse events in health care is an issue that will remain in focus. The consequences of error and accidents in this context are just too great to be ignored, both for the victims of error and for those at the sharp end of making one. Hospitals are complex in several areas, sound being no exception, and separating the information from the noise can be a formidable challenge. Medical technology is and will be one of the building blocks of modern hospitals, and a large part of this equipment is dependent on alarms to function as intended. When you add this to the sounds of everyday human action and interaction it creates a potential for a noisy and confusing soundscape. But must it be so?

When much of medical technology relies on alarms to keep patients safe, it unfortunately comes as no surprise that alarm hazards are one of the top ten patient safety challenges related to this area. Although there is an undeniable need for alarms, many of the devices that see widespread use across hospitals appear to have been designed without regard to neither context of use nor conscious product sound design, and two of the problem areas identified in part two, alarm fatigue and unsuitable alarm sounds, are a result of this. Alarms are too loud and too irritating, they do not convey a well-defined meaning and they can be masked by other, less important sounds. The uncritical approach to alarm design and implementation also provides an unwelcome contribution to the

level of noise. Soundscaping, sonification and product sound design are relatively young research fields, and it is perhaps not very surprising that neither are mentioned specifically in strategies for safety in health care. What should be more surprising and worrying is that the same strategies rarely deal with sound related issues by focusing directly on sound. The proposed solutions frequently emphasise better planning, management, training and standardisation, but as this paper suggests a more positive and comprehensive approach to sound can have positive effects.

Good product sound design involves crea4ng sounds that are pleasant, informative and fit the product, all at once. While pleasantness can be achieved by balancing psychoacoustic properties, it becomes far more challenging when you have to make sounds both pleasant and informative. Auditory display is a relatively young research field that is often thought of in conjunction with graphical user interfaces, but it gives good insight into how sound can support human activity and can thus be useful for several aspects of human-product interaction. Earcons in particular presents an option that can provide information without compromising pleasantness. Families of earcons can be created to give notice of different errors pertaining to the same system. From this follows giving individual devices a particular melody that can be built upon to allow identification of both the device and alarm inducing event in question. These melodies will have to be learned, but this also goes for simple alarm sounds.

As medical technology is increasingly populating the hospital landscape, more attention needs to be directed towards the

hospital soundscape. Focusing only on individual devices will never give a satisfactory contribution to patient safety and provide good working conditions for clinicians. Ensuring that a particular medical device has a perfectly pleasant and informative sound will do no good when this sound is masked by other less important sounds. I will also do no good if this sound, no matter how pleasant and informa4ve, is unwanted and useless, and only contributes to the already serious issue of noise pollu4on. Gaver, Hermann and Ritter have all advocated the use of sound to give informa4on and support human ac4vity, while Norman and van Egmond have called for better product sounds. The latter touch upon surroundings and context but lack a clear stance how and why these should be taken into consideration. In my opinion, good product sounds should contribute to good soundscaping. Good product sounds do not necessarily mean more sounds but better sounds and better silence.

This paper has suggested a need for a more conscious approach to sound and presented some untapped opportuni4es for using sound in problem solving, par4cularly within modern hospital. However, good sound design also involves knowing the limits of sound. Although sonification can be used to create a melody that can identify the complete problem, communicating this information by sound comes at a trade-off in duration. Requiring clinicians to listen through a 30 second alarm to figure out what is wrong will never be acceptable. In many cases a better solution will be to couple audio notifications with additional visual information. Sound can quickly alert us of an event while visuals can be used to quickly obtain information about what

is going on. Sound also has limitations when it comes to distance. Alarms are quite useless when no one is around to hear them. Good relay systems are needed to ensure that the alarm reaches the right person. Equal care must be taken in designing this system; the right person must be reached on 4me, the notification at this end of the system must be as informative as that of the original device and care should be taken to prevent it from being seen as noise by others. Sound design is an interdisciplinary field that leaves much of its definition and content to be decided by those who inhabit it. Musicians, acousticians and industrial designers can claim the same terms as their own, and adapt and apply them in very different ways without being accused of doing it wrong.

6. CONCLUSION

In writing this article I found that sound is a huge subject, even larger than I thought and in some regards I have only brushed the surface. Although there has been extensive research on sound and perception there are still several aspects that we cannot quite agree upon or easily explain. Within industrial design the opportunities that sound present appear to be largely overlooked, perhaps with the exception of car design. Whenever something is meant to make a sound then the sound should be considered as a part of the concept all through development, and not just something that is added as an afterthought.

Hospitals are not the only place where amount of sound producing technology will continue to increase, and where sound will con4nue to become noise if This paper has

attempted to pick some interes4ng approaches to sound design and present them in a way that can contribute to a discussion of why and how industrial designers should implement sound in the design process. However, more research is needed to ensure a future where the sounds of everyday things please many and annoy few.

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Open Design

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ABSTRACT

We have witnessed a shift from closed to open innovation and now trend-waves of product hacking, modification and steadily increasing user-involvement are continuing to erase the line between user and designer. The way things are designed and manufactured is constantly changing and the step beyond Open Innovation could be Open Design. A significant inspiration for Open Design is the Open Source movement that has developed and shared freely with the rest of the world a variety of tools and their source code. The result of this is that anyone has the opportunity to use, learn from, modify, and perhaps most important - reuse them. The mentioned trend-waves are also paving the way for Open Source methodologies into the realm of physical products – referred to by many as Open Design. Open Source is however not the sole contender in defining Open Design, as there are also those who refer to Open Design as design of frameworks enabling users to design their own unique products – also referred to as meta-design. This article aims to provide an overview of the term Open Design, its definition, history, importance and relevant literature.

KEYWORDS: Open Design, Open Source, Meta-design, Open Source Hardware (OSHW), Crowdsourcing, Arduino, RepRap

1. INTRODUCTION

1.1 Why Open Design

Some say that there are ecological and environmental reasons for why Open Design is an important topic; that industrial mass production and short product lifecycles is non-sustainable, damaging our ecology and that we therefore need to change the way we design and manufacture things (Hunt 2005) and (Bauwens 2009).

The value of transferring information and experience from past projects into new ones is obvious, but it's unusual to share this kind of information between individual designers or corporations. It has been pointed out that sharing of source code enables people to advance the state of the art, instead of having to reinvent the wheel

(Stallman 1985). Modifying or repairing equipment where the producer has gone out of business is also significantly easier where the equipment is well documented (e.g. as an Open Design) (R.Vallance et al. 2001).

Some people describe openness and democratization megatrends that could affect the way we look at design and manufacturing (Michel Avital 2011) (Bauwens 2009). The trend we see in innovation processes is going from closed to open, and that the line between designers and users is fading. Open Design could be the next step if this development continues. There are large growing communities supporting DIY, product-hacking, upcycling and open standards. Open Design is closely related to this and the interest for Open Design will much likely continue to grow.

Open Design can be viewed by Industrial Designers as an opportunity and framework for fun and free creative design activities decoupled from manufacturers and users demands. It provides a possibility to design with the designer in center as the main user (Kadushin 2011a) (Carolan 2011).

Some say that the role of Industrial Designers may change from designing things to designing frameworks like e.g. Automake and Future Factories that are software based frameworks for users to design things themselves. This role is referred to as meta-designer (de Mul 2011) (Atkinson 2011).

1.2 The origin of Open Source

In 1985, Richard Stallman published the GNU Manifesto (Stallman 1985) for the GNU project - aimed at securing free software for everyone. Much more than just saving the purchase cost of an operating system, the intention behind the project was (quoted from the GNU Manifesto):

• Avoiding wasteful duplication of system programming effort. This effort can go instead into advancing the state of the art

• Complete system sources will be available to everyone. As a result, a user who needs changes in the system will always be free to make them himself, or hire any available programmer or company to make them for him. Users will no longer be at the mercy of one programmer or company which owns the sources and is in sole position to make changes.

• Schools will be able to provide a much more educational environment by encouraging all students to study and improve the system code. Harvard's computer lab used to have the policy that no

program could be installed on the system if its sources were not on public display, and upheld it by actually refusing to install certain programs. I was very much inspired by this.

When Richard Stallman says free, he refers to having the freedom to edit and use the program and not having to pay for permission to use the GNU-system. Not necessarily that all copies of GNU should always cost little or no money. There is a critical difference between free as in freedom (libre) and free as in gratis. He thinks that source code should be freely shared and distributed, like other forms of scientific knowledge.

1.3 Open Source in the physical world

Digital prototyping in the form of 3d-printing has a history similar to that of OSS. A few years ago the only way you could get hold of a 3d-printer, was to buy a proprietary system for approximately $20,000. This all changed with the emergence of the free desktop 3d printer RepRap. Free in the sense that the printer is developed as an Open Design / Open-Source project and that complete online documentation is available freely. The RepRap is available as a kit for about $800 and fully assembled for about $1500. There are also other open source alternatives like the MakerBot and the Fab@Home.

The RepRap is powered by the Arduino which was developed as Open Source Hardware (OSHW). Arduino boards are available both as original and cloned versions, or you could make one yourself from blueprints and guides provided freely online.

The Arduino is powered by an OS electronics prototyping development platform called Wiring, which is based on the OS programming language and integrated development platform (IDE) Processing, and it's obvious that the sharing and collective effort all the way from the software development has made the 3d printing platform available to the masses. As more and more people gain knowledge and access to the 3d printer, further technological development steps can be expected, steps that could not be taken as fast or as easily without the openness and sharing of information which made the RepRap possible in the first place. In the physical realm just like in the software realm, we are seeing phenomena where key words are openness and sharing of information, similar to the values of the open source software world.

It is obvious that Open Design is of great current interest for many users and especially designers. We can also outline three particularly important questions: What is Open Design? How can you tell if a product is Open Design? Can Richard Stallman's idea of avoiding wheel-reinventions be realized within the physical realm? The rest of this article will be an attempt at answering these questions. It features a review of adjacent and founding terminology to try to clarify what Open Design is, and finally a discussion of its impact, its positive and negative sides and its future.

2. THEORETICAL BACKGROUND AND TERMINOLOGY

The term Open Design is defined by using a set of supporting terms as building blocks. The following paragraph is dedicated to define the terms needed to define Open Design.

2.1 Source Code

The term open-source originates from the software industry. Software is written as source code in a programming language like Java, and then compiled into an executable file which the computer can run. Source code is written in plain logical text, using the possibilities and limitations given by the specified programming language.

Source code is the only form where it is practically possible for a human being to read and edit a program. To be able to read, learn from and modify a program, one would therefore have to have access to the source code of that program (SearchSOA 1998).

2.2 Open Source Software (OSS)

Open Source Software is often referred to as software that is developed in compliance with the rules given in The Open Source Definition (Open Source Initiative 2004). Following is a summary of the rules that have to be met for software to be approved as OSS by the Open Source Initiativei

The software must be available in the form of source code, and must be free for all, private as well as commercial, for all applications (private or commercial and in all fields of endeavor), and all uses (as itself, modification, part of a bigger single work) as long as the user/re-user of the software provides the same terms for the original or modified original software in itself or as a part of a bigger single work. It may however not restrict other software that it exists alongside, e.g. on the same medium.

The fact that you can do (almost) anything you want to with the source code to is often referred to as libre, but it can still be

discussed whether this definition is truly open-source (libre), exemplified by David Winer: "A program is said to be open source if the full source code for the program is available publicly, with no constraints on how it can be used. That's it. We've looked at so many other possibilities, I've even discussed it publicly with Stallman, and he agrees that his philosophy is not open source, because there are constraints on what you can do with his code" (Winer 2000).

Currently Microsoft charges about $140 for their operating system Windows 7. The user-friendly Linux version Ubuntu can be downloaded for free and provides a lot of the same functionality. It is manageable for an ordinary user to install and use, and is in many ways it easier to use than Windows.

Once installed, it's very easy to get hold of supplementing software that can be used for e.g. Industrial Design purposes. This makes an ordinary user capable of developing products and designing, while sharing with and using the material of other users across the world and thus lowering the innovation threshold.

2.3 Open Source Hardware (OSHW)

OSHW is defined in the Open Source Hardware Definition 1.0ii as: "A term describing tangible artifacts – machines, devices, or other physical things – whose design has been released to the public in such a way that anyone can make, modify, distribute, and use those things. This definition is intended to help provide guidelines for the development and evaluation of licenses for Open Source Hardware". The OSHW Definition is practically equal to the Open Source Definition, only translated to deal with physical objects.

The communities supporting OSHW are steadily growing. Powered by a tide of product-hackers, DIY'ers, modders and homefabbers they stand in the frontline as perhaps today's most used and vivid Open Design community and they even have their own annual congress in the open source hardware summit.

Even though it includes "machines, devices, or other physical things", it is most commonly used with hardware as in electronics or mechatronics. The designs handled within Industrial Design often feature a visual "design" value that this definition does not take into consideration.

2.4 Personal Fabrication and Distributed Manufacturing

A product that is going to be manufactured has to be designed first. Open source software makes this part easier and more accessible to anyone, but does this matter when not everyone has access to equipment required for proper manufacturing? Partnership with a professional manufacturer has often been the answer but with the emergence of Open Design, product hacking, modification and DIY-products with its myriad of different one-orfew-off products calls for a completely different way of manufacturing.

Companies like e.g. www.ponoko.com and www.shapeways.com provide personal fabrication of products in numbers ranging from one and up. They provide an online marketplace where anyone can upload their designs, have them manufactured and receive them via mail. Also the designs can be made available for others, either for free or a price set by the designer. Designers can also create frameworks (meta-designs) where the user is able to easily design and order products via a user friendly interface. This production model is based on multi-purpose machinery like CNC equipment and

3d printers instead of specialized high capacity mass production lines.

The growth of free/cheap 3d CAD software and increased access to CNC tools and 3d printers also makes it easier to set up local production shops. An example of this is the FabLab project by MIT; aimed at giving anyone the opportunity to use the FabLabs tools to create almost anything. This model is called distributed manufacturing and could be considered a more climate friendly manufacturing method since nothing is created unless ordered by someone, and everything is (or can be) created locally.

Another example is supplied by MakerBot industries that buy home-printed pulleys from customers that have purchased one of their 3d

printers. Local-Motors, an open-source /crowdsourced car producer that sells limited series of customer designed cars provides another example. They open up shops in areas where there are a lot of people who have placed orders and make the cars locally. This makes it possible to incorporate a high level of customization and use of local materials and work-force. They also provide the customer with the experience of taking part in the build process in addition to using local resources and manpower. This can be considered as co-design taken to the next level and a research area all on its own. It's not just enabling the customer to influence the design by making suggestions and customizations like color or labeling of readymade designs – the customer has the possibility to be a part of the whole development process, from ideation to manufacturing. This could tie the customer closer to the product and result in a less "use and throw mentality" and thereby be a more sustainable production model.

2.5 Peer production

"Typical for peer production is that the producers create products (with both concepts being essentially misleading in this case!) in such a form that they form a commons which can be used and modified by others, who return it improved to the same common pool." (Bauwens 2009).

Peer production is basically the name of the open source information production model. Everyone participating in peer production makes their work available to others to use freely, as long as they in return make the modified work available under the same conditions.

2.6 Crowdsourcing

Crowdsourcing has been made popular by websites like crowdspring.com and 99designs.com and books like "how to unleash the power of crowds in your business" (Libert & Spector 2010).

Crowdsourcing in the context of design is often compared to designing on spec, and has been accused of ruining business for small graphical and web designers much like iStockPhoto has destroyed the business of professional stock photography.

The crowdspring model is like this (from their website): "You describe your requirements, dozens of designers submit web page design concepts and you only pay for the web page design you like best!" This is positive for those who buy the designs cheap, but the collective worker pool suffers from it.

"Crowdsourcing, though it may blend the best aspects of open source philosophy and the benefits of global business (including its outsourcing component), it might negatively affect a labor pool: the

crowd. To see it one way, the intellectual labor the crowd performs is worth a lot more than winning solutions are paid" (Brabham 2008).

This way, work-hours in the amount of tens of times the chosen design is wasted in the process and there is no guarantee that designers get paid for their efforts, resulting in a much harsher environment for small design firms.

Brabham further claims: "Crowdsourcing, a distributed problem-solving model, is not, however, open-source practice. Problems solved and products designed by the crowd become the property of companies, who turn large profits off from this crowd labor. And the crowd knows this going in." This is the exact opposite of Richard Stallman's idea of not having to reinvent the wheel.

In fact, this way, all of the participants in the project have to reinvent the wheel, and only the winner (if anyone) is rewarded. There are however examples where crowdsourcing is a good alternative. What is here defined as a good alternative is when the total work effort being done is rewarded fairly, meaning that no one (including the crowd) is taken advantage of. The SETI@Homeiii project is an example of (in this context) good crowdsourcing. It harnesses the power of otherwise inactive computers to create a powerful mesh-computer. This comes at little expense to those who own the computers, but it is a substantial resource for those who control it. But proper compensation doesn't have to mean getting paid. If the task in itself is amusing, further compensation may not be necessary. Another example of good crowdsourcing is an online game called Foldit (www.foldit.com), where people help researchers by simply playing a game where the puzzle solving relates directly to

scientific problem solving. In this case, the fun and challenge of the game is the reward itself, and gamers recently solved in three weeks the structure of a retrovirus enzyme that had been a scientific problem in over a decade.

The website www.innocentive.com is a place where scientific problems are posted by different corporations for anyone to solve. Problem solving by this model provides the diversity and widespread of knowledge that cannot be included on a single corporations payroll. Research indicates that the probability of solving a project on innocentive actually increases proportionally to the self-judged distance between distance between the solvers own background and the nature of the problem. "Innocentive solves 30% of the challenges that the in-house development wasn't able to. Besides, the answers sometimes come from completely unpredictable sources" (Lakhani et al. 2006).

2.7 Creative Commons Licensing

There are multiple licensing schemes available but it is the Creative Commons (CC)iv license which stands out. The reason for this is that the CC has been adapted to the respective national copyright laws in more than 50 countries and their clauses and freedoms are in force everywhere" (Beckedahl & Goetzke 2011). The CC is a level-based licensesystem where you can grant different levels of freedom to your works. You can choose whether your work can be used commercial or not (Non- Commercial/NC), whether the work can be reworked or not (No-Derivatives/ND), and whether the same license should apply to the reworked results (Share-Alike/SA). Always when using a CClicense, the user of a work is obligated to name the author of the work (BY). A commonly used license in Open Design products

is the CC-BY-NC-SA, which gives anyone the opportunity to use and modify but not commercially exploit the given design.

3. OPEN DESIGN

Open Design is a new expression and to understand its current content it is meaningful to review its birth. Finally, marked voids and profitability is also included in this section to view Open Design in a

broad context.

3.1 Beginning

The term open design appears first in the article "Open design of manufacturing equipment" (R. Vallance et al. 2001) where it's described as a bazaar design method, an expression originating from a software developer working on the Linux project. " I believed that the most important software needed to be built like cathedrals, carefully crafted by individual wizards or small bands of mages working in splendid isolation, with no beta to be released before its time … No quiet, reverent cathedral-building here—rather, the Linux community seemed to resemble a great babbling bazaar of differing agendas and approaches out of which a coherent and stable system could seemingly emerge only by a succession of miracles" (Raymond 1999). Raymond experienced however both in the Linux project, and in later projects that this process has its advantages. What he witnessed resembles a micro-version of the realm of modern science, with all its different researchers, with their different goals and agendas, but all with the same purpose: innovation and gaining knowledge by building upon the works of others.

Dr. Ryan Vallance and Dr. Samir Nayfeh founded in 2000, a non-profit organization named the Open Design Foundationv with the goals of promoting open design methods, develop and maintain an open design definition(standards for licenses),certify Open Design License agreements, and distribute for free, information on licensed Open Design projects. Their site however seems abandoned, and is mostly a relic from the birth of the expression Open Design. They have released The Open Design Definition V 2.0vi which is practically identical to the OSHWD.

3.2 Open Design

The OSHW Definition is an important influence on the development of a clear Open Design definition. Its main focus is hardware as electronics and machinery, but the concept could easily be adapted to include industrial product design. Maybe both Open Design and OSHW (in addition to several other definitions) needs to coexist within a hierarchy where Open Design acts as an umbrella term which includes the whole of a product and different sub-definitions like the OSHW address the different subtopics.

An important recent book on the subject is Open Design Now (Atkinson et al. 2011). It includes a collection of articles, including one by Michel Avital: "Open design stands for accessible design in the form of blueprints that are publicly open to view, modify and use under open-access terms.

Moreover, open design often implies that the design blueprints are available via open-access digital repositories, that they can be adapted at will to meet situational requirements, and that they can be used by consumers to fabricate products on demand by

commercial, off-the-shelf means of production." (Michel Avital 2011).

In his article, Avital refers to Michel Bauwens' model of Open Design which is divided into the following three parts. The input side: "with voluntary contributors, who do not have to ask permission to participate, and use 'open and free raw material that is free of restrictive copyright so that it can be freely improved and modified. If no open and free raw material is available, as long as the option exists to create new one, then peer production is a possibility." The process side: "based on design for inclusion, low thresholds for participation, freely available modular tasks rather than functional jobs, and communal validation of the quality and excellence of the alternatives (I call this peer governance)." And finally the output side, which: "creates a commons, using licenses that insure that the resulting value is available to all, again without permission. This common output in turn recreates a new layer of open and free material that can be used for a next iteration" (Bauwens 2009). Avital and Bauwens both also consider Open Design as part of openness megatrends, paving the way for new (amongst others) production, manufacturing and economic models. They also argue that Open design could contribute to making the pull market model more common. Exchanging the push model, where products are created in the hope that someone will buy them, for a pull-model where the users themselves hack, modify, request and create their own products.

"In general, push business models are based on top-down value chains where a line of a few massproduced products is distributed broadly through value-driven downstream marketing techniques. In

contrast, pull business models are based on bottom-up value chains where a line of customerconfigured products are distributed individually through features-driven upstream marketing techniques" (Michel Avital 2011).

Industrial Designer and educator Ronen Kadushin represents a similar but different approach. "A revolution in product development, production and distribution is imminent due to the Internet's disruptive nature and the easy access to CNC machines. Open Design is a proposal to make this happen. Its aim is to shift Industrial Design to become relevant in a globally networked information society. Open Design method consists of two preconditions:

1. An Open Design is CAD information published online under a Creative Commons license to be downloaded, produced, copied and modified.

2. An Open Design product is produced directly from file by CNC machines and without special tooling" (Kadushin 2011b). Ronen is an Open Design pioneer and has taught a onesemester Open Design course at the Burg Giebichenstein Art School in Halle in September 2010. He has also published on his website multiple Open Designs under a Creative Commons BY-NC-SA license which does not allow commercial use of the design.

The three mentioned Open Design models of respectively OSHW, Avital/Bauwens and Kadushin are all more or less based on Open Source methodology. Paul Atkinson and Jos de Mul represent a completely different approach, more focused on a change in the designer role.

"...professional designers will have to lose their egos and change their role from the design of finished products to the creation of systems that will give people the freedom to create high quality designs of their own" (Atkinson 2011). "...this calls for a new role for the designer. The designer should not give up his role as a designer (or restrict himself to his traditional role as designer of material or immaterial objects). Instead, he should become a meta-designer who designs a multidimensional design space that provides a user-friendly interface" (de Mul 2011). Meta-design is (like Open Design) a fuzzy term and there are also other completely different models that claim this name.

This means that the model described by Atkinson /de Mul could benefit from either claiming the term meta-design or choosing an entirely different name. Throughout this article however, this model is consistently referred to as meta-design.

To summarize Open Design is a view at the mentioned models and their similarities and differences in order to distinguish them from each other.

The OSHW Definition is a direct translation of the Open Source Definition into the physical world and requires all project details to be freely available for all types of uses with the only prerequisite that authorship/source is credited and that the same licensing scheme is applies to all derivatives. The OSHWD does not include limitations on production methods and is thereby separated from the others, but in order to tell the remaining models apart it's necessary to dig a bit deeper.

At the most basic level, Bauwens, Avital, and Kadushin all unites in Open Design requirements being:

• Project details (physical source code) are made available in some sort of digital repository.

• Fabrication is limited to commercial, offthe shelf, multi-purpose machines.

• Derivatives under the same licensing are allowed.

Kadushin's Open Designs are licensed under a Creative Commons BY-NC-SA license which does not allow commercial use of the design, making his model unique in this context. Bauwens and Avital go further than that and require that:

• Open Design project details (physical source code) should be free / libre. Meaning that they should be licensed in a way that allows for manufacturing, sale, distribution, use of the product and the physical source code, and allow derivatives, all under the same license as the original work.

Atkins and de Mul's meta-design model is difficult to compare directly but it's mentionable that it requires the use of off the shelf production methods. From this we see that the current definition of Open Design can be divided into two main directions. Meta-design (Atkins / de Mul) and Open Source based with its three sub-directions:

Avital/Bauwens, Kadushin and OSHW, illustrated by the following table:

	Provide project details online	Off the shelf production methods	Commercial use of project details
OSHW	Yes	No	Yes
Avital / Bauwens	Yes	Yes	Yes
Kadushin	Yes	Yes	No
Atkins / de Mul	N/A	Yes	N/A

Table 1: Comparison of the different Open Design Definitions.

Because the two directions are inherently different and the obvious link between Open Design and Open Source, I propose that the term Open Design is designated for the open-source-based models and that the term meta-design exist separately – at least it will throughout the rest of this article.

Meta-design is an interesting topic for further research but will only be superficially reviewed in this article as (Open Source based) Open Design remains the main topic.

3.3 Marked voids for Open Design

The following section is an attempt to identify more precisely, using existing successful projects, some marked voids where Open Design could thrive.

• Where the products offered in a niche, e.g. 3dprinters are all too expensive and complicated. This resulted in a marked void where the low cost 3d-printers like the RepRap came in. The consumers

themselves needed to create the technical solutions which the larger companies did not.

• Products for use in voluntary or ideal organizations, like OpenEcology's Global Village Construction Set.

• Where the customer wants a product which they can customize/hack/manipulate. Either in itself, or as a part of a bigger system. The users want products which can be tailored to fit their needs, both in function and performance as well as looks. An example product filling this void is the Elphel camera system.

• When the technology offered to students (and e.g. artists) is coming short and needs evolving. A flourish of new product opportunities and technologies evolves as a result of playing with new technologies. Like the release of The Arduino made the RepRap possible, the hacking of the Microsoft Kinect and PS3 Eye has already (e.g. the Eyewriter) and will continue to spark technology innovations.

• When there is a craving for a product that for some reason the existing companies won't make. It's too big of a task for one person to do alone but it can be done as an Open Design with a big enough community. Examples are Pandora and Rallyfighter.

• A lot of people hack, manipulate and create products for fun as a hobby. They prefer to use Open Designs because they are well documented and easy to reuse. There are several big communities supporting this, like hackaday.com,makezine.com, instructables.com and thingiverse.com. This can be seen as a direct comparison to what has happened with art, music, graphic design, video-making etc. where creating has become inclusive for all and independent of

publishers or producers, made possible by free sharing and the internet.

The need for a development platform (like e.g. the Arduino) is a pulling force that triggers someone or a community to make one. The fact that it was developed as an open source project made it more accessible and then created a creative pressure, a push-force which has sparked the creation of a myriad of products that incorporates the Arduino, and which most likely would not have existed without. If the Open Design community gains further influence and size there will much likely be a correlated growth in the number of projects.

Highly compatible educational or user-driven Open Designs that each spawns multiple other Open Designs. This even creates a new marked for people in discovering product opportunities using Open Designs.

Also emphasizing the marked possibilities in Open Design is Michel Avital: "Open design presents entrepreneurs and agile companies with a grand opportunity to expand existing markets, to develop new ones, and to capture large shares from current market leaders. Mobilizing open design to generate organizational value and to boost its market position requires radical strategic and operational changes" (Michel Avital 2011).

3.4 Profitability of Open Design

Open Design as in industrial product designs like those of Kadushin is such a new phenomenon that there are too few sources and projects to assess its profitability directly. Projects from closely

related models like OS and OSHW has therefore been reviewed in this section.

A presentation (Torrone & Fried 2010) gives an overview over current OSHW project's revenues. It shows that there are several successful projects regarding revenue, and it's obvious that OSHW projects are capable of generating massive markets and income, and often not only for those making it, but a lot of surrounding actors, that in their turn contribute to making the product attractive to the users. The Arduino for example is produced by multiple businesses and is making millions of dollars in revenues for a number of actors. The creators have released the Arduino as OSHW, and risked not making a single dollar, but with a few smart moves, as copyrights on the name, and licensing fees, they make money on high-quality clones in addition to their own, while anyone is free to produce as many copies as they want to. Getting starter capital can be a challenge for many projects, and not all ideas are able to gain sufficient support through the classical investment models.

To fill this void a company called kickstarter (www.kickstarter.com) has been started. It allows entrepreneurs to present their idea and get funds from individuals interested in the project (basically in the form of presale). This way it's possible to target and involve the user-group even before production has started.

A blog comment reads the following: "Your jobs board helped me find work at a company that is about to release some really cool open source hardware…In discussions with customers its greatest appeal is that it is open source: if we, the company, go out of business or somehow ceased to exist, customers would be able to find another source of the board without having to redesign their

entire product line. Of course, margins are pretty slim when it comes to hardware like this that will be integrated into other hardware, so what we are really selling is support and engineering" (Devlin 2011). In the OSS world, there is a myth (amongst others) claiming that there is no money to be made from OSS. To disprove this, Tim O'Reilly used an example from the hardware world:

"It is true that open source software will reduce the amount of money that is spent on existing commercial software (which is why hardware vendors like IBM are so eager to embrace it – it cuts out the "Microsoft tax"). Disruptive technologies like open source software development reduce the margins of existing players, lower the barriers to innovation, and end up expanding the market – for players who are able to quickly understand and play by the new rules.

For a historical parallel, you have only to look at the history of the personal computer industry. Essentially, IBM changed the rules with the release of the specification for the personal computer as an open standard. For some years, there was an obvious battle over proprietary extensions to the open standard, but eventually, at the systems level, it became clear that the strategic advantage was not in gaining proprietary advantage, but in supplychain management. … If certain types of software become more of a commodity, the skills needed to prosper change accordingly" (O'Reilly 1999).

In the GNU Manifesto (Stallman 1985) a footnote reads: "I think I was mistaken in saying that proprietary software was the most common basis for making money in software. It seems that actually the most common business model was and is development of custom software. That does not offer the possibility of collecting rents, so

the business has to keep doing real work in order to keep getting income. The custom software business would continue to exist, more or less unchanged, in a free software world. Therefore, I no longer expect that most paid programmers would earn less in a free software world."

Michel Bauwens presents the possibility for corporations to contribute to open source projects. "For example, contributors could be on the payroll of hierarchal corporations, but still put the resulting work in the commons, where it is available for further peer improvements. In fact, for Linux and many free and open source software projects, this is the main reality, with nearly three quarters of Linux programmers being paid by companies" (Bauwens 2009).

4. PROPOSED NEW TERMINOLOGY

4.1 Source Code in the Physical world

Writing software source code, is in fact manufacturing a product (program). Completing it takes no more effort than running it through a compiler, and a lot of open source programs are shared primarily in the form of source code.

To address the source code issue further, it would be useful to have a more suitable term than "source code in the physical world." Unable to find such an expression in existing literature I proposed one myself. Combining the terms "source code" and "blueprints" resulted in the term source prints.

The nature and contents of source prints changes with regards to what kind of physical product they are referring to. For example the source prints of a brick could at first seem to be very simple and only consist of a simple height x width x length formula.The acid test of

this concept will be the process of trying to make a product from the supplied source prints, but it's obvious that making a brick isn't that easy. Much more information would be needed, including:

- **Chemical formula for the brick-mixture**
- **Physical manufacturing specifics like pressure and hold-times.**
- **Drying-time and temperature or curing process specifics.**

Describing the brick with this level of detail makes it possible to reproduce it so precisely that the performance of the original brick in terms of material properties like brittleness, e-module and so on are also copied. If the use for this brick is merely to be a paperweight, it could be enough with just the size, as any hard and dry material would do. The level of detail required will vary with the use of the documentation. And it may be useful to introduce some sort of source print level system to differentiate between different detail levels according to use.

Knowledge from the world of science experiments with its demand for scientific experiments to be reproducible in order to be creditable can be used as an argument for what source prints should include. To call the documentation of a physical artifact source prints, these source prints would have to supply sufficient information to make the artifact completely reproducible.

For a simple electronic device confided in a casing, the source prints will look something like this:

- **Electrical schematics**
- **Electrical design (PCB layout)**

• Casing design (CAD-file)

• Bill of materials (BOM)

• Source code of the software used

• Source code of the hardware in the case of programmable hardware

In an industrial design project there is still a lot of information that remains excluded from this list like e.g. ergonomics studies and other parts of the analysis phase. Sharing this would be vital in avoiding wheel reinventions, and the decision process should be included into the source prints if a total documentation is the goal of the source prints. But this is not necessary to reproduce the product and therefore not necessary to qualify as an Open Design.

Sharing all decision-making, meanings and intentions with a product also has downside in the suppression of alternative product-interpretations and unintended uses (both constructive and destructive). It can also seriously damage a user's impression of a product. A comparison can be made between designers and other artists. Often musicians or poets avoid interpreting and explaining their lyrics, giving the users (or audiences) an opportunity to add meaning and value to the products through their own interpretations.

Industrial Designer Jens Dyvik is currently (independently) researching personal manufacturing and open source design, and has published some designs on his website under a creative commons non-commercial share-alike license. He has written down some relevant thoughts about the FabLab project: "Even if a FabLab is open 24/7, it is no good to the global community unless the

knowledge generated is being shared in a universal language. In order to share, you need to document your work. And documentation seems to be the great shame of many FabLabs. Writing in understandable English is only the beginning. We need sharing systems for not only how things were made, but also how it was designed, pictures of the parts, the assembled result and how the design can be further improved" (Dyvik 2011).

The question of whether to share the whole decision process or not is an interesting question and could be a topic for future research.

4.2 The compiler gap

The shareability of source prints is greatest when they are in their digital form, as they can be shared via the web. There is value in studying products in the form of source prints alone, but the main purpose for physical products is their lifetime in the physical world. As opposed to software, there is in the physical world, a significant gap between the "physical source code" and the finished product or prototype. There is no one simple generic physical replacement for the compiler, and instead the need for processes, raw-materials and knowledge that stands between product in its digital and physical form creates an obstacle that I propose to name the compiler gap.

The resources available for an object to transfer across the compiler gap can change according to geographic location of the transformation, and this may in many cases affect the detail level and content required in the source prints. The use of standardized parts and multi-purpose / standardized manufacturing tools could however significantly decrease both the size of the compiler gap and the problems related to geographic location.

When it comes to products like the Arduino, a product too complicated to manufacture yourself (at least for now, in the form of finished PCB's), and so versatile in itself that it has little need for immediate customization, it will be better to buy big batches from a specialized producer. This requires significant amounts of money and this creates a marked for actors that buy in large quanta and sell to end-users, like e.g. Sparkfun (www.sparkfun.com).

The possibility of gaining knowledge through online sources and communities means that you can save money by doing things yourself. Explicitly this means that it's possible to exchange "compiler time" for cash. Reversely put this also means that you could get paid to cut others compiler time. This creates possibilities for a marked where people get paid for their efforts and knowledge instead of patents and marketing, and gives e.g. schools or students the possibility to utilize otherwise unused workshop time to make extra money.

5. DISCUSSION

5.1 Why not Open Design?

Is Open Design unarguably positive? In the cases where Open means that source prints remains open and free, that will in many cases pose as a big problem. The common objection is that information is part of a corporation's intellectual capital and that sharing this freely will waste otherwise potential earnings. Other concerns are about the safety of the modified designs and concerns with the company being linked to unsafe unstable products, but then it's useful to apply the part of the OSD that states that a producer can require the modified product to go by a different name. Also obviously firms are worried that opening up their designs and giving

them away freely causes them to lose money, as people or other suppliers are free to make them their selves or sell them. (Abdelkafi et al. 2009) argues that the use of open source development in the physical realm is slower than ordinary development. They also state that the success of an open source project is dependent of to what extent the project is able to attract participants. They also emphasize that the inherent characteristics from the application of open source principles complicates the transition from software to physical objects.

Jos de Mul has identified four main problems with Open Design. The first is the cost associated with physical manufacturing, and the fact that the result product has to at least account for that cost, although this seems to be an ever decreasing problem with the emergence of the 3d printers.

The second problem is that many people are not able or willing to participate in the design process.

Thirdly, there is no guarantee that the product subject to an open design process benefits from it. The crowds' effect and varied input on a product may impact its reliability, functionality and beauty, both positively and negatively.

A fourth issue is that while opening up and freely sharing the tools and knowledge of different branches of engineering is giving people the ability to create beautiful and innovative products, they may also create dangerous and destructive products, like e.g. weapons or viruses. In 2002, molecular biologist Eckhard Wimmer designed a functional polio virus on his computer with the help of biobricks and printed it with the help of a DNA synthesizer (de Mul 2011).

5.2 Open Design in education

Using well documented Open Designs as a teaching tool could provide students with insights and basis of comparison as well as enabling them to advance technology by building upon the work of others. A drawback is that it could prove difficult to be original enough and that the designs end up as copies instead of derivatives. As an aid in cutting prototyping time and being able to create more realistic and advanced prototypes there is great potential in the use of OSHW like the Arduino and affordable manufacturing technology like 3d printers, desktop DIY CNC's and so on. Free software also makes the design tools much cheaper and more available. (Steeg 2008) argues that the emergence of distributed manufacturing results in a removal of the mass market barrier and that anyone can sell a design to anyone else, which makes the whole world a marked for students. He also mentions the opportunity for schools to make money by becoming local Ponoko manufacturing partners.

Further he points out the contradiction between the globally increasing support for sustainability and the focus on design for mass production and consumption commonly exercised in design education.

Designing frameworks for users to design their own products is a fairly new phenomenon and majorly untouched by design education. Meta-design could be the future role of the industrial designer as argued by Atkinson and de Mul, and in that case it would be a good idea to include meta-design in the industrial designer's curriculum.

6. CONCLUSION

Open Design is a fuzzy expression but its current definition can be divided into two main directions: meta-design (Atkins / de Mul) and Open Sourcebased (OS-based) with its three sub-directions (Avital / Bauwens, Kadushin, OSHW). This article proposes to use the term Open Design exclusively for the open-source-based models and that metadesign is kept separate.

(OS-based) Open Design could be seen as part of a bigger and possibly paradigm shifting movement: Open X / Open Everything. (OS-based) Open Design could contribute to advancing the state of the art by building upon the works of others. Designing a product as an (OS-based) Open Design may or may not improve its quality compared to a traditional design process, but it has been convincingly argued that it will make the product more accessible, replaceable and reusable.

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ii http://freedomdefined.org/OSHW

iii http://setiathome.berkeley.edu/

iv http://creativecommons.org/

v http://opendesign.org

vi http://opendesign.org/odd.html

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Norwegian University of Science and Technology

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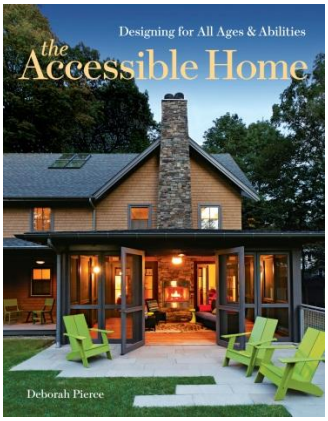
The Accessible Home: Designing for All Ages & Abilities
New Book by Architect Deborah Pierce



Newton, Connecticut (October 23, 2012) – The Taunton Press is pleased to announce the publication of *The Accessible Home: Designing for all Ages and Abilities,* by Deborah Pierce. Foreword by Michael Graves, FAIA.

This first-of-a-kind home design book addresses the needs of families, couples, and visitors looking for an accessible home that is both beautiful and functional. The Accessible Home shows how ordinary people with extraordinary challenges can partner with architects, designers, and their own families to create homes that restore capabilities, independence and the grace of daily living.

The book is also a tool for the more than 80 million Baby Boomers to age in place in their current homes and lead a lifestyle with independence, comfort, and safety for decades. A recent survey by AARP revealed that 84 percent of Boomers would like to stay in their current homes during retirement, but only 16 percent have taken any steps to adapt their homes accordingly.

Author Deborah Pierce is one of our nation's foremost experts on universal design. As an architect for the past three decades, she has

been focusing on how a home serves the activities of daily living. As a result, the projects in this book convey the power of universal design – useable by everyone.

Michael Graves, FAIA, says, "Deborah Pierce tackles the small problems along with the large in her quest to make wonderful places where people with disabilities can live comfortably and safely."

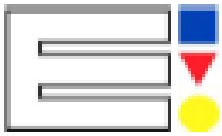
Homeowners, architects, designers, remodelers and builders will find ideas, inspiration and courage to create homes that are unique to each household's requirements and at the same time, attractive to broad segments of the population. She shows us that "accessible" can be beautiful and functional, light and airy, low-maintenance, safe and comfortable, and that universal design today is a far cry from the grab-bars and ramps of yore.

***The Accessible Home* features 25 new and remodel projects and 225 photos from across North America to show readers how to create a home that serves its owners for years to come.**

Title: *The Accessible Home: Designing for All Ages & Abilities*
Publish date: October 23, 2012
Publisher: The Taunton Press
ISBN-13: 978-1-60085-491-0
Price: $27.95
Pages: 224
Photos: 225
Drawings: 30
Cover: Paperback
Trim Size: 8 ½ x 10 7/8 inches
Taunton Product: 071400
Web site: http://www.taunton.com

About the author: Deborah Pierce, AIA, is principal of Pierce Lamb Architects in Newton, Mass. and lectures across the country on the topics of architecture, accessibility and universal design.

APPEAL:



EIDD / Fundacion ONCE Book Project
'Design for All in Action – The European Experience'

Call for Submissions

A major new publication on Design for All projects commissioned by EIDD – Design for All Europe and Fundación ONCE

Design for All (DfA) is design for human diversity, social inclusion and equality (EIDD Stockholm Declaration, 2004[1]). It supports the creation of products, services and systems that can be used by as many people as possible without the need for special adaptation and has a people-centred approach at the heart of it. DfA has origins in the field of accessibility but has grown to encompass much more. It can meet the great social challenges of our time such as ageing populations, the need to include differently-abled people in mainstream design as well as engage with people excluded on the basis of social, economic, financial or geographic boundaries. Inclusion is central to a DfA approach, bringing with it better design thinking, improved products and services, market success and socially-centred innovation.

DfA has been appropriated by designers working in different disciplines such as consumer products, packaging and communication design, transport and mobility as well as the built environment and sustainable development. The book will look at issues concerning DfA methods for involving people in the design process, improving quality of life for all and building a case for widespread practice. Case studies describing how DfA policy or legislation has influenced design practice can also be submitted.

There is a need to progress DfA from being just seen as an ideology or philosophy to becoming a practical part of the everyday design process and demonstrating the value of the approach. This publication seeks good examples of DfA that include people whether old or young, differently-abled, of any gender, culture or race.

The aim is to convey the practical experience of implementing Design for All drawn from designers, educators, policy makers, businesses and other organizations, articulating the key elements for success as a good practice guide for others to follow.

It will seek to achieve the following objectives:

• Collect interesting European and global experiences on Design for All in all design sectors including the built environment, products, services, IT, transport and information design.

• Analyze each experience and outline key factors in describing their success. The editorial team will look at each accepted case study to see how other people working in DfA may benefit from the learnings and how work might be transposed or reproduced in other areas, sectors or countries.

• Publish a book in Spanish and English – the first of its kind – that exclusively showcases DfA case studies and the importance of design that considers human diversity. The book will be distributed across the EU.

If you would like to be included please send an abstract of 200 words written in international English for consideration by the editorial team. Guidelines as below:

- Abstracts should describe design stories or case studies that address the publication theme of Design for All in Action, explicitly stating how it can be considered to have a people-centred approach.
- Market-ready solutions are preferred but the editorial committee will consider abstracts that describe exceptional work that may not be on the market.
- Abstracts are in international English and NOT academic English. The editorial team will give advice on final contributions.
- Abstracts are solicited from individuals, companies, industry, universities, research facilities, government bodies, voluntary sector organizations or anyone who has a DfA story to tell. Designers, students, start-ups, educators, marketers, policy-makers, managers, academics and business leaders are also encouraged.
- Abstracts should include a short descriptions of: the project: user groups: design process: outcomes; and any measures of success.
- Authors of successful abstracts will be required to submit their completed articles of between 1000 to 1500 words.

Abstracts should aim to include:

- Project description
- Methodology (have users been approximately involved?)
- Description of the process
- Description of impact (has the work had a significant effect / benefit?)
- Outline of innovation (is the work described genuinely new or novel?)
- Pictures, figures and tables

- References

Timetable for submission:

- 1 January 2012 to 15 February 2012: abstracts of 200 words sent to Merih Kunur at merih.kunur@network.rca.ac.uk
- 15 March 2012: the editorial board reviews submissions and advises successful authors
- 30 April 2012: completed articles received
- 30 May 2012: articles reviewed by editorial committee and feedback given to authors
- 30 June 2012: 'Camera-ready' articles submitted by authors for inclusion in the book
- 15 August 2012: ready for print
- Autumn 2012: book launch

Editorial Committee:

Lead editors:

Finn Petrén, President, EIDD Design for All Europe

Jesús Hernández, Dirección de Accesibilidad Universal, Fundación ONCE

Editors:

Avril Accolla, Vice-President, Design for All Italia

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Peter Neumann, President, EDAD, Germany

Chris Ramsden, President, Chartered Society of Designers, UK

Key contacts:

Book facilitator: Merih Kunur, Royal College of Art, UK

merih.kunur@network.rca.ac.uk +44 (0) 7789 727272

References:

Ref 1: EIDD Stockholm Declaration, 2004

www.designforalleurope.org/Design-for-All/EIDD-Documents/Stockholm-Declaration/

2.

€ Design | Measuring Design Value

Dear Stakeholders and Partners,

we are happy to enclose for your attention the **Analytical Framework Paper**, as part of the first delivery of the **€Design Project**, an initiative that aims to identify and establish guidelines for measuring design as a factor of economic production and its impact on GDP.

€Design counts with the participation of six European partners: BCD Barcelona Design Centre, Coordinator (Spain); Copenhagen Business School (Denmark); designaustria knowledge centre & interest organization (Austria); Hungarian Intellectual Property Office (Hungary); SVID Swedish Industrial Design Foundation (Sweden) and the University of Cambridge / Design Management Group (United Kingdom).

The project, co-financed by the European Commission, ENISA (Spanish Ministry of Industry, Energy and Tourism), the Swedish Agency for Economic and Regional Growth and the Austrian Federal Ministry of Economy, Family and Youth, with a budget of one million euro, will analyse and define the conceptual framework of design in the economic context, in order to measure it as a tool for user-centred innovation and as economic factor of production. The objective is to obtain tangible results that demonstrate the importance of design as a crucial element to enhance the innovative capabilities of Europe and increasing economic growth and business competitiveness in the global market.

The initiative is part of the 1st Action Plan of the European Design Innovation Initiative, a commitment of the Innovation Union Europe 2020 flagship to exploit the full potential of design for innovation and to reinforce the link between design, innovation and competitiveness.

Please feel free to disseminate this document amongst your associates or colleagues, as well as through your website.

We are particularly interested in receiving your feedback. Please send your comments to: katharina.beran@designaustria.at.

With regards,

Katharina Beran & Severin Filek
Project Manager Director

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Museumsplatz 1, Hof 7, 1070 Wien
T (+43-1) 524 49 49-0
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COORDINATOR: PARTNERS: COFINANCED BY:

NEWS:

1.

Blastcrete's Concrete Pump Attachment Features Universal Design

Blastcrete Equipment Company offers the Model RD6536 skid steer pump attachment.

Blastcrete Equipment Company, manufacturer of concrete mixers, pumps and related products, offers the Model RD6536 skid steer pump attachment.

• Three-inch (7.6 cm) hydraulic squeeze pump is ideal for ICF, block fill, form and pour, driveways, basements and various shotcrete applications.

• Ability to pump grout materials, 3/8-in. (.9 cm) shotcrete and 3/4-in. (1.9 cm) structural concrete mixes.

• Fast, efficient solution for contractors performing a variety of concrete and shotcrete applications.

• Variable speeds of 0 to 25 cu. yds. (0 to 19 cu m) per hour.

• Vertical pumping distance reaches 50 ft. (15 m) with the use of a rubber delivery line, while horizontal distance can reach up to 250 ft. (76 m).

For 60 years, Blastcrete Equipment Company has been manufacturing solutions for the shotcrete industry. With a complete product line consisting of concrete mixers, pumps and related products, Blastcrete Equipment Company is poised to meet the needs of the commercial and residential construction, ICF and SCIP building systems, refractory and underground markets.

For more information, call 800/235-4867 or visit www.blastcrete.com.

(Courtesy :Constructionsourceguide.com)

2.

Punjabi University develops 'text-to-speech' software for people with vision disabilities

Panjabi University, Patiala, has developed a "text-to-speech" software using which people with vision disabilities will be able to hear any text written in Punjabi. The TTS software will be the first one to translate other languages into Punjabi and convert the text into speech.

Funded by the department of science and technology, the TTS system has been developed by the computer science department of the Punjabi University.

Dr Gurpreet Singh Lehal, who was part of the team that developed the software, said, "The system can be used as an add-on tool embedded with web browsers that will enable computers to read a website in Punjabi language."

"The system can translate languages, including Hindi and English into Punjabi," said Lehal.

He added that the total project cost came around to Rs 19 lakh.

Lehal said in a book was to be heard, it would have to be first scanned and then use a computer fitted with the software to convert the text into speech.

IIT, Hyderabad, was the first institution to develop such a system. The IIT had developed TTS system for Hindi.

"The system will also be a great help to all the persons with cognitive disabilities like dyslexia (difficulty reading), attention deficit disorder, and learning disabilities in general," Lehal added.

The university authorities are expected submit their project to the Union government in the first week of January and also put the software on its official website. The software can be downloaded from the university website from January, 2013.

(Courtesy:: The Times of India)

3.

Indian scientists develop 'Mounisara' software to help people with hearing disabilities

Unlike the popular notion, we learn from what we hear and not what we see. Wondering how difficult it makes learning for kids with hearing disabilities!? The increasing number of deaf children dropping out of school every year speaks for itself.

While Bengal is one among the states with the highest concentration of people with hearing impairment, it also features almost on top of

the list when it comes to the number of children with hearing disabilities taking admission and yet dropping out of school. Worried at the alarming trend, a premier scientific institution of the city has devised a software that will translate written text into sign language for immediate assimilation of people with hearing disabilities .

The software called Mounisara (end of silence) has been developed by four scientists of the Variable Energy Cyclotrone Centre (VECC) – a wing of the department of atomic energy. A senior teacher of sign language from a state aided-school for the hearing impaired was also roped in for the project to retain authenticity and uniformity of the sign language.

The software that has already been installed in as many as 45 special schools and also conventional schools which admit children with disabilities project was started in August 2007. Pegged at Rs 1 crore, the five-year long project was fully funded by the department of atomic energy.

Interestingly, Subha Sarkar, the schoolteacher who helped VECC with the sign languages for all conventional words in use, has parents and a brother who are hearing impaired. She is the only person in the family who does not have disabilities. Thus, she was naturally drawn towards mastering the sign language and doing her bit to standardize it.

"We are able to translate Bengali and Hindi texts for the moment as was the mandate of the project. Bengali because it would be of use for the region and Hindi because it can then be disseminated by the centre among Hindi-medium schools across the country," said Biswajit Sarkar, a scientist in the team.

"We have been successful in translating Barna Parichay, Sahaj Path and several other books that are used in primary schools with the help of our software. It has a simple process. All you need to do is install the software in your computer and then key in the chapters you wish to translate. You will automatically see the book getting transformed into a series of sign languages making it possible for child with a hearing disability to read the book without hiccups," Sarkar said.

Despite the software being a success, VECC is now faced with a bigger challenge of modifying the software in such a way that even English texts get translated into sign language. Terming the initiative by VECC as "commendable", educationist Prasanta Roy said while Braille books have brought about a revolution among those without vision, those without speech do not have such texts to help educate them, adding to their misery.

Source: The Times of India

PROGRAM & EVENTS:

1.

International Design for All Foundation Awards 2013

The International Design for All Foundation Awards recognise public, private and not-for-profit initiatives from across the world which aim to enable everyone to participate in society on an equal basis. In so doing, they draw international attention to examples of best practice in Design for All.

The categories for the present edition are as follows:

- **Project undertaken by a not-for-profit organisation.**
- **Project undertaken by a government or other public body.**
- **Project undertaken by a private company or professional.**
- **User-centred design in Living Labs: Project proposal.**

Key dates

- **10 December 2012: Opening of call for applications.**
- **17 February 2013: Deadline for submission of applications.**
- **20 March 2013: Award ceremony during the International Design Biennial in Saint-Étienne, France**

2

Social Capital and Entrepreneurship Workshop at CSCW 2013

At the 16th ACM Conference on Computer Supported

Cooperative Work

February 23-27 in San Antonio, Texas, USA.

There is a strong relationship between social capital and entrepreneurship. Yet we know little of how groups across cultures and socio-technical configurations interact and *collaborate online* to *transform innovation into commercial and social ventures*.

This one day workshop will explore, through different perspectives, the challenges for CSCW in supporting the development of social capital for entrepreneurship, highlighting the gaps and opportunities for designers.

A key part of the agenda for this workshop is to form understandings of the formation of social capital and entrepreneurship activities in contrasting cultures and socio-technical configurations.

We hope to foster dialogue between academics in different disciplines interested in interdisciplinary research in social capital, entrepreneurship and CSCW.

3.

Cameroon 2013 - International Workshop "Ageing and Healthy Environments"

There has been great interest in the workshops taking place in Cameroon in May 2013 and the full program should be finalized in early December 2013. Due to the level of interest we have opened up the program to accept a number of abstract with the deadline for submission being 30 November 2012.

4.

entries for the 2013 Mark of Excellence Systems Integrator Awards will be accepted through Sept. 14, 2012. The industry-recognized competition honors excellence in innovation and achievement in custom home electronics, services and installation technologies. The 2013 Mark of Excellence finalists will be announced in November and the winners will be awarded at the Mark of Excellence Awards Reception on Jan. 9, 2013, during the 2013 International CES.

New categories include Tech for a Better World and Accessible and Universal Design Technologies.

5.

6.

7.

TEI'13 - Seventh International Conference on Tangible, Embedded and Embodied Interaction

Seventh International Conference on
Tangible, Embedded and Embodied Interaction
February 10-13, 2013. Barcelona, Spain.

Seventh International Conference on
Tangible, Embedded and Embodied Interaction

February 10-13, 2013. Barcelona, Spain.

8.

HCI International 2013

21 - 26 July 2013, Mirage Hotel, Las Vegas, Nevada, USA

9.

1st Call for Papers: WG 9.4: Social Implications of Computers in Developing Countries

12th International Conference on Social Implications of Computers in Developing Countries

Conference Theme: Into the Future: Themes, insights and agendas for ICT4D research and practice

Ocho Rios Jamaica, 19-22 May, 2013

Submission Deadline: 26 November 2012

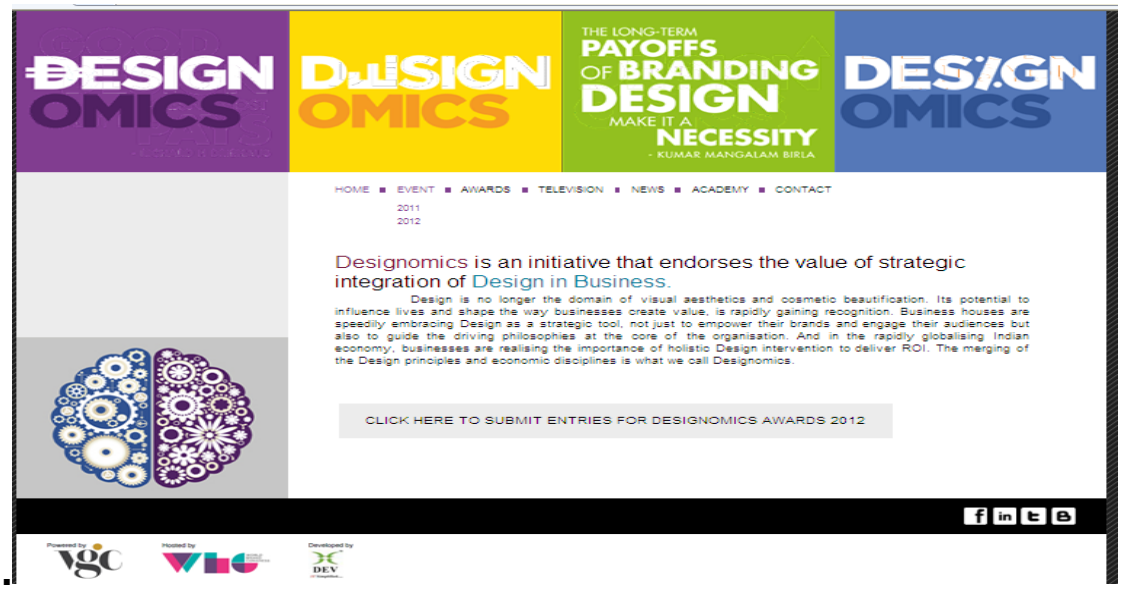
10.

1st Call For Papers, 17th Annual EUROMEDIA'2013 Conference, April 15-17, 2013, University of Lincoln, Lincoln, UK

11.


Calling designers & architects
Consider 1.13 billion people with unique needs worldwide
ENTRIES DUE FEBRUARY 18, 2013

12.


DESIGN OMICS
DESIGN OMICS
THE LONG-TERM PAYOFFS OF BRANDING DESIGN MAKE IT A NECESSITY
- KUMAR MANGALAM BIRLA
DESIGN OMICS
HOME ■ EVENT ■ AWARDS ■ TELEVISION ■ NEWS ■ ACADEMY ■ CONTACT
2011
2012
Designomics is an initiative that endorses the value of strategic integration of Design in Business.
Design is no longer the domain of visual aesthetics and cosmetic beautification. Its potential to influence lives and shape the way businesses create value, is rapidly gaining recognition. Business houses are speedily embracing Design as a strategic tool, not just to empower their brands and engage their audiences but also to guide the driving philosophies at the core of the organisation. And in the rapidly globalising Indian economy, businesses are realising the importance of holistic Design intervention to deliver ROI. The merging of the Design principles and economic disciplines is what we call Designomics.
CLICK HERE TO SUBMIT ENTRIES FOR DESIGNOMICS AWARDS 2012
vgc
DEV

13.


AAATE 2013
12th European AAATE Conference
aaate
Association for the Advancement of Assistive Technology in Europe
Vilamoura, Algarve, Portugal
19 - 22 September, 2013

14.


NFPA
CONFERENCE & EXPO
JUNE 10-13, 2013 • CHICAGO, IL
McCORMICK PLACE CONVENTION CENTER

15.


Universal Design Summit 2013
St Louis, MO
As an industry leader we cordially invite you to attend our
5th Universal Design Summit (UDS5).
This event is focused exclusively on housing and communities that meet the interests of your 21st century customers.
Learn about Better Living Design, the new national initiative that will change the landscape of UD practice and consumer demands.
Meet 500 industry leaders from around the country who are including accessible and Universal Design in new and remodeled homes.
Get the latest information about accessible and universal products and designs.
National Conference
Universal Design SUMMIT 5
May 6-9 2013
udsummit.net

16.


UNIVERSAL LEARNING DESIGN
Universal Learning Design
Universal Learning Design
BRNO, 11–15 FEBRUARY 2013

17.

products, news, business

2013 IDEA open for entries

28 November 2012 by Kate Jones

The 2013 International Design Excellence Awards is open for entries.

home / 2012 / november / 2013 IDEA open for entries

The Industrial Designers Society of America (IDSA) are calling for entries for their annual International Design Excellence Awards® (IDEA) competition for 2013.

18.

International Istanbul Initiative on Ageing 4-6 October 2013

Call for Abstracts - Now Open!

The International Federation on Ageing and Turyak Seniors Council Association cordially invites you to **submit abstracts for oral presentations** at the International Istanbul Initiative on Ageing. All abstracts will be reviewed by the Program Committee and assigned to the appropriate concurrent session for oral presentations. Abstracts from around the world are welcomed to share best practices to the regions of the Middle East, Northern Africa, Eastern Europe, and surrounding countries of Turkey.

Abstracts must relate to one of the 13 sub-themes identified.

Abstract submissions are entirely separate from full paper submissions, and will therefore *not* be eligible for financial prizes or publications. For more information about Full Papers visit www.ifa-fiv.org.

Deadline: May 31, 2013 at 5pm EST

19.

20.


IDA
Congress
2013
Istanbul
Education & Research
Conference

JOB OPENINGS:

1.

A well-known Furniture Manufacturing Company based in Mumbai - Furniture Kraft International Pvt. Ltd. (www.furniturekraft.com) is looking to hire a Designer to take care of their new range of sofas to be shortly introduced in the market.

The Designer should be well aware of the best materials used in the sofa industry and should be able to generate BOQs and coordinate with the production team.

The position is based at the Company's Head Office at Shah and Nahar Ind Estate at Lower Parel, Mumbai.

More Details can be requested by sending an email to Mr. Mustafa Merchant (MD) directly on mustafam@furniturekraft.com

2.

looking for talented graphic designers with experience in designing corporate branding, and its applications. Designing pack designs for some of the top FMCG brands in the country/ region. Also experience in retail branding and environment branding.

Must have a design degree and experience with branding/ design agency.

Location is in Bombay so need people from Bombay or who can re-locate to Bombay, if they have to. Not looking for Freelancers and out of town candidates who want to work on project basis.

People who can think, conceptualize and execute design strategy independently across mediums and touch-points. Need someone who can join ASAP.

Please to apply to Francis D'Costa with CV, salary details, notice period, folio's to dcosta.francis@gmail.com

PS: Freshers may apply, for a junior designer role

3.

looking for freelance Illustrators to develop illustrations based on business, lifestyle and other various concepts in contemporary or other Indian art forms like Mughal, Madhubani etc

If interested, please mail for further info at business@fanaticstudio.com

4. TI Cycles is looking for multiple positions for Designers who can be part of design team at Chennai. Pl go through the details below, interested can forward their resume and portfolio of work to sangewarr@tii.murugappa.com within 10 mb.

TI Cycles has been at the forefront of personal mobility solutions for over 6 decades and has gone from being a pioneer in bicycle design and manufacture to a complete mobility and well-being expert. Standing for the core promise of fun, fitness and freedom, TI Cycles offers consumers a range of bicycles, e-scooters, fitness equipment and infant mobility solutions.

1. Position : CFM & Graphics Designer *Function : Product Development *Location* : Chennai

Job> responsibilities (key responsibilities and focus areas)*

1. Lead the product graphics design solutions for all products

2.CFM palate and graphics guidelines based on brand positioning and consumer segmentation

3. CFM trend tracking

4. Take ownership of releasing/archiving of artworks

5. Sign off on all final graphics/colour samples as per guidelines

6. Graphical User Interface design support

Skill Set

- **should be proficient in new product development process.**
- **should deliver engineering design solutions independently**
- **should have exposure to product validation and testing process for**

off the self-products

- **should be proficient in cost management for new products**

Experience Profile*

Bachelors or Masters in Graphics Design/Visual communication or equivalent fresh or 2-3 years experience in CFM & product design graphics in consumer durable and automobile industry

2. *Position* Product Designer - Fresh

***Function* Product Development *Location* Chennai ***

Job responsibilities (key responsibilities and focus areas)*

1.Deliver all Industrial design needs for specified product category as per the profit plan within the agreed time & cost

2.Create product concepts under Advance Design based on deep rooted consumer Insights

3.Develop Product Improvement ideas for value enhancement, standardisation and cost leadership

4.Assist in formulating the Brand design guidelines based on Brand Architecture

Skill Set

1.Passion for design and sense for balance with out of the box thinking for design solutions

2.Good ability to communicate the ideas visually and verbally

3.Proficiency in 3D software ,Adobe Photoshop/Illustrator and Corel Draw is a recommended

4.Technical knowhow of manufacturing processes will be added advantage

***Experience**

Profile* Bachelors or Masters in Industrial Design from Design Institute NID/IDC/IITD/MIT/SID etc

3.*Position* Product Designer – Exp *Function* Product Development

***Location* Chennai ***

Job responsibilities (key responsibilities and focus areas)*

1.Deliver all Industrial design needs for specified product category as per the profit plan within the agreed time & cost

2.Create product concepts under Advance Design based on deep rooted consumer Insights

3.Develop Product Improvement ideas for value enhancement, standardisation and cost leadership

4.Assist in formulating the Brand design guidelines based on Brand Architecture

5.Work cross funtionally to ensure the design intent from concept to production

Skill Set

1.Passion for design and sense for balance with out of the box thinking for design solutions

2.Good ability to communicate the ideas visually and verbally

3.high Proficiency in 3D software ,Adobe Photoshop/Illustrator and Corel

Draw is must

4.Good expousure to technical knowhow of manufacturing processes

5.A fitness freak and passion of cycling would be added advantage

Experience Profile

Bachelors or Masters in Industrial Design from Design Institute NID/IDC/IITD/MIT/SID with 3-4 yrs of Exp prefrablely with Consumer Durable / Automibile indutry.

4.Position : Design Manager *Function : Product Development *Location* : Chennai

Job responsibilities (key responsibilities and focus areas)*

- **Deliver all Engineering design needs for New products as per the profit plan within the agreed time & cost**
- **Drive Product Improvement through value enhancement, standardization and cost leadership.**
- **Establish of Product validation process and identify test standards to comply for New businesses**
- **Interact closely with vendors for product/components developments ensuring the design intent.**

Skill Set

1.Passion for design and sense for balance and out of the box graphics

and illustration skills

2.Good ability to communicate the ideas visually and verbally

3. High Proficiency in Adobe Photoshop, Illustrator and Corel Draw is a must

4. Technical knowhow of print media and techniques for Product graphics

Experience Profile

- **BE in Mechanical or equivalent with 6-8 yrs of experience in New product Development in consumer durable or automobile OEM.**

5.

Visual Design defines the product visual identity for SAP products. Based on the requirements described by UX Design and Solution Management, Visual design supports development projects in delivering graphical assets and detailed design specifications for the target UI technology to enable the implementation of the product visual identity.

Typically you will work in a multi-functional team with UX designers, solution management and development throughout the entire development cycle.

This is a pure visual designer requirement and not meant to be a stepping stone to interaction design. You should be extremely passionate about graphic design.

*** Job Role:***

- Definition of visual identity in alignment with corporate branding strategy.

- Creative impulse and direction for an entire look and feel for a new UI technology.

- Detailed visual design to support creation of complex UI patterns

- Establish new visual design standards in the industry.

- Create specifications and style guides**.**

- Generate visual designs and pixel perfect artifacts to evangelize product capabilities.

- You must have great production skills (typography, layout and color) and a portfolio to prove it.

Experience & Educational Qualifications:*

- 2-6 years experience as a graphic designer

- Preferably a bachelor's degree / diploma in design but a strong portfolio holds more weight-age.

- Portfolio should exhibit understanding of user experience design principles, knowledge of UI best practices and usability

- Fluency in current graphic design trends

- Good illustration skills to translate metaphors and visual storyboarding will be a plus.

- Interactive prototyping skills will be a plus.

Technical Skills:

-• Mad skills with Photoshop, Illustrator and PowerPoint. Not afraid to learn new stuff.

- Knowledge of best practices while designing for the web and apps .

- Comfortable in using non-digital medium to express visual ideas.

Soft Skills:

- Very strong communication skills.

- Multi-task and manage multiple deadlines.

- High energy and drive to work in a startup mode.

- Ability to work under pressure and confidence to deal with complex issues.

- Hands-on and detail oriented.

-• Conceptual thinking, flexibility and ability to juggle with multiple responsibilities.

If interested please send your resumes to: srividya.v@sap.com.

6.

We are a Telecom Billing and Settlement solutions provider based out in California and Hyderabad. We are looking for an experienced front end Developer with 3 to 5 years of experience to join us at the earliest. The eligible candidate will be working on cutting edge Digital Media solutions using some of the upcoming and exciting technologies. If you are a game for a fast paced environment with huge opportunity to learn and grow, reply to ravishyam.s@... with the requested details, we will schedule a discussion with you

Basic Qualification:

•Graduate/Post Graduate

•3 to 5 years of experience with Front End Application development

Technical Skills:

●HTML5, CSS3

●Hands on experience with JavaScript and JavaScript Libraries

●Possess an advanced knowledge of web and mobile UX/UI; adhere to and extrapolate complex design systems

●Develop and test across multiple browsers, platforms, and devices, including smartphones and tablets.

●Experience with building Responsive and or Adaptive layouts

●Experience with Video delivery platforms and Video rendering technologies will be highly preferred

●Experience with LESS and or SASS is highly preferred

Please mail us your latest resume ASAP along with the details requested below:

●Current CTC:

●Expected CTC:

●Current Location:

●Willing to relocate to Hyderabad: Yes/No

***We are looking for someone who can join us at the earliest, candidates ready join us within couple of weeks' time will be given high preference**

7.

Think Design Collaborative currently has an opening for Industrial Designer at its New Delhi office. Suitable for candidates who are willing to work across various domains of design like: Furniture & Space design, Design Research, Packaging, Consumer Durables, etc.

Location: Delhi, India Please send your CV & Portfolio to arun [@] thinkdesign [.] in

INDUSTRIAL DESIGNER

Requirements:

*** Bachelors or diploma in Industrial Design with 0-2 years experience.**

*** Candidates who are willing to work across various domains of design will be given preference.**

*** Strong time management, communication and interpersonal skills.**

*** Strong skills in sketching and presentations.**

*** Strong sense of form and proportions with attention to details.**

*** Good knowledge of software : Rhino, 3DS Max & AutoCAD**

is must. (use of these software should reflect in your portfolio)

*** Working knowledge of other tools like Creo, Keyshot, Photoshop, Corel Draw, etc. would be desirable.**

*** Ability to work independently and in a team.**

*** Excellent written and verbal communications.**

*** Prior Knowledge of working on furniture & space design projects would be a plus.**

What Think Design Collaborative is offering:

*** Challenging and exciting projects**

*** Creative work environment**

*** Attractive compensation commensurate with performance**

About Think Design:

Think Design is a Global Research, Design and Innovation consultancy with focus on Industrial Design and User Experience Design. We work across a broad spectrum of industries, including Appliances, Furniture, Telecommunications, Automobiles, Education, Retail, Software Products, Enterprise & Web Application, Mobile Interfaces and Embedded Applications. Established in 2004, Think Design operates from New Delhi and Hyderabad, with partners across the globe.

8.

Nokia - NID Digital Lab, Bangalore is looking for some one who is specialized in Photoshop, Illustrator, Flash, Indesign, Coreldraw.

Mainly the work will involve designing posters, templates, banners, print layout etc using DTP tools. Interested person should be based in Bangalore.

Any one who is interested in freelance, part-time, or full-time work can get in touch with Mamata N. Rao(mamatarao@nid.edu) and Jagriti P Galphade(jagriti@nid.edu)

9.

Ergo design private limited (ergo form), is an engineering design management company, that focuses on the total product design and includes in its core capability, the design & development of products through a process of Industrial Design and Engineering, specifically in the areas of transportation, product, retail and urban design.

They arelooking for graphic designers.. both for internship and job opportunities. you can have a look at their website: http://ergoform.in/

Interested applicants, who can relocate to Bangalore, can send their resume to eddy@ergoform.in ergoform | think. create.ergoform.in think. create.

10.

Eschmann textures India is looking for Graphic Designer (Fresher) Please send an email with your resume and portfolio to the following email address.

Email: anmotwani@eschmanntexturesindia.org

11.

Interaction designers/Visual experience designers please share your portfolio at qalqi@qalqi.com

We are building a design team for one amongst the Fortune 500 companies in India. Please go through below job description for more details.

Interaction Designer/Visual Experience should have-

*** -2+ years of experience working in design studios, agencies or corporates.**

*** Strong knowledge of User interaction patterns in Mobile applications - Iphone, Ipad, Andriod, Blackberry and Windows 7 Mobile.**

***Commendable experience with Photoshop or Illustrator for Mock-ups**

*** Should be able to use Mid fidelity tools like Balasmiq, Axure or Paper prototyping techniques**

***Should go with the believe of 'God is in the detail'**

***Enjoy solving complex problems and materialising quickly**

***Good presentation, drawing and writing skills**

***Good knowledge on both quantitative and qualitative usability research methods**

***Ability to work in a fast-paced environment**

*** Best remuneration for deserving candidates**

Please share your portfolio at qalqi@qalqi.com and you can contact on +91 962 060 3379

12.

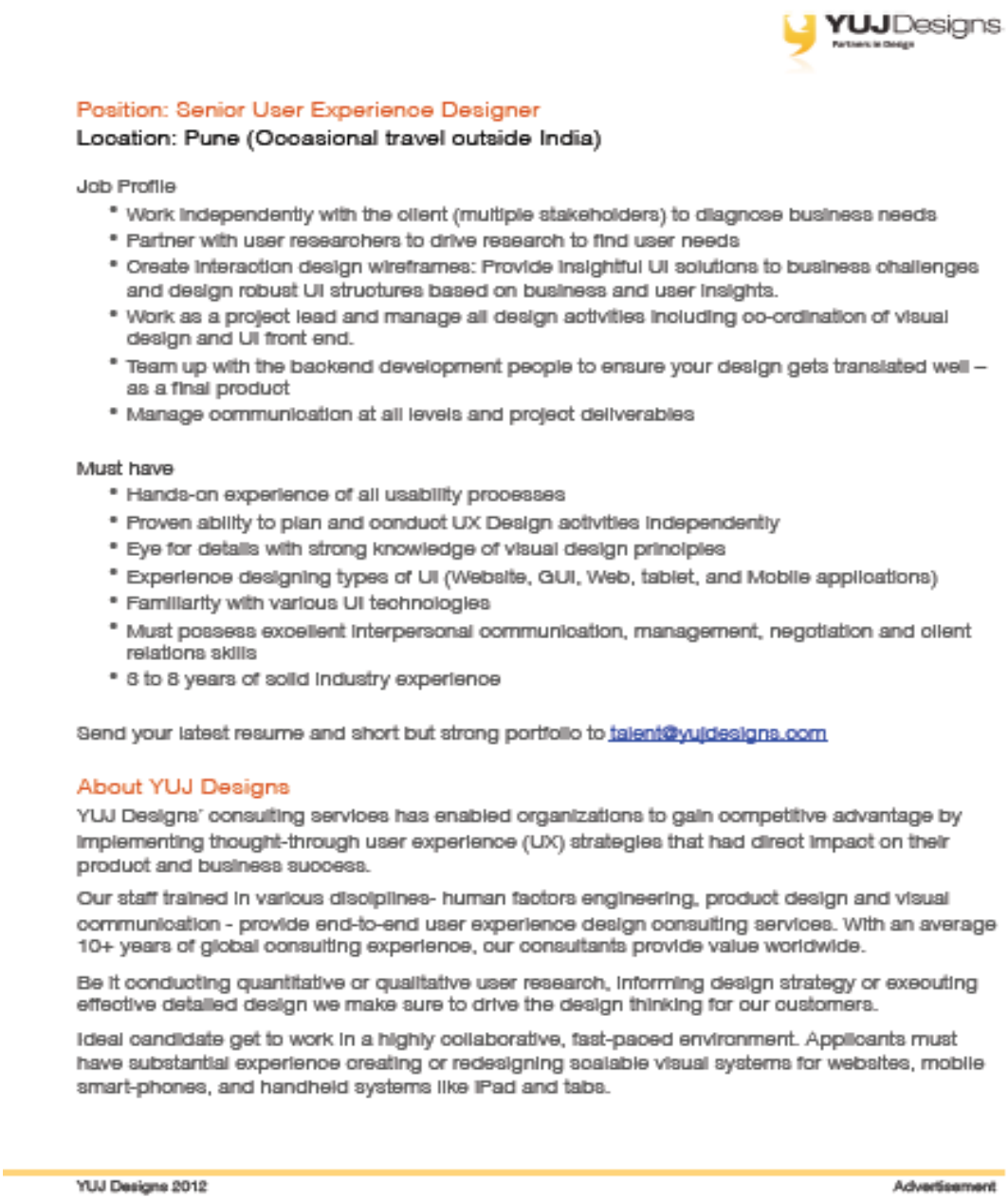
Eschmann textures India is looking for Graphic Designer (Fresher)

Please send an email with your resume and portfolio to the following

email address.

Email: mailto:anmotwani%40eschmanntexturesindia.org

13.



YUJDesigns

Position: Senior User Experience Designer

Location: Pune (Occasional travel outside India)

Job Profile

- Work independently with the client (multiple stakeholders) to diagnose business needs
- Partner with user researchers to drive research to find user needs
- Create interaction design wireframes: Provide insightful UI solutions to business challenges and design robust UI structures based on business and user insights.
- Work as a project lead and manage all design activities including co-ordination of visual design and UI front end.
- Team up with the backend development people to ensure your design gets translated well – as a final product
- Manage communication at all levels and project deliverables

Must have

- Hands-on experience of all usability processes
- Proven ability to plan and conduct UX Design activities independently
- Eye for details with strong knowledge of visual design principles
- Experience designing types of UI (Website, GUI, Web, tablet, and Mobile applications)
- Familiarity with various UI technologies
- Must possess excellent interpersonal communication, management, negotiation and client relations skills
- 6 to 8 years of solid industry experience

Send your latest resume and short but strong portfolio to talent@yujdesigns.com

About YUJ Designs

YUJ Designs' consulting services has enabled organizations to gain competitive advantage by implementing thought-through user experience (UX) strategies that had direct impact on their product and business success.

Our staff trained in various disciplines- human factors engineering, product design and visual communication - provide end-to-end user experience design consulting services. With an average 10+ years of global consulting experience, our consultants provide value worldwide.

Be it conducting quantitative or qualitative user research, informing design strategy or executing effective detailed design we make sure to drive the design thinking for our customers.

Ideal candidate get to work in a highly collaborative, fast-paced environment. Applicants must have substantial experience creating or redesigning scalable visual systems for websites, mobile smart-phones, and handheld systems like iPad and tabs.

YUJ Designs 2012 Advertisement

14.

VGC is currently looking out for a Design Creative Director for our Mumbai office.

VGC is an idea based holistic Strategic Brand Design Consultancy. We are looking for someone with strong credentials in strategic Design Processes, combined with a high level of ideation + creative quotient, married with a robust understanding

of skill sets across 360 degrees of Brand Design management. Ideally should have spent 7-10 years in the field of Design having experience of the entire Design ecology spanning Branding, Packaging, Digital, Graphic Design, Communication, Electronic media, etc. Would be great if this is also accompanied by a well-articulated presentation skill set and a penchant for managing client and team relationships.

All interested candidates are requested to send in their résumés to creative@vgc.in

15.

This position is for Bangalore Location. The ideal candidate will:

· Possess 2-6 years as a visual design experience in product development as an individual contributor or architect within the enterprise software industry.

· Possess extensive experience with developing and iterating designs in -- Photoshop, Illustrator, Flash, HTML, JavaScript, CSS.

· Possess strong information visualization skills and prototyping skills. (Html & Flash)

· Enjoy working with the technically complex systems.

· Work effectively in a team environment consisting of other UX professionals, Software developers, Product managers and Exec-level managers

· Possess outstanding verbal and written communication skills to effectively communicate designs, ideas, and concepts

Interested candidates should send their cv and portfolio (not more than 4mb) to pradipta.sarkar@oracle.com

Please mention the subject line "JOB: Visual Designer for Oracle (Bangalore, India)"

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Address for Correspondence:

13, Lodhi Institutional Area,
Lodhi Road, New Delhi-110 003India.

This Newsletter is published monthly, by
Design for All Institute of India,
3 Lodhi Institutional Area,
Lodhi Road, New Delhi-110 003 (INDIA)
Tel: +91-11-27853470

E-Mail: newsletter@designforall.in
Website: www.designforall.in

(Cover Design: Norwegian University of Science and Technology)