

Sustainable practises

In the context of a case study on oral healthcare at Philips Research

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ABSTRACT

During the last decades the field of sustainable product design has been subject to change and a new field has emerged; Design for sustainable practices. It is founded on the notion that the environmental impact of products and system often are greatest during use. Researchers within the design for sustainable practice field argue that designers can reduce use-impact by purposely shaping behaviour towards a more sustainable alternative through product and service development. To do so there is a need for frameworks, methods and tools to support the design process. Particularly within the fuzzy front end of the design process, one lack a best practice in regards to design for sustainable practices. This paper looks at the feasibility of different tools and methods, which contribute to better-informed decisions in an early phase of the design process. This is done in the context of a case study on oral healthcare at Philips Research, in collaboration with the Norwegian University of Science and Technology. The paper concludes that there is a particular need for tools and methods within data and opportunity analysis and assessment, so one can explore and compare environmental impact from behaviour and practices. Finally there is good prospect to adapt methods from adjacent scientific fields.

KEYWORDS: Sustainable practices, Fuzzy front end, Method, Tools, Philips Research, Oral healthcare

1. INTRODUCTION

This paper looks at the feasibility of different tools and methods, which contribute to better-informed decisions in an early phase of the design process, more specific within the field of sustainable practices. This is done in the context of a case study on oral healthcare conducted at Philips Research in collaboration with NTNU.

First the background and field of sustainable practices is presented. This is followed by a section on the cross disciplinary framework used in the oral healthcare case; combining input from

- A: Design thinking
- B: Ecological psychology & behaviour theory
- C: Environmental aspects & Industrial ecology
- D: Oral healthcare aspects
- E: Fuzzy front end & innovation theory

Based on influence from the above-mentioned fields, five target categories & two pillars of special interest are identified for information gathering and assessment;

	Environment	Health
1.User experience		
2.Market		
3.Technology		
4.Organisation		
5.Policy & Legislation		

Table 1: The projects 5 target categories for information gathering and assessment, and the two pillars of special interest; environment and health

The framework section is followed by an outline of the oral healthcare project and a section on different activities conducted linked to the 5 target categories. Some results are presented from each activity. After a discussion on the use of these methods one conclude among others that there is a particular need for tools and methods aimed at data and opportunity assessments, so one can explore and compare environmental impact from behaviour and practices. One also finds good prospect to adapt methods from adjacent fields.

2. DESIGN FOR SUSTAINABLE PRACTICES

During the last decades the field of sustainable product design has been subject to change (Boks & McAloone 2009). From it`s focus on cleaner production strategies in the 1980s (Keitsch 2011) and being established as a research field in the early 1990`s (Pettersen and Books 2009) it has been subject to a variety of different focus areas; From Life Cycle Analysis and materials, energy and toxic emissions through the need to adapt to more legislation, the introduction of product service systems (ibid) and a more user centred focus (Keitsch 2011). This is also reflected in today`s expansion of the sustainability term to include aspects like social-, corporate- and economic sustainability (Pettersen, Boks 2009)

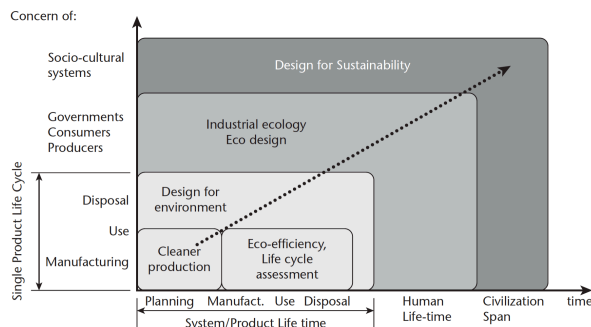


Figure 1. Successive changes in industrial design (Keitsch 2011)

Over the last years a new focus within the field has emerged, which is founded on the notion that the environmental impact of products and system often are greatest during use (Pettersen, Boks 2009, Guardian 2010). The idea is that a resource efficient use of products should complement technological solutions (Pettersen, Boks 2009). This need for a more human centred focus strengthen the interaction between eco-design, user centred design (established design discipline) and social sciences. This way of thinking is today commonly referred to as *design for sustainable practices* and constitutes the context of this project and paper.

Unfortunately consumers are slow to adopt more sustainable behaviour, despite being exposed for campaigns and information exhorting them to change behaviour (DeVries 2006).

Researchers within the design for sustainable practice field argue that designers can reduce use impact by purposely shaping behaviour towards a more sustainable alternative through product and service development (Bahmra et al. 2008, Elias et al. 2008, Lockton et al. 2008, Wever et al 2008).

Due to Eco design`s tradition arising from technical disciplines the research on the human side of product use and sustainability is quite limited. (Wever and Boks 2007)

This paper will hence look at methods within sustainable practices and their feasibility. The main concern will be methods, which contribute to better-informed decisions in an early phase of the design process. The methods are discussed within an oral healthcare case from Philips Research.

2. FRAMEWORK IN A CROSS-DICIPLINARY FIELD

As mentioned, design for sustainable practices is a fairly new field. Particularly in relations to oral healthcare there is a lack of “best practices” and previous studies to draw experience from.

Wever and Boks (2007) discuss some possible frameworks for assessing opportunities in their article *Design for Sustainability in the Fuzzy front end*. They point out the lack of sustainability focus in today's Fuzzy front end. Further they ask if this might be due to lack of tools and frameworks or just the way existing tools are being used. A clear answer is not given but they indicate that both the tools and the way they are used may be improved.

As a result of the lack of a coherent framework, processes and methods, the case study combine input from several fields, both established and less defined. The idea was to explore process and methods for increased quality information aimed at new product development. Among the more central contributions to the process and method used in the case, one find;

- A: Design thinking,
- B: Behaviour/practice theory,
- C: Environmental aspects, Industrial ecology
- D: Oral healthcare aspects
- E: Fuzzy front end theory and innovation theory

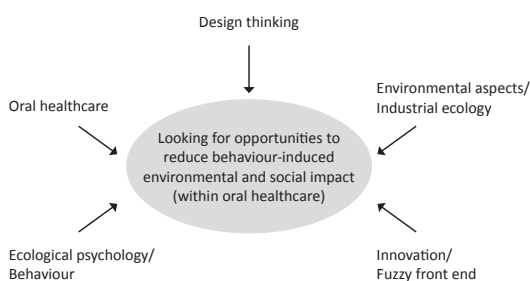


Figure 2. Cross-disciplinary context of the oral healthcare case, possible method input form adjacent fields.

2.1 Design Thinking

From design thinking, a great deal of influence was made from Context mapping with its advocates Visser, Strappers and Lugt (2007). This due to, context mappings special emphasis on opportunity identification and early phase.

2.2 Ecological psychology, behaviour theory:

Related to behaviour change, Fogg`s (2009) behaviour model together with Klöckners and Blöbaums (2010) Comprehensive action determination model (CADM) played a central role. This due to its inclusion of context when dealing with ecological behaviour, which made it interesting to combine with design thinking process and methods having context as a core element.

2.3 Environmental factors

Concerning environmental factors there were less focus on one direction or framework on a superior level and more use of pick and mix from previous “hands on” studies. One study of particular interest was Elias, Dekoninck and Culleys (2008) behaviour and energy study. Which was used to study water consumption.

2.4 Oral healthcare

The topic of oral healthcare had more a role as the domain to explore and implement ideas within. But Ramseier and Suvans (2010) *Health behaviour change in the dental practice* and Hovius (2011) focus on motivational interview, have had some influence in determining where to place focus in information gathering.

2.5 Innovation and Fuzzy front end:

Input on innovation/ fuzzy front-end process and method was heavily influenced by Koens theories (2002). This due to a low threshold for practical use of his framework. The following section will take a closer look at Fuzzy front end and Koens framework.

The traditional focus within design for sustainability has been on the process after a design brief has been formulated (Wever et al. 2007). In relations to this fact Wever (Ibid) state a

need for greater emphasis on sustainability in the early stages of the design process. This importance of the early phases is underlined by Zang: “Most projects do not fail at the end; they fail at the beginning” (Zhang 2001).

Fuzzy front end is referred to as the first stage of an innovation process, it also go under names such as Front End of innovation, Phase 0, Stage 0 or Pre-project activities (Rosenqvist 2009). It is often referred to as a blurry non-structured phase, which leads up to a more structured part of the development process (New product development). Due to these unstructured characteristics the Fuzzy front-end process may be considerably different within various companies and projects (Nobelius 2002).

Koen (2001) and Kim & Wilemon (2002) have a similar understanding as Griffiths-Hermans and Grover (2006) and describe it as a phase dealing with the process from a perceived opportunity to a more defined idea or concept. It also deals with the decision to take a concept further into a defined innovation process. In the case study subject to this paper a special emphasis was placed on Koens (2002) understanding.

Koens New product development model

Koen (2002) present a model, which indicates the processes ideas are subject to in Fuzzy front end. The model is iterative, as Koen states:

“New concept development is not a linear process with specified steps and timing” (Koen 2002).

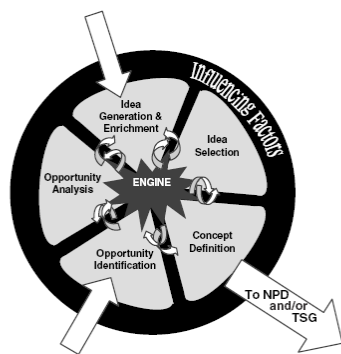


Figure 3: New concept development (Koen 2002)

The model structure key components of the fuzzy front end. It is structured into 3 different aspects;

1. Influencing factors;. Among others:
 - a. Organisational capabilities
 - b. The outside world
 - c. Enabling sciences
2. Engine; driving forces. Among others:
 - a. Leadership
 - b. Culture
 - b. Business strategy
3. Activity elements, “processes”; which one can control. The elements are:
 - a. Opportunity identification
 - b. Opportunity analysis
 - c. Idea generation and enrichment
 - d. Idea selection
 - e. Concept definition

The arrows suggest that a project will begin within A. *Opportunity identification* or C. *Idea generation and enrichment*. Hence this paper mainly concerns these two activity elements. In addition B. *Opportunity analysis* is included due to its special interest in regards to calculating environmental and social impact. D. Idea selection and E. Concept definition is usually subject to being visited later on in the traditional design thinking process and is therefore left out of this paper.

2.6 Five target categories in the oral healthcare case study.

Based on the influences from the fields mentioned in this chapter, five target categories for specific information gathering and assessment were identified:

1. User experience
2. Market
3. Technology
4. Organisation
5. Policy/legislation

Within these categories the two fields of oral health and environment were of particular interest. (See table 1.)

3. CLARIFICATION OF TERMS

3.1 Sustainable design:

"Taking all ecological, social and economic concerns into account in product and service systems, meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Keitsch 2011).

3.2 Social Sustainability:

Opposed to economic and environmental concerns the social aspects of sustainable design are less defined (Lilley 2009, Colantonio 2007). Lilley state that social sustainability may encompass;

"Personal responsibility, quality of life, health, well-being and happiness, democratic participation and cooperative behaviour" (Lilley 2009)

In the case study, social sustainability was split in two, covered by the pillar of special interest; *health* and the target category; *user experience*.

3.3 Opportunity

"A business or technology gap, that a company or individual realizes, that exist between the current situation and an envisioned future in order to capture competitive advantage, respond to a threat, solve a problem or ameliorate a difficulty" (Koen 2002).

4. CASE STUDY ON ORAL HEALTHCARE

The case study referred to in this article was conducted at Philips Research Eindhoven in collaboration with Department of Product design at the Norwegian university of science and technology (NTNU). The topic of oral healthcare was chosen due to available resources and interest from people within oral healthcare at Philips Research.

4.1 Philips Research

Philips research is a global organization that helps Philips introduce innovations. They develop new technology and investigate potential growth areas for Philips. It is one of the words largest corporate research organisations.

Oral healthcare at Philips Research focus on the future of oral healthcare both developing technology and looking into potential growth areas for Philips. Sonicare is the Philips brand for oral healthcare products; among these are power toothbrushes and the floss substitute product Airfloss.

4.2 Project outline

The *project goal* was to look into oral healthcare behaviour with sustainable practices in mind. The superior research question to answer was; *"How can Philips help people do oral healthcare in a more sustainable way."*

The outline of the project was guided further by among others the sub question; *"Concerning practices directly connected to Oral health care practices, where are the main opportunities for reducing behaviour-induced environmental, and social impacts found within the use cycle?"*

Due to the projects characteristics of exploring fuzzy front end & opportunity identification, the target group were kept with a broad definition. Thinking that limiting target groups might also limit opportunities discovered. Two target groups were singled out; Adults within the age groups 20-35 and 55-70, medium to high income within Norway and the Netherlands. The project was looking for opportunities and ideas that would be on the market within 10-30 years.

The project duration was one year, and in this time one person worked full time on the project, pulling in other resources from Philips and NTNU when needed. This paper only concerns methods and activities used in the first two months of the project, due to the focus on fuzzy front end

The next section will look closer at an excerpt of the activities and methods used the first two months of the project. The activities to be further discussed in this paper are highlighted in the overview of relevant activities from the first two months in table 2. The majority of activities would cover several of the target categories. To simplify, the activities are listed in the table based on their primary target category.

Target category		Activity:	Method inspiration:	Element from Koens framework:
User experience:	<u>1</u>	Diary/sensitizing tool & interview, <i>Context mapping</i>	Visser et al. (2007)	Opportunity identification, Idea generation and enrichment, Opportunity analysis
	<u>2</u>	Generative sessions, <i>Context mapping</i>	Visser et al. (2007) Stickdorn (2012) Philips (2011 b.)	Opportunity identification, Idea generation and enrichment
	<u>3</u>	Video study in bathroom, <i>covert observation</i>	Buur et al. (2000) Liem (2006)	Opportunity identification
	<u>4</u>	Idea generation workshop, <i>Design with intent</i>	Lockton (2010)	Idea generation and enrichment
	<u>5</u>	Idea generation workshop, <i>Comprehensive action determination model (CADM)</i>	Klökners & Blöbaum (2010) Moore & McWaters (2013)	Idea generation and enrichment
	<u>6</u>	Calculating water consumption, <i>User efficient design</i>	Elias (2009)	Opportunity analysis
	<u>7</u>	Calculating environmental impact, <i>Eco it</i>	Life cycle assessment software <i>Eco it</i>	Opportunity analysis
	8	Overt observation, <i>talk out loud session with users, open interview</i>	Liem (2007) Visser et al. (2007) Hasso Plattner (2015)	Opportunity identification
	9	Theory study & interviews, <i>existing studies within Philips.</i>		Opportunity identification Opportunity analysis Idea generation and enrichment
	10	Questionnaire, <i>quantifying data</i>	Oppenheim (1998)	Opportunity identification Opportunity analysis
	11	Charging study, user's self-report on charging behaviour, digital diary		Opportunity identification
	12	Idea generation workshop based on ergonomic archetypes	Moore & McWaters (2013)	Idea generation and enrichment
	13	Idea/experiment workshop on in mouth experience	Hasso Plattner (2015) Moore & McWaters (2013)	Opportunity identification Idea generation and enrichment
	14	Extreme context study, oral healthcare in contexts with limited water and recourses		
	15	Idea generation workshop, Personas based on extensive user research. All departments OHC	Facilitated by external consultancy on assignment from Philips	Idea generation and enrichment

Market:	16	Building future scenario	Golücke (2001) Verellen & Dè Winter (2010) Philips (2011 a)	Opportunity identification Opportunity analysis
	17	Participation, observation IDS cologne Exhibition		Opportunity identification Idea generation and enrichment Opportunity analysis
	18	Interview with consumer research Philips	Hasso Plattner (2015)	Opportunity identification
	19	On-going projects, predicting the future study		Opportunity identification
	20	Blog analysis		Opportunity identification
Technology:	21	Visit production facility		Opportunity identification
	22	Technology based co- design workshop researchers	Visser et al. (2007)	Idea generation and enrichment
	23	End of life (product)- workshop	Lockton (2010) Ihobe (2000) UNEP (2009)	Opportunity identification Idea generation and enrichment
	24	LCA on commonly used Oral healthcare products	UNEP (2009)	Opportunity identification
	25	Weekly lectures from dentist		Opportunity identification
	26	Smart homes excursion		Opportunity identification
Organisation:	27	Weekly meeting sustainability interest group Philips		Opportunity identification Opportunity analysis
	28	“Speed date” employees		Opportunity identification
Policy and legislation:	29	Lessons learned from past projects		Opportunity identification Opportunity analysis
	30	Theory study Philips strategies		Opportunity identification Opportunity analysis
	31	Cooperation with the president of International Federation of Dental Hygienists		Opportunity analysis

Table 2: Activities conducted in the first two months of the oral healthcare case study.

The majority of activities would also cover both pillars of interest (environment & health) at the same time. In a simplified model; table three link the prime pillar of interest to each activity.

	Environment:	Health:
User experience	3, 4, 6, 7, 10, 11, 14	1, 2, 5, 8, 9, 12, 13, 15
Market	18, 20	16, 17, 19
Technology	23, 24	21, 22, 25, 26
Organisation	27	28
Policy and legislation	29, 30	31

Table 3: Activities linked to their primary target category and pillar of interest.

5. ACTIVITIES, IMPLEMENTATION & RESULTS

5.1 User insight:

The first of the 5 target categories for insight was User experience. Since the project was looking into behaviour induced social and environmental impacts, in the light of design thinking, this category was by far the most important.

Visser et al. (2007) points out that contextual knowledge consists of different levels hence different methods has to be used to access this knowledge. See figure four. Based on this model, different studies and approaches was chosen to complement each other giving an overall understanding of oral health care practices within the target groups.

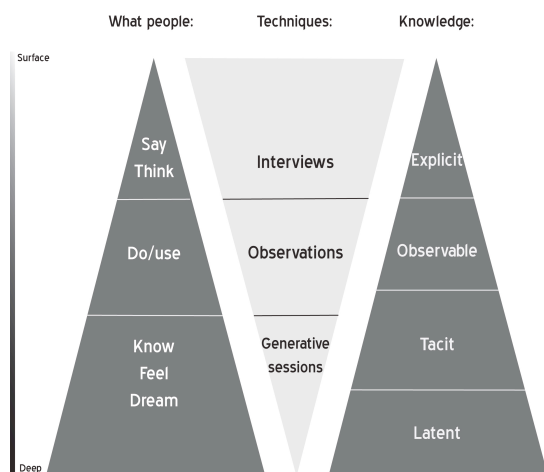


Figure 4: Different knowledge of experience is accessed by different techniques. (Visser et al. 2007)

Jong and Maze (2010) look at practice oriented design process and emphasises the need to have a broad approach when exploring practices. An extra element of looking at oral health care practices in contexts that differentiate from the context of the typical target groups were therefore added. Among these: an historical component; cultural differences; and oral healthcare practice in situations with limited water and electricity.

Activity 1: Diary/sensitizing book & interview (Visser et al. 2007)

A two weeks diary, which would also act as a sensitizing book aimed at a later workshop, was given to 15 participants. 10 of the participants were chosen based on criteria for the two different target groups. The last 5 participants were chosen based on diversity in cultural background, to include potential new perspectives. The study was preformed based on Visser et al. (2007) methods. In addition to the cultural probes, the participants were subject to two home visits and an interview.



Figure 5: Diary book, colour pencils, camera and stickers

Primary finding:

Oral healthcare is a habitual practice.

Feasibility:

The study was very helpful in establishing a connection between the researcher and the participants. It also created interest from the participants and worked nicely as a sensitizing tool. For it to work as a sensitizing tool it had to include open assignments, i.e. the theme was "Body care". Due to this, one lost out on more specific oral healthcare insight. The open uncertainty of tool worked fine with the European and African participants. On the other hand, some participants from Asia struggled with the lack of "correct" answers or a clear definition of body care.

Activity 2: Generative sessions

(Visser et al 2007, Sanders & Dandavate 1999)

The two weeks of sensitizing were followed by three generative sessions, with 5 participants at each of the sessions. The aim was to gain insight into what users know, feel and dream, often referred to as tacit and latent knowledge. The outline and method of the generative sessions were based on Visser et al. (2007) and Sanders and Dandavate (1999). The videotapes from the session were analysed & findings were clustered into categories. In addition the data were analysed based on Klöckners and Blöbaums (2010) CADM model, mapping possible reasons for identified behaviour.

Primary finding:

Participant's oral healthcare knowledge, interest and experience could be divided into 5 main categories: Health, Social, Routine, Sensorial and Physical context.



Figure 6: Two participants making collage, which they will use to backtrack their way of thought.

Feasibility:

The method was time-consuming, but provided valuable insight into oral healthcare practices. In addition it generated the researchers interest and an emotional connection to the data. This was vital when diving into the extreme loads of user-research data at Philips Research.

Activity 3: Video study in Bathroom, Covert observation (Liem 2006, Buur et. al 2000)

Oral healthcare consist of practices that to a large extent is unconscious and habitual. In addition the social norm is strong. It is therefore difficult to get objective data on the subject. A challenge with the Oral Health care practices were the private context in which some of the practice was carried out. To get insight into what people do, a video study was conducted. In this study a video camera was placed in a private bathroom shared by 4 people and their 5 visitors.

The study lasted 3 weeks. Ethical concerns were heavily discussed. And the study was carried out in accordance with ethical research guidance and Norwegian legislation.



Figure 7: Video setup in the bathroom

Primary finding:

Data on water consumption and 3 stereotype routines were identified: 1. Stressed random, 2. Controlled relaxed, 3. Routinely lazy. The aspect of how social factors affected habitual oral healthcare routine was discovered, making stereotype 1 and 3 change behaviour when context was changed.

Feasibility:

This study was useful in the way that it provided a new perspective and valuable insight into habits and routine. Buur et al. (2000) identifies

the need to take video beyond "Hard data" in *User Centred Design*. Based on their methodology, the data was also used to create stories that framed different practice-issues later on in the process. Looking at cost benefit, the costs in this case is quite high; the method is subject to serious ethical debate, which in this case meant time-consuming preparations and bureaucracy. Recruiting and setup of video and sensor equipment, storage of data etc. also takes time and might be expensive.

Activity 4: Design with intent, idea workshop (Lockton 2010)

In collaboration with Dan Lockton the project arranged a workshop with the environmental interest group at Philips; a cross-disciplinary group consisting of 20 engineers, designers, psychologists and other health specialists. Lockton facilitated a workshop using his design with intent method. Basing the tasks on our findings. The participants worked on ideas around water consumption and understanding of time, while doing oral healthcare.



Figure 8: Participants using the design with intent sheets to generate ideas.

Main finding:

Pool of ideas stretching from having a fish inside your toothbrush, to gamification of the brushing process.

Feasibility:

There is quite a high cost in this kind of event, making use of a larger group of employees. In addition there might be a confidentiality risk in bringing in researchers from outside the

company. But the method proved highly effective for generating ideas. In addition the group were taught a new method and one got internal focus on designing for environmental practices, which spread to other projects.

Activity 5: Idea generation using CDM (Klökners & Blöbaum 2010)

Having analysed the user research data based on the CDM, one could also use the model to trigger ideas on the different aspects that could have an influence on behaviour. Each influencing factor was introduced with relevant clips from the bathroom video study, to give inspiration for how the different factors could influence oral healthcare behaviour. This was followed by a structured brainstorm using each factor to trigger ideas for behaviour change. Particularly water consumption was explored in this workshop with 10 design students.

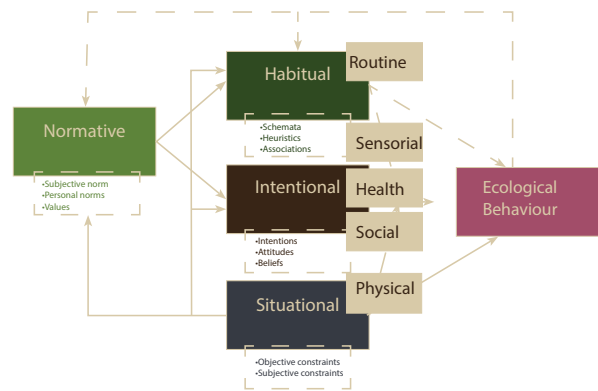


Figure 9: The CDM model linked to the cluster findings from the generative session

Main finding:

Similar ideas as from activity 4, but more diversity in the ideas.

Feasibility:

Low costs and easy to use, could also be used with little preparations if the participants have some knowledge of practice and behaviour within the domain.

Activity 6: Calculating water consumption
(Elias 2009)

The video material from the covert observation was analysed to calculate water consumption. This was done based on Elias' method of user efficient design, but where he had calculated energy usage and timeframe of opening a refrigerator door, one in this case calculated water usage when brushing teeth. Every opening and closing of the tap was registered like shown in table four.

Further the different activities were clustered into 4 phases:

1. Initiation; involving activities like wetting the toothbrush, apply toothpaste etc.
2. Execution; involving activities like brushing, spit toothpaste etc.
3. Ending; involving activities like drinking water, rinsing toothbrush etc.
4. Aftercare; involving activities like rinse sink wash hands etc.

Based on this data we calculated the water usage of each phase.

Date	Time start Video capture	Open/ close tap Time	Person	Open/close	Activity	Water temperature	Water pressure
4. feb	08:36:29	08:36:38	B	Open	To wet toothbrush	Cold	Medium
Friday		08:36:41	B	Close			
		08:36:48	B	Open	To wet toothbrush with newly applied toothpaste	Cold	Medium
		08:36:49	B	Close			
		08:38:12	B	Open	To rinse sink	Cold	Maximum

Table 4: Excerpt from datalog, based on bathroom video study.

Main finding:

Average amount of water used while brushing teeth is 2,1 L. In a year a person would use approximately 1750 L of water while brushing teeth. People use less water when brushing with others. Phase two and three bring about the highest water consumption.

Feasibility:

It proved very useful with hard data in regards to communication with engineers and researchers. But was extremely time-consuming and not worth the investment to manually log all the data. Just by observing the video one would get an impression of the main usage of water, which one could argue is sufficient enough in a design process, especially in the fuzzy front end. If one could log the data in a different manner this method would be more interesting to apply.

Activity 7: Calculating environmental impact using “Eco it.” (Eco it)

To calculate the carbon footprint from Oral healthcare the project made use of the Life cycle assessment software Eco it. Data from the activities performed to gain insight into user experience and technology were fed into this programme.

Main finding:

There was a inconsistency between the behavioural data like water consumption, water pollution etc. obtained and the data the software was asking for, i.e. more product/production based data. Due to this, “Eco it” did not generate much trustworthy data.

Feasibility:

At the time of this activity in 2012, “Eco it” was not a sufficient LCA software to deal with behaviour based impact, particularly when it came to water-, electricity consumption and pollution. Through the years more LCA software have been developed and other software might give better results.

5.2 Market

Activity 16 & 17: Building future scenarios & visiting IDS Cologne exhibition

(Golücke 2001, Verellen & Dè Winter 2010)

The main directions & Ideas identified in the different activities listed in table two, were rated based on their accordance with Philip Research’s own future scenario and market strategies.

We then paid a visit to the IDS cologne, central exhibition on oral healthcare with 139 000 trade visitors from 152 countries. Here we looked at trends and competitive products before we developed more specialised scenarios and did a new rating of ideas.

Main finding:

Some ideas were dropped based on competitors having developed similar products. Others were highlighted based on some scenarios getting more credibility seeing today’s trends. One also got a lot of input on new ideas.

Feasibility:

Might be done with small costs. Scenarios, strategies and the future will always have some uncertainty. But the more info one gets, the better. Making future scenarios is highly dependent on involving the right people.

5.3 Technology:

Activity 24: LCA of commonly used oral healthcare products.

(UNEP 2009)

A Life cycle assessment on commonly used oral healthcare products today were conducted, among these; Sonicare electrical toothbrush, normal toothbrush, Air floss. This was done to look for particularly severe environmental impacts or areas for easy improvement

Main finding:

Transportation, electricity consumption during use phase, pollution and waste were the most likely improvement areas of most of the products

Feasibility:

Doing a detailed LCA takes time, and in this case we did not get any surprising data out of it. If one were working with redesign or product improvements the detailed feedback would be very helpful. The activity got the researchers and engineers to become more aware of environmental aspects of their work. But in the case study one looked at opportunities and ideas 10-30 years ahead, hence the LCA seemed less relevant.

5.4 Organisation:

Activity 28: “Speed date” with employees

To gain insight into organisation, pick up on ideas and their ambassadors or conflicts etc. We arranged a speed-date session over three days. Booking 10 minutes meetings with employees from the entire oral healthcare department, and other key figures in the company.

Main finding:

Nice pool of ideas, and some understanding of which ideas would have enough support to be further developed. Organisational, strategic understanding.

Feasibility:

Minimal investment. Fruitful outcome, and worth doing.

5.5 Policy and legislation:

Activity 29. Lessons learnt – former projects

We did a session with employees, which had been in the department 5 years or more. Going through old projects discussing success and failure factors.

Main finding:

Similar ideas came up in circles around every 5-7 year, due to organisational changes and high turnover of employees. Often marked-, corporate factors or policy changes would decide if a project became a success or not in the later stages of the development.

Feasibility:

This activity needed little investment but had a nice outcome for all parties involved.

6. DISCUSSION

Feasibility or the choice to use a method is in the end a question of costs and benefits. If the results is worth the costs of effort, time and expenses etc. This again depends on the available resources and ones goal. It is therefore of importance to underline that the following discussion is made within the context of the case study on oral healthcare.

The oral healthcare project was looking at opportunities to change behaviour; hence user insight methods were stressed. At the same time it is important to remember as Koen (2002) states; that opportunities and ideas in the fuzzy front end might arise from all kinds of factors and influences like technology and enabling sciences, business strategies etc. Hence the five target categories; market, technology, organisation, policy and legislation, and user experience became a framework in this oral healthcare project.

Market

To look for opportunities derived from market insight, emphasis was placed on Philips’s market research and future scenarios for healthcare (Verellen & Dè Winter 2010). Working with future scenarios is a great tool to see new opportunities and assess ideas through the process. The challenge with building scenarios is off course the uncertainty. The method is quite vulnerable in regards to who is involved and the available knowledge.

Technology

For identifying opportunities deriving from technology development, a lot of work spun around mapping already existing ideas and involving engineers in idea generations. Highlighted in this paper was the method of life cycle assessment of different oral healthcare products. There is a long development time from an idea at Philips Research until it might be part of Philips’s product portfolio. Depending on the product from 5- 20 years. Hence looking at

today's products and their impact became less relevant, and did not give much to the process.

Organisation

The target category of organisation was based on the fuzzy front-end theory specifically Koens idea of the engine and influencing factors. Where organisational factors influence the possibility for an opportunity or idea to nurture and develop into a product or service. To understand a company's formal and informal structure, systems and people one need time. "Speed dating" with different employees was a great tool to get a quick introduction to people, knowledge and structures, especially for a researcher new to the organisation.

Policy and legislation

One of our target categories was also "policy and legislation".

Due to the researchers knowledge within their field, and the company's strategies to some extent reflecting expected legislation changes, it became a natural part of the activities aimed at other target categories. Learning from the past was a great tool, first of all to have another look at projects that have been stopped in the past, but that might work in the future. But also to see which factors affect the process from an idea to a successful product or service. An interesting finding was that the factors of legislation, or the influencing factors you have less control over according to Koen, is the ones often stopping projects that have reached a concept stage.

User experience

So having looked at the target categories: market, technology, organisation and policies and legislation it is time to end by looking at the target category of user experience. - A vital factor especially in a technological driven company as Philips Research, where development of ideas have a high degree of technology focus.

The diary study together with generative sessions is great methods to gain qualitative user insight both to discover and assess ideas and

opportunities. It demands some investment particularly in regards to time. But the main challenge with these methods in the oral healthcare project was not time but the environmental aspects. The methods are developed to gain insight into a domain, in this case oral healthcare. It is based on the participants being the expert sharing ones knowledge and interest. In the generative sessions method the researcher have "no agenda" apart from learning from the participants. If none of the participants have an interest in environmental behaviour, like pollution of water or waste, one would not naturally get information on specifically relevant practice and behaviour data. If one were to try to adapt the methods to include more relevant data for environmental impact, trough for instance steer conversations and tasks in the direction of purchasing behaviour or what you do with your old toothbrush, the researcher is dependent on knowledge in the field of environmental assessments and impact from behaviour.

In Philips Research, with its size and organisational structure, most employees have a role as specialists. In other words specialists in user research do the user research, and the engineers work with the technology issues etc. Therefore the challenge is not recourses to do user insight studies or the lack of data. The challenge is to exchange the user insight knowledge to the other disciplines. In this case study the exchange of knowledge and use of the data were mainly executed through the idea generation workshops.

One idea generation workshop mentioned in detail in this paper made use of Lockton's (2010) design with intent method. The design with intent workshop needed quite some investment due to the size of the event, but the execution worked really well on a cross disciplinary group, generating a lot of ideas.

To be able to use the design with intent method and other ide generation techniques to change behaviour, it is vital to know why people act the

way they do. Klöckner and Blöbaum (2010) Comprehensive Action Determination Model were used as a tool to analyse user insight data to understand why a person would behave in a particular way. The model was also used to generate ideas. The model worked great as a tool for idea generation. But the CADM's focus on one person and this person's intentions habits etc. made it difficult to generalise and work with behaviour on a general level as needed by a designer. *In other words we are missing a tool or explanation model to fill the gap between the psychology and the design field.* The CADM model being too detailed and too little context aware.

To be able to use the design with intent method one also needs to know what kind of behaviour is of interest to change. Defining the ideal oral healthcare routine in regards to health and environmental impact was challenging. The health related preferred routine were highly individual, based on genetics, eating habits and general way of life. The preferred environmentally related oral healthcare routine was difficult to establish due to lack of knowledge on environmental impact, i.e. how would an increased use of fluoride products affect the environment? Leading to better oral health and less dentist visits, but more water pollution.

To help assess the issue of environmental impact the life cycle assessment tool "Eco it" was used. The choice was made based on availability and resources. The tool was of little help being heavily production/product focused. While most of the issues one needed calculating impact from was behaviour related, like resource consumption and pollution. A designer's need, working in early phase of idea development, is not so much the "accurate" carbon footprint, but rather being able to explore and compare behaviour and environmental impact. There are many LCA software and tools out there and hopefully there is another tool more suitable than our choice.

To use a LCA software like "Eco it" one needs accurate data. To calculate water consumption Elias's (2009) method was used. An Elias method is quite adaptable and gives good results. Being from 2009 it has some of the same issues as "Eco it", being heavily product focused. It would be interesting to see an adaptation also involving development of services. The method gave really good results, with accurate data on water consumption, and hence singling out which activities and behaviours to target. Though the manual logging of data was far too resource intensive. One person used two weeks to manually log data from three weeks of video recordings. As a designer the need for this type of accurate data is limited, and one would probably reach similar conclusions on which behaviour to target just by observing the videos and logging data in a less detailed fashion. On the other hand in a research facility as Philips research, the hard data had an added value, giving credibility to the project in an environment with high focus on scientific approach.

This discussion with qualitative vs. quantitative data has been a constant underlying topic in this project. The design process emphasis on intuition and often rapid decision-making based on all type of available data, might come in conflict with the psychologists detailed scientific method or the industrial ecologists love for quantitative data. In my opinion the different methods and established fields are not so different as it might seem. We are almost there, the methods just need a bit of adaptation so the benefits are high enough for the resource constrained designer to use them. If the researcher using this methods and tools have broad knowledge on sustainable behaviour and practices, the tools and method are more easily adapted by the researcher. The less knowledge the researcher has in this field the better adapted the tools and models would have to be.

7. CONCLUSION

- The most urgent area lacking methods within the design for sustainable practices, (in regards to fuzzy front end) exist in data and opportunity assessment. Tools to explore and compare environmental impacts from behaviour are severely needed.
- There are missing a tool or explanation model to fill the gap between the psychology and the design field in regards to explaining behaviour and practice.
- User insight is vital in design for sustainable practices, particularly in technology driven companies like Philips Research.
- User insight methods from context mapping are time-consuming but worth the effort. Nevertheless, the methods fall short with regards to targeting specific data or behaviour on environmental impact, due to its focus on the user as an expert within a domain.
- Scenario planning, “speed-dating” employees, “lessons learned” are great tools to discover opportunities based on input from markets, internal organisation, policies and legislation.
- “Eco it” does not work as a tool in the context of sustainable practices.
- The adaption of existing methods from other fields should be possible. But there is still the challenge that methods explored in this project are too extensive and time-consuming for them to be used efficiently in the early phase of a design process.
- Idea generation techniques with cross-disciplinary teams works well to generate ideas and discover opportunities from all target categories.
- A life cycle assessment on products does not give much relevant input to projects looking for opportunities for new product development 10-30 years ahead.
- Lockton’s (2007) design with intent method for idea generation works very well when you have identified which behaviour to change.
- The Klöckners and Blöbaums (2010) Comprehensive action determination model is detailed and too person-focused when analysing the reason for a specific behaviour. Hence, adaptation is needed for the tool to be efficient in the design process. As an Idea generation tool it works well.

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