Managing Social Impact in Design

Tools and methods for anticipating consequences of technology

Jantine Bouma

MANAGING SOCIAL IMPACT IN DESIGN

TOOLS AND METHODS FOR ANTICIPATING CONSEQUENCES OF TECHNOLOGY

PROEFSCHRIFT

ter verkrijging van
de graad van doctor aan de Universiteit Twente,
op gezag van de rector magnificus,
prof. dr. H Brinksma,
volgens besluit van het College voor Promoties
in het openbaar te verdedigen
op woensdag 11 september 2013 om 14:45 uur

door

Jantje Trijntje Bouma
geboren op 20 maart 1968
te Dokkum

Dit proefschrift is goedgekeurd door:

prof. dr. ir. P.P.C.C. Verbeek promotor

prof. dr. ir. W.A. Poelman promotor

ISBN: 978-90-365-00654

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PhD Thesis
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Wâlterswâld, September 2013

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Key words: social impact, social mediation, contextual characteristics, social ecology, social-oriented research, social innovation, user-centred design, technology, product innovation
ISBN: 978-90-365-00654

Cover design by Robbin van Nek
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Summary

We need look no further than the use of email communication, mobile phones and cars to understand that technology has wide-ranging social consequences. What is more, designers are plainly not always aware of the social consequences of technology, despite practicing user-centred design. Email, for instance, was developed as an efficient mode of communication between two actors. As we all know, the introduction of email has fundamentally changed traditional business and office practices. These side effects were not identified until long after email was introduced.

During recent years, designers have grown increasingly interested in these social aspects. Modern information technology, in particular, creates extensive possibilities to influence social behaviour. Persuasive technology has been developed to increase, e.g., environmental friendliness. Once a designer aims at defined social changes, the consequences of technology for practices become a responsibility, too.

The present research is aimed at providing tools and methods to anticipate social consequences at an earlier stage of the design process. These consequences of technologies in social environments will be called social impacts. In order to be a meaningful concept for designers the characteristics of a particular technology that are responsible for social impacts must be identified. Social consequences of technologies have not been observed very thoroughly from a user-centred design point of view. Therefore, this thesis is aimed, not only at gaining knowledge about social impact, but also translating these insights into workable instruments for designers.
This leads to the following research questions:

1. What relations can be identified between social impacts and characteristics of technologies?
2. How can a designer anticipate social impact?
3. How can social impact be managed in design environments?

Analyzing social impact

Current goals and approaches of user-centred design fall short when it comes to instructing researchers about the role of social impact. A new approach needs to be developed. Therefore, a more fundamental approach is needed to describe the concept and translate this into appropriate tools. From literature it is found that a social environment influences a technology and a technology influences a social environment. The process leading to social impact is called mediation, and refers to the transformation process between humans and technologies. In order to understand what characteristics of a technology lead to a certain form of social impact, more insight is needed into the process of mediation.
Contextual characteristics of a product interact with a social environment. In order to identify these characteristics, it is necessary to shift from a use level towards a social level. This implies that mediation needs to be understood on a social level. Social mediation may therefore be defined as 'the process leading to changed practices after a certain technology has been introduced'.
The shift to a social level has consequences for the analysis of the social context. A social ecological approach is suggested to make the complexity of a social environment comprehensible. This approach allows for the description of a complex reality and enables knowledge from other fields of research to be included.

Besides a new way of analyzing reality, the paradigm of social impact refers to new goals for designers. Social impacts cannot be analyzed from goals related to the use level, such as, for example, usability. So, general social goals related to the variety and frequency of interactions in a social environment will be used to evaluate social impacts.

The overall structure of this study conforms to the Design Research Methodology, in which a descriptive, prescriptive and evaluation stage is distinguished. This has been applied to three contexts: a specific social environment, a generic social environment and a design context. Or from another perspective, a concentric approach is followed, as each step brings us closer to the end goal.

The descriptive research relating to the specific social environments consists of two cases. The first case describes the social impact of digital whiteboards on practices at elementary schools. A digital whiteboard will have intended and unintended consequences. The question is whether it is possible to identify these consequences for the social environment of a classroom and to link these consequences to relevant contextual characteristics.
The social ecology of a classroom comprises its physical design, individual and social factors. These factors all influence the learning environment. Ideally, interactions in a classroom support the goals of adaptive teaching. With the introduction of a digital whiteboard, classroom practices are altered. The question is then whether the changes are in line with these general goals of teaching.
To understand the social impact of digital whiteboards, changed practices in elementary schools were examined. Several intended and unintended social impacts were noted. The unintended consequences were linked to contextual characteristics of the product in question. In this way, designers of new digital whiteboards will be able to influence future impacts. Thus a social ecological approach combined with observing exactly which classroom practices changed due to the use of the digital whiteboards, and how, yielded a workable result.

In the next case, the interrelations between technical products, physical design, social factors and individual factors were observed in cohousing communities. A cohousing community is an interesting research object, because it combines physical design characteristics and social formal structures intended to ensure optimum social interactions. Characteristics that lead to these interactions had previously been identified in earlier research and are called 'social contact design principles'. These are static design principles for cohousing communities that apply to the physical design and the social structures of a cohousing community. In order to understand the relation between physical, technical characteristics and social interactions two studies were performed.
In the first study, several technical changes in cohousing communities were examined. It was found that social mediations were influenced by specific characteristics of an individual community. For example, in the case of conflicts within a community, the physical design principles that were aimed at increasing social interactions were found to be able to have an opposite effect, as well.
The second study focused on interactions within common areas of a cohousing community and identified guidelines for designers to promote intended social impacts. These guidelines were adapted from insights about interaction and mediation patterns.

This research yielded information about the differences between social environments that could lead to differences in impacts. Furthermore, it was concluded that communities are dynamic networks, which in turn affects how social impacts should be identified and anticipated.

The two cases were analyzed to gain general insights into the relation between the social impacts and contextual characteristics of technologies. To identify social impacts, a social ecological approach is first applied to understand important influences in a social environment. The cases analysed within the scope of this study show that analyzing a specific social environment will reveal specific factorial influences. The influences within a social context therefore need to be carefully selected. However, a generic format on the basis of individual, social and physical-technical design factors can be a starting point. Contextual characteristics are revealed through the shift to the social level.
Social mediations can be identified through an interpretation of changed practices; changed practices can be linked to the contextual characteristics of a particular technology. They are developed and strengthened through a pattern of interactions between humans, groups and physical and technical designs.

Anticipating social impact through identification or simulation

Based on the analysis of social impact, a working model has been constructed to anticipate social impact in specific social environments. The steps of the working model have been validated in two cases.
In the first case, the social impact of technical changes from the internet was identified on behalf of a real estate office. New practices proved to lead to changed contextual characteristics; the social impact of the internet reduced the importance of certain characteristics of the physical office.
The second case described an approach in which social impacts were anticipated in a cohousing community by applying dynamic social contact design principles. The social ecology, practices and mediation possibilities had already been described in previous research. For the specific product, however, new information was needed about communication practices. Applying the right approach to gain information about the social context was shown to be rather difficult.

In order to anticipate social impact in general social environments, we need to be able to simulate practices. Therefore, an approach to simulate behaviour of individual users (the persona approach) is transformed into a more comprehensive description on a social level; called the screenplay approach. A screenplay consists of information about individuals within their social environments, social interactions, and their physical and technical interactions. So a screenplay is based on a socio-ecological description of reality. To simulate practices, scenarios are constructed based on this socio-ecological description.
This analysis led to an adapted version of the working model. The model is evaluated in one case: anticipating the social impact of a 'heart manager' for general environments. Impacts can be highly unexpected due to variations between social environments. It has been shown that the use of the screenplay approach to simulate practices can help designers anticipate social impacts. In a generic environment, the number of variations can help improve the quality of anticipated impacts. In a specific social environment, the quality of insights improves the quality of the anticipated impacts.

Social impact in design

The insights into social impacts have also been taken as a starting point for the creation of new knowledge related to social impact in design contexts. The influence on user oriented approaches, the formulation of design specifications and disruptive design is discussed.

This research has focused on consequences. To designers, intentions are also important. So, the insights on social impacts are a contribution, but not a total solution, for a new approach in social centred research.

A second finding is that, while social impact may fit into general design approaches as far as the formulation of design specifications is concerned, this does not automatically generate an awareness of social impact. A third finding is that social impact is an important outcome for innovations in healthcare. Therefore, it is important that awareness about disruptiveness is extended to the insights that have been derived in this research. To reach this goal, a model of awareness has been developed.

The evaluation of the model of awareness revealed that respondents (students) find it difficult to think about the complexity of social environments. Insights into this complexity need to be acquired.

Conclusions

The conclusions will be answered per research question.

1. What relations can be identified between social impacts and characteristics of technologies?

Social impact is developed through social mediations between a social environment and a technology. A social ecological approach can be used to identify the characteristics of a social environment that will influence social mediation. For a technology, contextual characteristics need to be identified. Social mediation is a process of direct and indirect interactions with involved actors in a social environment.

2. How can a designer anticipate social impact?

Social impact can be anticipated with the help of a working model. An extended view on how social-centred research should be applied has been visualized in a conceptual model. The original aim of this project was to gain a better understanding of the impacts of new technologies to prevent unintentional harmful outcomes for the users of such a new technology. Within the development of this research, it was found that conclusions about social impact were relevant for general design projects as well.

3. How can social impact be managed in design environments?

The social impact approach fits within social centred research approaches in design contexts. To facilitate its implementation, three instruments have been developed for designers:

- a working model to generate awareness of social impact;
- a model to visualize possibilities for analyzing impact;
- a working model for the anticipation of social impact.

These represent the steps in the Social Impact Approach: Awareness, Visualization and Anticipation.

I started this thesis with the assumption that a designer is morally responsible for social consequences of design and should be enabled to anticipate social impacts. My research will contribute to discussions within the field of designers on the role of social impact in design.

Samenvatting

Het lijkt zo evident. Technologie kan leiden tot veranderingen in ons gedrag en hoe we met anderen omgaan. Email, telefoons, auto's hebben ons leven geheel veranderd. Wordt met die verandering ook rekening gehouden in de ontwerpfase? Het antwoord luidt zelden. Ontwerpers hebben vaak geen idee. Email leek een mooie en efficiënte vervanger van de brievenbuspost, maar het is duidelijk dat email ook fundamentele veranderingen heeft gebracht in traditionele bedrijfs- en kantoorpraktijken.

De laatste jaren hebben ontwerpers een groeiende interesse getoond in sociale aspecten van nieuwe technologieën. Moderne informatietechnologie, in het bijzonder, creëert uitgebreide mogelijkheden om sociaal gedrag te beïnvloeden. 'Persuasive technology' helpt om nieuwe producten te ontwikkelen die, bijvoorbeeld, energiebesparend gedrag stimuleren. Wanneer een ontwerper het doel heeft om sociale veranderingen te initiëren worden de gevolgen van die veranderingen ook een verantwoordelijkheid van de ontwerper.

Dit onderzoek is gericht op het ontwikkelen van hulpmiddelen voor de anticipatie op sociale gevolgen tijdens het begin van een ontwerpproces. De gevolgen van technologieën in sociale omgevingen zullen sociale impacts genoemd worden. Om op sociale impacts te kunnen anticiperen, moet een ontwerper weten welke eigenschappen van een technologie verantwoordelijk zijn voor welk sociaal gevolg. Deze zullen geïdentificeerd moeten worden.
Sociale gevolgen van producten hebben tot nu toe niet erg veel aandacht gekregen in mensgerichte ontwerpmethodes. Daarom zal dit proefschrift niet alleen gericht zijn op het verzamelen van kennis over sociale impacts, maar ook op de vertaling richting werkbare instrumenten voor ontwerpers.

Dit leidt tot de volgende onderzoeksvragen:
1. Welke relaties kunnen geïdentificeerd worden tussen sociale impacts en eigenschappen van technologieën?
2. Hoe kan een ontwerper op sociale impact anticiperen?
3. Hoe kan sociale impact gebruikt worden in een ontwerpomgeving?

Analyseren van sociale impact

Uit het voorgaande blijkt dat huidige doelen en aanpakken van mensgerichte ontwerpaanpakken tekort schieten. Er zal een nieuwe aanpak voor sociale impact ontwikkeld moeten worden. Een meer fundamentele aanpak is daarom nodig om sociale impact te beschrijven. Uit theorie blijkt dat een sociale omgeving beïnvloedt wordt door een technologie en een technologie beïnvloedt door een sociale omgeving. Het proces dat leidt tot sociale impact wordt mediatie genoemd, en refereert aan een transformatieproces tussen mensen en technologie. Om te begrijpen welke eigenschappen van een technologie leiden tot sociale impact, is meer inzicht in het proces van mediatie nodig.
Contextuele eigenschappen van een product interacteren met een sociale omgeving. Om deze eigenschappen te identificeren is het nodig om een verschuiving te maken van het gebruiksniveau naar het sociale niveau. Dit betekent dat mediatie op een sociaal niveau begrepen dient te worden. Sociale mediatie wordt daarom gedefinieerd als 'het proces dat leidt tot veranderende sociale praktijken nadat een zekere technologie is geïntroduceerd'.

De verschuiving naar een sociaal niveau heeft consequenties voor de analyse van de sociale context. Een sociaalecologische analyse wordt voorgesteld om de complexiteit van een sociale omgeving bevattelijk te maken. Deze aanpak maakt het mogelijk een beschrijving te maken van een complexe werkelijkheid en om kennis uit andere takken van wetenschap te gebruiken.
Naast een nieuwe manier van het analyseren van de werkelijkheid, refereert sociale impact ook naar nieuwe doelen voor ontwerpers. Sociale impact kan niet geanalyseerd worden vanuit doelen van het gebruiksniveau, zoals voor bijvoorbeeld, gebruiksvriendelijkheid. Dus, algemene doelen zullen gebruikt worden om sociale impacts te evalueren.

In dit onderzoek zijn een beschrijvende, een prescriptieve en een evaluatiefase opgenomen. Deze driedeling is toegepast in 3 contexten: een specifieke sociale omgeving, een generieke sociale omgeving en een ontwerpcontext. Of, om vanuit een ander gezichtsveld te verwoorden een concentrische aanpak is toegepast, waarin iedere stap leidt naar het einddoel.

Het beschrijvende onderzoek dat gedaan is in specifieke sociale omgevingen bestaat uit twee cases. De eerste case beschrijft de sociale impact van digitale borden op lagere scholen. Een digibord zal bedoelde en onbedoelde gevolgen hebben. De vraag is of het mogelijk is om deze gevolgen te identificeren voor de sociale omgeving van een klaslokaal en deze te linken aan relevante contextuele eigenschappen van een digibord.
De sociale ecologie van een klaslokaal bestaat uit het fysieke ontwerp, individuele en sociale factoren. Deze factoren beïnvloeden de leeromgeving. In de ideale omstandigheid ondersteunen interacties in een klaslokaal het doel van adaptief leren. Met de introductie van een digibord worden praktijken veranderd. De vraag is of deze veranderingen in lijn zijn met deze algemene doelen van lesgeven.
Om de werkelijke verandering in het klaslokaal vast te stellen zijn sociale praktijken onderzocht op lagere scholen. Verschillende bedoelde en onbedoelde veranderingen zijn gevonden. De onbedoelde effecten zijn gelinkt aan contextuele eigenschappen van het digibord. Op deze manier kunnen ontwerpers van nieuwe digiborden toekomstige praktijken op een positieve manier beïnvloeden.. Dus een sociaalecologische aanpak, gecombineerd met observaties in de werkelijkheid geeft een goede indicatie van de sociale impact van digiborden en tevens een werkbaar resultaat.

In de volgende case zijn de relaties tussen technische producten, fysiek ontwerp, sociale en individuele factoren onderzocht. Een woongemeenschap voor ouderen is een interessant onderwerp voor onderzoek, omdat het een combinatie geeft van fysiek ontwerp en formele sociale structuren die gericht zijn op het verstevigen van sociale interacties. Eigenschappen die leiden tot sociale interacties zijn vastgesteld in eerder onderzoek en worden zogenoemde 'sociaal-contact-ontwerpprincipes' genoemd. Dit zijn echter statische principes. Om de relatie tussen de fysieke, technische en sociale eigenschappen van een woongemeenschap te begrijpen zijn twee studies uitgevoerd.
In de eerste studie, zijn verschillende veranderingen in woongemeenschappen onderzocht. Sociale mediaties bleken beïnvloed te worden door hele specifieke eigenschappen van een gemeenschap. Bijvoorbeeld, in het geval van conflicten in een gemeenschap, bleken de fysieke ontwerpeigenschappen die gericht waren op het bevorderen van sociale interactie, deze juist tegen te werken.

De tweede studie was gericht op interacties in gemeenschappelijke delen van een woongemeenschap en heeft richtlijnen geïdentificeerd voor ontwerpers om sociale impact te promoten. Deze richtlijnen werden aangepast aan inzichten over interactie en mediatiepatronen.
Dit onderzoek heeft tot informatie geleid over het verschil tussen sociale omgevingen en het effect daarvan op sociale impacts. Verder, is geconcludeerd dat gemeenschappen dynamische netwerken zijn en dat dat invloed heeft op de manier waarop sociale impact geïdentificeerd en geanticipeerd moeten worden.

De twee cases zijn geanalyseerd om inzicht te krijgen in de relatie tussen sociale impact en contextuele eigenschappen van technologieën. Een sociaalecologische aanpak is toegepast om te begrijpen welke belangrijke invloeden er zijn in een sociale omgeving. De twee cases laten zien dat voor iedere sociale omgeving specifieke invloeden gelden. Deze moeten zorgvuldig geselecteerd worden. Daarnaast blijkt dat een generiek model met individuele, sociale, en technisch-fysieke factoren als startpunt gebruikt kan worden. Contextuele eigenschappen worden geopenbaard door de verschuiving naar het sociale niveau.
Sociale mediaties kunnen geïdentificeerd worden door een interpretatie van veranderde praktijken. Deze veranderde praktijken kunnen gelinkt worden aan contextuele eigenschappen van een product. Ze worden ontwikkeld en versterkt door een patroon van interacties tussen mensen, groepen, de fysieke omgeving en technische producten.

Anticiperen van sociale impact door identificatie of simulatie
Gebaseerd op de analyse van sociale impact is een werkmodel geconstrueerd om sociale impact in specifieke sociale omgevingen te anticiperen. De stappen van het model zijn gevalideerd in twee nieuwe cases.
In de eerste case is de sociale impact van technische veranderingen door het internet voor een makelaarskantoor geïdentificeerd. Nieuwe praktijken leiden tot veranderde contextuele eigenschappen. De sociale impact reduceerde het belang van bepaalde eigenschappen van het fysieke kantoor.
De tweede case beschreef een aanpak waarin sociale impact geanticipeerd werd in woongemeenschappen door het toepassen van dynamische contactprincipes. De sociale ecologie, sociale praktijken en sociale mediatiemogelijkheden waren in eerder onderzoek bepaald. Toch bleek aanvullend onderzoek over communicatiepraktijken nodig om een goed product te kunnen ontwerpen. Uit beide onderzoeken kwam naar voren dat niet alle stappen van het werkmodel goed uitgevoerd waren.

Om sociale impact ook in algemene sociale omgevingen toe te kunnen passen is het nodig om sociale praktijken te simuleren. Daarom is een aanpak om individueel gedrag te simuleren (persona-aanpak) veranderd in een meeromvattende aanpak op een sociaal niveau. Ik heb dit de screenplay-aanpak genoemd. Een screenplay bestaat uit informatie over individuen in hun sociale omgeving, hun sociale interactie, en hun fysieke en technische interacties. Een screenplay is gebaseerd op een sociaalecologische beschrijving van de realiteit. Deze zijn nodig als startpunt om praktijken te simuleren. Voor deze simulaties worden scenario's geconstrueerd.

Deze screenplaymethode heeft geleid tot een aangepaste versie van het werkmodel voor algemene sociale omgevingen. Deze versie is gevalideerd in een case: de anticipatie van sociale impact van een 'hartmanager' voor hartpatiënten. Een

‘hartmanager’ is een product dat de hartslag en gps coördinaten registreert en alarm slaat wanneer een patiënt in een gevaarlijk conditie verkeert. Dit is een voorbeeld van een product dat in veel verschillende sociale omgevingen gebruikt kan worden. Impacts kunnen daardoor heel verschillend zijn. Het is duidelijk geworden dat deze aanpak designers kan helpen om op impact te anticiperen. Het is gebleken dat in een algemene omgeving het aantal variaties kan helpen om tot een goede inschatting van sociale impact te komen, terwijl in een specifieke omgeving de kwaliteit van de gevonden impacts een goede anticipatie bepaalt.

Sociale impact in design

De inzichten in sociale impact zijn een startpunt voor de creatie van nieuwe kennis in ontwerpomgevingen. De invloed op gebruikersgeoriënteerde aanpakken, het formuleren van ontwerpspecificaties en innovaties wordt verder bekeken.
Het onderzoek heeft zich gericht op gevolgen, maar voor ontwerpers zijn intenties ook belangrijk. Dat betekent dat het onderzoek een bijdrage is, maar geen totale oplossing voor sociaalgeoriënteerd onderzoek. Een tweede uitkomst is dat sociale impact past in algemene ontwerpaanpakken, waar het gaat om het specificeren van ontwerpspecificaties. Dit leidt echter niet automatisch tot bewustwording bij ontwerpers. Een derde uitkomst is dat sociale impact een belangrijke doel moet zijn bij innovaties in de gezondheidszorg. Het is dan ook van belang dat bewustwording over verstorende innovaties wordt uitgebreid met inzichten uit dit onderzoek . Om dit doel te bereiken is een model voor bewustwording ontwikkeld. De evaluatie van het model voor bewustwording leerde dat respondenten het moeilijk vinden om de complexiteit van sociale omgevingen te bedenken. Inzichten in deze complexiteit moeten aangeleerd worden.

Conclusies

De conclusies zullen per onderzoeksvraag behandeld worden.

1. Welke relaties kunnen geïdentificeerd worden tussen sociale impacts en eigenschappen van technologieën?

Sociale impact ontwikkelt zich door sociale mediaties tussen een sociale omgeving en een technologie. Een sociaalecologische aanpak kan gebruikt worden om de eigenschappen van een sociale omgeving te identificeren die sociale interacties beïnvloeden. Voor een technologie dienen contextuele eigenschappen te worden geïdentificeerd. Sociale mediatie is een proces van directe en indirecte interacties met betrokken actoren in een sociale omgeving.

2. Hoe kan een ontwerper op sociale impact anticiperen?

Sociale impact kan geanticipeerd worden met behulp van een werkmodel. Terwijl een uitgebreide blik van hoe sociaal georiënteerd onderzoek moet worden uitgevoerd er voor kan zorgen dat de juiste aanpak gekozen wordt. De originele bedoeling van dit onderzoek was om beter inzicht te genereren in sociale impact om onbedoelde en schadelijke gevolgen van nieuwe technologieën te voorkomen voor de gebruikers. Het is gebleken dat conclusies van dit onderzoek ook interessant zijn voor algemene ontwerpprojecten.

3. Hoe kan sociale impact gebruikt worden in een ontwerpomgeving?

De sociale impact aanpak past binnen een sociaal georiënteerde aanpak in ontwerpomgevingen. Om de implementatie te faciliteren zijn drie instrumenten ontwikkeld:

- een werkmodel om bewustzijn te creëren voor sociale impact;
- een conceptueel model om mogelijkheden om sociale impact analyseren te visualiseren;
- een werkmodel voor de anticipatie van sociale impact.

Deze drie instrumenten representeren de stappen in de sociale impact aanpak: bewustzijn, visualisatie en anticipatie.

Het startpunt van dit onderzoek was dat een ontwerper moreel verantwoordelijk is voor sociale gevolgen van zijn ontwerpen en dat hij/zij in staat gesteld moeten worden om sociale gevolgen te anticiperen. Mijn onderzoek wil een bijdrage leveren aan discussies in ontwerppraktijken over de rol van sociale impact in hun ontwerpstrategieën.

Preface

'It moat fan oanhâlden komme'

In 1968 I was born in a little place in the northern part of the Netherlands, called Dokkum. At that time possession of technologies in average families were limited. We, for instance, didn't own a car. This meant my father had to drive to work on his bike every day. He was not sure whether a car would be a possibility for our family. We didn't have a telephone, so my parents had limited contacts with family and friends that lived some distance away. For social contacts they were depending on new friends that lived nearby.

I was the second child, my sister only differed 17 months, so my mother (who took care of the children) was limited in her freedom of movement. Hence, most interactions in our lives took place in a limited area and were determined by (a lack of) technical possibilities; all groceries, for instance, were bought in the local area. From this context in which they lived it would have been a shock if they would have been put in a time machine and had been directly moved towards 2013 to see their world changed completely.

In reality my parents never have been shocked, because they gradually adapted towards all new technologies and opportunities. This has caused a considerable change in behaviour. They now, for instance, travel through Europe with a car and caravan, and search in foreign countries for bars with wifi connections for their internet devices.
So, changes of technologies gradually enter our lives and we hardly notice how much our lives have changed and will change. Maybe, in 45 years, when I look back on my live, I will conclude the world has changed as much as it has changed from 1968 towards 2013.

During my own working life practices have changed as well. In 1991 I started as a usability researcher for Philips at the innovation department of the Domestic Appliances and Personal Care division. I performed tests on usability, was involved in the translation of test results towards functional requirements, identified shaving experiences through market research, developed approaches to measure these experiences, organized brainstorms with end-users, etc. The nine years I have worked for Philips I consider to be the foundation for my knowledge on user-centred research. However, the way I worked at Philips differed much from the way I work nowadays. I performed most of my work at the office, because I did not have access to my files and email at home. We worked strict hours from 7.45 until 16.15. When I couldn't finish my job in time, I stayed until I was done. So, there was a strict separation between work and private life. I didn't have a mobile phone or a laptop. Going on the road, therefore, was very relaxing.

Nowadays I can work anywhere, at any time. And this is what I do. My working routines have changed completely. This has led to the consequence that the boundary between private and professional life has faded away. This change of behavior has led to more flexibility for my personal life, but also to the fact that work is always in my

mind. Students mail me whenever they want to and expect me to answer them immediately. When I am sitting at a terrace enjoying nice weather, I can be confronted with mail from work.

On the other hand, this new way of working has enabled me to perform a PhD research while having a family with young children. Enabled through new technology, like a laptop and a mobile phone, it was possible to work at home frequently.

In my thesis, I have pointed out that changes due to new possibilities of technologies have a reciprocal relation with a social environment. The influence of my thesis on the scientific social environment needs to be considered in the coming time, however the consequences of the influences of my social environment on my work are presented for you in this book. In this thesis I have divided influences of social environments in different factors: physical design, technical, individual and social factors. Examples of these influences are: the physical context of the university, a quite working place to write; technical tools like my laptop and mobile phone; my individual characteristics and experiences (the quote above explains something about my character); and last but not least social factors like my promotors, colleagues and family. All these factors have influenced implicitly and explicitly the construction of this thesis.

For the social support I received I would like to thank some persons specifically. In the first place I would like to thank my promoters: Wim Poelman en Peter-Paul Verbeek. Your support during the last years was essential. Wim, I would like to thank you for the inspiring conversations we had. You made me see new opportunities for my research and advised creative approaches. Peter-Paul I would like to thank you for your enthusiasm, your fundamental remarks on my work and for opening a door to the world of philosophy. My gratitude furthermore goes out to my graduation committee for assessing this thesis, providing feedback and being part of the PhD defence ceremony.

Without the enthusiastic motivation of Rianne Valkenburg to start my research, I would not stand her today. Thanks for your stimulating advice and I hope we can do something together in the future. Liek Voorbij was my first supervisor. She taught me the switch from practical research towards academic research. Thank you for your constructive feedback and the pleasant meetings we had. My research on digital whiteboards has benefitted from the insights of Nienke Nieveen from the Netherlands Institute for Curriculum Development (SLO).Thank you for the enjoyable cooperation. The English text has been edited by Karen Laird, which has made the text more readable.

I would like to express my gratitude to Andries van den Berg, Liesbeth Jorritsma from bureau Noorderruimte, Gerrit Kuiken and Els Bos from the school of Engineering of the Hanze University of Applied Science for the opportunity and support they gave me to perform my research. Furthermore I would like to thank all my colleagues from Human Technology and my colleagues of 'bureau Noorderruimte' especially of the group 'Krimp en Leefomgeving' with Sabine Meier. I had many discussions with students about my work and they were involved in a lot of studies. Thank you for your support.

Manon thanks for the cooperation, our inspiring bike trips and shared emotions during our research process. Gerda thanks for your creativeness, enthusiasm and great cooking! I am glad the two of you want to be my paranimfs.

In the writing process I needed a quiet place to write. My brother and sister in law Freerk Klaas and Hennie Reitsma have offered their house, which I could use as often as I would. I would like to thank them for their hospitality and tasty coffee.

My whole family has encouraged me to write this dissertation. My children Freerk and Minke reflect for me what is important in life; they helped to keep the research in perspective. My best coach has been my husband Oege, who has stimulated me when I needed it and been critical at other moments.

Contents

Introduction: social consequences of technology – a responsibility for designers?

1.1 Introduction

The Stone Age was a great age in human history: human beings learned to make and use sharp tools, weave cloth, build living quarters, domesticate animals, plant seeds, harvest crops and sense the returning cycles of the months and years (Palmer, Colton, & Kramer, 1984). In the view of Palmer et al. these steps in human civilization are strongly related to the development of technical tools. These early forms of technologies extended the capabilities of humans (Poelman, 2002) enabling them to become predominant over their natural environments. Although these technologies were still unsophisticated, the social consequences were very considerable; without these tools, people living in the Stone Age would not have been able to settle in one place and would still have been forced to live as nomads. This transformational effect of technology on the lives of human beings is called mediation (Verbeek, 2005b).

It is a big step from the Stone Age to today's society. The last century has brought innovations, such as the computer, antibiotics and nuclear power. Technology is advancing at a rapid pace and new services and products are continuously being introduced. We communicate, travel and live in a fast changing world. Technology has brought new opportunities, but is able to disrupt social processes as well (Valkenburg, Vos-Vlamings, Bouma, & Willems, 2008). Just as in the Stone Age, when the development of tools had a huge impact on the human life, the impact of today's technological developments cannot be overestimated. For instance, cars have brought wrought social changes in our lives far beyond simply enabling people to go from a to b. They enable people to do things that were more difficult before: to go wherever they want to go, to meet people they want to meet, to live in places that were not connected to their work, etc.

Manufacturing technology has changed dramatically as well; from simple tools for a specific user to increasingly complex products produced in large numbers. Designing has become a task that has been delegated to specialized practitioners. To be a designer, different kinds of knowledge have to be integrated in one person. In-depth expertise about the technical discipline has to be combined with integrative thinking. This is what the Stanford school has called a T-shaped professional (Valkenburg, et al., 2008).

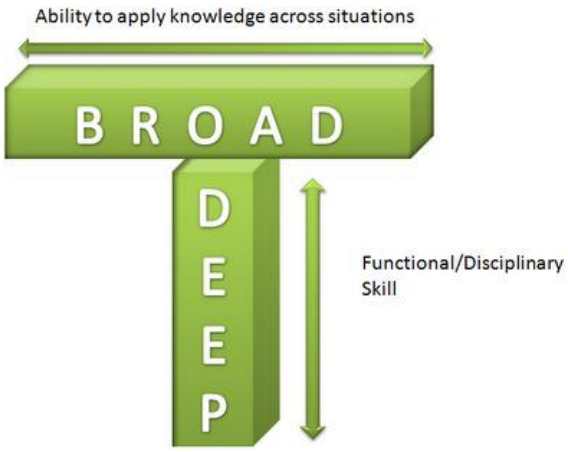


Figure 1.1: the T-shaped designer

The term T-Shaped professional has become closely associated with the pioneering design firm IDEO and its CEO Tim Brown. According to Brown (2005), designers need to have a principal skill that describes the vertical leg of the T, i.e., they are mechanical engineers or industrial designers. But they need to branch out into other disciplines, such as anthropology and to gain a knowledge of these, in order to be able to explore insights from many perspectives and thus to arrive at a better understanding of human needs. A T-shaped designer thus has the skills to understand how to design technology (in-depth expertise), plus an understanding of the complexity of the context in which the technology will be used (integrative thinking).

One aspect of understanding the complexity of the world that has been covered by designers is the fact that they seek to design products that fulfil human needs; the so-called user-centred design approaches. These approaches are mainly focused on designing interactions between a user and a product, or as Kolko (2007) defined it, 'the creation of a dialogue between an user and a product, system or technology'. This definition shows that user-centred design approaches focus on the use of products. The question is whether a focus on the use of a product is adequate in itself to understand the complexity of a context.
A focus on the use of products is related to the fact that many designers aim to satisfy human needs (Margolin & Margolin, 2002). According to Woodhouse and Patton (2004), great care goes into proximate design of particular products, which might be extended to the broader processes of design. They ask what it would take to enable the social costs of innovations to be identified. In their view, the focus on the design process and human needs should become a focus on the whole social system. So, in their opinion, social consequences of technologies should receive more attention in design practices.
Designers are realizing the fact that new ways of looking at design are needed, which has prompted the emergence of integrative approaches like 'Design Thinking and 'Service Design'. Design thinking is a *human-centred innovation process that emphasizes observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping, and concurrent business analysis, which ultimately influences innovation and business strategy (Lockwood, 2009, p. xi)*. 'Service Design' combines multidisciplinary backgrounds and aims for solutions, rather than focusing on one specific aspect. According to the Copenhagen Institute of Interaction Design: *Service Design is an emerging field focused on the creation of well thought through*

experiences using a combination of intangible and tangible mediums (Stickdorn & Schneider, 2010, p. 30). These approaches have in common that they offer a more holistic approach towards design; with less of a focus on specific aspects, more focus on a solution for a certain problem.

Next to becoming more holistic, designers have become aware of the possibility to influence the behaviour of users, as well. Approaches like persuasive technologies (Fogg, 2002) and design with intent (Lockton, Harrison, & Stanton, 2008) have focused on the question of how users can be influenced with the help of technologies. This is necessary, because design goals are shifting from individual needs for products to be usable, useful and desirable towards social goals, which are beneficiary for our society. For instance, technology is being developed to increase healthy ageing and energy saving. Innovation is moving towards a socially driven orientation (Green, 2007).

Norman (2010), however, states that design problems focusing on social goals involve complex social and political issues and this implies that designers have to become applied behavioural scientists: *'Designers often fail to understand the complexity of the issues and the depth of knowledge already known'*. So, in the vision of Norman (2010), new methods and new ways of analyzing social contexts are necessary in order to solve these complex design problems.
Introductions of new technologies have social consequences. Not because they intend to, but because these technologies enable new behaviour. Once designers start to aim at social goals, it may be meaningful to explore the role of the designer from the perspective of consequences.

In this Chapter, I will therefore introduce a new paradigm in design research, which focuses on social outcomes of new technologies. I will first discuss whether social consequences of designs should be a responsibility of a designer *(1.2)*. Secondly, the boundaries of the present study will be defined through a definition of the central concept of this thesis: social impact *(1.3)*. Thirdly, I will discuss an example of technology in a social environment that visualizes the need to understand social impact *(1.4)*. Finally, I will discuss the problem statement and the research questions associated with this concept *(1.5)*.

1.2 Social consequences of technology as an aspect of ethical considerations

Papanek, a well-known designer, was one of the first to emphasize the importance of unintentional consequences of design. The unequivocal opening statement of his famous book 'Design for the real world' cannot be misinterpreted: *'There are professions more harmful than industrial design, but only a few of them' (Papanek, 1985).* Designers were harmful, in his view, because they design things people don't need, are responsible for more garbage, pollution and unsafe situations. Nowadays, designers have grown more aware of these negative effects. Unintentional consequences of design, like pollution, are identified and anticipated. Sustainable design has received much attention, although there is still room for improvement.
Berdichevsky and Neuenschwander(1999) discussed the ethical responsibility of designers regarding unintentional outcomes of the introduction of new designs that intend to induce new human behaviours. They argue that social changes

should become the designer's aim. In their view, a designer is only responsible for unintentional unethical outcomes that are reasonably predictable. It is perfectly reasonable to assume that in 1985 (the year Papanek published his book), the contaminating effects of newly developed products might not have been predictable. Nowadays, however, nobody would claim that the polluting effects of technologies are not a responsibility. A consequence becomes predictable once a designer is aware of this. Hence, designers may well have a responsibility to become aware of the consequences of products.
Perhaps it is better to focus on the question of whether social consequences of design are related to the introduction of a product. Recent insights in mediating effects of technology have shown that technology has an effect of its own and may cause social changes in itself. As Verbeek writes: '*the fact that technologies-in-use inevitably play a constitutive role in the actions of their users places mediation in the heart of ethics' (Verbeek, 2006, p. 13)*. From this point of view, designers have an ethical responsibility because of the dependency between the introduction of a product and social changes.
So, just as Papanek wrote about the physical consequences of design, we must now become aware of the social consequences of designs.

1.3 Social impact as an operational concept of mediation

As the first paragraph pointed out, cars have influenced our lives dramatically and this influence has spread through our whole society: from traffic jams to shopping malls, holidays, concerts etc. However, understanding all the layers of influence that have been responsible for these changes goes perhaps too far, and it is highly questionable as to whether a designer needs to anticipate and identify such changes in all cases; after all, most new products will have far less impact on our lives. The boundaries of impact that will be researched within the scope of this study should therefore be carefully defined. To this end, I will discuss the concept of impact of technology in greater detail.
A first distinction can be made between primary and secondary impact. Traditionally, the primary impact of a product is what a designer is aiming at; the growth of a user's capacity (Dorrestijn, 2009). When a product is introduced, potential users will ask themselves questions, such as: Does the product appeal to me? How does it work? How can I use it? Such questions resemble the first phases of product use. The questions users ask themselves in these first phases of product use relate therefore to marketing and usability issues.
The secondary impact on users and society is the one that changes the behaviour of people and society (Dorrestijn, 2009). This definition of technology bears on the impacts to which this research relates. An example is the way cars have changed our society. Traditionally, the focus of a designer has been on the use of a car. What about the usability? How safe is it to use the car? If, instead of on use, the focal point of the designer is on the social consequences of a car, the changes occurring in the practices of users in a social environment, such as, for example, the changing shopping habits of new car users, could become a focus. Such observations may reveal the impact within the direct social environment of the user. The question is whether such a boundary is sufficient for a designer.
At first glance, it would seem sufficient to look at the direct social environment of a user; most social goals of new designs will first need to change the direct social environment of a user in order to aim at higher defined goals within a society. For instance, a product that is meant to reduce the energy consumption of users must

first influence the direct practices of the users before it can contribute to a more sustainable environment. Furthermore, small changes in communication and interaction are said to be enough for big changes in social norms and behaviour (Postmes, Steg, & Keizer, 2009). My focus is on this delimited concept of secondary impact. In this thesis I use the term social impact to refer to impact in a social environment of users.

Social impact is a central concept in this thesis and will be defined as:
The interpretation of changes in interactions within a social environment due to a technology.

To interpret such changes in interactions, first, the social goals of a certain context must be understood. This is in line with the usability approach in which the individual goals of users are the starting points. In the next section, an example of anticipated social impacts with regard to the introduction of ambient technologies will be discussed in greater detail.

1.3.1 An example

Due to the greying of our society, geriatric care can no longer be guaranteed in the long term. Older people may have to live independently for a longer period with the help of products that sense their environment, anticipate user needs, and act appropriately (Vastenburg, 2007). In a matter of years, homes could be filled with context-aware, networked and pro-active devices. At Philips, this vision of pervasive technology is called ambient intelligence (E. H. L. Aarts & Marzano, 2003). Traditional design has focused on explicit interactions in a reactive setting; traditionally, products react to users' actions, and user-product interactions are explicit. With the introduction of these devices, implicit interactions are introduced as factors that influence the output of devices. Through sensor technology, people's behaviour can be monitored and registered. A device can learn from the user and make pro-active suggestions. In the case of fall prevention for the elderly, a device might detect the fact that a person has not moved or is lying in an unnatural position on the ground and alert caregivers. Or a global positioning system for people with dementia might prevent a person from getting lost, or emit a signal if the person leaves the house. A user may not be aware of this technology and its outcomes. The question is, whether such 'invisible' technology will have social consequences that will change interactions within the social environment of older people and their caretakers.

Social consequences of new technology have been the subject of several studies. One example is a study performed at the Rathenau Institute in the Netherlands (Schuurman, El-Hadidy, Krom, & Walhout, 2007). Schuurman et al. analyzed the consequences of Aarts & Marzano's concept of ambient technologies (2003), in which they proposed a new technology with five layers of intelligence that build on each other.

Embedded	Many networked devices are integrated into the environment
Context aware	These devices can recognize you and your situational context
Personalized	They can be tailored towards your needs
Adaptive	They can change in response to you
Anticipatory	They can anticipate your desires without conscious mediation

Table 1.1 The five key characteristics of ambient intelligence as suggested by Aarts and Marzano (2003)

In the study, the Rathenau institute examined current and future scenarios for each layer of intelligence (Schuurman, et al., 2007). The scenario discussed here is an example of context-aware technology that is still limited in intelligence. The scenario describes a man with heart problems who wants to go on a holiday with his wife. His cardiologist doesn't want to let him go, unless he is willing to use a 'Heart Manager'. The Heart Manager consists of sensors on his body that continually register his heart rhythm and brain activity (via ECG and electroencephalography). These sensors were provided by his insurance company. Were any problems with his heart to develop, ambulances or doctors would be directly alerted.
While on his holiday, he also went mountaineering, during which activity the sensor registered declining cardiac function. After the holiday, he was confronted with this information by his medical coach during a regular check-up. The coach indicated that his insurance might not insure future trips that included hiking in mountains.
For the Rathenau institute (Schuurman, et al., 2007), it is evident that such consequences have ethical implications. One of the identified themes is the way individual needs of patients versus collective needs are to be treated. Ambient intelligence creates the possibility of adapting to highly personalized needs of patients, such as, in the above example, the support during mountaineering. However, it also creates new possibilities for other parties, in this case, an insurance company, who might ask its policyholders to demonstrate healthier (risk avoiding) behaviour.

This scenario was composed by researchers of the Rathenau institute in cooperation with experts in the field of these new emerging technologies. It provides information about possible outcomes of mediation. But as mediation comes about in a complex interplay between technologies and their users (Verbeek, 2006), other consequences can be imagined as well: the influence of individual characteristics, social factors and differences in physical environments. So, although the Rathenau institute acquired important information from the study, it is by no means certain that all reasonably predictable results were found. This may relate to the aim of the Institute: to focus on a broad discussion about ethical implications of new technologies and not to identify all relevant social impacts that are to be expected.
However, when a designer sets out to develop a new product, he may find he needs more specific information about the anticipated social impact of the new product. What other consequences can be thought of? Which characteristics of the new technology are responsible for which outcomes? Which intended outcomes will be reached? Which concept should be chosen? A designer needs

information that will allow him to make choices about the product that is to be developed.

1.4 Problem statement

The introduction of a new technology leads to social impacts. As technology has an influence on social changes, the designer of such a technology has a responsibility for its outcomes; especially when a designer is aiming for social changes.
The example of the Rathenau institute shows that anticipating the social impact leads to interesting insights. However, it is unclear whether all influential impacts have been found. New approaches, such as Service Design, are more holistic and provide designers with a broader context. But the standard approach in such projects is to observe a context and derive product specifications from research; in other words, the social context is regarded as a static element.
In my opinion, designers are too focused on the primary goal of the products and tend to forget about side effects. We recall that email was developed for its efficiency in communication between two actors. If research focused on the intended goal of email had been carried out, this would have shown that it would indeed yield a far more efficient mode of communication. Unfortunately, the introduction of email has also produced irrevocable changes in practices in offices. These side effects were identified long after email had been introduced, when there was no way back.
For technologies developed to serve future social goals within the domains of, for instance, healthcare and energy, such an outcome could even be harmful. If, years after the introduction of the Heart Manager, we discover that undesirable changes have occurred in the practices between patients and caregivers and healthcare providers, it is too late to stop the use of such a technology. Perhaps unwanted practices could have been prevented by adding other features to the Heart Manager or by modifying the formal social practices in hospitals. In such cases, therefore, it is essential to anticipate or at least identify social impacts at an early stage.

1.4.1 Research questions

The primary goal underlying this thesis is to explore ways to anticipate the social impact of new technology in order to support socially sustainable designs. This leads to the following research questions:

A question related to the content of the problem:

1. What relations can be identified between social impacts and characteristics of technologies?

Secondly, a research question addressing the research process:

2. How can a designer anticipate social impact?

And finally, a question related to the application of the acquired knowledge:

3. How can social impact be managed in design environments?

In the next Chapter, the first research question is examined on the basis of the literature. This will lead to a theoretical framework.

1.5 Methodology

To answer the formulated research questions, it is necessary to design a research approach. This section explains the methodological approach, which has been chosen. This thesis builds upon the work of Poelman and Eekels in the way that it tries to find answers for fundamental approaches in product innovations. The focus is on the ethical boundaries of technologies that influence the process of defining functionalities. Poelman (2005) stated that these functionalities need to be carefully selected. It is a process to widen the perspective and moral responsibility of designers. A major difference is that in this thesis, the search for functionalities is based on a user-centred perspective, rather than the more technical orientation of Poelman and Eekels (1995).

Furthermore, this thesis builds upon the work of Verbeek (2005b) on mediation of technology. It is an attempt to transform a technical philosopher's insights about the effect of technology on humans into applicable principles for design contexts. The theoretical basis of this thesis is founded on the ideas of scholars such as Latour (2005) and others within the Actor Network Approach, and Akrich (1992), who wrote about the reciprocal relation between intentions and consequences.

Finally, the conceptual framework of Clitheroe, Stokol et al. and the work of environmental psychologists in the field of health interventions (Clitheroe, Stokols, & Zmuidzinas, 1998; Lounsbury & Mitchell, 2009; Stokols, 1996) have provided a framework that can be used for insights from other social disciplines for this thesis. As consequences are found through complex interactions in social systems, it is necessary to build upon many different sources and to have the possibility to integrate this knowledge.

1.5.1 Research approach for the assessment of social impact

Besides a theoretical foundation, any research on social impact must be carried out in a responsible way. The results of this study need to be in line with expectations that have been aroused. Therefore it will be discussed in detail how the research was set up.

Designers need ways to understand meaningful social impacts of a product that is about to be designed. The outcomes of this research should enable designers to act on anticipated social impacts. To this end, this study will address how social impacts are developed in social environments; the focus lies on pattern recognition, insights into cohesions and relations, rather than a quantification of identified social impacts in reality.

This is in line with other user-centred approaches. Kanis (2000), for instance, questions whether validity in ergonomics research is a useful concept. According to Kanis (1998), user trialling in a design context is not about the prediction of averages and dispersion in quantitative measurement results, but rather about the identification of different types of usage. It is of little concern whether a particular use pattern is observed once or twice in 10 subjects. What is important is the use variation (Kanis, 1998). Typically, in design research, a combination of facets is studied, taking a holistic approach rather than performing research driven by a need to generate fundamental design knowledge (Blessing & Chakrabarti, 2009).

However, a holistic approach does not exclude the use of quantitative methods. In general, a quantitative approach is applied to investigate or measure the degree in which phenomena occur, while a qualitative approach is applied to investigate the nature of a phenomenon. Increasingly qualitative and quantitative approaches are

being combined to obtain a full picture of the study, which eventually leads to the richest pictures; at least in the eyes of Blessing and Chakrabarti (2009).
So, every method in usability research is 'just' one way of looking at reality. And researchers recognize that all methods have limitations (Creswell, 2008). A combination of methods allows a researcher to gain a wider perspective on a certain phenomenon. Therefore the principle of triangulation will be applied. Triangulation is the use of multiple sources and mixed methods to gather and strengthen evidence about a researched subject (Blessing & Chakrabarti, 2009; Creswell, 2008). As I am aiming for a rich picture of the concept of social impact, qualitative and quantitative approaches will be combined.
The research strategy applied constitutes a transformative procedure in which the researcher uses a theoretical lens as an overarching perspective within a design that contains a mix of methods (Creswell, 2008). This has consequences for the way the research is performed. A combination of methods will be used to gather evidence about the phenomenon of social impact. However, the focus remains on understanding all relevant variations in the phenomenon of social impact. In this sense, the overall approach has a qualitative nature, because of the search for variation instead of validation.

Setup

The first research question is related to the content of the problem: What relations can be identified between social impacts and characteristics of technologies? The kind of social impacts that can be found in social environments is not yet clear. Hence the first research question explores how intervening factors influence each other in order to define the relationship between impacts in social environments and the contextual characteristics of technologies *(Chapters 2, 3, 4, 5)*.
The second research question addresses the research process: How can a designer anticipate social impacts? To answer this question, the steps that have to be taken to anticipate social impact must be understood. A tool is required to be developed and evaluated. However, at this stage the characteristics of a tool that is able to be integrated in a design context have not yet been established *(Chapter 6, 7)*.
Therefore, the third research question is focused on the application of the knowledge that has been obtained: How can social impacts be managed in design environments? In the last stage of research, a translation into a design practice is made. In this phase, a review-based evaluation of design practices are combined with insights from the research into social impact *(Chapter 8)*.
And finally, general conclusions on all research questions will be drawn *(Chapter 9)*.

In figure 1.2 the relation between the chapters has been visualized.

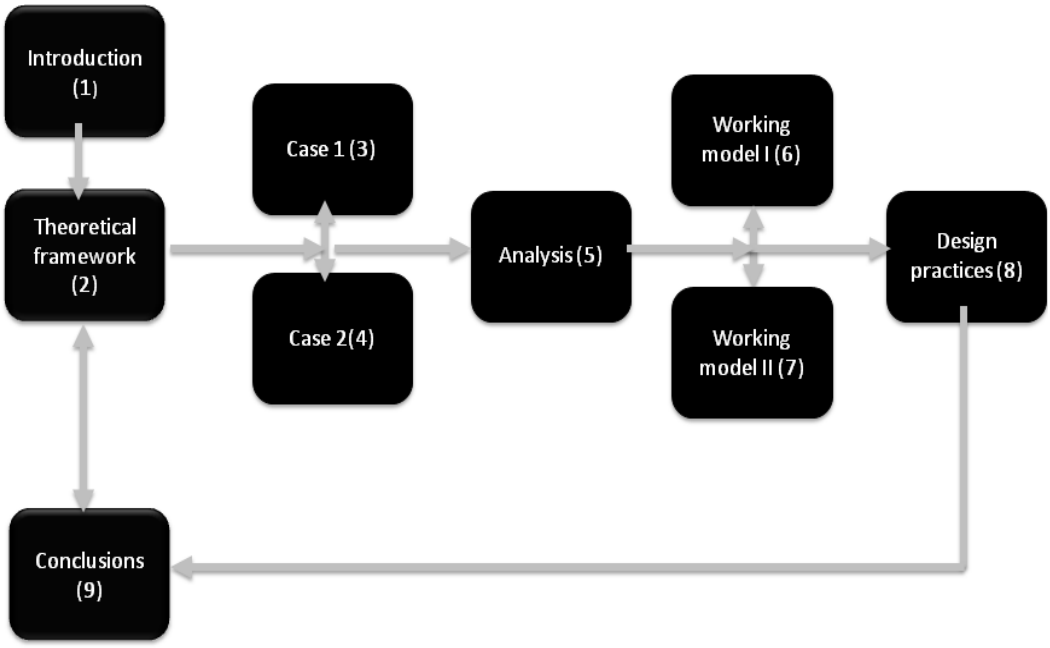


Figure 1.2: setup of this thesis

Chapter 2: the identification of social impact

2.1 Introduction

In the introduction, social impact was introduced as a consequence of mediation between a social environment and a technology. This social impact consists of intended and unintended outcomes. Unintended consequences that are harmful may need to be prevented. As I explained, the social consequences of designs have not been an explicit aim of researchers and designers. The concept of social impact therefore needs to be elaborated and an approach allowing social impacts to be anticipated needs to be developed. This is a new element in design research, and therefore anticipating social impacts will not be my first focus. Before we can understand social impact, we must first acquire an in-depth knowledge of how social impact can be identified.

Social impact has been defined as changes in interactions in a social environment that occur after the introduction of a new technology. To establish, for example, the social impact of the microwave oven, we must first understand the interactions that have changed as a result of its introduction. Hence, what interactions changed within families after the introduction of the microwave? To answer this question, a knowledge of the social environments in which microwave ovens are used is required.
This knowledge also includes the social goals of the relevant social contexts. If microwave ovens are found to have had social impacts, the next thing to find out is whether these changes were desired, not desired or even harmful. In other words, the social impacts need to be related to the social goals of the families involved.
However, when information about social impact is used in design projects, a designer may need to know which characteristics of a technology have been responsible for these changes. In the example of the microwave oven, therefore, we need to find out which characteristics of the oven mediate with the social environment. This is especially true in the case of harmful impacts.
This immediately raises a further issue. We aim to identify intended as well as unintended social impacts. Unintended means that unknown characteristics of a social environment *or* unknown characteristics of a product are responsible for social impacts. So, we might need to understand the mediation process between the intervening technology and its social environment in order to identify these characteristics. In the case of the microwave oven, understanding how the mediation process between a microwave and its social environment has developed may lead to the identification of the characteristics of the microwave that have been leading to unintended social impacts.
It may be clear -from this example- that the identification of social impact requires in-depth theoretical knowledge about the elements influencing social impact. In this Chapter, therefore, the phenomenon of social impact will be explored further.

First, however, I will start with a short discussion of the context within which an approach comprising the identification and anticipation of social impact will be used. In a design context, a subject like social impact will probably be integrated into user-centred design approaches. Therefore, a first check will be to determine the goals associated with this approach and whether an approach which includes identifying social impact fits into current practices.

To summarize, elaborating on social impact will lead to the following topics in this Chapter: a reflection on current goals of user-centred design approaches *(2.2)*, a conceptualization of social impact *(2.3)*, preliminary conclusions *(2.4)* and methodological reflections on the further approach of research *(2.5)*.

2.2 User-centred design

As stated in the introduction, the social impact of a product is often an unintended outcome of design. A large part of the work of innovators is to incorporate predictions about the world into the technical content of a new object (Akrich, 1992). According to Akrich (1992), the end product of an innovation always contains a script or a scenario; 'like a film script, technical objects define a framework of action together with the actors and the space in which they are supposed to act'(p.208) . Products contain implicit scripts that lay down how users act, and designers are responsible for developing and writing these scripts. However, there is often a gap between the envisioned script and reality, between the user as projected by the designer and the real user, between the world inscribed in the object and the world described by its displacement (Akrich, 1992): envisioned scripts will be different in the real world, leading to unexpected interactions; users are different than expected, which may lead to other goals or abilities of users; the functions of a product work out differently when used, due to invalid specifications or multiple purposes of a function. To close this gap, research on innovations must continually go back and forth between the designer's intentions and the product's use in reality. Designers have recognized this problem and many developments in design research have been focused on shrinking this gap between the ideas of designers and reality.

A user-centred approach to design offers one way to get a grip on the reality of use. User-centred design integrates approaches focussing on the interactions between user and products, in order to overcome the poor design of products (Norman, 2005). Emphasizing the needs and abilities of the assumed users has led to more usability and understandability (Norman, 2005). Yet usability is only a portion of a larger set of characteristics that are relevant during the interaction between a user and a product. Therefore, according to Kolko (2007), many user-centred design practitioners have adopted the platitude that designed products should be usable, useful and desirable (Sanders, 1992)[1].

Usable refers to a strong and close connection between the functionality of the product and the abilities of the end-user (Kolko, 2007). A focus on the usability of products emphasizes all kinds of detailed measurements of human characteristics and has led to insights on product use with regard to cognitive, sensory and physical aspects of humans (Dirken, 2004). Testing functions of products based on ergonomic requirements has led to products with better usability. For instance, various Design for All or inclusive design approaches (Newell & Gregor, 2000) have led to better accessibility of buildings for people with disabilities and several ergonomic approaches have led to less complex software applications.

Usefulness refers to the match between the functionality of a product and the goals a user has in mind (Kolko, 2007). Products are often seen as instruments for users to reach their goals (Norman, 1999). If a user wants a cup of coffee, a coffee machine can help in fulfilling this goal. The interaction between the user and the product is a way to

[1] In our book on Human technology Interaction (Valkenburg et al. 2008) we defined use-quality in similar fashion; in our definition, a person should be able to *know* how to use a product, he

fulfil this goal and is evaluated by its effectiveness and efficiency. The interaction between a system/product and a user is represented as a cycle.
From the user's perspective, the user first establishes a vague goal, which the user specifies by forming an intent. Then the user can determine a sequence of actions that are executed in the world. After the product responds, the user perceives the state of the world, which is interpreted and evaluated with respect to the intended goal, after which the cycle repeats itself. A way to evaluate usefulness is to observe and interview users within the sequence of actions which are performed in the process of use (Valkenburg, et al., 2008).

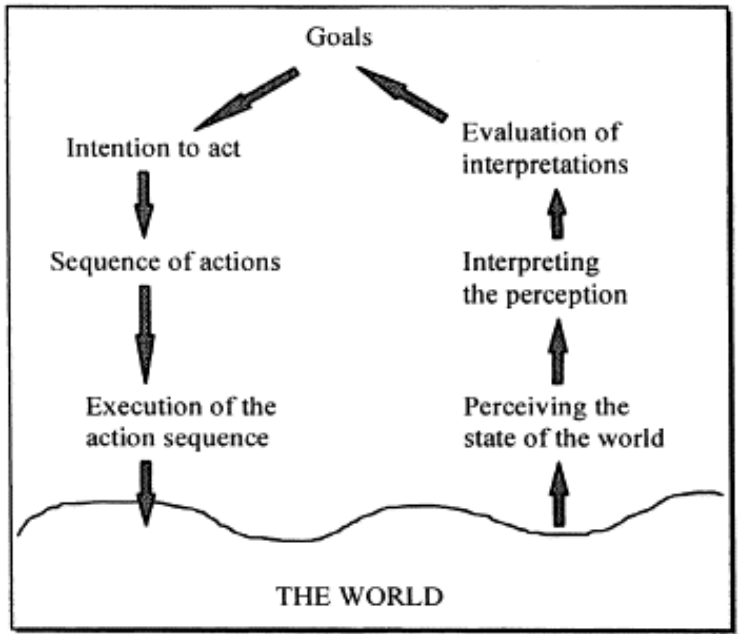


Figure 2.1: the action cycle of Norman (1999)

Desirability is associated with the notion that a product may successfully fill an emotional, or subjective niche (Kolko, 2007). This is an increasingly important aspect for companies that are looking for ways to differentiate themselves. According to Brown, the CEO of IDEO – a company that is considered an innovative design company- , human needs are generally implicit. To identify the user needs that boost the desirability of products, these implicit needs must be made explicit (T. Brown, 2009). According to Brown, one way to learn about implicit goals is to perform ethnographic research. Ethnographic research focuses on collecting rich, detailed data and focuses on implicit aspects and processes of the context (Courage & Baxter, 2004).

In the introduction, I mentioned that in order to identify social impact the interactions between a product and its social environment must be understood. When investigating the usability and usefulness of a product within the scope of a user-centred design approach, all attention is focused on the interaction between a product and a user and none on social environments. However, other methods, used to explore desirability, for example, offer a much wider scope. Ethnographic research, for instance, examines the context of use to identify users' needs. Depending on the situation, a researcher might focus on the use context, but could include the social context, as well. However, ethnographic research collects data that is used to arrive at the specifications of a product. In other words, it is a one-way analysis from a context towards a product. Our aim, however, was to elicit the impact of a product on the social context and to

translate the insights thus obtained into design specifications. Hence, the current approaches used in user-centred design are not directly applicable, without modifications, in research into the identification of social impact.
First, however, I propose to analyze the concept of social impact in a more fundamental way.

2.3 Conceptualizing social impact

To gain a better understanding of social impact I will start with a review of the thinking about the influence of technologies on social environments. Woodhouse and Patton provide a first explanation of why designers have a limited view of reality. In their opinion, a focus on humans (in their words clients) also means that designers tend to assume that each design is politically neutral (Woodhouse & Patton, 2004). This would be a technological deterministic view of the influence of new technology. According to Tatnall and Gilding (1999), a common approach to researching technical innovations is to focus on the technical aspects of an innovation and to treat 'the social' as the context in which its development and adoption takes place. These technological determinist approaches assume that all outcomes of technological change are attributable to the technological rather than the social aspects (Grint and Woolgar 1997). At the other extreme is social determinism, which holds that relatively stable social categories can be used to explain technical change (Law and Callon 1988).
A representative of this area coexists under the umbrella of Social Shaping of Technology, which considers technological determinism an inadequate description or explanation of technological innovation or of social change (MacKenzie & Wajcman, 1999). Social Shaping of Technology takes a particular philosophical view of the nature of knowledge and its manifestations in society, specifically that knowledge and its products (including science and technology) are essentially social phenomena (Lievrouw, 2006, p. 249). However, adherents of Social Shaping of Technology have recognized that their explanation remains essentially linear (MacKenzie & Wajcman, 1999) . Both social and technical determinism seems to be flawed (Law & Bijker, 1992). A socio-technical approach, in which neither human nor nonhuman positions are privileged, seems more realistic (Latour, 1992). So, technical objects and people are brought into being in a process of reciprocal definition, in which objects are defined by subjects and subjects by objects (Akrich, 1992).This socio-technical approach is implemented in the Actor Network theory. The subject and objects, described by Akrich(1992), form a network with each other containing both human and non-human elements. These elements are called actors.
An actor is not just a 'point object', but an association of heterogeneous elements, themselves constituting a network, so each actor is also a simplified network (Law, 1992). This means that networks can be analyzed on several levels. Law and Callon (1992) describe the case of an aircraft, in which the influences between global and local levels were analyzed and it was concluded that identifying these different levels turned out to be important elements in understanding the outcomes in reality.
Networks themselves, constituting heterogeneous elements, are heterogeneous as well. Law (2006) cites an example provided by Madeline Akrich (1993)[2], in Sweden, in which a network surrounding a briquette machine interacts in a certain way. The transfer of this machine to Nicaragua is the start of a transformation process that changes the machine and the Nicaraguan network. Other characteristics of the

[2] I have used an example provided by John Law (2006), as Akrich's (1993) thesis was written in the French language

machine become important and therefore the machine functions differently. So the outcome of a transformational process (in the words of Law, a sociology of translations) due to an intervention of technology in Sweden is different from the outcome of these transformations in Nicaragua.

Actor Network Theory is concerned with tracing the transformations of these heterogeneous networks (Law, 2006). For research on social impact, this socio-technical transformation process within and between networks is an essential step that needs to be elaborated in more detail. More insights into these transformations will reveal how social impacts have been constructed in a certain social context. However, it is not the aim of this study to understand the heterogeneity of networks; the aim is to understand the transformation that is initiated when a new technology is introduced in a certain network. This is what Verbeek calls technical mediation; the transformation process between humans and technologies.
Technical mediation can be considered to be the process leading to social impacts and is therefore a relevant concept in this study. In the next section, I will elaborate this concept further.

2.3.1 Social impact and technical mediation

Verbeek states that '*Technologies enable us to perform actions and have experiences that were scarcely possible before, and in doing so, they also help us to shape how we act and experience things' (Verbeek, 2008, p. 94).* Technology, therefore, is active: it helps to create a situation that was not possible without technology. Activities of humans are co-shaped by the things they use (Latour, 1992). This can be illustrated by an updated example from his book 'What Things Do' about a palm computer (Verbeek, 2005b). A tablet with a high-speed connection makes it possible to work at anytime, anywhere. Its size and easy accessibility even allow users to work while waiting for a train to arrive. Hence the tablet has created a different situation from before. In the old situation, the wait could have been accompanied by a moment of boredom, reflection or have even offered the possibility of social interactions with other travellers.

Two perspectives of mediation can be discerned: one that focuses on praxis and another that focuses on perception (Verbeek, 2006). The mediation of action (praxis) is related to the 'script' concept. In this view, technology is part of a script. Artefacts have scripts that prescribe specific actions, while inhibiting others. A microwave oven serves to warm food easily and efficiently, while preserving the quality of the food. This allows individual members of families to eat at a time that suits them. In many families, this has totally changed eating patterns.
The mediation of perception has to do with amplification and reduction of certain aspects of reality (Verbeek, 2006). Through the social network site Facebook, people become acquainted with aspects of friends, such as the kind of music someone likes, his or her friends, etc. which they might not have discovered in face-to-face situations. These aspects amplify the image of such a friend. But the use of Facebook also reduces aspects of reality. There is no face-to-face contact and communication is limited to chatting. The mediation of perception influences people more indirectly and may change norms and values. Such changes in norms and values are also seen as a result of medical technology. Now that prenatal testing can make more information available to parents and physicians than ever before, discussions about ethical issues have ensued. Gradually, however, the use of this information to help make difficult decisions concerning the termination or continuation of a pregnancy is gaining acceptance.

The technical mediation theory explains how technologies change the behaviour and perceptions of humans. Understanding mediations, therefore, may explain how social impacts develop in a social environment. If a designer attempts to influence the social impact of a product by changing its technical characteristics, it is important to understand how technical mediations can be influenced. For this reason, mediation will be a central element within this thesis.

2.3.2 The role of technology within mediation

Technology is a broad term. Schön (1994) defines it as 'any tool or technique, any product or process, any physical equipment or method of doing or making, by which human capability is extended'. This definition shows that technology can relate to processes, designing and functionalities. In this thesis, technology relates to the function it fulfils for its users. Therefore, Poelman's definition of technology (2005) is used, i.e., 'technology is a known and available tool or technique to realize a functionality'.

The relation between products and users is generally related to the direct interaction between a product and a user. This is what Dorrestijn calls the primary impact of products. To understand social impact, it is important to gain insight into secondary consequences (Dorrestijn, 2009) as well; the impact of introducing a product on a certain social context. However, which characteristics of a product lead to primary interactions and which lead to secondary impacts? If a designer wants to prevent harmful social impacts, he needs to know which characteristics of a product are responsible for social impact in the first place.

In the discussion about the mediating effects of a microwave oven on the behaviour of members of a family, the only function that was examined was the basic function of these ovens, i.e., the ability to warm food easily and fast. But a microwave oven has far more functions. These functions are needed to perform the actions in order to warm the food. The question is how these functions, like on/off buttons, time and heat controllers, alerts etc. mediate with the context. And what kind of impacts can be found? Are they primary or secondary impacts?

This is a question Brown and Duguid tried to answer in their analysis of the role of products within contexts, when they ran up against the problem of the inseparability of products and their contexts (J. S. Brown & Duguid, 1994). To encourage reflective reliance on the contribution of context, Brown and Duguid found it helpful to think in terms of a relation between centre and periphery. Some actions of a product are related to the centre and some to the periphery. Typing on a typewriter, for instance, can be regarded as an action within the centre of a product; the fact that typing on the typewriter makes noise and therefore communicates the fact that someone is at work to co-workers in an office can be regarded an interaction within the periphery. However, when the noisy typewriter starts to make strange noises as an indication that a malfunction has occurred, this sound can be interpreted as a centre relation. Depending on the user, centre-periphery relations can differ. A car mechanic can have different centre-periphery relations than the owner of the car. These examples show that centre-periphery relations are indeterminate and practical (J. S. Brown & Duguid, 1994).

The question is what happens with centre-periphery relations when a product is replaced with another product. For instance, what happens when the typewriter is replaced by a computer? Not only do the centre relations change, the periphery

changes as well. At the centre, the use of a computer may change the way a text is created, enabled by the fact that a computer has the ability to customize texts once written. In the periphery, the keyboard makes less noise, and thus no longer informs the co-workers about the intensity of work a colleague is performing; a technical colleague is no longer able to anticipate malfunctions simply by listening. A computer, therefore, changes the direct interactions, as well as the social context of the computer.

2.3.3 Contextual characteristics and social mediations

Based on the example of the typewriter, it is evident that even small details of products can produce social impacts. This also explains the difficulty in drawing a clear distinction between primary and secondary impacts: they are just as inseparable as products and contexts are. This also has to do with the fact that a single aspect can be related to a primary and a secondary impact. Nonetheless, we want to be able to distinguish characteristics that are relevant for identifying social impact from those that are not.

A pragmatic distinction may be to indicate whether interactions are influencing social contexts or not, in order to identify contextual characteristics of a product. This would mean that a microwave oven with poor usability would therefore have a limited impact on housing patterns; hence characteristics related to this poor usability are relevant for understanding social impact. Understanding poor usability is not a concern. Understanding poor usability can be considered a network within a network, as discussed in a previous section. Law and Callon (1992) described an example in which networks were identified on a local and global level. This led them to distinguish between different levels within networks. Determining the right level of observation is also essential.

The focus must therefore be shifted from a user level to a social level. This shift is in line with the work of Tromp that focuses on attempts of designers to *intentionally* influence social behaviours of humans through the use of artefacts (Tromp, Hekkert, & Verbeek, 2011). The analysis of networks will therefore be carried out on a social level.

This shift also indicates that mediation will be analyzed on a social level, as mediation is an important notion to understand how social impacts have been developed. For this reason, it will be referred to as social mediation. Social mediation will be defined as 'the process leading to changed practices after a certain technology has been introduced'. On a use level, technical mediations refer to changes in actions and experiences, while on a social level, social mediations refer to changes in social practices. The use of the word practice is to distinguish social behaviour from individual behaviour. Because social mediation is a new concept, I will focus on exploring this phenomenon further in my empirical research.

2.3.4 The role of a social environment within mediation

In a previous section, the influence of technology on the mediation process was discussed. Mediation is recognized as a complex interplay between technology and a social environment. Context of use has been an important issue in recent design approaches. The use of products in a context and its users are observed in order to gain in-depth insights into implicit needs[3] of users (T. Brown, 2009). Specifications for new products are determined from observations in the social environment derived, for instance, from ethnographic research.

Besides an earlier observation made in this Chapter, that ethnographic research has a unidirectional focus (which is wrong from the point of view of this study) it has other limitations, as well. Ethnographic research leads to the gathering of qualitative data from contexts, which might lead to new ideas for innovations. However, approaches with rich qualitative data are still limited in their validity and data gathered from these studies may be too complex to analyze (Davidoff, Lee, Zimmerman, & Dey, 2006) and for use by designers.

This relates to Norman's comments about the way designers perform their research, especially when they are pursuing social goals. In his view, design education needs to change because of these social goals (Norman, 2010); designers today suggest that current existing knowledge is not applicable to design projects. Norman (2010), however, claims that designers are not aware of the depth of knowledge already available from social scientists. This would argue in favour of an approach that actively tries to use more knowledge that has been developed through social sciences.

An approach that attempts to understand the complexity of social environments can be found in the area of environmental psychology. Environmental psychologists are concerned with the effects of interventions meant to promote health. It was found, however, that health promotion was too complex to be analyzed from one perspective. Person-focused interventions or environmentally-based interventions alone proved to be insufficient (Stokols, 1996). A shift from person-focused and environmentally-based to community-oriented health promotion has therefore become evident in several research streams.

This is called the social ecological approach. According to this theoretical approach, individuals are treated as active agents who constantly shape, and are shaped by, their environments (Lounsbury & Mitchell, 2009). Physical and social features of the environment influence people's transactions (Clitheroe, et al., 1998). Social ecological analysis emphasizes the dynamic interplay and interdependence of situational and personal factors (Stokols, 1996). In order to be able to do so, an interdisciplinary approach between several disciplines is needed: '*The sociological perspective on health promotion is based, not on a singular discipline or theory, but rather on a broad, overarching paradigm that bridges several fields of research*', (Stokols, 1996, p. 285).

The term ecology pertains to the interrelations between organisms and their environments (Stokols, 1992). From its early roots in biology, the ecological paradigm has evolved in several disciplines (psychology, sociology, economics and public health) to provide a general framework for understanding the nature of people's transactions with their physical and socio-cultural surroundings see table 2.1.

[3] According to Brown, a designer should help a user to articulate latent needs they may not even know they have; to make implicit needs explicit(T. Brown, 2009). It is beyond the scope of this thesis to start a discussion about implicit needs.

Health promotion orientation	Theoretical and research perspectives associated with each orientation
Behavioural change and lifestyle modification	Operant behaviour modification Social learning theory Health belief model Theory of reasoned action Theory of planned behaviour Stages of behaviour change theory Risk perception theory Fear arousal/protection motivation theory Personality theory Health communication and mass media
Environmental, enhancement and restructuring	Industrial hygiene Ergonomics/human factors Occupational epidemiology Facilities design and management Architecture and urban planning Injury control Environmental health science Health effects of involuntary smoking Social support and organizational development
Social ecological approach	Cultural change models of health Bio psychosocial model of health Person-environment fit theory Stressful life events research Ecology of human development Public health psychology Social epidemiology and medical sociology Social ecology of health Community health promotion Public policy initiatives Health cities movement

Table 2.1 Theoretical and research perspectives associated with behavioural change, environmental enhancement and social ecological approaches to health promotion (Stokols, 1992)

The basic assumption of a social ecological approach is that all complex systems are, by definition, made up of a number of interacting parts. In general, these components vary in their type, structure, and function within the whole system(Costanza & Mageau, 1999, p. 105).

The principles of social ecological systems are analogues to biological eco-systems. These were proposed by Kelly (1966)[4], who identified four key principles in a social ecology:

1. *Interdependence, which refers to structural characteristics, whereby a change in one component of a system affects all other components of the system. This component reflects the reciprocal influence among components that occurs over time.*
2. *Cycling of resources, this refers to the use and distribution of resources within an eco-system. Environmental biologists would point the food chain as one example of the cycling of resources, but an equally good example would be economics and how money flows from one person to another in exchange for goods and services.*

[4] Cited from Lounsbury and Mitchell (2009).

3. *Adaptation, the process by which individuals and communities effectively use (or reuse) resources, such as how they change or respond to accommodate a new situation.*
4. *Succession. Succession is a special case of cycling resources. Whereas cycling of resources helps us understand the movement of resources into and out of a community, succession refers to the movement of people themselves into and out of a community.*
   (Lounsbury & Mitchell, 2009)

The principle of interdependence is likely to be an essential principle for the anticipation of social impact. A designer is able to anticipate future dependencies and the effects of these interactions. Adaptation, another interesting principle for designers, is influenced by many other aspects as well and is beyond the scope of this research. The principles of 'cycles of resources' and 'succession' are less relevant to any discussion on the impact of new technologies.

The social ecological approach has given health workers the possibility to anticipate the effectiveness of their intervention. However, this approach has not yet, or at least not yet widely, been applied in design practices, and should be introduced carefully. A first attempt might be to use it as a way to gain insight into unintended consequences, rather than for the construction of intentions. It would therefore seem to present an interesting option for use in identifying social impact. Using a social ecological approach allows a complex reality to be described, enables knowledge from other fields of research to be included and may yield, through the determination of influential factors, a less complex (and designer dependent) analysis of social environments. The social ecological approach reveals which practices within a reality need to be observed. For an ecological model to be useful, the main components of the system must be identified. For this reason, ecological models are comprised of two or more analytical levels (Stokols, 1996). Based on the conceptual framework developed by Clitheroe et al. (1998), a format is used in which physical, individual and social factors serve as a preliminary classification (see figure 2.2). The factorial framework provides a basic description of influences in a social environment, which can be used to understand social mediations.

So, the use of a social ecological framework is used to understand patterns in a social environment, which helps to understand social impact and to construct social mediations.

2.4 Conclusions: towards identification of social impact

At the beginning of this Chapter, I quoted a statement from Akrich(1992) that a designer is concerned with the intended idea of a product and the outcomes of the product in the real world. The intentions of designers are changing, as they wish to influence user behaviour and thus influence social processes. The focus on the user in so-called user-centred approaches provides insights into the aspects of the real world that concern usability. Understanding the impact of products in complex social systems, therefore, requires an approach that affords a broader view of reality. The social ecological approach can provide a way to gain insight into the interdependencies in a social system. Goals (derived from insights from social sciences) might prove helpful in identifying the impact on a social system. The question is how and whether real social impacts can be identified and anticipated. This is the central theme of this thesis.

Some preliminary findings:

Reciprocal relation:
The relation between a technical object and a subject is reciprocal. This socio-technical approach is represented by the Actor Network Theory. Relations between actors consist of heterogeneous elements constituting a network. A new technology that changes interactions within a network sets a socio-technical transformation process in motion; this is called mediation.

Social level:
In order to anticipate social impact, a shift must be made from a use level to a social level. This research focuses on a higher level of analysis; the social level is seen as a higher network that has interdependencies with the use level. This higher level of analysis might also provide indications as to which characteristics of technologies are relevant for the assessment of social impact.

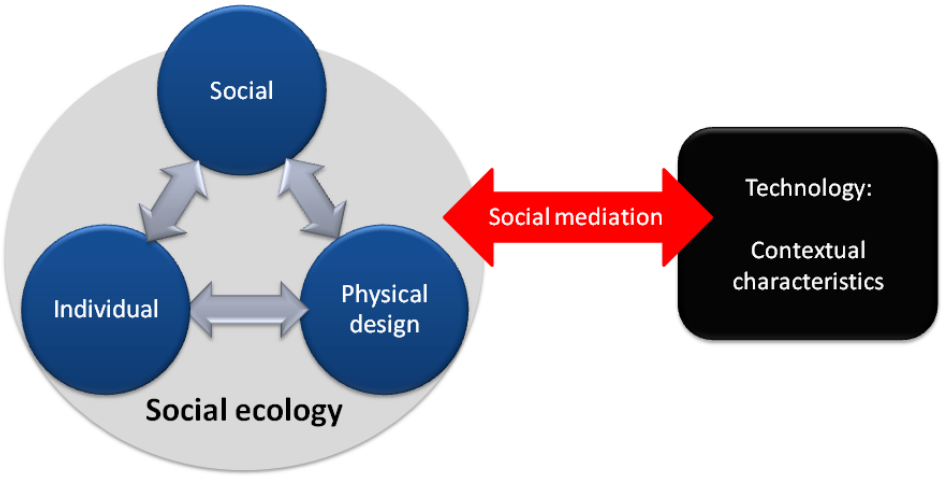
Social mediation:
Social mediation is a central element within this thesis. The identification of social impacts alone will not lead to insights for designers. What is needed is to understand how a technology and its social environment mediate with each other, in order to determine the characteristics which have led to these mediations.

Contextual characteristics:
Distinguishing the mediation processes leading to social impact might be difficult, because product and contexts are inseparable. Characteristics of a product may sometimes refer to the primary impact (usability) of a product, while in another situation, the same characteristics may refer to the secondary (in our case, restricted to social) impact of a product. To be able to anticipate social impact, it is important that we are able to identify meaningful characteristics. It needs to be established whether it is possible to find relevant 'contextual' characteristics.

Social ecological approach:
The complexity of social environments is actively explored through a social ecological approach. The social ecological theory has the same starting points as the Actor Network Theory regarding the reciprocal relation between actors in a network. As the social ecological approach is based on a broad overarching paradigm that bridges different kinds of theories rather than visualizing complex networks, its approach to reality is fundamentally different. The analytic framework, however, may be very useful to gain insights into social systems. Actor Network Theory offers one way to understand how technologies have mediated, but has limited capacity to anticipate a new reality. However, this is still an assumption. Whether a social ecological approach offers a means to anticipate social impacts remains to be established.

The elements that need to be understood in order to identify or anticipate social impact are visualized in the figure 2.2.

Figure 2.2: visual representation of social impact



As previously noted, Norman stated that designing technology for complex social issues needs a new approach that includes the complexity of problems and insights of social sciences already available. As the social ecological approach is a framework that bridges several fields of disciplines, it may offer possibilities for assessing social impact. It provides the holistic view that is needed to understand the complexity of social environments. This 'contextual framework' can identify important aspects and patterns of social environments.

2.5 Consequences for the research approach

In the previous section, I explained the theoretical foundation for the assessment of social impact. The assessment of social impact, however, has consequences for the methodological approach of this research. As concluded earlier, a general user-centred research approach cannot be applied in this study. In this section, the consequences of the previous insights for the execution of my research are discussed. First, I briefly describe the standard approach used in user-centred research.

The support for a designer is meant to enable him to incorporate social impact as an intervening variable into a design practice. Understanding social impact will never be a central aim of research. Therefore, the stages used in standard user-centred research approaches can be applied in this study, as well. The first stage of user-centred research is comparable with a common scientific approach, in which a theoretical basis is checked against reality (induction) or a theoretical framework is constructed on the basis of reality (deduction). However, for the results to be able to be used in a design project, this must be followed by a second research stage, in which the results are translated into design specifications (this approach to user-centred research has been visualized in figure 2.3)[5].

[5] This is a basic approach that we applied in our book 'Human Technology Interaction' (Valkenburg, et al., 2008), where we referred to these phases as orientation, research and translation.

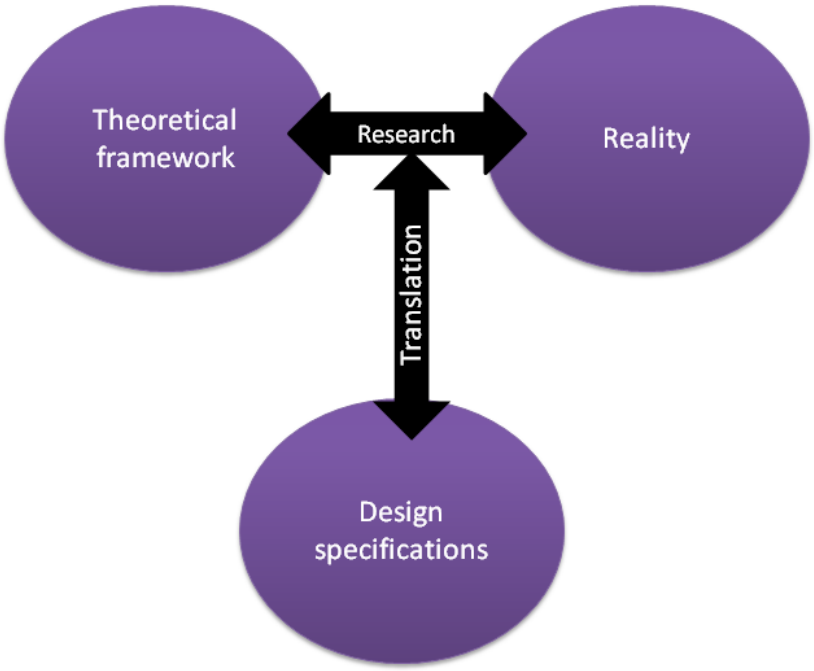


Figure 2.3: the stages in user-centred research; after the empirical research has been conducted, a process for translation into a design practice must be generated.

Stage 1: conducting research

This research has been performed based on two assumptions. The first relates to the remarks of Norman about the use of insights from social sciences. He argues that a new approach to user-centred design is necessary, which includes using more insights from the social sciences. This is a basic assumption of this thesis and explains why a social ecological analysis has been performed in the cases that were studied. This research step is intended to yield a preliminary description of reality. This description can be considered a starting point for the empirical study and can be used to interpret practices in social environments.

The second assumption needs some introduction. In this Chapter, I have stated that in order to understand social impacts a shift needs to be made from the use level to the social level. This has consequences for the way in which this study will be performed. More factors of influence will need to be included in an analysis. This means that research performed in a social environment needs to be restricted to the essential aspects. Otherwise, it may be difficult to gather reliable data. Akrich (1992) showed that there is a difference between the intended outcome and the actual outcome of technologies, or in other words, things work out differently in reality. To find out why, it is necessary to determine precisely which interactions have changed. A social ecological analysis only reveals influences. Research in reality reveals what actually happened. This means that it is necessary to understand when, how often (etc) actors in a social environment interact with each other and to identify which changes in social environments are found. I have called these interactions in a social environment 'practices'. Practices are in line with individual behaviours; practices take place on a social level, while behaviours take place on a use level.

A second assumption, therefore, is that to understand practices I will have to focus on interaction patterns and how they have changed in time. These changes will be made clear in the cases studied, while insights from the social ecological analysis will give meaning to these differences.

Stage 2: translation of research towards constraints

In the second stage, the social impacts need to be translated into constraints for designers. Constraints can only be identified if the contextual characteristic that is responsible for a particular social impact is known. For an analysis of this kind, an understanding of how social impacts have developed is needed; what social mediations have taken place in a particular social environment? To this end, an analysis of the results obtained during the first stage must be performed. In addition to focusing on the identification of social impacts, therefore, I have also focused on the development of social impacts through social mediations.

Obviously, the results from research on social impact cannot be assessed on the basis of the goals in user-centred design. Other goals must therefore be used to interpret whether the impacts that were found are desired or not desired. In the next section, I will discuss how social impact can be judged.

2.5.1 Goals for user-centred research on social impact

A theoretical framework has been constructed to understand the social impacts of technologies. This can be compared with a normal usability approach, in which a conceptual model to understand the cognitive functions of humans is defined. However, in research on usability, a goal is always linked to an approach. Understanding cognitive functions is not enough; the usefulness of the technology must also be understood, for which a moral assessment is required. In the case of social impact, it must first be determined whether an impact is wanted or unwanted in order to be able to specify the constraints to be applied to a new design. I propose, therefore, to link the outcomes of the research to the goals of social environments.

Besides providing a framework to understand influencing factors in social systems, the use of the term ecological systems provides information about the general goals of ecologies. As has been pointed out, ecologies can be viewed from many perspectives, whether they are economic, biological or social. For ecological systems, goals are formulated that help in maintaining the system. An ecological system needs to be sustainable in the sense that it has the '*ability to maintain its structure (organization) and function (vigour) over time in the face of external stress (resilience)' (Costanza & Mageau, 1999).* Health is a measure of the overall performance of a social system. *'A healthy social system is optimal if it is stable and sustainable- that is, if it is active and maintains its organization and autonomy over time and its resilient to stress'*(Costanza & Mageau, 1999).

A way of analyzing the potential stress resilience is to evaluate the number and diversity of interactions. An unwanted social impact could destabilize the social ecology of a social system, for instance, by causing the frequency and variety of social interactions to decline.

The use of an ecological approach is not restricted to understanding possible effects of technology. We also want to gain knowledge about the health of a social environment. Just as in usability projects, the goals and needs of a user form the starting point of a design project. The use of social goals will be explained with the help of an example. To anticipate the social impact of a new technology that is about to be introduced in a facility for the elderly, for example, understanding the social environment may lead us to determine general goals that are relevant to describe the social health and stability of the social community. Based on insights from social sciences on, for example, the wellbeing of the elderly, general goals may be defined. This might result in the use of

goals learned from sociological insights about social capital[6]. Social capital is a notion that is used to describe the importance of a social network for the wellbeing of humans. Social capital is dependent on a network of personal relationships and social exchanges. When this network is included in a shared social network with forms of reciprocity and trustworthiness, this can be seen as social capital (Portes, 1998; Putnam, 2007). Putnam distinguishes bonding capital, that reinforces exclusive interaction and homogeneity, from bridging capital that brings different types of people together. In the social capital and health literature, indicators of interpersonal trust and membership in networks of voluntary associations aggregated to the community are the most common measures of social capital (Veenstra, 2005). For the elderly, it is difficult to maintain their social capital at an acceptable level in the face of cognitive and physical deterioration. Activity patterns in daily life become more focused on the home and local environment in later stages of old age. Diversity dominates in the early stages of late adulthood and convergence in the latest stage (Drooglever Fortuijn & Hallberg, 2006). It is important that social capital is not negatively influenced by unintended social impacts.

In the case of senior citizens, the social environment may well be at risk of becoming unhealthy, due to a decrease in diversity and frequency of interactions. A new technology focused on such target groups should, at the very least, not interfere with social interactions and preferably should work to strengthen ecological structures and make a social network more sustainable.

The research goals and method have been explained. In the next section, I will describe the total research process.

2.5.2 Research structure

To understand and interpret the overall research structure, the Design Research Methodology of Blessing and Chakrabarti (2009) has been used to distinguish various stages. Design research starts with a research clarification, in which the design goals are described. The second stage is what they call descriptive study I (DS-I). This stage aims at increasing the understanding of the factorial influences on the phenomenon that is being researched. The third stage is a prescriptive study (PS), which aims at developing a tool for improving design practices. The last stage is called the descriptive study II (DS-II) and focuses on the evaluation of the support. The DRM approach focuses from the start on improving and understanding design practices. This study has been focused on understanding practices of social groups. This means that I had a different starting point.

Furthermore, within social environments, various levels of difficulty can be found. In a well specified social environment with a limited amount of variation, it may be easier to anticipate social impacts than in a social environment with many variable circumstances. The aim is to start in a particular social environment and to graduate to the increased complexity of less well defined social environments. However, understanding complexity within social environments does not cover all contexts in which social impact needs to be explored.

[6] I am aware that a concept like social capital and the vision of Latour on the construction of networks may seem contradictory. However, social capital is not used in a scientific way, but in a pragmatic way; as a means to interpret technological changes. Besides analyzing impacts, meaning must be given to these impacts. Otherwise the tool will remain ineffective.

Eventually, social impact needs to be used in a design context. Hence, the last step will incorporate design contexts and their complexity.
Switching between levels and contexts provides insights on different levels and adds extra information about variation in the phenomenon of anticipations of social impact. I consider this research an exploratory approach towards a greater understanding of the phenomenon of social impact for design practices. In table 2.3, the stages of research with the studies that have been be carried out have been linked.

Context	Research clarification (RC)	Understanding existing situation (DS I)	Developing supports to reach a desired situation (PS)	Evaluation of supports (DSII)
General	Review based *(1)*	Conceptual model *(2)* and conclusions *(9.3)*	Final working model and visualization support *(9.4)*	
Known social environments		'Simple' context Digital whiteboards *(3)*	Analyzing results of descriptive studies: Working model*(5)*	Case 1: Real estate offices *(6. 2)* Case 2: Cohousing communities *(6.3)*
		'Complex' context Cohousing communities: study I *(4.3)*	Cohousing community (PS) Social mediation possibilities*(4.4)*	
Unknown social environments			Adapted working model *(7.2, 7.3)*	Case 3: Ambient intelligence *(7.4)*
Design practices		Based on literature review and evaluation of the supports *(8.2)*	Model of awareness *(8.3)*	Evaluation of the model of awareness *(8.4)*

Table 2.2 Overview of the research design based on the DRM framework (Blessing & Chakrabarti, 2009, p. 15)

Another way of visualizing the research approach is shown in figure 2.3. It represents the process of development of this research project from a concentric point of view. The individual steps in the process are necessary to move towards a specific goal. But all the steps build on each other and the final conclusion is entered during the process of research.

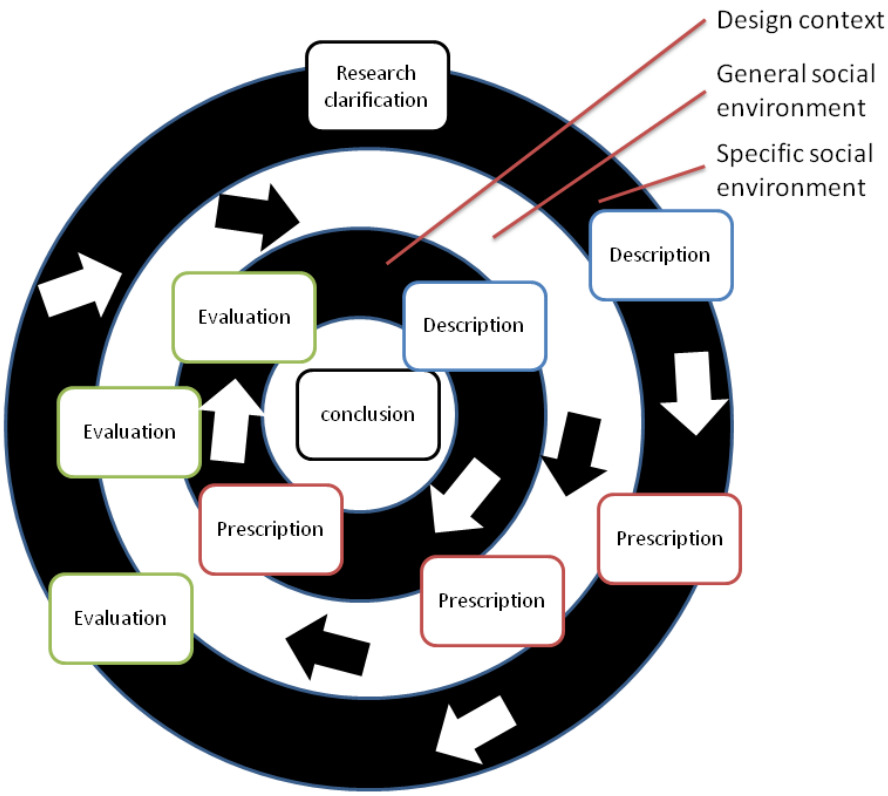


Figure 2.4: concentric approaches, adapted from Poelman (1998)

This thesis, therefore, is structured as follows:
In *Chapter 3,* the first descriptive study is discussed. This was a study on the influence of digital whiteboards on classroom interactions at elementary schools. The aim was to analyze social impact and to determine whether it is possible to identify the contextual characteristics of a technology. This research was performed in a social environment with a limited number of factorial influences.
In the second descriptive study in *Chapter 4,* the complexity has increased. In a cohousing community for senior citizens, the influence of different physical characteristics was introduced, as well as a combination of formal and informal social structures, which increased the complexity of interaction patterns. In a second prescriptive study, a tool is developed to influence social interactions, based on the observation of interaction patterns in cohousing communities.
The results of the descriptive studies are combined and analyzed in *Chapter 5*, leading to the development of a working model for the identification of social impacts in known social environments.
Two cases are described to evaluate the working model in *Chapter 6*. The first case describes the use of the model in an assignment for real estate students. The second case describes its use by an industrial design student tasked with developing a new technology to promote social interactions in a cohousing community.
In *Chapter 7,* an adapted working model and tool to simulate practices is developed to anticipate social impact in unknown social environments. This tool is applied in a case for ambient intelligence.
A review the consequences of insights into social impact for design practices led to the model of awareness described in *Chapter 8*.
Finally, general conclusions will be drawn in *Chapter 9* about the phenomenon of social impact. The insights yielded by the evaluations ultimately led to an adapted working model and a visualization support.

Chapter 3: The social impact of digital whiteboards

3.1 Introduction

Chapter 2 discussed a theoretical framework to identify social impacts within social contexts. The present descriptive study was carried out to obtain a better understanding of the existing situation and to discover more about the factors influencing social impact. This study explores the social impact of an intervention which occurred at elementary schools in the Netherlands, involving the use of digital whiteboards in the classroom. This was a large-scale intervention, which took place across similar environments, and which received much academic attention. The approach described in the previous Chapter was applied: a social ecological model was constructed on the basis of the literature *(3.2)*. The results of an observation and survey research are used to analyze how interactions have mediated (*3.3)*. The outcomes of the study are discussed *(3.4)* and finally, conclusions are drawn as to what the insights of this study imply for the theoretical model *(3.5)*.

3.1.1 Technical interventions in the context of an elementary school

Based on the information in Chapter 2, we can conclude that a school is an example of a social ecological system, as it encompasses dynamic interactions of individuals with their environment across time and space (Lounsbury & Mitchell, 2009). Introducing a digital whiteboard into a social ecological network of this kind may affect existing interactions. After all, changes in the context lead to intentional and unintentional changes due to aspects that can be related to social, individual and physical factors (Clitheroe, et al., 1998). Van den Akker (2007) described this interdependence of factors in the context of the school, in which he compared the school curriculum (i.e. a plan for learning) with a spider web, where the components (such as the teacher's role, grouping etc) are the threads that are linked together. One of the challenges is creating balance and consistency between all the components of a curriculum in such a way as to promote the envisioned educational aims. A digital whiteboard could have a destabilizing effect within this system.

In order to study the social impact of digital whiteboards in classrooms, we need to understand what goals are relevant to evaluate this. Roschelle, Pea , Hoadley, Gordin and Means (2000) identify four fundamental characteristics of how technology can enhance both what and how pupils learn in a classroom: (1) active engagement, (2) participation in groups, (3) frequent interaction and feedback, and (4) connections to real-world contexts. They also indicate that technology use is more effective as a learning tool when embedded in a broader educational reform movement that includes improvements in professional development of teachers, curriculum, student assessment, and school's capacity for change. Technology, therefore, needs to be evaluated on the way it is embedded in, and in line with such an educational movement. In the Netherlands, 'adaptive education' has long been an important ideal of Dutch elementary schools (Blok, 2004). According to Blok, adaptive education is the purposeful adaptation of learning processes to the

different needs of learners in the same classroom, instead of focusing on the class as a whole. This is a reform process that is comparable to the Comprehensive Reform Models in the United States, i.e., the Success For All Approach (Slavin, Madden, & Chambers, 2000) and Comer's School Development Program (Cook, Murphy, & Hunt, 2000). Although educational experts have different views on how to implement adaptive education, there is some common ground on general issues that relate to interactions in classrooms. Education is considered adaptive if a teacher focuses on differentiation between pupils on aspects that have to do with: goals, instruction, learning times, norms and pedagogical approaches (Blok, 2004). Teachers should adjust their interactions to the needs of pupils. For reading education at primary school, this may lead to convergent differentiation (Houtveen & van de Grift, 2007): all students have the same aims, some pupils require extra instruction moments to reach these aims. Furthermore, interactions between good readers and readers whose reading skills are less well developed are important, as well. Effective teaching and the amount of time spent on reading is considered essential (Allington, 2002). So, in this example good adaptive reading education is related to various interaction patterns within a classroom. The question is how the outcomes of the use of digital whiteboards intervene with the various interaction patterns within classrooms; will they promote, or maybe even be counterproductive to adaptive strategies?

3.1.2 Digital whiteboards

Digital whiteboards are entering the elementary schools very rapidly. 65% of the teachers at elementary schools in the Netherlands already use digital whiteboards in their teaching (SLO, 2010). According to Levy (2002), digital whiteboards encourage students to give answers to questions, through the visual and conceptual appeal of the information and learning resources that are displayed. This may increase conceptual interaction, which may stimulate interactive whole-class teaching (Beauchamp & Parkinson, 2005; Levy, 2002; H. J. Smith, Higgins, Wall, & Miller, 2005).

The question is whether a digital whiteboard in itself will have the capacity to make stimulating whole-class teaching happen. This technological determinism is questioned by Fisher (2006). He argues that these assumptions concerning technology 'leave largely invisible the work -intellectual and emotional- which teachers must undertake, in order to use the technology to realize the claimed potential improvements and transformations' (p. 297). Fisher recognizes the fact that other factors influence the potential of technology in classrooms, as well. His remarks support the vision described in Chapter 2, that social mediation is a socio-technical phenomenon.

For an ecological model to be useful in the anticipation of social impact, the main components of the system must be identified. For this reason, such models incorporate two or more analytical levels (Stokols, 1996). Based on the conceptual framework developed by Clitheroe et al. to describe environments and behaviours, a format comprised of physical, individual and social factors that form the actors of this complex interplay will be the starting point of this study. The technical intervention will be evaluated on its transforming abilities to influence interactions in the social system. These are characteristics that influence the context (J. S. Brown & Duguid, 1994); the so-called contextual characteristics.

The social impact of digital whiteboards should be in line with the rationales of the social context, or, in this case, adaptive learning. Unintentional consequences that might be harmful to these goals are unwanted. This leads to the following research question: What is the social impact of digital whiteboards on interactions in classrooms analyzed from the perspective of physical, individual and social factors and how do these social impacts relate to designed technical characteristics of digital whiteboards?

Figure 3.1: materials for daily planning and individual assignments at elementary schools

3.3. The social ecology of a classroom

Digital whiteboards influence the script of users through the replacement of the old blackboards. This mediation between user and artefact is formed by interactions. A new technology will be translated into a form that is more appropriate for potential adopters, by choosing some elements of the technology and leaving out others (Tatnall, 2010). In this study, changing interactions will be linked to relevant factors of the social ecology of classrooms. For any given environment, an unlimited array of contextual factors that might influence the interaction could be identified. The challenge is to identify those factors that are most crucial for understanding these (Clitheroe, et al., 1998).

3.2.1 Physical factors of classrooms

Physical factors include characteristics of the physical and technical environment and the way they interact with humans and influence interactions between humans. There is a complex relationship between the physical structure and arrangement of the room, the teacher, the students and the distribution of space (Rivlin & Weinstein, 1984). Aspects of the physical factors may have changed through the use of the digital whiteboard.

First of all, the design of the classroom influences the pupil's achievements. Several studies have shown the influence of stimuli in the physical environment (such as colour, materials, posters) on involvement and effectiveness (Rivlin & Weinstein, 1984). Another physical factor that needs to be considered is the influence of light and noise on cognitive performances. If changes in the amount of light and noise in the classroom occur as a result of the introduction of the digital whiteboard, this may influence the achievements of the pupils; light and noise influence cognitive performances of students, affecting, for instance, long-term memory recall (Knez, 2001; Knez & Hygge, 2002; Rivlin & Weinstein, 1984).

A digital whiteboard is an element that changes the physical environment. Because of this, it may have indirect influences on the achievements of children. This is related to the way a teacher uses the digital whiteboard.

3.2.2 Individual factors: the role of the teacher

Individual factors include values, goals and related behaviour (Antonides, 2002) and conscious and sub-conscious processes of actors involved (Sunstein & Thaler, 2008). The more behaviour is automated, the more attention can be focused on activities (H. Aarts, 2009). Automatic behaviour makes executing tasks easier, but also more predictable. Steps that needed a great deal of attention at the beginning of a learning curve, become standard procedures when they are automated (for instance, driving a car). Goals can be automated, as well (H. Aarts, 2009). Aspects of choices that were first the subject of evaluation, such as opting for a particular approach or a particular product, can be automated after repeated balanced decisions.

In many classrooms, the teacher is still the leading social actor regarding the use of digital whiteboards; hence, his or her ability to incorporate its use into the teaching process is considered. One aspect that influences the ability of a teacher to use the digital whiteboard is experience. When activities and goals of a teacher are automated, teaching becomes easier, but also more predictable and difficult to change. The role of experience is also illustrated in the Concerns-Based Adoption Model (Loucks-Horsley, 1996). This model (and other developmental models of its type) holds that people considering and experiencing change evolve in the kinds of questions they ask and in their use of whatever the change is. In general, early questions are more self-oriented. For example, on being told about a new development, the teacher's questions are likely to relate to the way this may affect him/her. The second phase is more task-oriented: the teacher is engaged with new tasks, time demands and material, which will lead to questions about these issues. Finally, after self- and task concerns have been largely resolved, the focus shifts to the impact on pupils. During this phase, teachers reflect on how programs can be improved for their pupils, together with their colleagues. Ultimately, if the program is a success, a teacher will start seeking new and better options for change. Depending on the complexity of the change it may take years to go from one phase to another. A certain degree of task automation is required in order be able to move to the stage of mature use. A change, such as the introduction of the digital whiteboard, causes the assessment process preceding automated behaviour to become more salient, and therefore people will be more open to change (Aarts 2009). Hence, if modifications in the automated behaviour of teachers and changes in their pedagogical knowledge and beliefs are desired, a change of script through new technology might be an opportunity to facilitate that process.

3.2.3 Social factors: the role of the learners

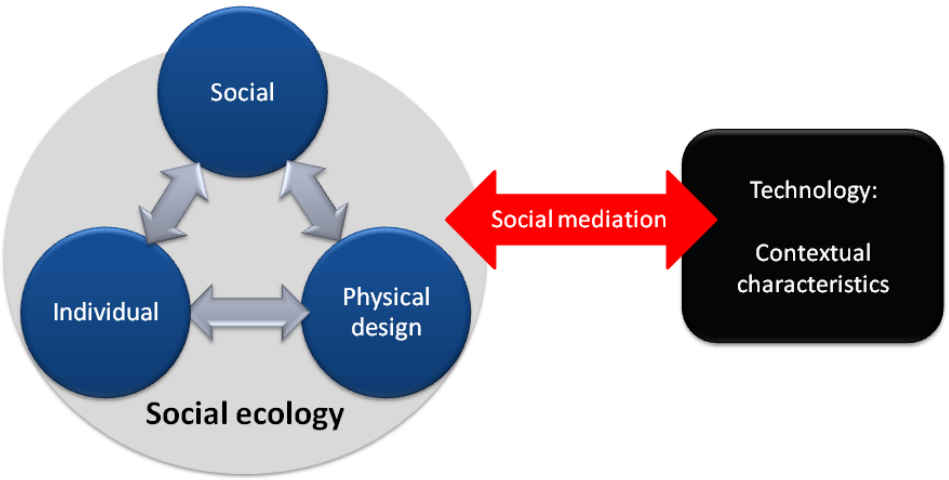
Social factors include relationships between persons and/or groups. A formal relation can include the group's approach to solving problems or a hierarchal structure, whereas informal relations are usually more subtle (Clitheroe, et al., 1998).

When teachers interact with a digital whiteboard, they are interacting with their pupils as well. They must understand the characteristics of their 'audience': some audiences show a wide variation, for instance, due to diversity in abilities (sometimes amplified by the fact that some schools have combined grade

education). This means that a teacher has to address many learning needs in the same classroom.
A teacher has several options to organize the education of pupils; whole class instruction, individual work and small group work. The general question is: what kind of interaction is necessary for which purposes? For example, for group work to be effective, the teacher must delegate (parts of) his authority (Cohen, 1994); pupils require clear instructions for individual work and for whole class teaching, a teacher must interact with the whole group in a way that activates pupils through several forms of interactivity (Kennewell, Tanner, Jones, & Beauchamp, 2008). These examples show that variety in tasks and roles of teachers are needed for education to be effective. In the reading education example, it was shown that this variation in interactions may increase following the introduction of adaptive methods.
In order to fulfil these tasks and roles as a teacher, the social environment of the school is important, as well. A digital whiteboard may be a carrier for (in)formal interactions with other teachers and sharing knowledge on how to use the digital whiteboard in educational settings. Technical training together with informal working groups may stimulate interactions between teachers. Inspiring examples of other teachers (also outside the school) may help to implement changes in the curriculum (Thijs & van den Akker, 2009). In the case of digital whiteboards, exemplary materials can also be found on the internet.

In summary, the context of a classroom consists of physical, individual and social factors that are all linked together and that may influence the mediating effect of a digital whiteboard on student performances. In order to be supportive of the learning process, these changes need to be in line with the rationale of the school, i.e., in this study, adaptive learning (see figure 3.2).

Figure 3.2: visual representation of social impact



3.2.4 Research design

The social impact of digital whiteboards on interactions in classrooms was studied by means of: 1. classroom observations and semi-structured interviews with teachers and pupils at elementary schools in the Northern part of the Netherlands, and 2. a survey with teachers at elementary schools in the Netherlands.

The observations and interviews were conducted by bachelor's degree students at the Hanze University of Applied Sciences in Groningen. In pairs, the students spent seven (parts of) days observing thirteen different lessons in which the digital boards were used at three different elementary schools. Interactions in the class were observed on a physical, individual and social level. In the lessons, the digital whiteboard was used by a teacher in different settings. The observation data from each pair of observations was compared before being used as data in this study.
The survey was distributed though a specialized website for teachers (www.kennisnet.nl) and completed by 44 teachers. These teachers were required to go to a specialized site for digital whiteboards or respond to an email alert to fill in the questionnaire, and are hence considered to be digitally able.
The social ecological model (figure 3.2) was operationalized into different items for the survey:

- General questions about the respondents' experience as a teacher, the classes they teach and their experience with computers.
- General questions about the characteristics of their digital whiteboard and the physical characteristics of the classroom.
- Statements about changes in interactions in the class due to the use of the digital whiteboard with regard to motivations of pupils, usage of the board, individual motivation of the teachers, influence on interaction patterns (whole class teaching, individual work, working together in groups), etc.

The aim was to be able to describe changes in interactions. In that sense, the data was used descriptively. The only quantitative analysis (a Mann-Whitney U test) made was to see what significant changes could be found between groups of teachers with fewer than ten years of experience and teachers with more than ten years of experience.
The questionnaire was filled out by 17 male (39%) and 27 female (61%) respondents. Of this group, 26 (59%) had been working as a teacher for fewer than 10 years, 3 (7%) 11-20 years; 11 (25%) had been working for between 21-20 years and 4 (9%) had worked for over 31 years as an elementary school teacher. The two biggest groups in the study were that of the experienced teachers (more than 20 years) and that of the younger teachers (fewer than 10 years). Most teachers had had fewer than two years of experience with their digital whiteboard. Eight teachers had already been working for more than two years with a digital whiteboard .
In the Netherlands, both combined grade classrooms and single-grade classes occur. In some cases, this is by choice (Montessori, Dalton), in others, economic and demographic factors play a role. Of the respondents, 29 (66%) mainly taught in single-grade classrooms, while 15 (34%) mostly taught in combined-grade classrooms.

3.3 Results

The results are presented per social ecological factor.

3.3.1 Changes related to physical factors

The digital board was observed to have been placed in the schools in the same position as the blackboard used to be. Due to the fact that the board can be operated by a personal computer, the teacher has more opportunities for interaction (e.g. lessons are prepared behind the desk while pupils are working). In

most classes, the curtains were closed while the digital whiteboard was in use. On one occasion, the curtains remained open. Here it was noted that pupils at the back of the class had difficulty reading the digital whiteboard.
In multigrade classes, at times some pupils must work individually, while the teacher teaches others with help of the digital whiteboard. The students observed that some pupils therefore had to work individually with closed curtains, in darkened conditions.
The use of the digital whiteboard changed the physical environment in that that a large screen with visual possibilities now took central stage in the classroom. Seven respondents (16%) spontaneously referred to this as a positive change in their answer to an open question on the survey.

Figure 3.3: a digital whiteboard in use in a classroom, the classroom is rather dark and all attention from the learners is drawn towards the whiteboard

3.3.2 Changes related to individual factors

In order to learn which interactions had changed through the use of the digital whiteboard, the activities of the teachers with their digital whiteboards were logged: a teacher showed a page from a book or highlighted a piece of text six times; it was used to watch a video or program three times; it was used once to prepare a following lesson; once, a pupil did an assignment on the board; once, a pupil held a presentation and an interactive lesson (with the use of internet) was noted once.
Based on these activities, three different changes compared to using the blackboard were observed. In the former situation, the teacher would read from a textbook, or write some questions on the blackboard instead of showing digital pages of the book on the digital whiteboard; another difference was that it was not possible to prepare a lesson on the blackboard from behind the desk while the class was working individually, and finally, it was difficult to have an interactive whole-class lesson with the use of internet with the pupils.

The influence of involvement was tested in the survey to see whether there were significant differences between teachers with less teaching experience (<10 years) or with more teaching experience (>10 years). In this group, the majority had twenty or more years of experience.
Regarding the items 'I find the digital whiteboard easy to use' and 'the digital whiteboard does what I want it to do', respondents who had worked for more than ten years as a teacher tended to report finding it difficult to work with the digital board. Furthermore, their lesson preparation time had increased more than the teachers with fewer than 10 years of experience as a teacher. On the other hand, more respondents who had been working for more than 10 years as a teacher use lessons and materials from the internet, and more teachers in this group see positive changes in social interactions as a result of using digital whiteboards.
In addition, teachers were very positive about the influence of the digital board on their professional development. Only two teachers (out of 44) did not agree with the statement that the digital whiteboard had a positive effect on the development of their professional skills. Moreover, the majority of respondents (40 out of 44) found that the digital board had inspired them to change their pedagogical principles.

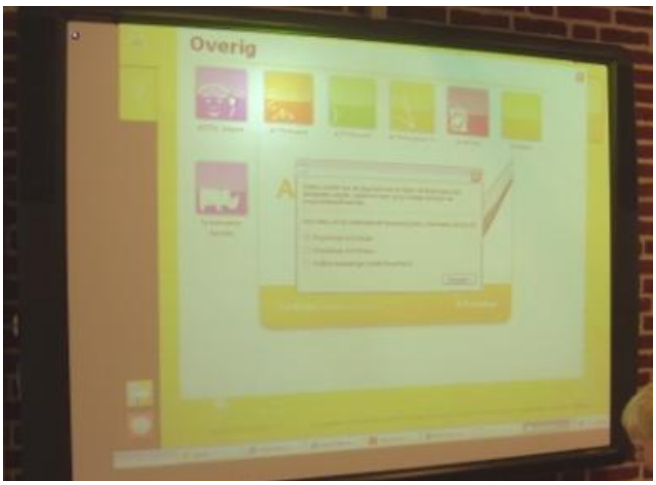


Figure 3.4: software developed for digital boards

3.3.3 Changes related to social factors

In the survey, thirty-one (out of 44) respondents reported that whole class teaching increased due to the use of the digital whiteboard. Twelve respondents spontaneously mentioned that digital whiteboards led to more interactivity with the pupils; a small majority (26) of the teachers also indicated agreement with the statement that use of digital whiteboard increased the degree to which students actively contributed to the lessons and a majority (38) reported that it enhanced their ability to make connections to the real world. Other aspects were less positive: the item 'working together in groups' remained the same according to most teachers (37) and 34 respondents noted that using a digital whiteboard neither increased nor decreased the feedback frequency.
The survey also contained questions about asking colleagues at school for help and information about the use of the digital board, to which 31 (out of 44) indicated agreement with the statement that they spoke frequently about the use of digital whiteboards with colleagues; 29 respondents indicated that they made use of their colleagues' expertise when they had questions about the digital whiteboard. It was a topic at team meetings in a few cases (13). Most respondents (41) claimed that they used exemplary materials from the internet.

The results are summarized in table 3.1.

Factors	Effects related to the goal of 'interactive whole class teaching'	Effects with unrelated consequences
Physical	The board can be used in the standard way or via the computer on the desk Changed design of classroom can stimulate achievements of pupils	Impact of closed curtains on ability to work individually (especially in multigrade classes)
Individual	Professional development of teachers Automated behaviour of teacher can be de-automated	Influence of involvement: More preparation needed for lessons (especially for elderly teachers) Automated behaviour of teacher can be de-automated
Social	More use of knowledge of colleagues, example lessons on the internet Motivation of pupils	Digital whiteboards tend to be used for all kind of tasks Increase of whole class teaching

Table 3.1: Effects of the use of digital whiteboards in classrooms at elementary schools. Based on the literature and research, possible effects of the digital whiteboards were noted. It has not been established whether in this particular case de-automation of behaviour has led to effects that have an effect on the estimated goal of digital whiteboards.

3.4 Discussion

The digital questionnaire was filled in by 44 respondents, all of whom were teachers visiting Dutch websites that provided information about interactive whiteboards. Though the numbers and the way the respondents were reached are not representative for Dutch teachers, they may represent the group of digitally able teachers that use interactive whiteboards. This is due to the exploratory nature of the study. Effects detected may need further investigation.

Social mediations were observed in this study and some unintended outcomes were noted. An important unintentional outcome for digital whiteboards may be the fact that its use has an influence on lighting aspects in the classroom; pupils have to work in dark environments due to physical characteristics of the digital whiteboard. An extra factor that amplifies this outcome is the fact that teachers not only use the whiteboard for the goal of interactive whole-class teaching, but for a plurality of tasks, such as the projection of assignments on the board. Learners, therefore, had to work individually while the digital whiteboard was in use. Furthermore, pupils in one grade in combined-grade classes had to work by themselves, while pupils in the other grade were taught by the teacher who was using the digital whiteboard. The consequences of this for the learning abilities of children (Knez, 2001; Knez & Hygge, 2002) should be examined, especially considering the fact that teachers expect to increase the amount of time spent working with the digital whiteboard (up to 50% of their lessons) in the future (SLO, 2010).

Whether or not the changed design of the class affected the children remained unclear. Teachers called the use of visual data an important benefit of the digital whiteboard. This may be helpful in activating certain desired goals of children. A stimulating environment may help the children to be more involved in tasks they are doing. These insights on so-called power cues (Lindenberg, 2008) could be used to make the use of the digital whiteboard more effective.

According to the model of involvement (Concerns Based Adoption Model), it may take teachers years to go from one phase to another, from self-oriented to task-oriented to an orientation on impact on pupils. For this reason, the results of teachers with varying amounts of experiences were analyzed. This showed that teachers with more experience have more difficulties using the digital whiteboard, but also have more ideas on the impact of the change on the children. This observation suggests that a teacher's previous experience influences his or her degree of involvement and therefore also the way a teacher interacts with the digital whiteboard.

Most teachers agree that the digital whiteboard offers a means to promote their own professional development. It also helps them to find new ways of connecting with colleagues and to use materials taken from the internet. Even if the majority of teachers should fail to be as enthusiastic about these aspects as the 'digitally able group' that responded to the questionnaire, the introduction of the digital whiteboard is still a way to de-automate teacher behaviour and to make the assessment process preceding automated behaviour salient once again (H. Aarts, 2009). The question whether in this particular case such de-automation of behaviour was successful remains unanswered.

A majority of the (innovative) teachers communicated with other teachers about the use of the digital whiteboard in their lessons. The digital whiteboard was also an activator for using lessons from the internet. Previous research has shown that these elements are important for implementing new curricula (Thijs & van den Akker, 2009). So the digital whiteboard can be seen as an enabler for more social interaction within and between the social group(s) of teacher(s). Whether this also holds for less 'digitally able' teachers needs to be confirmed.

The digital whiteboard was introduced as a means to increase interactivity between a teacher and his pupils. This was also mentioned as a great advantage in the questionnaire. In the observations, however, most lessons were pretty standard. Of the thirteen lessons observed with a digital whiteboard, only one

lesson showed the desired interactivity with the whiteboard. The respondents to the digital questionnaire reported a more interactive use of the digital whiteboard, although this was unable to be confirmed. What is interesting is the fact that teachers use the digital whiteboard for all kind of tasks, besides interactive teaching. Other studies have also found that the idea of a digital whiteboard as a means to transform educational practices in interactive environments is relatively rare (H. J. Smith, et al., 2005). Levy (2002), for example, reported that most teacher-pupil interaction occurred *after* whole-class teaching with digital whiteboards.

A majority of the teachers reported that whole class teaching increased due to the introduction of digital whiteboards, a finding confirmed by previous research (H. Smith & Higgins, 2006). As was pointed out in the introduction, adaptive learning requires specific interactions within classrooms. The reading education example showed that variations of interactions are needed, as well as diversity in instruction levels adapted to needs of pupils. Without aiming to understand exactly how these insights need to influence social interactions in classrooms, it can be questioned whether a digital whiteboard -as an amplifier of one kind of interaction form- is the optimum tool for such an environment. Indeed, Kennewel, Tanner, Jones and Beauchamp (2008) go so far as to suggest that the use of digital whiteboards can be seen as a backward step, in that it gives a new impetus to traditional, teacher-centred approaches.

So, the effectiveness of digital whiteboards in supporting interactive whole class teaching can be questioned, but even more questions can be raised by the side effects on other important goals of education. Van den Akker (2007) refers to a curriculum as a spider web, in which all the components are linked together. The question is whether other components in the web can provide a counterweight to decrease the influence of a digital whiteboard in order to arrive at a balanced situation.

From this analysis, the contextual characteristics of a digital whiteboard can be identified that lead to social impacts. Contextual characteristics are related to changed social practices and these are linked to outcomes. In figure 3.5, unwanted impacts of digital whiteboards have been visualized and the contextual characteristics that are connected with these unwanted impacts.

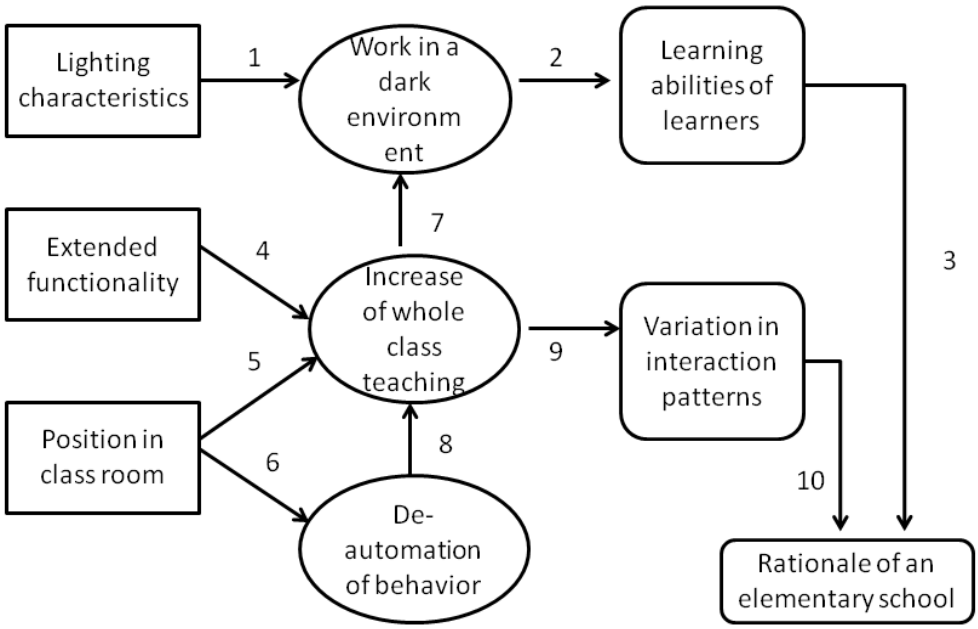


Figure 3.5: the relation between contextual characteristics of digital whiteboards and social mediations at elementary schools. The contextual characteristics of a digital whiteboard mediates practices in a school class; lighting characteristics lead to darker environments *(1)*; the extended functionality and position in the classroom leads to an increase of whole class teaching *(4,5)*. The position in the classroom also leads to a de-automation of teacher behaviour, making old behaviour impossible *(6)*. Changed practices can strengthen other practices as well; the increase of whole class teaching is strengthened by the fact that a teacher is open to change due to a new script *(7, 8)*. The social ecological model shows that these characteristics of a school class can influence learning abilities of children and variations in interaction patterns *(2, 9)*. These characteristics can negatively influence the rationale of an elementary school; adaptive learning *(3, 10)*.

Three important contextual characteristics of digital whiteboards were identified on the basis of unwanted social impacts: lighting characteristics, extended functionality and position in the classroom. If a designer wanted to improve the social impact of digital whiteboards, working on these characteristics would become central items. For instance, a decentralized position of a digital whiteboard in a classroom would change the script again. Creating the possibility for pupils to work together at a smart table (Steurer & Srivastava, 2003) could increase the variation in social interactions in classrooms again.

3.5 Conclusions

This research aimed to establish whether a social ecological approach would be beneficiary for the evaluation of social impact of digital whiteboards. It has yielded a number of insights. The social ecological approach has provided a means to understand a social environment in a simplified way; it offered a means to gain a holistic view of all the consequences of the introduction of digital whiteboards in classrooms. This was reinforced by two elements of the approach:

- The use of generic goals instead of specific goals.
- Analyzing changed social practices instead of focusing on the use and effects of new technologies.

Several contextual characteristics have been identified based on social mediations that can be used for new designs.
It has been shown that technologies can be analyzed on different scales for design research purposes. To gain a deeper understanding of reality, a designer can switch between networks; the social and the use level.
A second research question focused on the relation between social impact and contextual characteristics of new products. It was found that results from the empirical research revealed changed practices, while the social ecological analysis revealed influences. The combination of these insights provides information for the construction of social mediation patterns (see figure 3.5).

In the next chapter, a more complex social environment is observed and the focus of research is shifted to the relation between characteristics of the social environment and social impact.

Chapter 4: Social impact in cohousing communities

4.1 Introduction

The previous chapter showed that using a framework of physical, individual and social factors could help in identifying the contextual characteristics of products that influence the social context. Furthermore, examining social goals that pertain to the health of a social environment is useful in determining aspects which are important for reaching these goals. However, the research on digital whiteboards did not differentiate between different social ecologies, although the results showed that experienced teachers used the digital whiteboard differently than new teachers did and that the social impact might be very different in mixed grade than in single grade classes. Furthermore, the influence of differences in the built environment was not included in the analysis. Just as for technical products, the characteristics of a physical environment interact with an environment and have a mediating influence. A second, more complex descriptive study was therefore carried out to advance our understanding of social impact in social environments. Results from both studies will be compared and analyzed in Chapter 5.

A prescriptive study on the use of insights about social environments for design practices was also performed to explore whether design principles could be formulated on the basis of social mediations. In the built environment, the use of 'social contact design principles' has already been adapted in some habitats, such as, for example, in cohousing communities. The individual, social and physical aspects of the social ecology in a cohousing community have already been studied and are evaluated regularly in cohousing literature (McCammant, 1994; Meltzer, 2005; Williams, 2005) regarding their contribution to the goals of the social community. As Williams puts it:

'Cohousing provides a useful case study for analysis because it uses design (social contact design) and formal social structures (resident management and organization of communal activities, non-hierarchal structures and decision making processes) to encourage social interaction in neighbourhoods. In addition, informal social factors and personal characteristics of those living in cohousing communities predispose them to social interactions (p.196).'

And according to Torres Antonini (2001):

'A study of cohousing allows us to explore the unique phenomenon of communities purposely designed for social connectivity and support (p.17).'

The study of cohousing is interesting from an academic perspective, because it is an example in which an optimal living environment for elderly has been created that has proven to strengthen social networks for its dwellers. For research on social impact, cohousing is interesting because the influences of characteristics of a community on social interactions have already been observed. This makes it possible to construct a very specific and validated social ecological framework and to understand whether physical design characteristics have a positive or negative influence on social interactions.

This chapter starts with a description of the context of cohousing *(4.2)*. Next, a descriptive study on social mediations in several cohousing communities is discussed*(4.3)*. This is followed by a prescriptive study that focuses on anticipations of social impacts through the formation of design principles *(4.4)*. Finally, conclusions will be drawn *(4.5)*.

4.2 The context of cohousing

Cohousing is a topic of renewed interest in the Netherlands, especially for populations of over 50 years of age and as an alternative for professional and family care. In a cohousing community, people share daily life activities in a specially developed facility. These facilities comprise multiple dwellings (20-30) that are oriented around a common open area and a common building (Durret, 2005).
Cohousing first appeared in Denmark during the 1970s and spread throughout northern Europe during the eighties. In the nineties, it took root in the United States, Canada and Australia. More recently, projects have appeared in Britain, New Zealand and Japan (Meltzer, 2005). It is a form of collective housing that originated in the 1960s in the shape of the commune. The modern form of cohousing is not no longer utopian or ideologically based, although dwellers of cohousing communities may have strong traditions of group solidarity with sometimes organic and ecological interests in common (M Brenton, 1998). In the Netherlands, too, cohousing is considered an interesting alternative for elderly; already, 276 cohousing communities have been founded (Jansen, Stavenuiter, Dijkhuis, Dongen, & Tricht, 2008).

Much attention has been focused in the literature on the physical design aspects and the formal social structures of cohousing communities. Durret (2005) has defined six components which cohousing projects share, which have also been adapted by others authors (Williams, Meltzer etc):

1. *Design of the community*: in many cases, cohousing communities have been initiated by the residents themselves and they participate in the design process for the housing development. Organizing and planning a cohousing community requires time for group meetings, research, and decision-making. A feeling of community emerges during the period when residents are working together to reach their common goal.
2. *Social contact design principles*: Cohousing residents emphasize design aspects that increase the possibilities for social contact.
3. *Common areas*: A common room is an extension of each private residence and provides a place for community activities.
4. *Management of the community*: residents manage the development, making decisions that address common concerns at community meetings. Responsibilities are typically divided among work groups in which all adults must participate. Residents must learn to work together and find the best solutions through consensus in the group.
5. *Non hierarchal structure of the community*: There are no true leadership roles, the responsibility for decisions is shared.
6. *Own source of income*: there is no shared community economy, unlike in the early communes.

The components (except no. 6) refer to physical design and formal social factors. Other factors, such as informal social interactions, are more spontaneously derived by dwellers themselves, although the application of social contact design principles is expected to stimulate spontaneous interactions. Selection committees have been put in place in most communities to select dwellers with more or less the same values in order to prevent conflicts (Meltzer, 2005; Williams, 2005).

In cohousing communities, physical design and formal social structures are seen as enablers of social interactions (Torres-Antonini, 2001; Williams, 2005). The influence of technology, however, has not been incorporated as an influencing factor at all (see figure 4.1), even though technology has already entered communities in many forms. This raises the question of how mediating aspects of technology interfere with the main goals of dwellers in cohousing communities. Do the design principles of cohousing need to be adapted, as new technology might be mediating the behaviour of its dwellers?

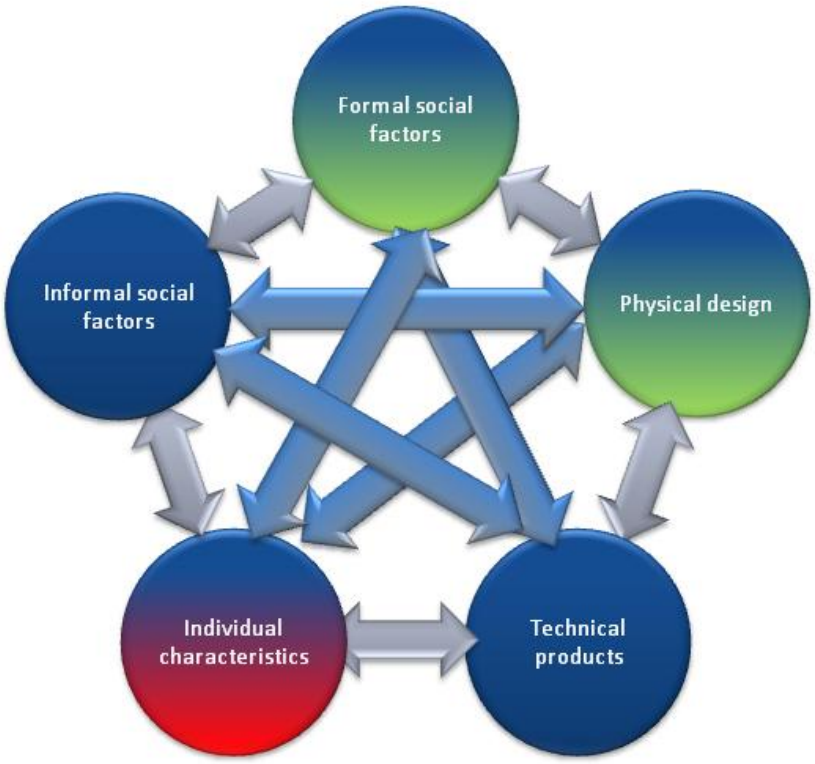


Figure 4.1: the social ecology of a cohousing community: Physical design properties and formal social factors are pre-described, while the others factors are more or less open. Communities try to influence individual characteristics through individual selection

The goal of a cohousing community is to provide its dwellers with an opportunity to live independently and remain socially active. An important aspect to consider is whether the dwellers benefit from living in such a community. This is related to the social wellbeing of the dwellers. Social wellbeing depends on the network of personal relationships and social exchanges that take place (Jong Gierveld, 1998). When this network is included in a shared social network with forms of reciprocity and trustworthiness, this can be seen as social capital (Portes, 1998;

Putnam, 2007). The cohousing community can provide such a network for its residents. It is generally assumed that cohousing leads to an increase in social interactions and this has also been established in various studies (M Brenton, 1998; Torres-Antonini, 2001; Williams, 2005).

Although attention has been focused on several aspects of cohousing communities, the question is how ideal cohousing communities are in reality. As an individual is an active agent that constantly shapes and is shaped by its environment (Lounsbury & Mitchell, 2009), similarity in behaviour within cohousing communities can be expected. Still, differences will exist: individual goals and values and social informal aspects may vary, not all communities will have adopted all described principles and moreover, as it is an alternative for senior citizen housing in the Netherlands, ageing problems may have an influence, as well. Therefore, a closer look will be taken at the social ecology of cohousing communities.

4.2.1 The social ecology of a cohousing community

Social interactions are seen as an important aspect of cohousing and these can be positively influenced by the physical design. This influence is enhanced by the presence of three variables. The first is the opportunity for contact between residents; second, the proximity of the apartments and third, the availability of appropriate space to interact (Fleming, Baum et al. 1985). The closer people are brought to each other, the greater the chance of meeting one another and the greater the chance of the formation of friendship and social interaction (Abu-Gazzeh, 1999).

The design approach used in cohousing adopts most of the architectural and urban design principles identified in the literature as being crucial to high levels of social interaction in neighbourhoods, the so called 'social contact design principles'(Williams, 2005). Several studies in cohousing dwellings and buildings show that aspects such as proximity of the dwellings, the position towards other houses, buffer zones between private and general space, surveillance within the community and shared pathways affect social interactions in the community (Abu-Gazzeh, 1999; Cooper Marcus, 1986; Fleming, Baum, & Singer, 1985; Gehl, 1987; McCammant, 1994; Williams, 2005).

Communal spaces provide opportunities for social interaction. If a common room is situated centrally and is easily accessible, more dwellers will use the facility (Williams 2005). Furthermore common spaces (indoor and outdoor) need to be of good quality and, at the same time, flexible (McCammant 1994; Abu-Gazzeh 1999). Opportunities for surveillance within the community are a key to higher levels of social interaction: "The nearby environment is the basis of communication and identification of common interests between inhabitants" (Abu-Gazzeh 1999).

Designers of cohousing communities have tried to create an optimal environment for social interactions by adapting the physical characteristics of the physical environment. As noted above, other factors also influence social interactions, which means that dwellers do not automatically have an active social life in such a community. The members of the community need to be actively involved in forming the basis for a healthy social interactive community.

Initial contacts in a community generally take the form of passive interactions with neighbours. Passive interactions are the unintentional encounter of persons (Abu-Gazzeh 1999). These interactions are a form of passive community building and

may lead to feelings such as 'convenient' social control, common feelings of security and/or wellbeing (Felbinger and Jonuschat 2006). If passive contacts between residents are frequent, there is a probability of the formation of friendship and active social interactions (Abu-Gazzeh 1999).
Active interactions are intentional and may lead to active community building, like sharing interests between dwellers through common activities (Felbinger and Jonuschat 2006). These active interactions are a main characteristic of cohousing communities. Active interactions can be divided into informal and formal interactions. Informal interactions include the personal relationships between individuals (or relations within a group). Formal interactions relate to organizational policies and structures. In cohousing communities both forms of social interactions exist.
In cohousing communities, there is no condition of management. The design process and the daily organization are the responsibility of the residents of the community. Decision-making is based on consensus between dwellers, i.e., the residents make collective decisions on subjects that are important for the community. Usually, formal meetings are organized that are attended by the residents. Formal communication is not always easy. It may lead to conflicts between residents, which has been described in many communities (Brenton 1998; Meltzer 2005; Williams 2005). The possibility of conflicts is reinforced by differences in values and goals. The more people with interfering values and goals interact with each other, the more likely it is that conflicts will develop. In order to prevent such conflicts, cohousing communities try to attract a homogeneous group of people with similar values and goals - usually people who choose to be actively involved in the community and are socially able. However, attracting the right kind of people is not always easy, and sometimes, new residents need to be chosen very quickly.
This casts some doubt on the idea that social interactions are a predictive measurement of social wellbeing. Social wellbeing is dependent on the network of personal relationships and social exchanges that take place (Jong Gierveld 1998). As previously noted, when this network is included in a shared social network with forms of reciprocity and trustworthiness, it can be seen as social capital (Portes 1998; Putnam 2007). Social interactions are a structural aspect of social capital. A cognitive aspect of social capital is related to trust and reciprocity of the social network. Aspects of trust and reciprocity may not be optimal in the case of conflicts within the community and should therefore also be taken into account in cohousing communities.
Furthermore, the literature on social capital has pointed out the importance of bonding and bridging contacts for people within a community. Too much in-group contact (high participation within the group, low trust outside the group) might lead to miniaturization of the group (Almedom, 2005). This means that social interactions within the group cannot provide all contacts for social wellbeing of the individual members.

Apart from values and goals, the age of the residents in a cohousing community is an important factor. The older people get, the more help they need and the less help they can offer to others. If the average age of the residents is too high, this may have a negative effect on the possible interacting activities of the group. Activity patterns, for instance in daily life, become more focused on the home and

local environment in later stages of old age (Drooglever Fortuijn & Hallberg, 2006). So, the risk of miniaturization increases with the ageing of the residents.

A healthy social ecology is a social community that is stable and sustainable. It needs to be active and maintain its organization and autonomy over time and needs to be resilient to stress (Costanza & Mageau, 1999). There seem to be influences in cohousing communities that could lead to an unhealthy situation.

4.3 Descriptive study: Observations of social mediations in cohousing communities

To gain insight into differences between social communities, examples of social mediations have been analyzed. A study was conducted that concentrated on the social and physical characteristics of five cohousing communities in the Northern part of the Netherlands. The study was organized and partly performed by students at the Hanze University of Applied Sciences. Semi-structured interviews were conducted with twelve residents of cohousing communities and photographs of the buildings and common areas were collected. Detailed questions were asked about the usage and patterns in the each community, concerning the use of common facilities, the formal procedures etc. These provided insights into the way interactions within the community take place. The respondents were chairpersons or other members of the board of the community. All community dwellers in this study were native to the Netherlands, with educational levels that varied from primary school to university and professional backgrounds ranging from housewives and farmers to higher management executives. Ten of the twelve interviewed members of the cohousing communities had completed a form of higher education (bachelor's and master's degree level). Most of the interviewees considered themselves to be active residents, despite having a few minor physical problems.

The communities differed in size and starting dates: community A consisted of 26 apartments and had been established 15 years ago; community B comprised 24 apartments and had been established 12 years ago; community C consisted of 49 apartments and had been established 5 years ago; community D was composed of 21 apartments and had been established 22 years ago; community E had 65 apartments and had been established 8 years ago. A characteristic of all cohousing communities was the use of consensus in decision making.

4.3.1 Results

The cohousing communities varied in many ways. Some general aspects that influenced the script have been noted:

One aspect on which the residents in the community showed variation was their origins. One woman (from A) was reported as saying: 'As a woman from the western part of the Netherlands, I don't have any women like me around here. They do have another mentality'. A chairperson (from B) reported that the local mentality of the dwellers prevented discussion between residents. Problems with conflicts between residents were reported in all the cohousing communities taking part in this study. Most conflicts were solved by intervention of the chairperson and the community board, sometimes with help from the housing association. A characteristic of all cohousing communities was the use of consensus decision-making.

Co-housing communities always have one or more sets of codes, rules or agreements that affect the behaviour of individual members (Meltzer, 2005). One of the cohousing communities (B) had no agreements in the beginning, i.e. no clear rules on what was expected from new dwellers and no member recruitment and selection process. The dwellers were put there by the housing association and, according to those interviewed, the community spirit was very low in the beginning. It took a great deal of effort to get people organized and engaged with the group.
All interviewed dwellers referred to the importance of a selection committee, although the procedures varied from community to community: from activity involvement (in a 'friends of the community' group in B and D) to selection interviews with a special committee (A and C). One community member (from A) reported that it was very difficult to say no to new dwellers, because vacancies were unacceptable to the housing association. In community C, this was also given as the reason that all the rooms had to be filled from the start and that almost everyone was accepted who was willing to live there. In community B, a new member must be actively involved in the community before he or she is accepted as a dweller.
Most of the interviewed persons considered themselves active residents, despite a few minor physical problems. They were very clear about what people can expect from the community. Helping each other is a core function of the cohousing community, but if somebody is in need of care, this must be organized privately. Three communities reported problems with the ageing of residents. Some activities had to be stopped (a common kitchen garden in A), and two communities (B and D) reported taking actions to attract younger people to the community.
All cohousing communities had adopted several social contact design principles (Williams, 2005), such as common facilities and shared pathways. Two communities were larger than expected from the literature (49 en 65 apartments). These communities were multi-floored buildings featuring a central atrium, which offered residents the opportunities for interactions when the weather conditions were poor.

The impact of changes in communities

The design process:
In most communities, changes in the physical design led to changes in interactions. In one community, a common room was upgraded and this resulted in more use of the facility. In another community, the design process itself, in this case, replacing the tablecloths, led to conflicts, so the change was reversed. In all the communities, consensus was required for new design decisions, which was reportedly a difficult task. The design process itself as a contributor to conflicts in communities was also found in a study conducted by Williams (2005).

Impact of new physical designs for cohousing:
Several new physical designs can be seen in cohousing communities, which have not yet been evaluated in cohousing literature. The intended role of the atriums was to provide residents with the opportunity to interact, even when the weather was poor. However, the actual use of the atrium in community C did not correspond with the intended function in the design, as people avoided social interaction in the atrium. Residents did try to stimulate the use of the atrium with

attributes (for fitness), decorations and small plastic plants (see figure 4.2). The residents cited two reasons for their dislike of the atrium. The first was the fact that all other residents can look into the atrium, whereas most people are desirous of more privacy in their social interactions. The second reason was related to the poor climate in the atrium (too hot in the summer and too cold during the winter). The atrium in community E (see figure 4.2) offered more privacy due to the use of (big) plants and trees.

Figure 4.2: the atrium in community C and the atrium in community E

Differences in mediation: the social impact of new technology

Two specific examples of mediation in action with different social consequences were observed. Both examples were related to the safety system of communities. All the observed communities were equipped with an access control and safety system (see figure 4.3) to prevent people from entering without the permission of a specific dweller. In two communities, unintentional consequences were spontaneously mentioned by respondents.

Community C was a newish community with a larger than expected number of apartments and an atrium. The process of design and realization took longer than expected, which, combined with the number of residents, made it difficult to follow a careful selection procedure. On completing the construction of the community, everyone who applied was accepted. The safety system was implemented when the community opened and special meetings were organized with the local fire-fighters and police on the subject of safety. As a result, safety was further addressed during a meeting with residents in which formal rules were laid down about allowing people to enter the building. Chairpersons were made responsible for compliance with the rules and confronted residents who were less meticulous about following these. After tightening the rules about visitors, the number of (uninvited) visitors entering the building decreased.

Figure 4.3: the safety system in community C

In Community A, the average age of the residents was high. Some activities, therefore, had to be stopped. It proved difficult to find new residents who are younger. The respondents reported frequent conflicts between the residents and that consensus is difficult to achieve in this community. An example was the friction that arose with regard to the new tablecloths in the common area. During a formal meeting, it was decided to keep the old tablecloths. In this community, frequent interaction was considered annoying, so the residents here tried to avoid encountering each other.
In this community, the use of the safety system led to a new informal network, according to the respondents. The characteristics of the system enabled all the residents to hear visitors through the intercom by picking up the phone, so they knew exactly who entered the building and who had let them in. This monitoring of new visitors was facilitated by the centrally located parking lot, where all visitors were required to park and which was overlooked by the rest of the community. So, the privacy of the residents is highly at risk in this community.

4.3.2 Discussion descriptive study

The present study is not representative for all residents of the cohousing communities studied, because the respondents were all chairpeople or board members. Still, the obtained results are in line with previous research from Brenton (1998) on cohousing for senior citizens in the Netherlands.
The general results show that cohousing communities have to deal with problems within the community. These problems are related to the fact that it is difficult for a cohousing community to create the 'perfect' situation described in the cohousing literature. New developments relating to the physical and technical characteristics of cohousing communities will have an influence, as well.
Social impact from the design process itself can therefore be expected, as mentioned by Williams (2005). Resident participation in decision-making processes is thought to increase levels of social interaction (M Brenton, 1998; McCammant, 1994). However, Williams found that decision-making also created conflict. Design decisions created some of the biggest conflicts found in her research.

Examples of changes, such as home technology and the use of atriums can be found in most communities. When such changes are introduced, the script of a community changes (Akrich, 1992), with unintentional social impacts as a result.
In the case of the atriums, the community gardens were replaced by a central, covered space. The (dis)use of the atrium in community C was unexpected, but

the solutions in community E might be interesting to study for this community. According to social contact design principles, a buffer zone between private and communal space is an important aspect (Abu-Gazzeh, 1999; Williams, 2005). A private garden works as a buffer between the communal garden and the private dwellings. In this case the plants in the atrium of community E might function as a kind of buffer zone. So the 'old' design principles could have been translated into principles for atriums.

Privacy was also related to the unintentional use of the intercom in community A. The intercom enabled dwellers to overhear other dwellers. In this case, the unintentional use was strengthened by the social contact design principles adapted in this community: surveillance and a general parking facility. Also, specific individual characteristics influenced the disuse of the intercom. This example illustrates the multistability (D. Ihde, 1999) of technology. It shows that the functionality of products is defined by its users.

Community C was located in the Northern part of the Netherlands in a small village with no significant criminality rate. It is questionable as to whether the implemented safety system was necessary in this community. Combined with social activities involving the fire department and the police, a process was initiated that could lead to fewer people from the outside entering the community. Ultimately, the installation of the system might be a change with unwanted social consequences. The literature on social capital refers to the importance of bonding and bridging contacts for people within a community. Too much in-group contact (high participation within the group, low trust outside the group) might lead to miniaturization of the group. This may result in unhealthy behaviour (Lindström, 2004). Knowing this, community C might well be regarded as a community (potentially) at risk.

Mediation with safety systems in communities A and C, therefore, led to different patterns of mediation. This is probably related to different social contexts and different characteristics of technology. However, both communities face unintentional social impacts that could be harmful for the rationales of the community and its residents.

Communities appear to depend on formal social factors in order to maintain a healthy social environment. Diversity in interactions between dwellers is an important aspect for the health of a community (Costanza & Mageau, 1999). This dependency on formal social factors does make a cohousing community a possibly less interesting alternative for the elderly, as it requires them to invest in the community and to be socially adept. Technology that could facilitate interactions in a more subtle way, e.g. one offering residents a choice whether to interact or not, could be an interesting option. Such nudges in the physical environment might be integrated in the script of the community.

Such nudges can have negative consequences as well. The visibility of the safety system in cohousing community C may have worked as nudges for its dwellers (Sunstein & Thaler, 2008). The technology formed a constant reminder (present in every room of the community) to control their safety issues.

4.4 Prescriptive study: Anticipating social impacts with the use of design principles

As the study discussed in the previous paragraph showed, physical design factors such as common facilities influence social interactions in cohousing communities. These 'social contact design' principles did not always work, due to social and

individual factors (partly) beyond the control of the residents. The principles adapted in the cohousing literature, however, do not incorporate differences between communities.
Another problem with the use of the social contact design principles is the interfering effect of technologies. While technological products mediate practices in communities, these influences have not been incorporated into the social contact design principles. It might be interesting to design new principles for cohousing communities that incorporate differences between communities and are applicable for technologies, as well.

Research design
Data was gathered by means of a student project that concentrated on the importance of common rooms for social interactions in two cohousing communities. The students attended shared activities in both communities and collected data on the residents' daily social interactions. The participants in the study kept activity diaries and the students conducted structured interviews with 10 residents in community A and 7 residents in community B and collected photographs and information about the floor plans of the communities. The residents were recruited during an organized activity to participate in the study. A classification of the Verwey Jonker institute was used for the question on the actual social interactions between dwellers in the community (van der Graaf, Boonstra et al., 2006).
The communities differed in size and starting dates: community A consisted of 21 apartments and was established 22 years ago; community B consisted of 14 apartments and was established 14 years ago. Both communities were situated in an old multi-floor building that had been redesigned for the purpose of a cohousing community. In earlier research (Bouma & Voorbij, 2009), it was found that cohousing communities differed in degree of social activeness. In some communities, few activities were organized and the board did not actively try to influence the atmosphere within the community. It was concluded that some communities were at risk of declining social wellbeing of the residents. In this study, a cohousing community with an active board that managed social activities (Community A: organized many social activities, external friends of the community group participated, now and then a survey was taken to evaluate the atmosphere, there were specific constraints for new members etc) was compared with a cohousing community with no active board (community B) to manage these aspects.

4.4.1 Results
The analysis of the floor plans of the communities showed that both communities had two major common areas in the building: the common hallway and the common room. The dwellers confirmed the importance of these common areas for social interactions. According to them, the most important ways to make contacts with other dwellers were during the shared activities in the common rooms (n=12), walking in the hallway (n=10) or waiting for the elevator (n=7 in community A). These areas therefore became the focus of the analysis.
While the common room was used for active (sometimes formal) interactions, the interactions in the hallway and in front of the elevator tended to be passive interactions, such as greetings and chats.

Community A

The common room in community A was located on the ground floor of the facility in the centre of the apartments (see figure 4.3). Although the common room was not located at the entrance, most dwellers were required to walk past the room to get to their apartments. Also, the lift and stairs were situated near the common room.

Several activities were organized in the common room: communal coffee drinking twice a week, painting and shuffleboard once a week, twice a month a so-called 'soos' (a social gathering where residents have a drink together) and a cultural activity (e.g. a reading or theatre) with a shared meal once a month.

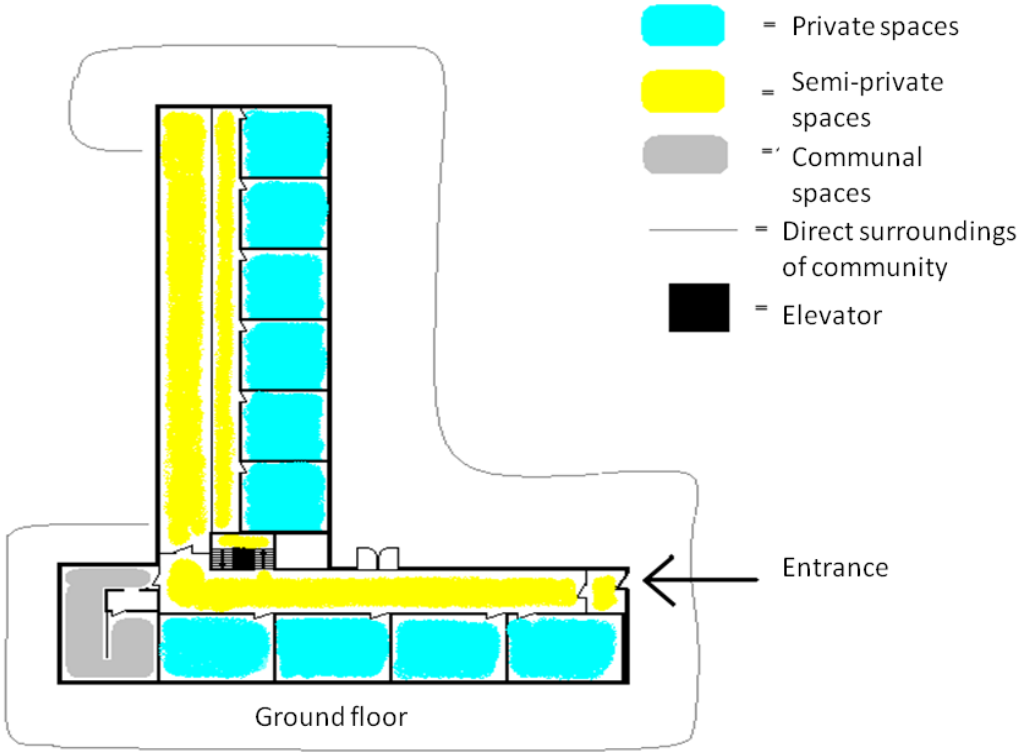


Figure 4.4: the location of the common room in community A in relation to the private rooms and the entrance (ground floor)

The shared hallways are important for passive social interactions (see figure 4.4). Greetings (n=6) and informal chats (n=7) were the most frequently mentioned interactions in this community. The hallways constituted a shared pathway in the community. Based on the floor plan, the apartments in the vicinity of the common room and the entrance may be expected to see a lot of traffic.

Besides the passive interactions in the hallways, active interactions between individual dwellers were also noted. Four people mentioned having regular contact with other dwellers, three dwellers mentioned that they did shopping for other dwellers, three went on holiday with other dwellers, four respondents reported helping each other in case of emergency and two invited other dwellers for social contact.

The diaries also revealed some non-regular common activities, which were not linked to the common areas, like going to the market, visiting a zoo and attending a cultural event

Community B

The common room in community B was located in a separate part of the facility (see figure 4.5). Only the dwellers in the two apartments near the common room could keep an eye on whether anything was happening in the common room. Other residents did not pass the common room on their normal walking routes.
In community B, the communal activities consisted of communal coffee drinking once a week and a formal meeting once a month. Occasionally, residents shared meals during holidays or shared trips to the theatre.
Passive interactions were also important in this community. Greetings (n=4) and informal chats (n=5) were the most frequently mentioned forms of interaction in this community. The hallways in the community were divided into two different halls: a semi private hall and a shared hall (see figure 4.5). The semi private hall, made up of an enclosed space leading to three apartments, resembled a hall in a normal house. One dweller viewed this as a private area belonging to the three households; the residents had set out plants in this area, which were tended to collectively. The shared pathway for all dwellers was the stairway and the hall linked to the stairs.

Besides the contacts in the common room and passive interactions in the hallways, active interactions between individuals were less frequent in this community. One dweller reported going shopping for other dwellers, two helped one other in case of emergencies and one dweller invited people for social contact.

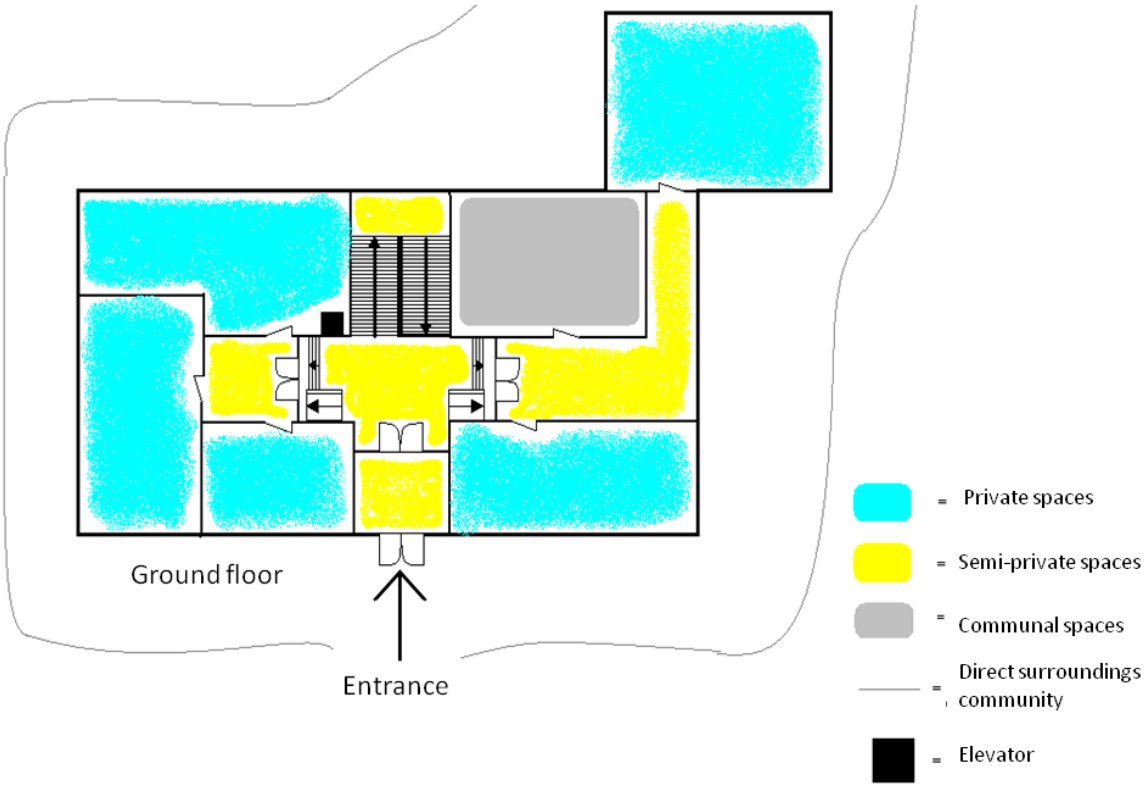


Figure 4.5: the location of the common room in community B in relation to the private rooms and the entrance (ground floor)

4.4.2 Discussion study 2

This present study was a follow up study to an earlier study into the social and physical aspects of cohousing in five cohousing communities. The communities participating in the first study were comparable with the communities examined here. They differed in frequency and diversity of shared activities.
The respondents were voluntary asked to fill in an activity diary during an organized activity. The respondents may therefore not be completely representative of the whole community; the procedure for recruiting respondents in both communities was the same.

The differences in frequency and diversity of organized activities between the two communities could have many reasons. Reflecting on the cohousing literature, the position of the common room in community B was not conducive to social activities. The room was not centrally located; there was no surveillance and no shared pathways to the communal room. Technology based on these functionalities may influence the script of the community and therefore have a mediating effect on the behaviour of dwellers. In the common room, technology could be helpful to promote the visibility of the common room. A possibility would be to show people at the entrance whether the common room is occupied or to notify dwellers in their apartment about the activities being organized in the common room. This might be an interesting option, especially for dwellers with physical limitations. Another possible function for technology might be to support dwellers in organizing activities in the community. If it is easy for dwellers to invite people to take part in an activity, to make a reservation for a room and to see who will attend this activity, possible barriers to organizing such an event might be overcome.
Formal activities occurred in both communities and were seen as a basis for conflicts in many cohousing communities. Social contact design principles might not have a big influence on these interactions, other than that a well-designed common room is more welcoming and can help in creating a positive setting for meetings. Possible functions, such as facilitating the selection of new dwellers and gaining consensus for design decisions, might help in solving or preventing conflicts. An example of such a system would be a consensus support system for group decision-making (Herrera-Viedma, Martinez et al. 2005). Such a system could have an influence on the scripts of the actions but also on the perception of dwellers.

In both communities, passive interactions like greetings and chats between residents were the most frequently mentioned type of contacts. The hallways were an important area for these interactions. In the cohousing literature, shared pathways were found to have been areas that had been observed, but the design and functions of shared hallways had not yet received much attention. In the Netherlands, Humanitas has paid attention to shared hallways, employing the use of conversation pieces and empathic design in homes for the elderly in the Netherlands (Becker 2003). It would be interesting to see if their approach also worked in cohousing communities.
In community B, the hallway was separated into two functions: a semi-private part for three apartments and a general hallway, which also contained a staircase. Semi-private buffer zones provide good opportunities for social interactions. They provide a gentle transition between public and private space (Abu-Gazzeh 1999). But in community B, this combined space might also lead to clustering within the

community. In such a small community, this may actually create social divides that otherwise would not exist (Williams 2005). In the case of dwellers that share such a hallway and have differences in values and goals, this may lead to 'territorial disputes' (Williams 2005).
In community A, active interactions were more frequent and diverse, whereas community B relied more heavily on passive interactions. The likelihood in community B of these passive interactions becoming active interactions was small, due to a less than optimal physical design. Technology might be able to influence these interactions by visualizing more aspects of the dwellers. In general, using the internet (especially social media) stimulates the amount and intensity of social contacts, relations and networks, both online and offline (Frissen 2004). A form of social media within the community might be a way for residents to have passive interactions on another level. If the frequency of contact were to be influenced, this might increase the probability that passive interactions could become active interactions. It would be interesting to see if a virtual community within a physical community would be able to compensate for limitations in design. Feelings of trust might be enhanced if the residents knew more about their neighbours.

Based on the discussed results, an overview of the relations between general interaction principles, social contact design principle and social interactions has been made. Functionalities can be derived from these relations (see table 4.1).

General Interaction principles	Social contact design principles	Interactions	Possible functionalities of technology
Frequency of interaction Trust Reciprocity Shared Values	**Hallway:** Shared pathways Buffer zones between private and general space Surveillance	**Passive, informal:** Greeting and talking in the hallways Contact for small tasks (plants, shopping)	**Mediation of perception:** Learning other aspects of dwellers for more contact Creating feelings of trust **Mediation of action:** Increase possibility to meet
	Common room: Good quality Flexibility Central position Accessible, Surveillance	**Active, informal:** Activities like playing cards, drinking coffee, painting etc	**Mediation of action:** Enhance visibility of common room Support in organizing: Reservation of rooms; visibility of attendees, etc
		Active, formal: Meetings Selection Design process Contact with housing association	**Mediation of action and perception:** Prevention of conflicts Support of selection Support of design decisions

Table 4.1 The relation between general interaction principles, social contact design principles, social interactions and possible functionalities of technology.

An important addition to this table is that these principles should not suggest that applying them automatically leads to a perfect social community. The principles should be applied in a dynamic way and a designer should focus on differences between communities. Social mediations can lead to changed practices in a

community. Contextual characteristics of future technologies should be identified in a later phase to be sure no unintended mediations take place.

4.5 Conclusion:

In this paragraph, I will draw some general conclusions for this chapter. The research was to establish how technologies mediate in social environments like a cohousing community. The study focused on understanding social environments and the influence of variations between social environments on social impacts.

Descriptive research

Variations between cohousing communities are related to the way social formal factors are applied, the individual characteristics of dwellers and to differences in physical design. Social contact design principles in a community with a positive ambience may work as an enhancer for interactions, while in a cohousing community with conflicts, social contact design principles may intensify conflicts or even lead to withdrawals from the community.

Prescriptive research

The social contact design principles described in the cohousing literature are too heavily focused on the way the social ecology of a cohousing community was intended to work. In reality, networks have turned out to be more diverse. Design principles that support anticipations of social impact should therefore be dynamic. Variations between social environments lead to differences in social mediations and therefore to differences in social impact.

In Chapter 5, the results of the descriptive studies in Chapter 3 and 4 will be further analyzed. The prescriptive study in this chapter will be followed up in paragraph 6.3.

Chapter 5: Identifying the relation between social impact and technologies

5.1 Introduction

The descriptive research of Chapter 3 and 4 was conducted to gain a better understanding of the relation between social impacts, technologies and social environments. In this chapter, an analysis of the empirical data retrieved in these studies is provided. An assumption of this thesis is that current goals of user-centred design are too limited for the scope of social impact. Researchers need a wider perspective for their studies. Therefore, this chapter first examines the point of view of the research described in the literature found on digital whiteboards and cohousing communities *(5.2)*. Secondly, the elements of social impact will be elaborated in greater detail. *(5.3)*. Finally, conclusions are translated into a working model for anticipating social impact in design contexts *(5.4)*.

5.2 The influence of point of view on research outcomes

According to Akrich (1992) the problem of designers is the tension between the designer's intentions and reality. To decrease this tension, a designer always has to go back and forth between the intended idea and the outcomes in reality. But a difficult question for designers is what kind of aspects of reality need to be integrated in an analysis. They cannot possibly integrate all aspects of reality, and therefore have to make choices.

Research on digital whiteboards focused in many cases on the use of a digital whiteboard in a classroom; it concentrated on the effectiveness of the technical device. These studies focused on the intended goal of improved interactive teaching. Although there was criticism about digital whiteboards, no studies were found that linked digital whiteboards to more generic goals of teaching and general social interactions in the classroom.

In the case of cohousing communities, the literature was mainly focused on the physical characteristics of the buildings, the individual characteristics of the dwellers and the social formal and informal characteristics of the social interactions between dwellers. Technical influences were not incorporated into these analyses. So, although the analysis was on a social level, the effect of technology had not yet been included.

This limited view of the existing research in this area confirmed the necessity to research and explore ways to gain more information about outcomes of reality, to enable a designer to anticipate and identify social impacts within design projects.

5.3 Identifying social impact

In Chapter 2, three elements of social impact were determined that needed to be understood in order to identify social impact: a social ecological approach, social mediations and contextual characteristics of technologies. A social ecology has an interdependent relation with a technology. Interactions are modified through social mediations and this process leads to social impacts.

5.3.1 The social ecological approach

As stated, a social ecological approach combined with observations in real world contexts has been applied as a means to gain the necessary information about the social environment. A framework consisting of different factorial influences from all kinds of disciplines enabled me to understand which elements of a social ecology were essential for the social goals and what consequences certain changes in the environment might have. A general format was provided by Clitheroe et al. (1998) comprising the four analytical factors which they identified: formal social, informal social, individual and physical factors. I have adopted this division as a starting point in the empirical research on digital whiteboards and cohousing communities.
In the research on digital whiteboards, however, I ended up using three analytical factors; in a classroom, it is not easy to make a clear distinction between formal and informal social factors. Therefore the division of factors was adapted to this specific context. In the research on cohousing communities, the factors described by Clitheroe et al. had previously been used in the work of Williams (2005). Based on this framework, Williams formulated social contact design principles that described the optimum physical, individual and social characteristics of a cohousing community to obtain optimal social interactions between dwellers.
In the empirical research, however, two major problems related to this approach were found: Firstly, new factors of influence were identified. Cohousing in the Netherlands has primarily been targeted at senior citizens. Ageing has been determined as a factor of influence for social interactions. So ageing needed to be incorporated into the social ecological framework. Furthermore, the newest technical systems installed in present-day cohousing communities have also been found to have an influence on social interactions.
Secondly, not all factors of importance turned out to be within the residents' control. For instance, in the literature on cohousing, it is noted that a community should be made up of people with similar values in order to prevent conflicts (M Brenton, 1998; Meltzer, 2005). In reality, it has proven a difficult task for a community to select people with comparable values and to maintain the suggested formal social organization. In the case of conflicts within a community, physical characteristics that were meant to improve social interactions actually proved to be counterproductive; leading to withdrawal from the community or an intensification of the conflict.

So, the factors of influence in a social environment need to be carefully selected. Furthermore, care must be taken, once the relations between actors within a social ecology have been identified, to prevent these from becoming static principles..

5.3.2 Contextual characteristics of products

In order to understand which characteristics of a new technology will lead to social impacts, the so-called contextual characteristics of a product must be determined. Contextual characteristics define those aspects of a product and its context that are available to each person in a social context that is involved in a particular interaction with that technology. According to Brown and Duguid(1994), the difficulty in determining contextual characteristics is that they can only be identified in the context of use.
In the empirical study, it was noted that contextual characteristics emerged when the focus of research shifted from the use level to the social level. In the case of the digital whiteboards, lighting characteristics turned out to be rather important, as became apparent when lessons were observed from the perspective of mixed grades in a single

classroom. The position of a digital whiteboard was another characteristic that proved to be important; the position enabled whole class teaching, which increased after the introduction of digital whiteboards; other interactions were not supported and decreased over time.
In the case of cohousing, physical characteristics were identified as 'social contact design' principles. These physical characteristics could be regarded as contextual characteristics. For instance, the use of shared pathways as a possibility to increase passive interactions between residents is clearly a physical characteristic of a hallway that is available to each person in a particular interaction. The difference from use characteristics becomes clear if we were to analyze the hallway from, for instance, an ergonomic point of view. In that case, the focus of research would be on the question of whether older dwellers were able to access the hallway, whether people in wheelchairs would have problems entering the facility etc. The focus on the possibility to have passive interactions (social level) automatically shifts our attention to how and where people interact and whether they have an environment that activates interactions.
From this analysis, other aspects can be derived that are related to independencies between both levels: if a dweller does not have the possibility to use a hallway (due to, for instance, a wheelchair), the contextual characteristics of the hallway that influence passive interactions will have no influence on social interactions.
This has another consequence. On a use level, physical abilities allow a dweller to use a hallway. On a social level, social skills and shared values allow dwellers to have social interactions. So, individual characteristics are considered that allow a person to have interactions with other dwellers. These are the contextual characteristics of the individuals in a cohousing community.

The analysis of this section showed that shifting between levels helps in determining characteristics for different factors of a social ecology. The contextual characteristic of individuals, technologies and physical environments should all be identified. Shifting between levels helps to widen the perspective of reality.

5.3.3 Social Mediations

In Chapter 2, the basic process underlying mediation was explained; the sociotechnical transformation process that starts after a new technology has been introduced. In the empirical study, social mediations were observed as a means to gain a greater understanding of mediation processes in social environments. It was noted that patterns of social mediations were influenced by different factors.

The first study on cohousing communities included the following example:
The implementation of a safety system at the start of the community resulted in special meetings with local fire-fighters and police on the subject of safety. As a result, safety was further addressed during a meeting with residents in which formal rules were set about allowing people to enter the building. Chairpersons were made responsible for following the rules, and they held residents who were less cautious to account. The number of (uninvited) visitors entering the building decreased after the rules on visitors were tightened.
The social process within the community resulted in strict rules. But the physical characteristics of the technology and the facility of the community may have had an influence as well:

- The technology was installed in the living rooms of dwellers and the central entrance of the facility, which therefore might have worked as nudges (Sunstein & Thaler, 2008). Every time a dweller was confronted with this technology, safety goals were activated. This might have led to increased awareness about safety issues.
- The physical characteristics of the community were another possible enhancer of safety behaviours. Due to social contact design principles, dwellers could view behaviours of other dwellers, which may have increased the possibility that unacceptable behaviour would be seen. This might have helped the implementation of these formal rules.

A pattern of interactions took place that mediated the outcome of strict safety behaviour in this community. The transformations were enabled by technology, strengthened by the fact of its visual presence in the living room and at the entrance of the building and strengthened by the social contact design principles of the building. The social transformations were a combination of individual and social factors. The rules were agreed during a formal meeting, while individual members confronted other dwellers with the rules. In this way, a chain of interactions influenced the mediation process that took place in the community.
Another example from a cohousing community also visualizes this pattern of social mediations. In this community, the use of the safety system led to a new informal network, according to the respondents. The characteristics of the system enabled all dwellers to hear visitors through the intercom by picking up the phone, so they all knew exactly who had been allowed to enter the building and by whom. This monitoring of new visitors was facilitated by the centrally located parking area, where all visitors had to park and which was overlooked by the rest of the community. Besides the physical characteristics of the building, ageing factors may also have had an influence. The residents no longer worked (and had time on their hands) and were generally less physically active (fewer opportunities to go out). Spending their time watching other residents was one way to get around.

This chain of interactions can be found in the research on digital whiteboards, as well. The digital whiteboard hung in the same place the blackboard used to hang in the classroom. The blackboard hung in a central position in the classroom and needed a large amount of light in order to be visible to all pupils. Putting the digital whiteboard in this position turned out to have a negative interaction with the visibility within the classroom, which meant that the curtains were closed (or other actions like putting out the lights were taken) in order to be able to see the digital whiteboard. These actions had an impact on the pupils who had to work in a dark environment. Learning achievements are negatively influenced by darker environments (Knez & Hygge, 2002). This negative impact was enhanced by other factors as well. Teachers have become enthusiastic about working with digital whiteboards and have therefore increased their use of these during their lessons. Besides being a replacement for the blackboard, the whiteboard can be used for other activities, such as watching television, internet access. Hence teachers expect to use the digital board in the near future in up to 50 % of their lessons (SLO, 2010), which will enhance this negative impact even further.

It can be concluded that in these examples, social mediations are constructed and strengthened through a pattern of interactions with individual users, groups and non-humans (technical and physical factors).

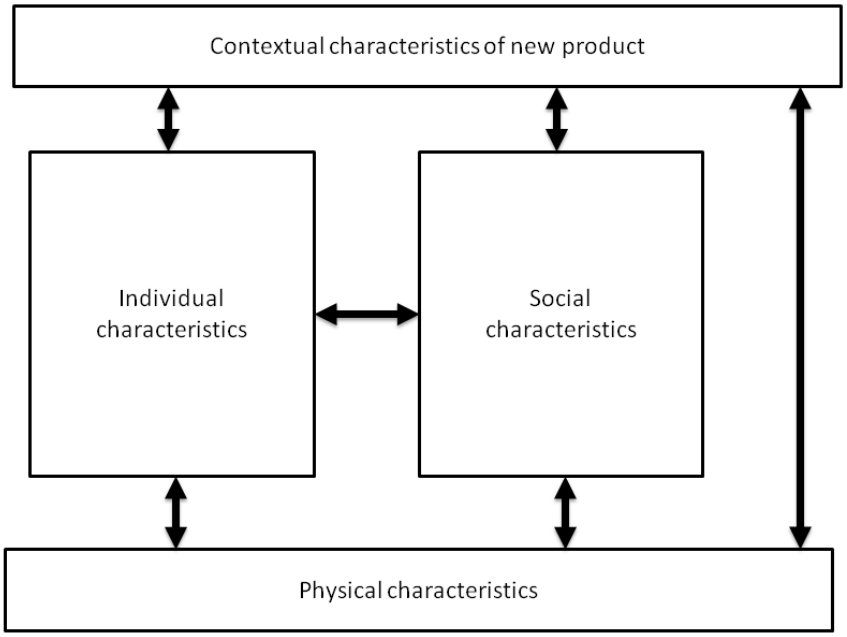


Figure 5.1: social mediation patterns

Figure 5.1 shows that patterns can have all kinds of variations in the way they evolve. Sometimes physical characteristics can have a very direct influence, for instance, in the case of the lighting problems that emerged in the research on digital whiteboards. As a result of the interaction between a digital whiteboard and a classroom, curtains must be closed or the lighting dimmed in order to be able to see the information on a digital board. In other cases, the influence of a physical environment can be very indirect. For instance, in the case of monitoring the whereabouts of the people in a cohousing community with a safety system, this was enhanced by the fact that the dwellers were enabled to observe visitors. These characteristics influenced the individual behaviour of people, which eventually influenced social interactions. For the identification of social impacts, this implies that information is needed about all influencing factors in order to construct social mediations.

Reflections on the nature of the found social mediations

The social mediations described in the previous section were derived from changing interactions within social networks. In this section, I will further elaborate on whether changing interactions are a valid indication for social impact. To do so, I will discuss the nature of the social mediations that were identified in the empirical study and examine their relation to the mediation theory of Verbeek.

In Chapter 2, it was discussed how mediation between a human and a product can have different consequences. A change in the actions and perceptions of humans can be the outcome of a new technological intervention. Changes in actions are related to the script concept of Akrich (1992); products contain implicit scripts that prescribe users how to act and therefore a change in a product leads to changes in behaviour. Changes in perception can occur because of characteristics of a technology that amplify and reduce aspects of reality and therefore offer a new perspective for humans (Verbeek, 2006).

An example of changed behaviour due to a new product was found in the case of the digital whiteboards. After a digital whiteboard had been installed in a classroom, changes in behaviour could be expected from day one. The former behaviour in working with the blackboard became impossible, while the digital whiteboard described new behaviour. The mediation process, however, must develop over time: in the beginning, a teacher must become accustomed to working with a digital board, pupils may be excited and ask for all kinds of actions, while later on, the teacher and pupils will adjust to the board and develop new habits. So, changes in the script lead to an instant change in behaviour, only this behaviour will develop over time into a new situation.
The second form of mediation appears to be more complex to identify. Perceptions change through changing technology, but the question is how mediations of perception can be identified. An example that clarifies changing perceptions through mediations is that of the use of sonograms (obstetric ultrasonography) during pregnancy. This practice has the potential to change the perceptions of users (Verbeek, 2006). In this case, changing practices of parents with this technology can be easily determined; for instance, the increase in the number of parents in the Netherlands who want to know the gender of their unborn babies says something about changing perceptions. So, the observation of changing practices within networks is still valid.

To add to the complexity, mediation processes can be influenced by mediations from other networks as well. In the introductory chapter to this thesis, an example was given regarding the social impacts of the washing machine. Focusing on the intentional goals of users, a washing machine was supposed to be a time saving device for families. However, as it turned out, families spent the same amount of time on washing they had done before(Forty & Cameron, 1986). A washing machine was not a time saver; instead, the washing machine led to an increase in how often people washed their clothes.
In a study conducted by Shove (2003) on developments in cleanliness, numerous influences on washing habits were described:

- Scientific knowledge about diseases and infections was responsible for changes in perceptions and new hygiene norms.
- Social ideas about identities and orders within society were responsible for higher cleanliness levels.
- Influences of detergent and washing machine manufacturers that served to stabilize and standardize definitions of normal practices.

In the light of these other impacts on the increased frequency with which people started laundering their clothes, the question is whether the washing machine should solely be regarded as a 'moralizing' machine (Jelsma, 2006). Shove showed that other social networks (manufacturers, scientific groups, etc) mediated with the social network of households, as well.

The example of the washing machine illustrates that social mediations can be quite complex. However, the change in practices of users and social groups with regard to doing laundry and washing machines offer an excellent means to interpret the social impacts of the washing machine. This example demonstrates that observing changing interactions is a valuable approach.

5.3.4 An operational definition for social mediations and practices

Within the reality of a social network, I have referred to practices as an overarching notion to describe patterns of interactions within a social network. Once a technology enters a social network, mediations with the involved actors start. These mediations will influence existing practices within social environments. However, no clear distinction between practices and social mediations has yet been determined. In the previous sections, we saw that it was possible to construct social mediations from changed practice within classrooms and cohousing communities. The description of a social ecology enables a designer to know what boundaries of reality need to be integrated within an analysis of a certain social environment; practices show the variations and actual interactions within these boundaries. From the observation of practices, it is possible to construct social mediations and it is possible to recognize which functionalities of a certain product are responsible for social impacts. In the light of this aim, understanding practices is an essential step.

In order to be able to define a practice more precisely, I will try to provide more insight into the difference between the two concepts. For instance, daily routines (washing hands) can be considered a practice within a certain household. If this routine is influenced by a technology, such as a new hygienic soap dispenser that provides feedback on how many germs there are on the hands on a user, the frequency with which individual members of the household washed their hands might increase due to the use of this new functionality. The process leading to these new changed interactions can be called mediations. After a while, the process of washing hands once again stabilizes and new daily routines are developed. The functionality of the technology that offers users information about germs has mediated behaviours of users and has eventually led to new practices.
This is an example in which a distinction between social mediations and practices can be determined rather easily. There is a clear intervention within a physical environment and changed practices are related to this intervention. Reality, however, is much more complex. Practices change all the time due to changes within the social environment (e.g. within a family, needs change as the children grow older), on an individual level (e.g. due to new needs related to changes in physical abilities), physical environments change (e.g. remodelling the home) and changing products (e.g. the purchase of new products such as notebooks, a tablet, etc). In other words, practices within families are constantly changing and therefore social mediations in environments are a constant factor in life. This makes it difficult to define a distinction between social mediations and practices.
I defined social mediation in Chapter 2 as 'the process leading to changed practices after a certain technology has been introduced'. For practical reasons, this has led to a focus on changes in interactions, especially on changes in the variety and frequency of interactions, as in this way it was possible to observe the actual changes that occurred in reality. Thus in the process of identifying social impact, an interpretation step is needed that focuses on the relation between an intervening technology and changed practices This yields a pragmatic, operational definition of social mediation:

Social mediation is the interpretation of changed practices; whether they can be related to a certain technology.

In order to be able to construct and interpret social mediation we need to identify and understand changed practices. The aspects of reality that characterize a practice have

not yet been defined. For this purpose, I will analyze the contextual information that was needed to understand practices in the empirical research conducted. This analysis may reveal the information that is required about social environments to construct social mediations. Table 5.1 offers an overview of the observed practices.

	OBSERVED PRACTICES	
LEVELS	Digital whiteboards (Chapter 3.) *Goal: Identify the social impact of digital whiteboards and the relation with contextual characteristics.* Methods: Observations Interviews Questionnaires	Cohousing communities (Chapter 4.) *Goal: identify the influence of differences between characteristics of social environments on social impacts.* Methods: Observations Interviews Participation in social activities Diaries focused on daily activities
INDIVIDUAL	Motivation (general towards teaching and more specific with regard to intention towards the use of digital whiteboards) Individual behaviour with regard to digital whiteboards	Differences between dwellers Backgrounds Motivation to live in a cohousing community Activity patterns (individual behaviour) **Ageing factors:** Age distribution within the community
SOCIAL	**Formal:** Changes within formal interactions with other teachers **Informal:** Changes in social interactions within the classroom Changes in motivations of the learners	**Formal:** Active (organized) interactions between dwellers (frequency, variety) Formal meetings (beside frequency, information about the process of consensus within the community and the amount of conflicts) **Informal:** Passive interactions (frequency, variety)
PHYSICAL	Influence of the position of the digital whiteboard Changing interactions related to physical characteristics Interactions between the whiteboard and the physical environment	In which room do which activities take place Interaction patterns; what contribution of physical characteristics on interactions in the community can be observed
TECHNICAL	Ability to use the whiteboard The way the whiteboard has been implemented General use of the whiteboard (for what kind of purposes, frequency, variations)	General use and implementation of new technical products Influence of the use on interactions

Table 5.1 practices observed in the empirical research

This leads to a generic overview of practices:

1. *Individual: individual motivations, values, behaviours, activities and abilities*
2. *Social: frequency and variety of social interactions*
3. *Physical design: the relation of interactions with the physical environment*
4. *Technical: the general use of technology with relation to changes in interactions*

The practices observed during the study were abstracted from the social ecological model. An example is provided for each of the above factors that explains the relation:
Re 1. In the description of the social ecology of a cohousing community on an *individual* level, the literature revealed the importance of homogeneity between values of dwellers in a cohousing community to prevent conflicts. In the present research, differences in values between dwellers were an item.
Re 2. Within the described social ecology of a classroom, 'ideal' *social* interactions were found; hence the variety and frequency of social interactions in classrooms were analyzed.
Re 3. Within the social ecology of a cohousing community, the *physical design* characteristics that lead to an increase of interactions were previously described in the literature. The actual characteristics of the observed communities were compared with these guidelines and to the actual frequencies and varieties of interactions.
Re 4. The intended goal of the technology of a digital whiteboard was to increase interactive teaching in a classroom. The tasks a teacher actually performed using the digital board were observed. In addition, any other kind of interaction that took place when the teacher used a digital whiteboard was observed.

It can be concluded that a description of a social ecology is needed to identify important influences, while practices reveal information about actual changes within social environments.

5.3.5 The moral assessment of social impact

As stated earlier, social impacts are not restricted to the intentions of a design. Focusing on the technology oriented goals of a product alone is therefore not sufficient. Consequences of products are not limited to these goals and can have all kinds of side effects. This is why generic goals of social networks were taken as the starting point for reflections on the impact of a particular technology in the empirical study. These general goals have been adapted from general knowledge about ecological systems. The goals that have been used were related to sustainability and health of social ecologies; to evaluate the number and diversity of interactions. In the literature about ecological systems, these are seen as important indicators for a healthy ecology (Costanza & Mageau, 1999).

In the present empirical studies on adaptive learning and social capital, these goals, although fundamentally different, were comparable regarding the way they could be analyzed from the perspective of interactions. Adaptive learning means that pupils need

educational support adapted to their specific needs. According to the literature, a diverse range of interactions is needed to realize these goals. In that sense, the increase in whole class teaching can be seen as a development that decreases the diversity of interactions in a school network.
In the cohousing literature, the wellbeing of residents is linked to social capital. Social capital includes shared norms of appropriate behaviour (a cognitive dimension) as well as social networks (a socio-behavioural dimension) (Veenstra, 2005). The socio-behavioural dimension is linked to the frequency and variety of interactions.
In both studies, the frequencies and variety of interactions are important indications for a healthy and sustainable ecology. Changing interactions within a network are related to the social goals of the observed social communities. This is an indication that social impact is a meaningful notion.

Frequency and variety of interactions is an important indicator for social impact and social goals can be connected to these indicators

5.4 A working model

In the previous sections, an analysis was made of the findings derived from the empirical studies described in Chapters 3 and 4. This analysis led to new insights into the construct of social impact. These findings have led to insights about ways to identify and anticipate social impact in design projects. In this section, the conclusions of these findings that are relevant for product designers are presented.
On the basis of the empirical research carried out, an analysis of how social impacts can be identified and anticipated was made. Identification is related to in-depth knowledge of a social ecology and a check against reality through a description of practices. Anticipation involves a systematic approach to finding and interpreting possible future social impacts. The next section lists the steps that are required to achieve this.

The examples of social impacts and their identification used in this analysis have promoted a better understanding of the mediation process. The process leading to the identification of social impact can be summarized in the following research steps:

1. *Determination of important influential factors* on the social environment related to social goals of a specific social network. In this study, we applied a social ecological approach to determine these factors. For a holistic view of a social network, a description of a social ecology should contain at least four factors of influence (e.g. individual, social, technical and physical factors). The social goals are related to the health and sustainability of the social ecology; the number and diversity of interactions. It has been found that it is important to determine specific factors of influence for any specific social network. A social ecology is a framework of theories rather than one specific way of thinking and therefore includes different insight from social sciences.
2. *Observation of new practices*. This is an attempt to describe changed practices in a social network resulting from the intervention of a specific technology. Practices that directly or indirectly have been influenced through an intervention need to be observed and are derived from the influences determined from a social ecology.
3. *Construction and interpretation of social mediation patterns.* Based on step 1 and 2, mediation processes can be constructed which will generate information about the way mediations have developed. The confrontation between insights from the

social ecology and actual practices leads to a construction of social mediations. This step is taken in order to understand which functionalities of a particular product are responsible for which kind of social impacts. The impact is related to changes in the number and diversity of interactions.

4. *Identification of relevant contextual characteristics*. Based on this step, a designer can gain insight into the characteristics of a product leading to undesired social impacts and the contextual characteristics that lead to desired social impacts.

The steps lead to the identification of social mediation patterns. Contextual characteristics –derived from these patterns- can lead to constraints for new developments. In the next chapter, the steps of the working model are validated in two cases.

Chapter 6: Anticipation through identification

6.1 Introduction

In Chapter 5, a working tool was defined that establishes steps for the identification of social impacts. These steps have been deduced from descriptive research. The next phase in my research is to see how the working model can be used. To this end, new descriptive research to validate this designer's tool has been carried out. Two cases are discussed that represent attempts to incorporate the social impact of technology as an influencing factor for new designs.

The first case *(6.2)* considered the identification of the social impacts of technology on working practices at a real estate broker's office. How has the use of search engines to browse through the houses listed on the internet influenced the brokers' practices? The social impact in this particular case needed to be identified and this led to new requirements for the physical offices of brokers. The second case *(6.3)* is a follow up of the study described in Chapter 4. It regards a design project, performed by a student at the University of Twente. The student's assignment was to design a product to improve social interactions in a cohousing community. The tool, developed in paragraph 4.4, is used as a starting point. This project resulted in the design of a message board system.

This chapter concludes with a discussion of the consequences of the gathered insights for the working model *(6.4)*.

6.2 Case 1: social impact in real estate offices

This case considers the social impacts of a technological development (the use of internet) on the process of selling and buying real estate properties. House hunters today can start their search for a new home on specialized internet sites (the main site in the Netherlands is: www.funda.nl). This has changed the role of a real estate broker. The homes that brokerages have listed can be searched and viewed on the internet, which means that customers can perform their own searches from behind their own computers. The question is how internet use has influenced the daily practices of brokers and what the consequences are of these changes for a broker's office needs. What would the ideal brokerage office look like, based on the social impact of the internet?

Figure 6.1: the traditional communication of a broker with his customers

Simultaneously, real estate agencies in the Netherland and especially in the Northern part of the country, are having to deal with the consequences of a failing housing market and a declining population. The international economic crisis has also negatively affected the housing market. Real estate brokers are therefore being forced to evaluate the way their business is organized.

The assignment

The students needed to identify the social impact of internet use on real estate brokerage practices. What would be the best physical environment to support the practices of a real estate broker? To understand the context of the broker, the students had to explore influences on a societal level, as well. To this end, they had to identify influences by performing analyses on a micro, macro and a mesa level:

- The mesa level was represented by means of a destep analysis[7] of societal influences.
- The macro level was represented by a construction of the social ecology (individual, social and physical factors).
- The micro level was represented through the construction of a persona (reflecting his professional and personal life).

This yielded a list of many kinds of influences, which served as a basis for an inventory of research practices. Furthermore, in order to gain an understanding of practices the students had to construct a persona and write scenarios about the daily life of a broker based on interviews and/or experiences from internships at real estate offices.
The insights about the social impact of the internet on practices formed the basis for a new concept of a real estate office.

6.2.1 Results

I will discuss the results of this project using the four steps of the working model.

Step 1: determination of the factors of influence

For this assignment, a standard format comprising technical, physical design, individual and social factors were given to the students. The students started with a brainstorming session that led to a list of influences (see the example in figure 6.2). After the brainstorming session, students had to perform desk research into a limited numbers of factors. They found that the literature mainly related to new forms of working ('het nieuwe werken') and to destep factors. They found information about the need for brokers to adapt to a new context, such as information about the influence of the greying of society, the dwindling population, the economic crisis, a crisis on the housing market and political changes in tax benefits of mortgage holders.

[7] Destep refers to demographic, economic, social, cultural, ecologic and technical factors (Kotler & Armstrong, 2009)

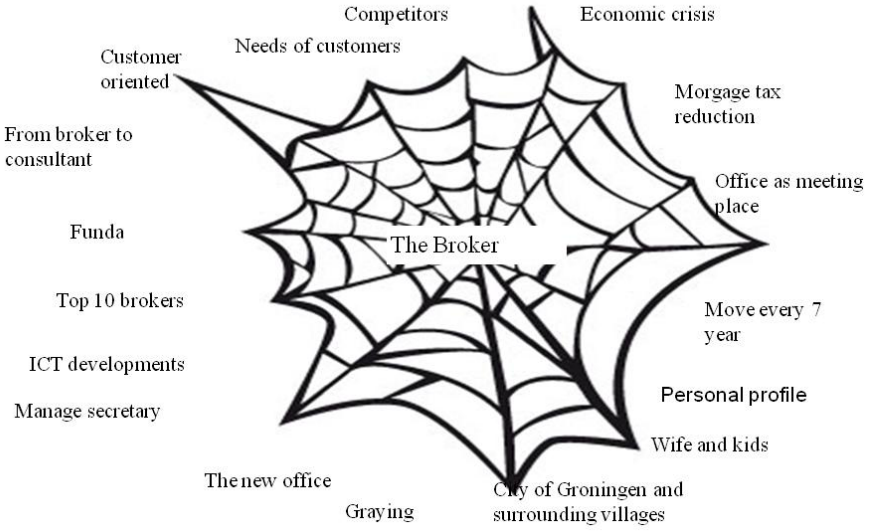


Figure 6.2: an example of an overview of influences made by students

Step 2: observation of new practices

The students described practices at brokers for different factors:

- *Individual.* Brokers mainly schedule appointments at the homes of the customers. Brokers have increasingly more flexible hours.
  The students analyzed personal needs of brokers, as well: The brokers studied in this case were small business owners (one broker with a secretary) with a wife and children. Their wives also held jobs (a necessity due to decreasing income). The brokers who had small children needed more flexibility in their daily routines.
- *Social.* The way the broker and his secretary work together has changed considerably. The secretary is generally contacted by telephone or email by customers. Hardly any customers visit the office anymore; the first impression and initial search is performed on the internet. Older customers still sometimes use a display window as a means to search for a new house.
- *Physical.* The office is open during office hours. In the showcase, the pictures of houses and some characteristics are presented. The office is designed to receive visitors and has a central location.
- *Technical.* Today's technology makes it possible for a broker to work anywhere (he is not bound to his office)

Step 3: construction and interpretation of social mediations

The students found that offices of the observed brokers were still based on the situation that a customer would go to an agency to look at the display window to check out the properties listed, even though in the current situation, most customers phoned or emailed the broker for an appointment to meet at the property on sale. The use of the internet has mediated the search process of customers from the physical offices of brokers towards the internet. On the internet, customers can browse the houses on sale, which makes their search less dependent on local brokers.

Step 4: identification of contextual characteristics

In the original situation, the location and window displays were the most important contextual characteristics of real estate brokers. These were responsible for the preliminary interaction with future customers. In the new situation, the first contact is

via the internet, which means that contextual characteristics have been transferred to the internet. However, the students skipped this step and went directly from a description of how the practice had changed to conclusions about the new criteria for real estate offices, discussing how interactions in the new situation should be organized.

The societal developments showed that there was a need to find new concepts for real estate offices. Based on the social analysis, the students concluded that the offices were no longer in line with their current use (still based on old practices). Based on the individual analysis (most students had a persona that had a wife and small children), the students concluded that it would help if the broker were to have more flexibility in his life, in order to support his wife in developing a career of her own.

Some students concluded that it would be better to have no office at all and some concluded a cheaper location outside the centre of a village with parking possibilities would be best. But all concluded that brokers having difficulties earning an income should not waste money on ineffective offices in the centre of cities.

6.2.2 Reflections

This assignment shows that contextual characteristics can be transferred from one technology to another and that the identification of contextual characteristics is not restricted to the technology that was responsible for a social impact. On the contrary, these new practices lead to a changed social ecology. When it becomes important for a broker to distinguish himself from other brokers on the internet, changes in work methods may be needed. Other individual characteristics of the broker might become important. So, the second step in the identification of social impact can influence the factors of the social ecology (first step).

The students, it should be noted were used to performing desk research on a societal level, which resulted in their paying less attention to the social level. Only a few students searched for information about new working practices. Maybe it would have been better if students had been forced to perform desk research on different levels.

In the assignment, the students focused on general practices of brokers. It would have been interesting to gain more knowledge about direct interactions with the internet. More details of interactions with the search engines would probably have yielded more detailed information about practices. In this assignment, the micro level was referred to as the individual level. It might have been better to refer to this level as the use level. This would have provided a sharper distinction to the individual factors of the social ecological framework. In a more in-depth analysis, it would be interesting to understand the contextual characteristics. Now, social impacts may have been so obvious that a more precise analysis was unnecessary.

The combination of identifying social impact and a destep analysis (or other analysis on a societal level) can be a way to find new goals and opportunities for new products. This leads to an adapted goal of the use of the working model. In a first strategic phase of product design, practices can be a basis for the identification of new goals. In Chapter 8, I will elaborate this insight further when discussing the implementation of social impact in design contexts.

6.3 Case 2: supporting social interactions in cohousing communities with technology

The second case describes an approach to improve social interactions in a cohousing community by applying dynamic social contact design principles. In this case, the practices within a community are well known and important influences of the social ecology have previously been extensively described in the cohousing literature (M Brenton, 2001; Durret, 2005; Meltzer, 2005; Torres-Antonini, 2001; Williams, 2005). Because the older residents in a cohousing community are vulnerable for unwanted changes in social interactions, the approach of the designer is to limit unintentional social mediations and to promote intentional changes.

In Chapter 4, differences in interaction patterns between cohousing communities were observed, from which possibilities for technology to stimulate interactions within different social ecologies were derived. An important difference between the communities was the difference between active and passive interactions. Active interactions are activities organized by community members; passive interactions are casual exchanges between dwellers in common areas. It was found that in one community, active interactions were more frequent and diverse, while the other community relied more on passive interactions. It was unlikely that the interactions in this community would move from passive to active, due to a less than optimum physical design. The common room was not positioned and designed according to social contact design principles.

Technology might be used to overcome such shortcomings in the physical design of cohousing communities, by influencing these interactions through a range of functionalities (see table 6.1). If it were possible to increase the frequency of contacts between dwellers, passive interactions would be more likely to metamorphose into active interactions.

General Interaction principles	Social contact design principles	Interactions	Possible functionalities of technology
Frequency of interaction Trust Reciprocity Shared Values	**Hallway:** Shared pathways Buffer zones between private and general space Surveillance	**Passive, informal:** Greeting and talking in the hallways Contact for small tasks (plants, shopping)	**Mediation of perception:** Learning other aspects of dwellers for more contact Creating feelings of trust **Mediation of action:** Increase possibility to meet
	Common room: Good quality Flexibility Central position Accessible, Surveillance	**Active, informal:** Activities like playing cards, drinking coffee, painting etc	**Mediation of action:** Enhance visibility of common room Support in organizing: Reservation of rooms; visibility of attendees, etc
		Active, formal: Meetings Selection Design process Contact with housing association	**Mediation of action and perception:** Prevention of conflicts Support of selection Support of design decisions

Table 6.1: the relation between general interaction principles, social contact design principles, social interactions and possible functionalities of technology

The assignment

This conclusion formed the point of departure for the design a of product that would influence the social interactions of dwellers of cohousing communities in a positive way, a project undertaken by a student at the University of Twente[8]. The student had to design a product for the social network of a cohousing community. That meant that he had to develop new approaches to the identification of needs of users on a social level. The study started with insights about the interdependent effect of technologies on social ecologies, but it was not quite clear how to find the right requirements for this product. The starting point for the student was the empirical study described in Chapter 4.

6.3.1 Results

I will discuss the results of this project using the four steps of the working model.

Step 1: Determination of the factors of influence

This first step had already been performed in previous research, as reported in Chapter 4. Table 6.1 offers an overview of the possible social mediations, which are able to be achieved with technology. The overview includes factorial influences based on a social ecology.

Step 2: Observation of practices

Practices were observed in two studies:

Study 1: Gaining insight into interactions of dwellers with technologies

In the first study, the student determined on his own how the research into the cohousing communities was to be carried out. Next to performing desk research, the student visited ten cohousing communities to gain insight into how the residents interacted with technology in general and to understand the way communication and activities within a community were organized. The communities were comparable to the cohousing communities in the initial study described in Chapter 4, in the sense that they were organized according to the principles of cohousing (McCammant, 1994). This first study led to the following insights:

1. Experience with technology

Experience with technology varied greatly within the communities. Some residents were regular e-mailers (including one 92 year-old), while others had no interest in computers or were lacking the skills to use one. Some of the dwellers had learned to work with computers at an older age. This result delivered insights into the individual capacities of dwellers.

2. Communication within a cohousing community

Communication within a community took place via various channels:

- During shared activities (active interactions)
- During incidental meetings in common areas (passive interactions)
- Via a bulletin board hanging, for instance, in a hallway

[8] The student carried out the project within the scope of his master's thesis studying the field of industrial design engineering. This contained more aspects than discussed here. General design approaches applied that were not relevant for the evaluation of designing for social impact have not been included in the discussion.

- Notes in the (physical) mailbox of dwellers
- Via a news letter or a news mail

This orienting research confirmed that passive interactions were important for the integration of dwellers and the atmosphere in the communities. While contacts were more easily maintained on a personal level, information about the neighbourhood and registration lists for new activities were hung on the bulletin board. Notes in the mailbox and individually addressed letters were generally used for more personal communications. General news about the cohousing community was shared via newsletters.

3. Activities

Organized activities depended on the willingness and activeness of the individual residents. Most activities were consistently attended by the same dwellers. The interviewed dwellers thought it would be better if more people joined in the activities. They felt that people should remain abreast of what was going on in a community and who was responsible for what. The activities were seen as opportunities to get to know one other in an informal way. These interviews confirmed that not all dwellers were as socially active as they perhaps should be.

While these interviews provided insights into individual views on social interaction, the individual interviews failed to indicate the characteristics a new product should have in order to be able to promote social interactions. More information about practices within the communities was needed. The focus of the student had been on practices relating to communication, as during the interviews, it emerged that communication within the cohousing communities could be improved.
In order to understand these practices, the student conducted a second study in cohousing communities that was to lead to additional insights into the way communication within a community occurred.

Study 2: Understanding communication practices

In the second study, the student and I decided to perform an intervention in seven communities. He sent several messages via a number of channels within the communities. Three forms of communication were chosen: word of mouth, notes in physical mailboxes and a message via a message board. The content of these messages was discussed with a member of the cohousing community, to ensure that the message itself contained no odd or irregular features that could negatively influence the validity of the intervention.
Dwellers of apartments were asked whether they had received a communication and what the message had been exactly. In six out of seven communities, more than 50 % of the residents were able to answer the questions; these communities were selected for further analysis. The total number of apartments[9] in the study was 86. In the six communities, the total response therefore was 62%.
Results:
The average time before the residents had received or read the message was:

- Word of mouth 1.5 days
- Mailbox 1.75 days
- Bulletin board 1.75 days

[9] Sometimes two dwellers living in one apartment were interviewed at the same time. They have been treated as 1 respondent.

The residents reported finding the message board the most interesting form of communication. Putting a message on the board was easy and within the control of the dwellers themselves. The message board also seems to be the most accurate way of spreading news in the community (see figure 6.3).

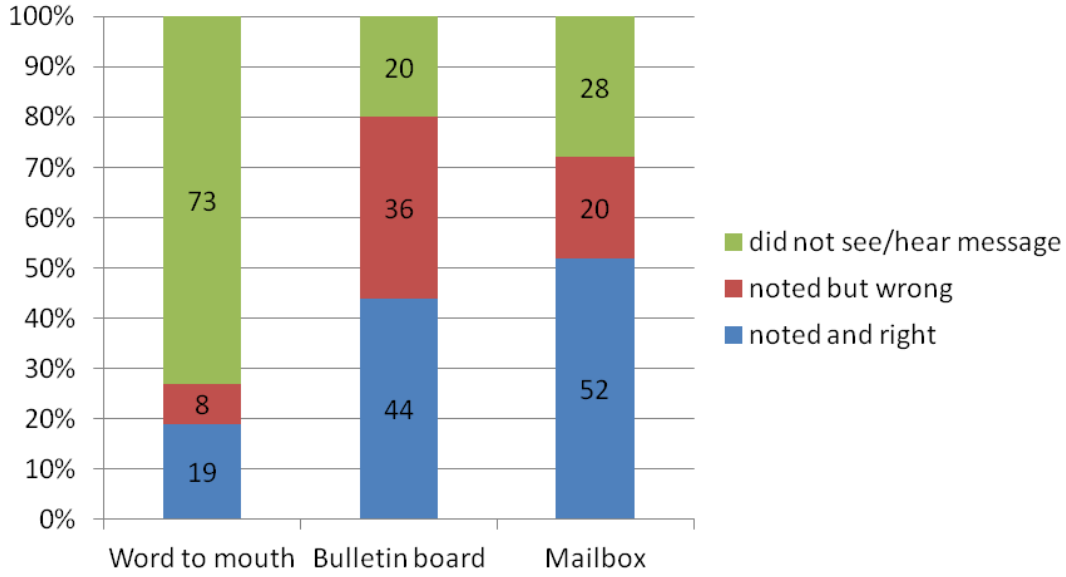


Figure 6.3: the outcomes of several communication activities in the cohousing communities

Step 3 and 4: Construction and interpretation of social mediation patterns and the identification of relevant contextual characteristics.

Based on the analysis of the study, the following could be concluded. A new technology would need to support social interactions as well as improve communications. Table 6.2 presents several possibilities to mediate social interactions that can be linked to the new product.

	Social mediation possibilities	Contextual functions of the new product
1	*Learning other aspects of dwellers*; It would be nice to know more about other dwellers, a social network like hyves/facebook offers details about the people they are connected with, which they would not learn from daily interactions.	Communication should become more interactive and show more details about a dweller.
2	*Increase possibility to meet*; Passive interactions are the basis for the formation of new friendships.	Position of technology should be in a common place. If new messages have been posted via a specific technology, dwellers could be alerted to the fact that a new message has been put out.
3	*Support in organizing activities*; if it were easier to organize an event, maybe activities could be organized more sponteneously.	Reduce the amount of time that elapses before dwellers have read a message. Make it easier to know who wants to announce a certain activity.

Table 6.2: linking social mediation possibilities with contextual characteristics

An interactive message board

Based on the above criteria, it was concluded that a system located in a common area of a cohousing community formed a promising starting point for further design. This led to the conclusion that a general board would be an interesting option:

- The bulletin board was preferred in the community and proved an accurate means to spread news.
- Its central position in the hallway could make the board an enhancer for more social interactions.
- Applying new functionalities to a message boards would not be a big step for dwellers lacking in computer skills.

Based on this information, a product was developed with similarities to the bulletin board. This product was called the Message-board system and was divided into two system components, namely a digital interactive bulletin board and a signalling module, that was to be installed in the residents' apartments. The digital interactive bulletin board closely resembled the bulletin board already in use, in order to foster its acceptance. According to the literature, a new technology is better accepted by the focus group (the elderly residents) when it is derived from a familiar product (Denissen, 2006).

Next to providing a method for disseminating information, the Message-board system offered residents of a cohousing community the opportunity to respond to messages posted via the system. This could lead to an increase of reactions of dwellers. The signalling-module alerted residents whenever a new message or reaction was posted. In this way, residents were stimulated to check for new messages and hopefully meet other dwellers on their way to the message board, which might stimulate passive social interaction.

Figure 6.4: visualizations of the students' concept

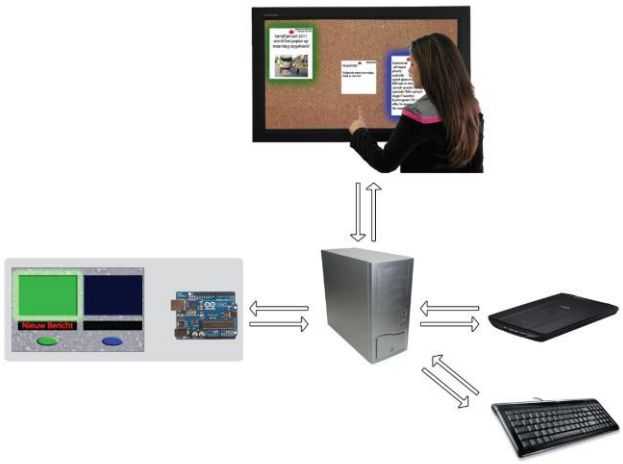


Figure 6.5: an overview of the system

The hypothesis is that by using the Message-board system, communication within the community will be stimulated; it will be easier to organize activities and due to the fact that responses that can also be posted on the message board, more messages will appear, while the signal might activate people to look at the board more often.

6.3.2 Reflections

In this case, the social ecology of a cohousing community had been described in previous studies and possibilities for mediations had been analyzed as well. The student had to influence social interactions through the development of a device.
Although information about the social ecology and practices within cohousing communities had been gathered for this specific question, which focused on communication within the community, more information was needed. The previous research had examined the general practices in a cohousing community, from which an overview of the possibilities to influence social interactions had been derived. For the next step, the student needed more detailed insights focused on the product he was about to design. The student therefore performed a new user study.
This was a new approach, and one in which not all the research conducted by the student turned out to be as effective as it might have been. Although (despite?) the fact that the student had visited ten cohousing communities and had conducted interviews with several dwellers within the communities, ultimately, he collected only a limited amount of information that was really useful for the design of the new product. He had been instructed to develop a product that would influence social interactions, but had not been free to determine his research approach. Normally, interviews carried out by Industrial Design students with users of products focus on the direct interaction with a product and needs are derived directly from the use of a product. The student needed to differentiate between the social and the use level. A better understanding of this distinction could have helped in performing better user research.
In previous research on the social level (Chapters 3 and 4), information about users was gathered through interviews, diaries (interaction patterns) and observations. In the second study, the student and I decided to try a new way of gathering information; a little experiment. However, the information this yielded was focused on limited practices of users. The information about communication practices did help in the choice of a new system, but it is questionable whether it was an efficient research method for a product designer.

Some reflections on the steps of the working model:
The first step is *the determination of the influential factors that determine a specific social network*. This step had been carried out in previous research.
The second step *is the observation of new practices* in cohousing communities. This step is meant to describe changed practices due to the intervention of a certain technology. It would have been better if the practices had been observed in the manner described in Chapter 5.3.4.
The third step is called *the construction and interpretation of social mediation patterns.* In this project, patterns are selected that need support and which are thought to be able to be influenced by technologies, in this case, previously constructed patterns. The study itself did not offer enough information to construct new patterns.
The fourth step is *the identification of relevant contextual characteristics* of the new product. In my first study, I ended with possible functions of new products, because it was unclear what kind of product would be designed. After the choice of the goals of the product and corresponding social mediation patterns, it became possible to identify contextual characteristics.
Due to a solid understanding of the previous research, the student was able to translate knowledge about practices and social ecologies into a product acceptable to dwellers of cohousing communities and theoretically with the potential to promote social interactions, with only a limited modification of practices. If the student had not had access to these studies, it would have been difficult to design a product with the same characteristics.
The difference between the aim of identifying social impact and the aim of promoting desired social impacts, as described in the previous case, led to modifications in the approach. Instead of focusing on new practices and social mediations, a designer should focus on existing practices and social mediation possibilities.

6.4 Consequences for the working model

In each of the two cases discussed above, the insights of social impact were applied in different ways:
In the first case, the social impact of the internet was a trigger for changed practices that have led to new requirements for offices of real estate agencies. Social impacts were found to change the contextual characteristics of the physical design. It might be wise to include changes in the contextual characteristics of the physical design and other technical products when aiming to anticipate social impacts. Furthermore, this case shows that social impacts can be used for broader formulated assignments in which strategies of companies are decided.
In the second case, the social ecology, practices and mediation possibilities had already been described in previous research. However, new information about communication practices was needed for a specific product. Applying the right approach to gain information about the social context was shown to be difficult. Hence, information on how practices should be observed is needed in future instructions.

In this chapter, the working model was evaluated for specific social environments. But in reality, designers have to develop products for general social environments, as well. Some products can and will be used in all kinds of contexts. In the next chapter, therefore, anticipations of social impact in the case of general social environments will be discussed.

Chapter 7: Anticipation through simulation

7.1 Introduction

In the previous chapter, a working model for anticipating the social impact of a product in a specific social environment was evaluated. Unfortunately, this is not a model that will work for all technologies, as many products are not designed to be used in a specific social environment only. Products such as tablets and mobile phones, for example, are used by different users, in all kinds of physical environments and social settings. We therefore need a model that can anticipate a product's social impact in a range of different social environments.
In this chapter, the working model is adapted to make anticipating social impact in general social environments possible. In the case of general social environments, it is difficult to identify interactions patterns and to translate these patterns into social mediation possibilities. To get around this difficulty, an assortment of social ecologies was created in which the future product might be used. Also, an approach was used in which practices were simulated.

This chapter discusses how, using a screenplay approach to simulate practices *(7.2)*, the working model developed in Chapter 5 *(7.3)* could be adapted for use in general social environments. The example of ambient intelligence given in the introductory chapter is used to illustrate the evaluation of the screenplay method *(7.4)*. Finally, the consequences of the findings for the working model *(7.5)* are examined.

7.2 A screenplay approach

In user-centred design approaches, it is common for product designers to anticipate future user behaviour. One well-known method involves the use of persona: abstract representations of users with which the designer engages in order to understand the end users of his product (Courage & Baxter, 2004; Pruitt & Adlin, 2006; Valkenburg, et al., 2008). One of the benefits of personas according to Courage and Baxter (2004) is that they can be used as a discussion tool in cognitive walkthroughs, storyboarding, construction of realistic scenario's and other usability activities. Using personas, anticipations of the future use of products can be made.
This benefit may be of particular use in anticipating social impact for general social environments.

Some points of attention have been configured on the basis of the literature on personas:

- Different persona's can be developed for different user types (three primary personas is a common recommendation)
- The personas need to be specific to the product that is developed. Generic personas do not exist.
- Personas should be based on data from usability research.

(Courage & Baxter, 2004)

Personas can be used to understand a person in his or her context and to anticipate current and future behaviours with the use of scenarios. To employ this approach on a social level, settings must be created that involve more aspects of a context. The

description of a persona must be supplemented by a description of physical, technical and social factors; in other words, a social ecological description must be provided.
This could be considered a *screenplay*, which is defined as *'the words that are written for a film / movie (= the script), together with instructions for how it is to be acted and filmed' (Hornby, 2010)*, i.e., an extended version of a script. The screenplay approach may be regarded as an extension of the persona approach, enhanced with a description of social structures, technical and physical design characteristics.

Factors of social environments
In some cases technologies may be developed for well-known and delineated situations. A surgical tool has limited contexts in which it will be used. Other products, like cars, will have less well delimited usages; a car can be used in very varied contexts (countries, circumstances), varied social contexts (business, holiday) and by different types of individual users (young, experienced, etc). The impact of factors in well-specified contexts can be understood through desk research. When attempting to assess social impacts in a less well known and more varied social environment, it might be better to focus on a number of variations.
Whether the screenplay approach is an interesting way of simulating social ecologies and practices needs to be further analyzed. In the next section, the consequences for the working model are discussed.

7.3 A working model for general social environments

The insights that have been derived about social mediations indicate that a chain of interactions merges into changed practices. In order to anticipate the impact of a product on a general social environment, a way must be found to form possible chains of interactions in a systematic manner. Two differences with the previous approach described in Chapter 5 should be noted. In the first place, the social environment in which the new product will be used is not specified. Depending on the goal of the product, this implies that a number of social ecologies need to be described. As a consequence, various practices need to be simulated. These two aspects shift our focus from in-depth insights towards an approach that offers the possibility to examine numerous social impacts.

This leads to the following steps:

1. *Construction of different social ecologies*. In the first phase, the social ecologies of possible future users of a product must be established. What kind of influencing factors are relevant in this specific case? Also, possible functionalities of the future technology need to be defined. All possible attributes will be gathered.
2. *Simulation of new practices*. The attributes from the social ecologies will be combined in a number of variations and translated into possible future scenarios. Social impact scenarios need to be made for a variety of social ecologies.
3. *Construction and interpretation of social mediation patterns*. In this phase, possible social mediations need to be identified. These are derived from the scenarios in step two. The confrontation between insights from the social ecology and simulated practices leads to a construction of social mediations. This step is taken in order to understand which possible functionality leads to which kind of social impact. For a correct interpretation of social impact, two questions need to be asked: Is the social impact likely to happen? Is the social impact wanted or unwanted, in the light of the general social goals of the specific environment?

4. *Identification of relevant contextual characteristics*. Based on this step, a designer is enabled to recognize which characteristics of a product lead to unwanted social impacts and which contextual characteristics yield the desired social impacts.

In the next section, I will apply the insights from the working model and the screenplay approach.

7.4 Case 3: ambient technologies

This case is a variation on research performed by the Rathenau institute into possible impacts of ambient intelligence, which was a trigger for the necessity of this thesis (Schuurman, et al., 2007). In the introduction, we examined an example taken from this study that demonstrated anticipated social impacts of ambient intelligence technology on future care practices (see section 1.3.1). The question was asked whether it would be possible to apply a systematic approach that enabled designers to find a wide variety of possible impacts.

One of the cases discussed in the study of the Rathenau institute is used for further exploration in this chapter. The case discussed is an example of context aware technology that is still limited in intelligence. A scenario has been constructed that describes a man with heart problems, who wants to go on a holiday with his wife. His cardiologist won't allow him to go, unless he is willing to use a 'heart manager'. The 'heart manager' consists of sensors on his body that continually register his heart rhythm and brain activity (via ECG and electroencephalography). These sensors were provided by his insurance company. Were any cardiac problems to arise, ambulances or doctors would be directly notified.
One of the activities he undertook on holiday was mountaineering. The sensor registered that his heart function lessened while climbing. After the holiday, his medical coach confronted him with this information at a regular check-up. The coach indicated that his insurance might not cover future trips that included hiking in mountains.

7.4.2 Results

I will discuss the results of this project with the help of the four steps of the adapted working model.

Step 1: Construction of different social ecologies.
The first step consists of constructing the social ecologies for possible future users. What screenplays can be determined that are relevant for this case?

The following screenplays were created:
For the individual factors: the various users who might receive a heart manager are described. These were:

1. An adventurous man (not afraid of a little risk) called John.
2. A concerned man (who has never changed his job and is likely to go on holiday in the Netherlands every year) called Patrick.
3. A critical teacher who is environmentally aware and politically left wing, called Steven.

For the social factors, a social setting was added to each of these individual users. A different perspective was chosen for each individual. This is also the case for the physical design context. For the future concept, eventual contextual characteristics were identified.

The result of step 1 is summarized in the table below:

INFLUENCES	DETERMINATION	ATTRIBUTES
INDIVIDUAL	identity, status, goals, skills, tasks, requirements, expectations	**John**: adventurous, education: university Middle class, sportsman, besides heart problems in good shape **Patrick**: conservative, low income, passive lifestyle, job as a factory worker **Steven**: teacher, environment aware, critical of technology, vegetarian
SOCIAL	(relationships) Formal; job, voluntary jobs, doctors and insurance company Informal; friends, family, neighbours Passive, active interactions	**John**: married, independent, no children, spends a lot of time with his friend. They organize a lot of activities **Patrick**: his daughter and son are his most important contacts. They visit him every Saturday (son) and Sunday (daughter). He is also a volunteer at the local football club. **Steven**: his children are very important; politically active for left wing parties, also active as an artist.
PHYSICAL	Housing characteristics Living environments Recreational environments	**John**: bought his house in Zeist and spends a lot of time with his wife decorating it. It is a characteristic, detached house. Holidays in Spain and Austria (they rent apartments or stay in hotels) **Patrick**: has a rental home in the northern part of the country (Meppel) in a row house. He spends his holidays in his own caravan at a campsite in Diever **Steven**; lives in the southern part of the Netherlands (Limburg) where he owns an old farm; biking trips to Norway and the former DDR.
TECHNICAL CHARAC-TERISTICS	Functionalities of technologies Contextual characteristics	The information provided by the heart manager can be handled in various ways (who and when do people have access to the data? No sharing for individual use Transmitted to all involved parties Transmitted only to specialists of a hospital When do people have access to this information? Only at the moment of heart failure Once a week Once a day Continuously The design of the heart manager: It is integrated in the body It is worn on the outside of the body How is the information shared with other instances via mobile connections with an epd that can be consulted only an automated message will be sent to the local 112 emergency service.

Table 7.1 Variations that might influence the social impact of the 'heart manager'

Step 2: simulation of new practices.

In this step various screenplays were constructed. The attributes in the above figures were combined in a number of situations. Links were made between a specific situation, a persona's character, other physical, social and individual characteristics and possible designs and functionalities of the heart manager.
The combinations of attributes led to different scenarios.

Some examples of possible scenarios:

Scenario 1: Mountaineer John is seeking new thrills

Screenplay: John (individual), influence of friends (social), holiday in Austria (physical context), the heart manager emits a sound as soon as he develops problems with his heart and then the emergency departments are sent an automatic message with his gps coordinates (technical attributes).

John has developed heart problems at the age of 62 and is really confused. He has always been an active man and had assumed that he would remain in good health well into old age. He has gone mountaineering his whole life and even undertaken some pretty difficult expeditions (even an attempt to scale K2, unfortunately without reaching the summit). Now John, his wife Jane and some friends were on their way for a pretty standard expedition in the Austrian Alps - the kind of expedition he would have laughed at before his health deteriorated. His friends (with whom he had been climbing for many years) have joined them and are teasing him about his new situation. John knows this is because he was always shooting his mouth off about people having 'preventable' diseases, criticizing their lifestyles (too many fish and chip dinners, too much drink). Furthermore, John has always been very competitive, and his friend secretly hopes that he will be forced tone down his views during this trip. Jane, however, is very concerned and hopes for the best. She was dreading this trip and warned John against going. But John wants to live his life to the full and would rather die than stay at home for the rest of his life. He tells Jane: if I develop a problems with my heart while I'm on a climb, the authorities will automatically be warned and they will try to rescue me. During the holiday, he is hardly aware of the heart manager; it is so small (the sensors have been inserted under his skin) that he tends to forget about his situation, particularly when he is really excited during climbing. It is a fantastic feeling.
During one of their climbing expeditions (Jane stayed at the hotel that day), the heart manager suddenly starts to beep. John is experiencing heart problems. An automatic message is sent to nearby rescue teams with gps data and information about his condition. Unfortunately, John and his friends are in an area where an alerted helicopter is not able to land and his friends have to carry him to a different location. The helicopter arrives just in time and takes him to a hospital in a city nearby. John survives, but his heart problems have worsened.
The Austrian authorities are not pleased about John's expedition and intend to recover the costs of the rescue from John's insurance company. Over the past years, there have been too many daredevils like John in these mountains, which has saddled the Austrian government with considerable extra costs.

The next scenario is a variation on the first: now, John's heart manager has been replaced by a more visual device, whose constant presence influences his daily behaviour.

Scenario 2: The influence of the physical design of the heart manager on John's behaviour

Screenplay: John (individual), friends and wife (social), restaurant (physical context), heart manager is visible under shirt (technical characteristics).

Everything is going well on John and Jane's holiday. They are very happy climbing together during the day and socializing with their friends in the afternoons. However, one thing is bothering John: the physical design of his heart manager. It looks like a small mobile phone and is attached to his chest. It is constantly bothering him (he feels it all the time) and when he wears a thin shirt, other people can see it. He has always been a very handsome man and still looks not a day over than 50. Unfortunately, the temperature in the restaurant forces him to take off his jacket. People ask him questions about his heart manager, while he was trying to forget his heart condition during his holiday. Although the evening is a pleasant one, he would actually prefer to go back to his hotel.

The next scenario introduces Patrick, who is a totally different person (see table 7.1 for characteristics). He has a device that allows him to monitor his heart condition constantly.

Scenario 3: the influence of new availability of information about his heart condition on Patrick's behaviour

Screenplay: Patrick with concerns (individual) worried children (social), at home (physical context) and a technology that provides constant information and that can be consulted through a smart phone; furthermore a daily summary of the information is available for his children (technical characteristics).

Patrick is having a difficult time adjusting to his heart condition. He is afraid to exercise (although the doctor has strongly recommended him to do so). Whenever his heart skips a beat, he worries that his heart problems have returned. His daughter has arranged for him to be fitted with a 'heart manager'. This device will provide him with information about his condition and make him feel more secure. He can monitor his heart rhythm on his mobile phone and he will receive extra warnings in critical situations. Patrick continuously checks the information provided by the device. After finishing a light task for his wife, he checks to see whether his data has changed. His children (who can read a blog with a summary about his condition during the day) add to his concerns by confronting him with variations in his heart rhythm. His doctor, however, assures him that these variations are normal. Since he has gotten his heart manager, Patrick has rarely left his house anymore.

The above scenarios can be extended to as many screenplays as can be thought of.

Step 3: construction and interpretation of social mediations.

For this step social mediations need to be identified. These will be derived from the scenarios in step two. Several mediations can be identified:

- In the first scenario, the technology did not mediate the direct practices of John: the device was invisible and therefore disappeared to the back of his mind rather quickly, so John received no feedback on his expeditions in the mountains. The fact that he would receive help whenever needed, together with the social pressure of his friends, increased the risks he was taking.
- The second scenario illustrates how the technology of the heart manager impacted on the wellbeing of a person. In this case, mediations of the heart manager with other visitors of this restaurant will influence John's behaviour in future situations.
- In the third scenario, the mediation of the availability of information on the behaviour of Patrick is discussed. The constant availability of information and the interpretation of data is another complex issue.

The mediations derived from the scenarios need to be interpreted to understand how these lead to harmful social impacts. Two questions are essential to this: Is the social impact likely to happen? Is the social impact harmful? These two questions are foremost in interpreting the impacts found for the heart manager. The likeliness of the impact should be analyzed in the light of comparable situations:

- Literature on the influence of social norms on our behaviour can validate whether social groups have major influence on our mountaineer John (Steg & Vlek, 2009).
- Risky behaviour, for instance in cars: sensation-seekers are known to exhibit more risky behaviour in vehicles equipped with anti-lock brakes (Jonah, Thiessen, & Au-Yeung, 2001).
- Impacts of background and foreground positions of technologies (Don Ihde, 1991).
- Information about the psychological consequences of e.g. wearing hearing aids could provide information about whether the visibility of a heart manager is an important factor that might influence John's behaviour.
- For John, being confronted with the heart manager could also have a positive effect, in that it might function as a nudge to remind him of his heart problems (Sunstein & Thaler, 2008). It is questionable whether in that scenario John would undertake the same risky expeditions as in scenario 1. The probability of this impact needs to be considered as well.

The possible harmful impact is related to generic social goals:

- John may be ashamed of his heart manager; he will isolate himself.
- The relation between Patrick and his children changes; they act as if they were his minders, which could cause the relationship to deteriorate.
- Etc.

Step 4: Identification of contextual characteristics.

Based on step 3, characteristics of technologies can be linked to possible impacts. This can help in the evaluation of functions of new products.

Contextual characteristics	Factors of influence	Social impact
Availability of technology.	Influence of social norms. Risky behaviour with ABS.	Might lead to increased risks.
Visibility of technology.	Influence of social norms. Impact of foreground and background positions of technology. Nudge to increase awareness.	Might lead to social withdrawal and increased safety behaviour.
Constant availability of data.	Impact of direct feedback on behaviour. Influence of social norms. Impact of foreground and background positions of technology. Nudge to increase awareness.	Individual and social behaviour may be adapted to control the data from the product.

Table 7.2 contextual characteristics linked to social impacts

In step four, factors of importance (from the analysis in step 3) must be linked to contextual characteristics and possible social impacts. Obviously, only impacts will be used which are likely to occur and which lead to wanted or unwanted impacts. Based on this overview, a designer can reflect on the desired functionalities of a heart manager.

7.4.2 Reflections and consequences

In this chapter, a switch has been made from the in-depth analysis of a specific social environment (Chapter 6) to a situation where a new product can be used in all kinds of social environments, i.e. from a heavily studied social environment to the case of a product (in this case, the heart manager) intended for use in a variety of environments. The number of social impacts may therefore be expected to rise. The aim in this case is to find as many social impacts as possible. The perspective has shifted from a qualitative analysis to a quantitative approach (e.g. a brainstorm).

Furthermore, variations in technical functionalities of the proposed new product proved helpful in providing information about the relation between functionalities and social impacts.

The validity of this approach might be improved by incorporating real data about users and social environments in this analysis, as is recommended in the persona approach. I have chosen to focus on the quantity of results and to perform an evaluation of the outcomes through desk research (does the literature suggest that the impact in question likely to happen?).

Consequences

When designing products for general social environments, a different approach is needed regarding anticipations of social impacts. Social impacts can be unexpected due to variations in social contexts. It has been shown that the adapted working model for general social environments can help designers to anticipate social impacts of new technologies.

Chapter 8: Social impact in design

8.1 Introduction:

In the introduction to this thesis, the specific characteristics of a designer were discussed. A designer is often called a T shaped professional: one that combines in-depth expertise about a technical discipline with the integrative thinking that is needed to understand other disciplines (Valkenburg, et al., 2008). According to Brown (2005) a T-shaped professional can be an industrial designer and, at the same time, have garnered a mastery of anthropological skills.
I have assumed that it might be useful for a designer to integrate knowledge from other fields instead of creating own knowledge through complex and intensive research methods. If a designer needs to acquire anthropological skills, for example, this may need to become in-depth expertise in this field. Another argument reinforces this assumption. A designer has to deal with increasingly complex technologies in an increasingly complex world. For instance, a complex product, such as ambient technology might be implemented in a complex social environment such as a hospital, which has acquired a lot of technology, new ways of working, etc. This may increase the need to gain insights from other disciplines, instead of generating this knowledge himself. However, the research has shown that current approaches do not include all necessary outcomes for user testing. This has been a main argument of my thesis; social consequences of new technologies need to be included in design practices.

In the previous chapters, I discussed how social impact could be anticipated. A working model was defined and evaluated. However, any new method or tool needs to be implemented in a design context. This may cause changes or demand adaptations on both sides. In this chapter, I will therefore examine how the concept of social impact may influence designers' practices *(8.2)*. Based on this discussion, a working model is defined to influence the awareness of designers with regard to social impact *(8.3)*. This working model will be evaluated *(8.4)* and the chapter will conclude with some consequences of the new insights *(8.5)*.

8.2 Designing social impacts

In this section, I will discuss how my vision on social-centred research may affect user-oriented design practices. I will focus on general practices with regard to user-oriented research and the translation of this research into design specifications:

- A conclusion of this study was that a social level needs to be included in user testing. This has consequences for the way user-oriented research is performed. The question is how designers should include social impact as a research objective.
- The evaluation of a product or a system has been based on the fact whether the use of a product or a system fulfilled the goal of a user. When other goals (of social environments) also become important, this may lead to different ways of defining new functions. An initial focus is, therefore, how to define functions of products in the light of the social impact these may have.

The empirical study concluded that outcomes of social mediations can be rather disruptive for a social environment. When social aims become important research goals for designers, it is necessary to understand how such disruptiveness will be dealt

with. There seems to be a contradiction between the goals of social innovations that may lead to disruptions in social environments and my conclusions about social impacts that may lead to cautiousness within design projects. Therefore, I will discuss how the paradigm of social impacts affects our insights into the disruptiveness of innovations.

The following subjects will be examined:

- consequences for user-oriented research approaches;
- the translation of research into design specifications;
- disruptiveness of designs.

First, general insights into practices in design contexts will be discussed. Secondly, these insights will be combined with insights about social impacts and finally, the consequences for design contexts will be reviewed.

8.2.1 Social impact and consequences for user-oriented research approaches

To understand the current approach of user-oriented research (Courage & Baxter, 2004; Kolko, 2007; Valkenburg, et al., 2008) it is necessary to understand what the aim of product innovation is. Product innovation is often viewed as being synonymous with finding and developing new product-market combinations(Buijs & Valkenburg, 2005; Poelman, 2005). In such approaches, the size of the market is emphasized. Market research provides opportunities to identify consumer needs. This demand-driven approach has gained preference over traditional supply-driven approaches. Market driven initiatives are progressively expanding to cover social services (Morelli, 2007). However, innovation is moving towards a socially driven orientation (Green, 2007); instead of consumption (supply-driven) and experience (demand-driven), transformation in the context economy is becoming an important priority. Examples of social innovation are the multidisciplinary approaches to Healthy Ageing and Sustainable Energy[10]. However, the quality criteria on which market-driven initiatives are based do not always match the criteria related to social quality (Morelli, 2007)[11].

In market-oriented approaches, consumer needs are an important factor. These needs were often related to relieving people of the tasks of everyday life. Many activities that used to be carried out by individuals themselves or within social and family contexts are now performed by something or someone else (Morelli, 2007). An example is the energy consumption of families. Instead of the users, the energy companies have assumed the responsibility for ensuring an energy supply during a cold winter. Energy is delivered automatically and without any restrictions to customers and has therefore retreated to the background in modern households (Don Ihde, 1991). According to Morelli, this process of creating more comfort leads to passivication; it relieves customers of responsibility or the need to perform any physical work. Passivication renders people incapable of finding solutions for themselves and undermines social relationships, as it replaces personal links and social networks. In the case of energy consumption, social innovations focused on enabling users to decrease their energy

[10] For instance the Healthy Ageing Network of the Northern part of the Netherland www.hannn.eu or the European Renewable Energy Research Centres Agency (EUREC) www.eurec.be.

[11] Morelli cites De Leonardis, O. (1998). In un diverso welfare: sogni e incubi, Feltrinelli Editore.

consumption are needed to make people capable of achieving these goals; activating users instead of making them passive.

Reference to the findings on social impact

In the theoretical chapter of this thesis, I explored the origins of the social ecological approach. In the area of health interventions, a focus on one aspect - for instance ,the physical environment - turned out to be inadequate. For health interventions to achieve results, the social ecology (individual, social, physical and technical factors) needed to be considered. In this way, a social ecological approach was helpful in showing a more holistic view of reality and therefore proved to be helpful when I wanted to understand consequences.

Consequences of these findings

If a designer wants to activate users from the perspective of social innovation, a holistic view on the social context that has to be changed is needed. The examples regarding social innovation show that aims of designers are shifting from an individual perspective towards a social perspective. Therefore designers need approaches that support this shift. The social impact approach aims to contribute to the further development of tools and methods for social innovation.

The social impact approach is focused on the identification of *consequences*. *Intentions* of social innovations need to be included in user-centred approaches, as well. This calls for other tools and methods. The social impact approach should be regarded as another type of social centred design approach.

Furthermore, the relation between activation and passivication seems to be more complex than suggested in my analysis. Wheelchair use can enable an elderly resident to leave his/her home and have interactions with other people. But if this use were to lead to a decline an elderly person's abilities by performing actions that would otherwise keep someone in better physical shape, this might, in the end, lead to a decline in the ability to interact. This relation should therefore be explored more in detail.

8.2.2 Social impact and the translation into design specifications

In design projects a distinction can be made between the design of goals and the design of means (Poelman, 2005). The process of defining desired functionalities can be regarded as a design of goals process, while the design of means focuses more on the realization of specified goals. The question is how the implementation of social impact, which suggests a new way of evaluating functionalities of designs, influences the formation and realization of new requirements.

A good designer needs to find a balance between the design of goals and the design of means. Wrong starting points, for instance, have negative influences on design projects. This can be found in approaches that focus solely on designing means; they start with 'ideas' (Cooper, 1986) that have not been thoroughly investigated. Such approaches ignore the question of how ideas for new products are generated (Poelman, 2005). In practice, designers have different focuses. Some specialize in the design of means, and are generally called mechanical engineers. Industrial designers, however, will try to generate and evaluate objectives for new technologies as well. They are much more involved in designing goals, which is related to a process of defining new functions for users to fulfil new needs. Both groups, however, are considered to be designers and

hence, for clarity's sake, I will refer to mechanical engineers when I want to make it clear that the focus is on designing means.
Although industrial designers are involved in the design of goals, in user testing the emphasis has mainly been on the design of means. This is because there were enough goals 'in stock' and goals were related to the satisfaction of needs of consumers (Poelman, 2005). So the task was delegated to marketing. According to Poelman (2005), goal setting is an important task for designers as well, because of wrong translations of goals into products. In his view, a more systematic approach to the design of goals in innovation projects is needed.

The goal of mechanical engineers is to realize specified goals. An engineer needs to have an understanding of the working of technology in the real world, which Roozenburg and Eekels (1998) refer to as the cosmonomy. This reality is simplified through causal models. Insights from causal models are translated into concepts, which can then be tested in the real world.

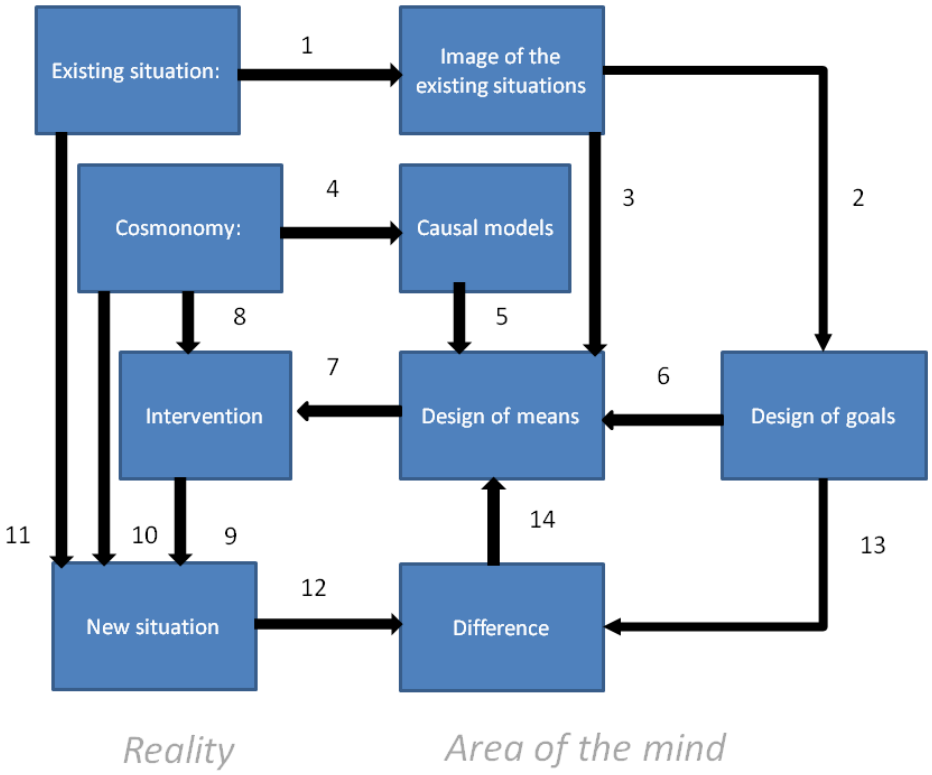


Figure 8.1: the structure of actions in product development, adapted from Roozenburg en Eekels (1998)

The development of the first Philips' Cool Skin shaver offers an example of this method[12]:

- The image of the existing situation of shaving was that electric shaving could be improved for its users *(1)*. The new product was intended to provide a better shaving experience and a more effective shave *(2)*; it was found that electric shaving could be improved by the use of a shaving emulsion *(3)*. The emulsion was a means to realize a goal *(6)*.

[12] I worked as a usability researcher at Philips Drachten for 9 years and was part of the design team that worked on the first Cool Skin shaver.

- It was found that a 'normal' emulsion would harm the plastic materials and the electronics of a shaver. Emulsion ingredients were needed that would not harm the electronics, and new plastic materials needed to be selected for the housing of the shaver that were less subject to corrosion. This required in-depth insights into the characteristics of these technologies and emulsions *(4)*. Based on theoretical assumptions (causal models), concepts were developed *(5)*, realized *(7)* and tested in realistic situations (intervention). This testing led to a new situation *(9, 10, and 11)*. Generally, a difference was found between the desired (goals of design) and the new situation *(12, 13)*.
- This procedure allowed possible impacts to be anticipated by means of several analyses. These analyses focused on possibilities and consequences of failures. So the means of design were put through extensive testing and the functions of the technical product (emulsion as well as the shaving device) were adapted in the process of design *(14)*. However, the goal of design, i.e. improving the shaving process with the help of an emulsion, was not evaluated within this approach.

Reference to the findings on social impact

If identifying or anticipating social impacts become part of the product development process, social impact will become part of the activities of a designer. Insights into social impacts and social mediations need to be translated into specification for new designs. The steps of the 'structure of actions' can also be applied in the social impact approach, as I show in the figure below.

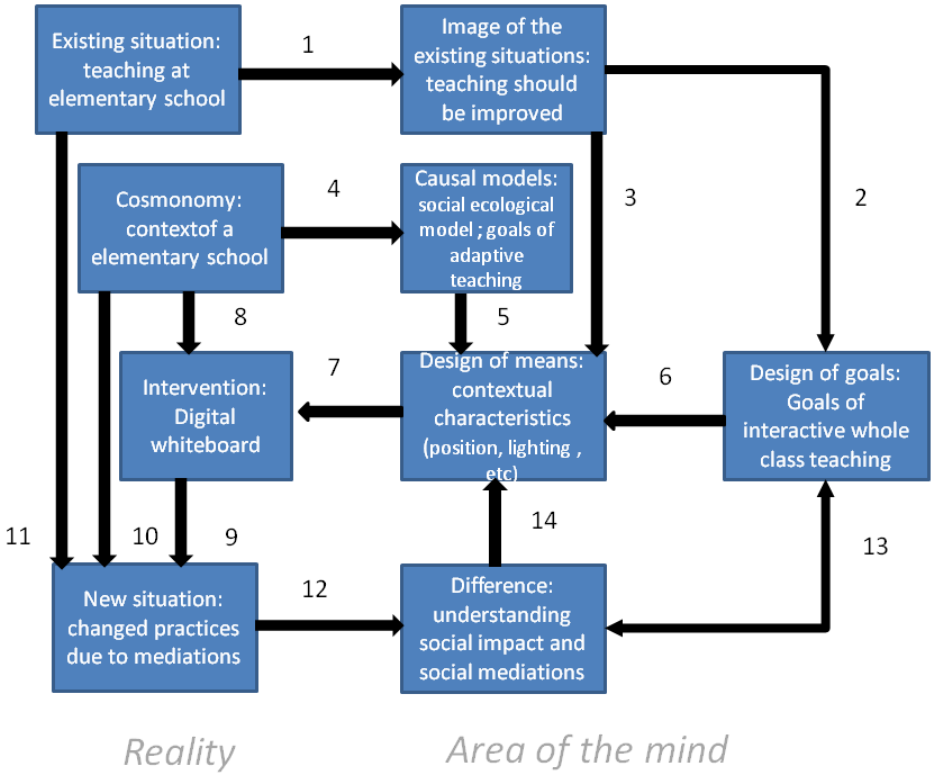


Figure 8.2: the structure of actions in the case of identification of social impact

Applying the structure of actions to the example in Chapter 3 of the digital whiteboards yields the following case, in which a designer performs all necessary steps in an ideal situation (which will not have happened in reality!) needed to design a digital whiteboard for an elementary school:

- The existing situation in an elementary school should be observed to understand what kind of improvements could be made to bolster the quality of teaching. The problem should be shared with designers and this knowledge will lead to an idea of what the purpose of a new design should be *(2)* and the means that could be used to improve the existing situation*(3)*.
- The cosmonomy of a school needs to be translated into a causal model *(4)*: a social ecological model connected to social goals of the environment. This knowledge influences the design of means *(5)*. Ideally, understanding the general goals of an elementary school and understanding the goals of design*(6)* might lead to anticipations of difficulties between goals of design and goals within the social ecology of an elementary school.
- Once the functionalities of a new product have been realized into a product *(7)* a developed whiteboard can be tested in reality *(9)*. The cosmonomy of a school will influence the new situation *(10)*. The differences between the new and old situations will be analyzed *(12, 13)* in the light of social mediations and observations of changed practices, which could lead to improved specifications for the digital whiteboard *(14)*.

The analysis of differences between the new situation and the goals of design yields new design specifications for a digital whiteboard, but it also could lead to questions about whether the goals for design were addressed in the right way.
Differences that turn up in the analysis of the way the digital whiteboards were executed relate to the design of means process; a better way of realizing functionalities is then needed. In the research on digital whiteboards, the importance of the lighting characteristics of digital whiteboards would have become apparent if they had been tested in advance. However, if it is concluded that the differences relate to the intended goals, the design of goals should be evaluated, as well. For example, in the research on digital whiteboards, the question of whether the increase of whole class teaching due to the intervention of a digital whiteboard would be harmful for goals of adaptive teaching, and therefore for the cosmonomy of an elementary school, might have arisen, which might have led to an adapted design of goals.
Designers could also try to understand the social impact of the developed concepts by performing a simulation. In this case, the sequence of actions could be performed to improve the design of goals process without having to invest sums of money in technical concepts.

Consequences of these findings

As we have seen, anticipating consequences fits into the structure of actions described by Roozenburg and Eekels. It is also clear that the standard work method can cause unintentional consequences of new technologies to be implemented by mechanical engineers, while social impacts are completely overlooked. A probable cause for this difference is that mechanical engineers are confronted with these unintentional consequences, which are unpleasant and unavoidable. Malfunctions within a product can lead to high costs and user dissatisfaction. In the case of social impact, however, consequences are not directly related to a new technology and may evolve over time. A designer is not directly confronted with unwanted social impacts.

According to Poelman(2005) the most important stage in the industrial design engineering process is the 'function analysis', which relates to the design of goals. The process of defining functionalities therefore needs to be evaluated in the same way the

realization of functionalities is evaluated and should be extended –if necessary- to social impacts, as well. An awareness of the need to anticipate social impacts will not develop automatically. It is therefore important that a designer is able to assess whether implementing the anticipation of social impact in a design process is necessary or not.

8.2.3 Social impact and disruptiveness of designs

According to Christensen, Bohmer and Kenagy (2000) disruptive technologies may be the cure for healthcare, because the healthcare needs to be transformed. Managers and technologies need to focus on getting less expensive professionals to do more sophisticated things (with the help of technologies) in less expensive settings. They compare the change that is needed to the transformation of mainframe computers into personal computers that brought a huge transformation in the way we work. However it seems difficult to change practices within the healthcare context because of resistance and a focus on the patients with the most difficult needs (Christensen, et al., 2000). So, it seems that disruptiveness is seen as an important indicator for social innovation in health care. The question, however, is whether the standard view on technologies will be of help in care organizations.

Disruptive Technologies in design environments are viewed from the perspective of whether they are able to change social contexts. An example is the introduction of the compact disc player and, more recently, the iPod (Schoormans & Bont, 1995). Strategic questions within companies are focused on the question of what kind of innovation is needed to make sure that a company stays healthy. Only focusing for instance on incremental innovations is considered to be a risky strategy that might harm a company in the long run (T. Brown, 2009).

This explains why a matrix to describe disruptiveness is called the 'Ways to Grow' matrix. A 'Ways to Grow" matrix visualizes how companies can manage their design based innovation portfolios. This model has similarities with the Boston Consultancy Group matrix (Morrison & Wensley, 1991), but is more focused on design issues.

The matrix evaluates innovation efforts within an organization (see figure 8.3). By mapping innovation efforts along a vertical axis representing existing users, to new users on a horizontal axis, companies can obtain a good picture of the balance of their innovation efforts. The focus in this analysis is how new product market combinations are made. The most innovative way to do this is to attract new users with a new technology; the safest innovations are steps in finding small changes for users that were already using a product (T. Brown, 2009).

This model focuses on what a company needs to know in order to design a new product (new offering) for new users. However, it does not explain how a newly disrupted social environment will develop. What kind of products change practices? The definition of Schoormans and de Bont (1995) offers only a restricted view of disruptiveness.

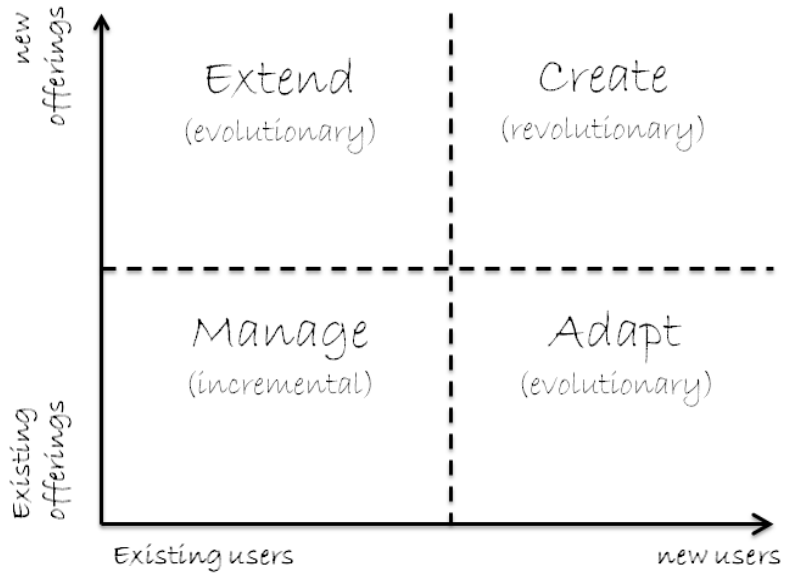


Figure 8.3: the Ways to Grow matrix (T. Brown, 2009)

Reference to the findings on social impact

According to the paradigm of social impact, the disruptiveness of designs are considered from the perspective of outcomes. When technology intervenes in a script, leading to changed practices, a technology is considered disruptive. Thus observed, innovation might be understood differently:

- A new technology (new offering) means that the kind of social impact that can be expected is unknown. It might be difficult to know which contextual characteristics will lead to what kind of social impacts; unintended outcomes may therefore be expected.
- Users are replaced by social environments: understanding new social contexts leads to difficulty in understanding the consequences of implementing a new product, because social patterns are not identified. Hence, there may be a higher risk of unintended outcomes. And, as demonstrated by the example of the iPod, even in the case of known social contexts, new practices could have developed in previous years that are not yet known.
- Another aspect that can be disruptive for a social context is the question of whether a certain practice is about to be changed through a new technology. A product designed to interfere with a script -as described in the previous section- might lead to changes in social interactions and can therefore be considered disruptive.
- User flexibility was also mentioned as an important aspect for the evaluation of social impact. Vulnerable users may have fewer options to adapt their behaviour to changed practices and are therefore more affected by the introduction of new products.
- When a product is developed for an undetermined social context, it is much more difficult to control and anticipate social impacts of a new product and hence the consequences can be more disruptive.
- Finally, a product that mainly influences individual behaviour (e.g. a shaver) is believed to be less disruptive than a product which influences social practices.

Consequences of these findings

As noted above, a change is needed in healthcare practices. Social changes can be enabled with the help of technologies. Disruptiveness has always been associated with social impact, as was illustrated by the shift from mainframe computers to personal computers. So, the model used to describe the impact of innovations for companies should be translated towards a model to describe the consequences for social environments. My research explored how such consequences can be identified and anticipated and thus contribute to a careful and controlled implementation of social innovations.

8.3 Awareness of social impact

The previous section concluded that a more detailed analysis of the disruptiveness of new products is possible. However, we also saw that product developers find it difficult to become aware of the necessity to anticipate social impact. A solution could be the development of a tool for designers that would enable them to apply these insights.

The analysis in 8.2.3. revealed several factors that influence the disruptiveness of a product for social environments, i.e.:

- What is known about the influence of (contextual) characteristics of a product?
- What is known about social environments in which the product will be introduced?
- Will the new technology have an influence on practices of users? Will it change a script?
- What is the flexibility of users? Can they adapt to changing practices?
- What are the characteristics of the social environment in which the technology will be introduced? Is it possible to specify a fixed social environment?
- What is the level of influence? Is the product expected to have an impact on individuals or can it be expected to have an influence on social practices as well?

The first two aspects are related to the matrix of the Ways to Grow matrix and the Boston Consultancy matrix, and are described from the perspective of the eventual impact on a social context (while the others are written from a design and a marketing context). The aspects describe the difficulty of a new innovation; in the case of new functionalities for a new social environment, a thorough evaluation of functionalities must be carried out by the company as well as an exhaustive investigation of the new social environment. This dimension focuses on uncertainty for a company.

The third and fourth aspects reflect the consequences for a social environment. If practices are changed, will they change in the intended manner? In the case of vulnerable users, will they be affected by changes of practices? This dimension therefore reflects the uncertainty for a social environment.

The fifth and sixth aspects are related to the possible scope of changes: If a technology is designed for a specified environment, it is easier for a designer to understand influences in a social environment. The level of influence relates to the primary influence of a product; if it is focused on individual use, social impact may be limited. If a product aims to influence the social level, the impact may increase. This dimension reflects uncertainty for a company and a social environment.

In summary, six dimensions are defined which are translated into three matrixes:

1. The newness of the functionality of a product **vs** the newness of the social environment; this explains the expected difficulty of an innovation.
2. The way practices will be influenced **vs** the vulnerability of the expected users; this explains the expected level of social impact.
3. The expected consequences for a social of individual environment **vs** the expected contexts in which the product will be introduced; this explains the expected scope of influence.

8.3.1 A working model

In this section I will discuss the six dimensions of the working model.

Matrix 1: expected difficulty of innovation

This matrix is linked to the 'ways to grow matrix' and aims to determine the level of innovation of a new technology. Introducing new functionalities in unknown social contexts causes uncertainty about the consequences. This makes it more difficult to anticipate social consequences.

New versus existing functionality:

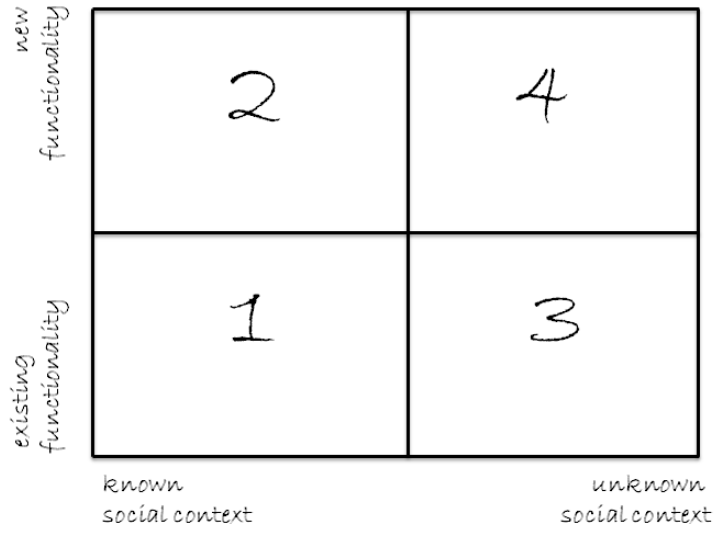
A user is only influenced by new technology if it offers new functionalities. A new functionality can be a new technology (for instance, nanotechnology), but can also be an existing functionality that had hitherto been unavailable to a user. The social impact of cars was felt only after users acquired cars.

Known versus unknown practices:

Practices consist of interaction patterns within social environments, such as the interactions between members of a social environment within a physical and technical context. An example would be the members of a family or workers in an office. It is easier to develop a product for a well-known practice than for an unknown practice. If a designer of office furniture decides to develop furniture for hospitals, he will discover that practices in offices are different from those in hospitals, and that therefore other demands will be made on products. These unknown practices might lead to unexpected social impacts.

The first matrix is visualized in figure 8.4.

Figure 8.4: expected difficultness of innovation



Clarification:

1. Existing functionality in a known practice often leads to small changes. New product functions may unintentionally influence practices in a social network. In cases of doubt, the contextual characteristics of functions could be determined.
2. A new functionality in a well-known practice might lead to social impact. It is not known which characteristics of a product will lead to which social impact, but the characteristics of the social environment are known and therefore reactions can be anticipated.
3. Existing functionality in an unknown practice may lead to social impact. It is not clear on what aspects the new practice differs from a well-known practice.
4. Implementing new functionality in an unknown practice is the most difficult. The impact of the new product is unknown, as is the response of the social surroundings to these changes.

Matrix 2: expected level of social impact

This matrix determines the ethical responsibility and necessity to anticipate social impact.

Reinforcing or influencing existing practices

A designer needs to consider what the starting point of a new design is and what his intentions are. Is it his intention to influence social practices or merely to reinforce existing practices?

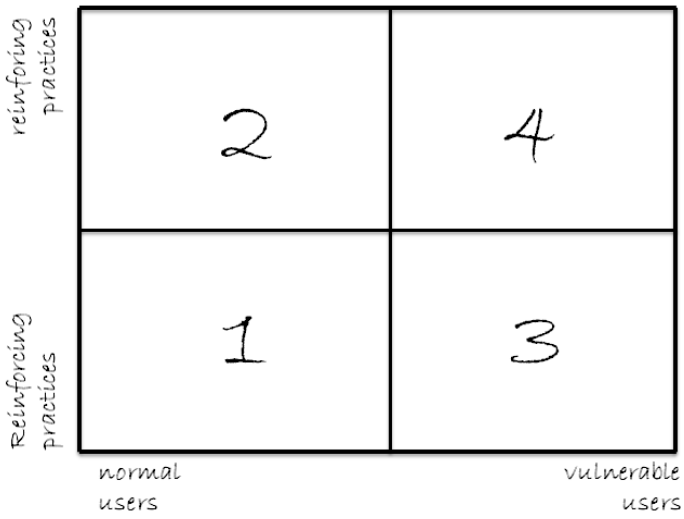
When a designer develops a product that enables distant care, a new work procedure is required to use this new device. However, the development of a product that helps a nurse lift a patient will have little to no impact on social practices. This also holds true with regard to unintended consequences. A new and improved soccer shoe will probably lead to better achievements, but will have no social consequences. The development of a router for wireless internet, however, can change the behaviour of teenagers, enabling them to use laptops in their own rooms without parental guidance.

Vulnerable versus normal users

Whether a user is vulnerable depends on the technology that is introduced. A change in our energy supply requiring us to use less energy and forcing us to use the washing machine at night can be inconvenient. But it is questionable as to whether such a change will lead to harmful situations. However, when a hospital introduces a new care system for nurses, the relevant patients are vulnerable to changes, especially if they are unwanted and unexpected.

The second matrix is visualized in figure 8.5.

Figure 8.5: expected level of social impact



Clarification:

1. Strengthening existing practices for normal users. The designer's intention does not lead to an intervention in a script that might cause a change in practices. For normal users, no sizable risk is expected.
2. Influencing practices for normal users requires more attention. If practices are expected to change, the consequences may need to be determined. If a company expects the purchase of a new computer system to lead to more efficiency, then social impacts can lead to unintended changes as well.
3. Strengthening existing practices for vulnerable users. Small changes are enough to cause negative impacts for vulnerable users. Small changes in practices can lead to harmful consequences, because vulnerable users may lack the flexibility to adapt to such situations.
4. Influencing practices for vulnerable users. This situation visualizes cases, in which it is clear that a designer is ethically responsible for possible intended and unintentional impacts.

Matrix 3: Expected scope of influence

This matrix determines the scope of influence of the anticipated social impacts.

Individual influence versus social influence.

This attribute is related to the possible influence of an anticipated product. Is it restricted to individual users or does it also involve social environments? A digital whiteboard is focused on the use in a social environment, while a shaver is focused on individual use.

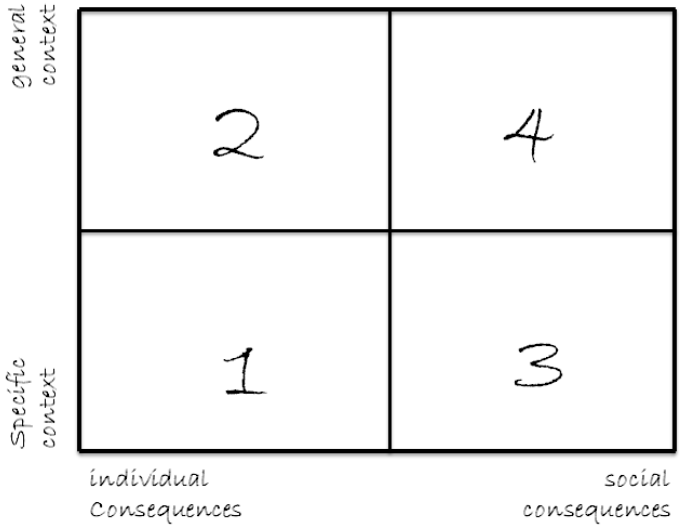
Specific versus general environments

Is it possible to determine what kind of users will be using a product, and in what kind of physical and social setting? In that case, social impact can be determined for a specific environment. If it is impossible to specify a social environment, we refer to a general social environment. To determine a specific environment, the following factors need to be described:

- A specific physical environment in which social interactions take place, for instance a classroom, a cohousing community, etc.
- A specific social environment, such as a family with young children, pupils of an elementary school, etc

When a technology is designed for general use, then considerable variations can be expected in the social environments in which the technology will be used. For instance, a laptop will be used in trains, offices, at home, in the garden, and in all kinds of social settings, such as during a lesson, for work, for pleasure, etc.
The third matrix is visualized in figure 8.6.

Figure 8.6: expected scope of influence on ....



Clarification:

1. Influence on individual behaviour in a specific social environment. When the social environment in which a product is going to be used can be defined; if solely focused on individual use, the scope of the product may be limited.
2. Influence on individual behaviour in a general environment. If the context in which a product is used cannot be specified and the expected influence of a product is restricted to the individual level, social impact may be limited as well. However, consequences are more difficult to control, because of the complexity involved in observing changes in practices.
3. Influence on social practices in a specific context. In this case, social impact can be anticipated through an analysis of the social ecology compared with practices in the social context (see Chapter 6). The focus lies on the quality of information.
4. Influence on social practices in a general environment. In this case, numerous impacts are possible. The scope of social impact is at a maximum. Social impact can be anticipated using the 'Screenplay Approach' (see Chapter 7). The focus is on the quantity of information.

The model of awareness does not give absolute, quantified results. The model is meant to stimulate discussion between designers and to stimulate the anticipation of social impacts in design contexts. In a next stage of research, it is important to verify

whether the model has the ability to generate new discussions between members of a project team.

8.4 Evaluation of the awareness working model

A descriptive study was carried out to evaluate the working model. The aim of this study was to find out whether future users of the working model would be able to use the model in the way this was meant to be used. Students doing a Care and Technology minor at the Hanze University of Applied Sciences were selected for this purpose. These students were working on the development of technologies for Healthy Living. One of the aims of the present research on social impact -amongst many others- is to reach students like these. The respondents had various backgrounds and worked in multidisciplinary product groups (technical, social and medical).

The respondents were presented with two cases and asked to decide how much social impact the products in these cases were likely to cause. The first case involved a urine analyzer intended for use in a hospital for patients in the intensive care. In the current situation, urine is collected and taken to a lab. In the new situation using the new analyzer, urine could be analyzed directly at the bedside.

Figure 8.7: the visualizations used to explain case A

The second case involved a homecare system developed by Nedap, a manufacturer of intelligent technological solutions. Nedap proposed to redesign its homecare system in order to make this suitable for hospital use. The system developed by Nedap is used as a planning system for home care. If a nurse from the home care service enters a patient's house, she checks in and out with her mobile phone. The nurse then becomes the source of information about the patient. At home, she can add comments about the patient in the computer and if she needs advice, she can ask a colleague who has also visited the client. This system works well in the home care environment and the idea is now to introduce an adapted version for use in hospitals. The idea is that administrative tasks will be much easier with this technology.

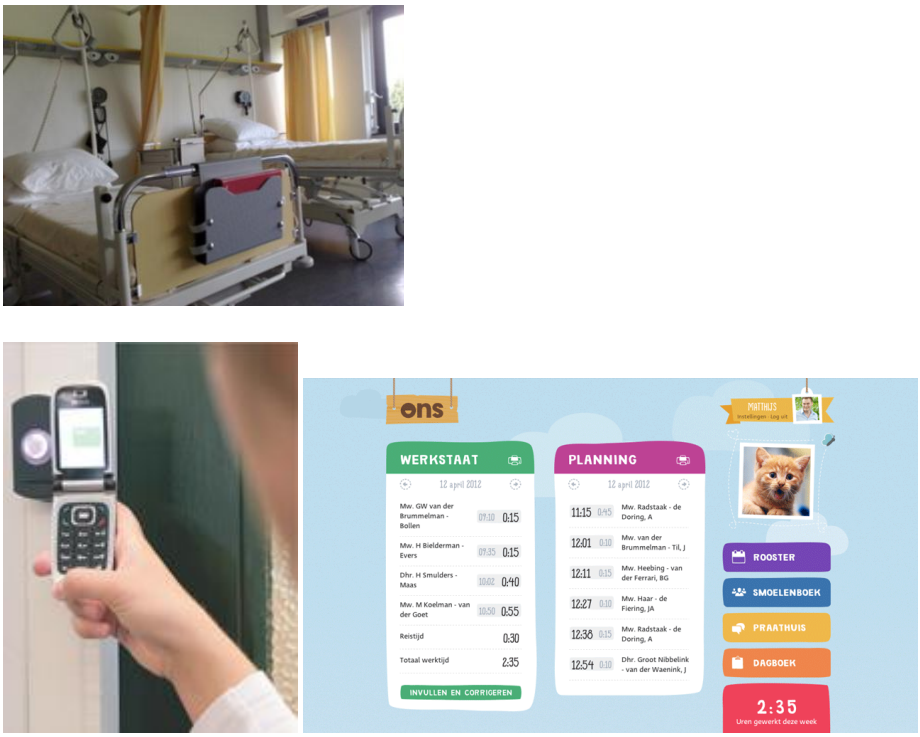


Figure 8.8: the visualizations used to explain case B

The products have not been developed at this moment. The respondents were asked to make a preliminary assessment anticipating the social impact of the products and needed to use the working model to help them to become aware of possible impacts.

Research design

Before the respondents applied the working model, they were briefly introduced to the concept of social impact and they received a short explanation of the heart manager case used in Chapter 8. Furthermore, the respondents were given a handout explaining social impact and containing examples of the different matrixes of the awareness working model.

In the questionnaire, the respondents were asked to rate each dimension on a scale from 1 to 4. Each score represented a position in the matrix. Furthermore, they were asked to explain why they had chosen a particular score. The respondents' explanations were categorized according to their relation with the question asked. If a respondent's explanation of his or her choice was in line with the dimension, I assigned this a green label. Choices that were more or less in line with the dimension, I assigned a yellow label. If there was no relation between the explanation and a dimension, I gave it a red label. The answers were only used to see whether respondents were able to justify their answers based on the given dimensions.

A second subject in the questionnaire referred to their opinion on the meaningfulness of the information for future practices and how they would implement a knowledge of social impact in their minor course project. This was asked to gauge the attitude of the respondents towards social impact and to see if the respondents were able to generate practical ideas from the working model.

Finally, the respondents were asked some general questions about background and gender.

8.4.1 Results

Twelve students from different academic backgrounds (social, medical and technical) completed the questionnaire; 3 female and 9 male. Completing the questionnaire turned out to be quite intensive. Respondents were concentrated at work (it looked like an exam) while going back and forth between the questionnaire and the additional information. The respondents took between 30 and 50 minutes to fill in the questionnaire. The results are represented by case and matrix.

Results for matrix 1: expected difficulty of innovation

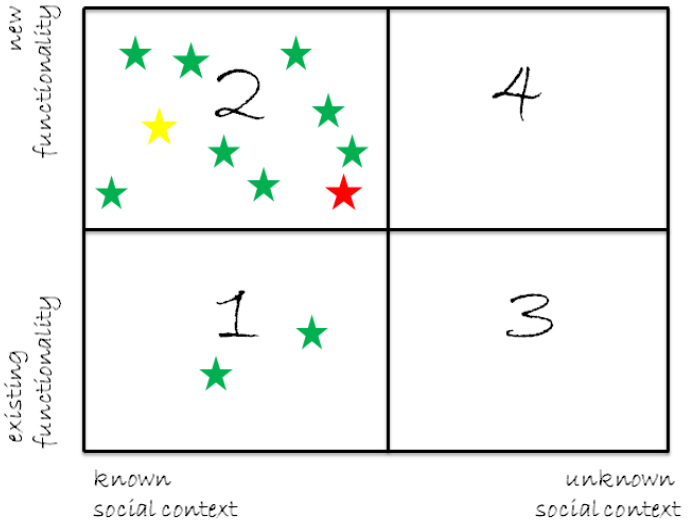


Figure 8.9: results for case A of the expected difficultness of innovation

Case A Urine analyzer:

The results are shown in figure 8.9. Most respondents agreed that the urine analyzer was a new functionality in a known environment. This was motivated, for example, as follows:

- It is already being used in a hospital. Only it has to be done in a laboratory, it is therefore a new functionality for the users
- there is already a procedure, the new product will only bring new functionality

One respondent's answer was not related to the matrix, and one was less directly related.

- When you analyze urine you want privacy

Only two respondents considered this an already existing functionality.

- Urine is analyzed at the bedside instead of in the lab; the functionality does not change

In summary, the respondents agreed on the fact that the product would be introduced in a known environment. Whether the functionality was new or already existed remained a point of discussion, although the majority agreed that it was new.

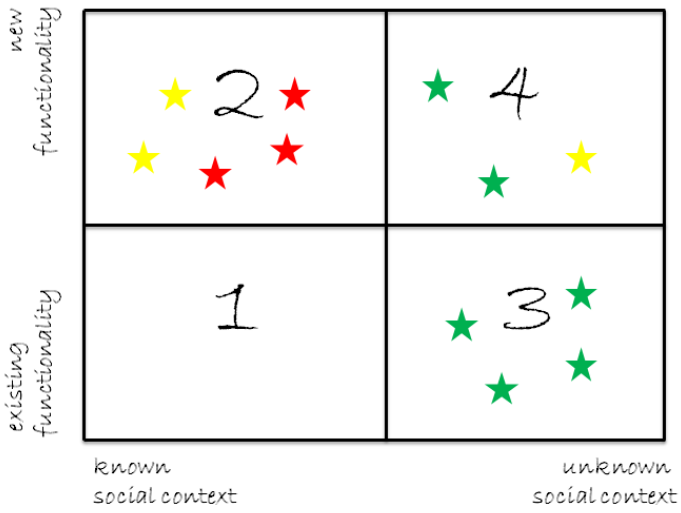


Figure 8.10: results for case B on the expected difficultness of innovation

Case B Planning system for a hospital:

The results are visualized in figure 8.10. In the second case, the opinions about the difficultness of innovation of the respondents were more varied and there were more answers that were not related to the matrix 'difficulty of innovation'. For instance, the five respondents who chose option 2, all gave motivations that were not in line with the dimensions. A few examples:

- I think that it is good when you know where a colleague is
- It is a new function, because it was not at their disposal. The patients have to log in every time, but they do in their own environment.

The respondents who chose other options were more in line with the dimensions. For instance respondents who selected option 3:

- It already exists in the homecare, it has to be adapted to a hospital(3x)

Furthermore, three respondents argued that this was a new functionality in a new environment and therefore chose option 4.

In summary: the answers of the respondents were more varied and the motivations were also less well related to the dimensions.

Results for matrix 2: expected level of social impact

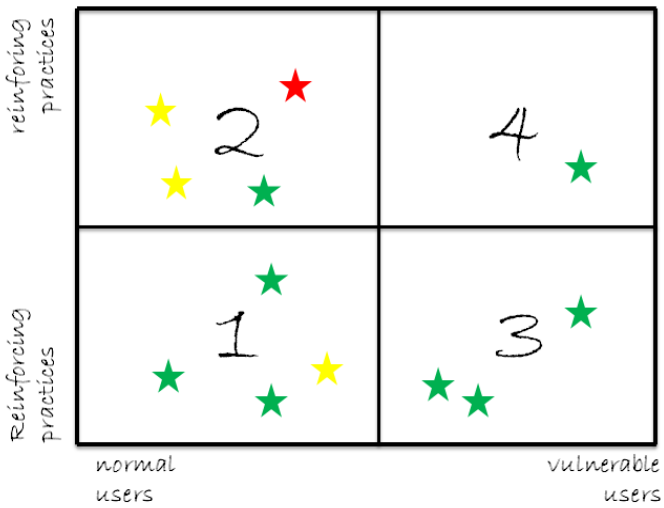


Figure 8.11: results for case A on the expected level of social impact

Case A Urine analyzer:

The results are visualized in figure 8.11.The expected level of social impact is viewed differently by the respondents. All possible options were filled in. Most respondents considered the target group of the product to be the patients' physicians. Out of this group, four respondents considered the urine analyzer to be a product that reinforces practices.

- The work of a doctor is made faster and easier

Four respondents thought that the product influences practices for normal users.

- You can see it as an extra toilet; you influence an existing situation

Other respondents focused on the patients as the target group

- This reinforces a practice; the new device provides direct results and a doctor can take immediate action. The consequences are for vulnerable users.

One respondent thought that the product influenced practices for vulnerable users:

- It can lead to new behaviour; maybe more tests will be done, which will lead to faster or less fast awareness. It concerns vulnerable users, because it can lead to a change in the process of care.

In summary, different arguments for the dimensions led to different opinions about the possibility of social impact.

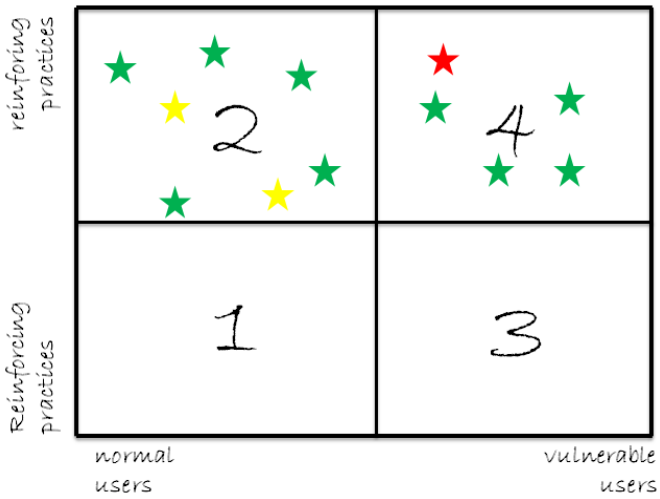


Figure 8.12: results for case A on the expected level of social impact

Case B Planning system for a hospital:

The results are visualized in figure 8.12.For this case the expected level of social impact is viewed more equally. The respondents agreed that the product would influence hospital practices. They differed on who the target group of the product was; seven respondents said that it influenced normal users, while 5 respondents argued that it influenced vulnerable users.

The arguments relating to normal users:

- The social impact is present, but it is difficult to think of unintended negative consequences
- Worker practice is influenced. There is less time needed for filling in the papers.

The respondents that focused on vulnerable users included interactions with patients in their arguments:

- You get input about your patients when you check in: the interaction with a patient may be lost. The patient may lose track of his data.

In summary, the respondents had different views on who had to deal with the consequences of social impact.

Results for matrix 3: Expected scope of influence

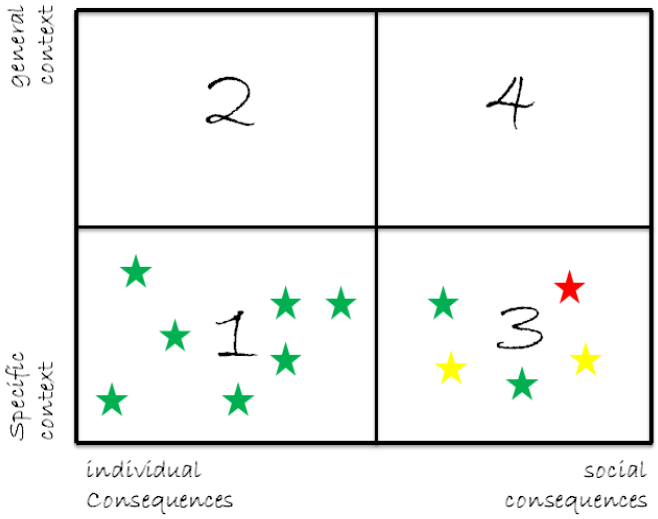


Figure 8.13: results for case A on expected scope of influence

Case A Urine analyzer:

The results are visualized in figure 8.13.The respondents agreed that the use of the urine analyzer occurs in a specified social environment. What they did not agree on is whether the product influenced individual behaviour or individual and social behaviour. Most respondents agreed that the scope of the product was limited to the individual:

- It is used in a hospital and only used by certain people.
- This changes the individual way of working, but it has no social consequences.

Five respondents thought that social impacts were expected for individual and social practices:

- For the patient the treatment may be the same; only faster. For a practitioner it may have more impact: the process may go faster.
- You need to understand that the privacy of people is important, so the other patient should not be able to see the result.

In summary, respondents did not agree as to whether consequences of product A were individual or whether social practices were also influenced.

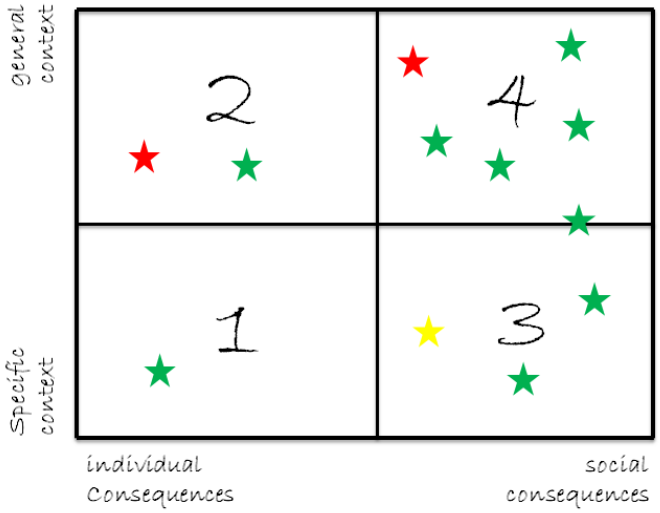


Figure 8.14: results for case B on expected scope of influence

Case B Planning system for hospitals:
The results are visualized in table 8.14.The respondents showed greater variation in their answers regarding the scope of influence of case B. Most arguments related to the dimension; however, the estimated use of the product was interpreted differently. One respondent thought that the scope of case B was limited:

- I think it will influence individual behaviour in a specific environment.

Two respondents thought the product could be used in general environments:

- Digital records are for individual use, but the product can be used in several social environments.

Three respondents argued that the product would be used in specified contexts, but that it influenced individuals as well as social environments.

- For the patient the treatment may be the same; only faster. For a practitioner it may have more impact: the process may go faster.

Six respondents argued that the product would be used in general social environments:

- This product changes practices of the workers. There is a chance that the system is going to be used to control the workers.
- If you don't work with the digital records you might function less well.

In summary, the respondents have different argumentations for the scope of influence of case B.

General results

In general, the respondents felt that information about social impact is important for future technological developments. One respondent stated:

- *This knowledge may have a big influence on the development of a technical product. It will be possible to make a more well- informed decision for the end product.*

However one respondent was less sure about the importance of social impact for general users:

- *Does technology influence social behaviour? Yes, but apparently our social need is not so great that we consider this a serious problem. For a product developer, it might be important that negative consequences don't become too big.*

A substantial majority of respondents said that they would include social impact in their project as a point of attention. Two respondents reported making explicit changes. One respondent questioned the functionalities they had previously defined in their project:

- *We aim to develop a logbook for heart patients; do they really want everybody to know what they do?*

The second student said that the support should not influence social environments:

- *We have to make sure that the tool we develop only focuses on individual use*.

Furthermore, two respondents made general observations about the working model. One student considered that the theory had been well explained, with good examples. Another student found the information very descriptive and would have preferred a more concrete presentation.

8.4.2 Reflections

This study was carried out to determine whether students were capable of using the model of awareness. Although some respondents used unrelated answers in some cases, most answers were related to a matrix. The model would therefore appear to be able to be understood by most respondents. Wherever the respondents appeared to be less clear about a case itself, their own interpretations increased. For instance, the respondents seemed to find it hard to interpret the social impact of the urine analyzer, which led to more unrelated answers being given, but for the planning system for hospitals it seemed to be less difficult to give answers that related to the different dimensions.

In general, it was found that respondents have difficulties in understanding the complexity of a social practice. An example of this is the fact that most respondents thought that specialists would be the sole users of a urine analyzer (case A) in a hospital, in the case of the new planning system for nurses (case B) , that only nurses would be involved and that these products would have no impact on patients. My assumptions had been that these would be clear examples of vulnerable users. Only one respondent, for instance, made an extensive analysis of case A:

It can lead to new behaviour; maybe more tests will be done, which will lead to faster or less fast awareness. It concerns vulnerable users, because it can lead to a change in the care process.

This answer is the kind of argumentation that will lead to increased awareness of social impact. For this target group, it may be necessary to increase understanding of the complexity of social environments. This might lead to a better understanding of the influences involved in the cases. Maybe the students would benefit from the Screenplay Approach described in Chapter 7. However, for practitioners in the field who are knowledgeable about the practices they are designing for, the awareness model may still be a starting point.

The handout with the information was clear according to one student, and included good examples; another student considered it a lot of text and very descriptive. It might be an idea to use visualizations for the dimensions to improve validity of the working model.

8.5 Consequences

From this chapter, the following consequences for the implementation of social impact in design contexts can be concluded:

- This research has focused on consequences. Intentions are important as well.
- The insights regarding social impacts are a contribution to a new approach for social centred research.
- Social impact will fit in design approaches, but awareness of social impact is not automatically obtained.
- Social impact is an important outcome for innovations in healthcare. Therefore it is important that awareness about disruptiveness is extended to the insights that have been derived in this research. To reach this goal, a model of awareness has been designed.
- Insights into the complexity of social environments need to be acquired by some of the target groups of my research.

Chapter 9: Conclusions

9.1 Introduction:

At the start of my PhD project, I decided to research the development of technologies for social environments, such as cohousing communities for senior citizens; new innovations tend to be developed for individual use and it was unclear how such innovations would work in social environments.
My initial, orientating research[13] in cohousing communities showed that in a number of cases, changes in physical and technical designs in communities had unexpected consequences that, in turn, could lead to unwanted consequences for dwellers. I decided to dedicate my research to identifying these consequences for social environments and the possibilities of including such consequences in design practices. Thus the social impact of technologies became the central concept of this thesis.

The concept of social impact as developed in this thesis led to the development of three instruments for designers:

- a working model for the anticipation of social impact;
- a conceptual model to visualize possibilities to analyze impacts;
- a working model to become aware of social impact in a project.

In Chapters 3 and 4, two empirical studies were described that focused on the identification of social impacts in specific social contexts. In Chapter 5, an in-depth analysis of how social impact can be anticipated was translated into an approach for specific social environments. This was validated in Chapter 6 in two practical cases. In Chapter 7, an adapted approach for anticipations of social impact in general social environments was defined: a screenplay method, which enables a designer to create social ecologies and simulate practices. This approach had consequences for the working model, which was then adapted for the screenplay method and was subsequently evaluated in a third case. The consequences of social impact for design practices was discussed in Chapter 8. The conclusion was that designers need to become aware of the fact that social impact can be an important issue. To this end, a model of awareness has been developed and evaluated.

In this final chapter, I will start with conclusions about the actors within a social environment that lead to social impact, which relates to the first research questions 'what relations can be identified between social impacts and characteristics of technologies?'*(9.2)*. From the evaluations in Chapters 6 and 7, new insights were gathered that led to a slightly adapted working model for the anticipation of social impact and a conceptual model that visualized possibilities to analyze impacts. This answers the second research question 'how can a designer anticipate social impact?'*(9.3)*.

[13] This preliminary research has been integrated into the more extensive research of Chapter 4

As a third subject, it will be discussed how the concept of social impact may influence practices of designers. The tools that have been developed are related to the third research question: 'how can social impact be managed in design environments?' *(9.4)*. The fourth subject of this chapter is an evaluation of the research approach *(9.5)*. Finally, I conclude this chapter with a number of general recommendations for further research *(9.6)*.

9.2 Analyzing social impact

According to this research designers need to understand a social environment that is to be changed. This is in line with approaches in usability that have the objective to improve the use of a product. So, the use of social impact in design practices aims at improving the impact of new technologies. For instance in the case of sustainable solutions for energy generation, it is necessary to understand changes in the social environment due to new solutions in order to secure the goal of sustainability.
In this research, generic social goals were used to interpret social impact. In a school environment, for instance, pupils need to learn, so the social goals used to interpret social impact were related to optimal interactions for learning, while in a community for senior citizens, the social goals used were aimed at optimal social wellbeing. The use of generic social goals for the interpretation of social impact was found to be a useful indicator.

In Chapter 2, a conceptual model was defined that visualizes the development of social impact (see figure 9.1). The elements of this model will be discussed more intensively in the next section.

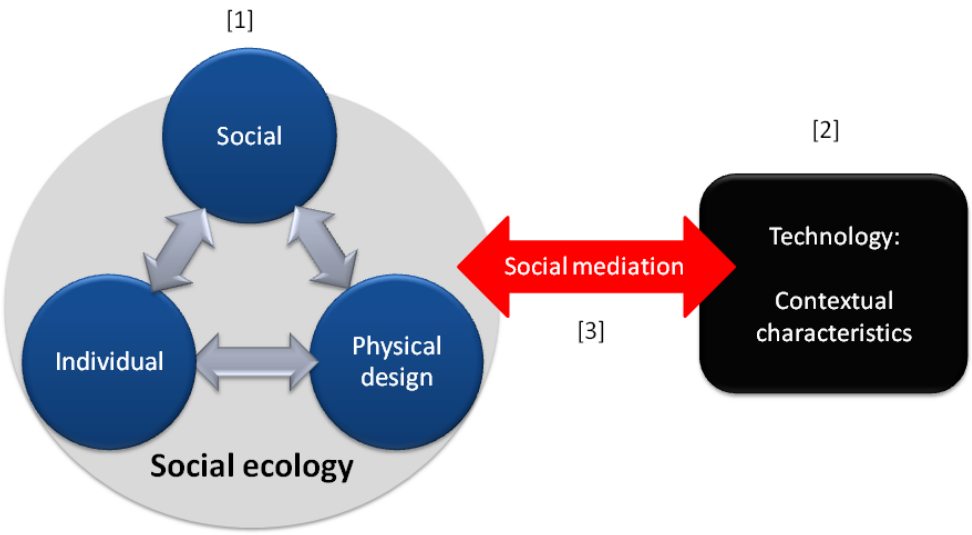


Figure 9.1: visual representations of the elements that are concerned with the formation of social impact

Theoretical principles visualized in the model:
In order to find outcomes of technologies on a social level, our knowledge of reality needs to be expanded: from the traditional use context to a social context. This has led to the following starting points:

- A social ecological approach enables us to determine the factors of influence within a social environment (Stokols, 1996) *[1]*.
- Contextual characteristics of products interact with the social environment (J. S. Brown & Duguid, 1994) *[2]*.

- The introduction of a new technology leads to a interdependent relation with a social environment(Akrich, 1992; Latour, 1992; Law, 1992), called mediation between an user and a technology in a certain context (Verbeek, 2005a). Mediations in a social environment lead to the involvement of additional actors and therefore they are called social mediations *[3]*.

In the next section, further conclusions will be drawn.

9.2.1 The social ecological framework

The social ecological approach was applied to understand networks in a social environment in a better way. The use of a framework with physical, social and individual factors as a starting point for the theoretical description of a social environment turned out to be helpful. Moreover, the framework proved to contribute to the construction of social mediations in a later phase of this research. In the case of digital whiteboard, for example, research into the influence of light on learning abilities of pupils indicated that changes in lighting characteristics in a classroom would be an important point for observation, but this insight also helped to interpret social impacts. The social ecological framework thus made it possible to construct a framework of important influences for the empirical research and the subsequent interpretation of social mediations.

The social ecological framework is a gathering of influences, which combined lead to a more holistic understanding of a social environment. This has been found to be an important characteristic. Static principles[14] require 'ideal' circumstances, which are difficult to achieve. Even in specific environments like cohousing communities, which are organized and designed by the same starting points, variations between communities were found that led to differences in social interaction in a community. Hence, a dynamic understanding of reality is preferred.

This is in line with the literature on the Actor Network Theory, which states that social environments have an interdependent relation with an intervening technology (Akrich, 1992; Latour, 1992; Law, 1992). This means that a technology influences a social environment, but is influenced by the characteristics of the social environments, as well. The impacts of a technology will differ due to differences between social environments, which means that every social environment will have its own mediation process. An approach to identify or anticipate social impact needs to take these variations into account. This means that besides understanding influences, insights into the variations between social environments are essential. This can be achieved through the observation of varied practices.

9.2.2 Contextual characteristics

The theory showed that a product cannot be separated into use characteristics and contextual characteristics. The same functionality of a product could perform actions related to use and actions related to the context (J. S. Brown & Duguid, 1994). The sound of a typewriter sends a signal to co-workers that someone is busy working, and provides the information on a use level that the machine is working well.

This inseparability between context and use was also found with regard to social impact. For instance, the shift from a typewriter to a computer has changed the writing process of students dramatically. Students now have the possibility to write drafts of a text and gradually improve it, which has led to new writing behaviour. However, social

[14] Like the design principles for cohousing communities(Durret, 2005; Williams, 2005)

interactions between students and their supervisors have changed as well. A student can easily send an early draft to a teacher and a teacher will more frequently require major revisions to be made. Writing my thesis on a typewriter would have changed my individual process, as well as my interactions with my supervisors.
In the empirical research, it was also found that contextual characteristics are not always recognized as such and may not have been intended to have an influence on the social context. For instance, examples were found of technical solutions for a product -not intended to influence behaviour of users- that became a contextual characteristic.
Furthermore, it can be concluded that the importance of contextual characteristics within a social environment can change through social mediations. A new technology can take over interactions with the social context. For instance, in Chapter 6 it was shown that while a real estate broker's physical office used to function as the centre of his interactions with customers, this role has now been taken over by the internet. So besides the identification of contextual characteristics of a new technology, it is important to understand changes in contextual characteristics of the existing physical and technical environment.

9.2.3 Social mediations

Verbeek (2005a) identified two forms of mediations: of praxis and of perception. Verbeek analyzed how characteristics of technology can influence human behaviour. In this research, I have focused on the process of mediation to make the identification of contextual characteristics possible. It is an approach that helps in determining outcomes of mediation, whether these have originated from a change in praxis or a change in perception.

Social mediation has been defined as the process leading to changed practices following the introduction of a particular technology. Chapter 5 provides an extensive evaluation of social mediations. It was found that a focus on changes in interactions was useful; especially a focus on the variety and frequency within a social environment and the development of these changes. This is a practical solution that allows a valid observation of a changed reality.

In the research, social mediation processes were identified by examining and interpreting changes in practices; the construction of a mediation process between an intervening technology and its social environment. This is a pragmatic approach, used for the identification of social mediations. In reality, social impact occurs in an ongoing process of mediations. For instance microwaves may have mediated family patterns for years, eventually leading to completely changed eating patterns. To observe these changes would require long-term research in social environments.
So, an observation of changed practices does not reveal the kind of mediations that have taken place, it is a static observation of a current situation. The construction of mediations is a step that a designer or a researcher himself must perform.

Technical mediations between technologies and actors have been focused on direct relations between a subject and an actor. In a social environment, indirect interactions can also be expected. In the previous section, the social impact of the computer on writing processes of students has been discussed. This impact of use also influences the interaction with the students' supervisors. The changing practices between a student and his supervisor can therefore be viewed as an indirect mediation of a new technology. In this case, the technology of a computer is understood to have enabled

the change in the review process of an assignment. Without the advent of computer technology, this change in practices would not have been occurred.
This insight into social mediation has two consequences: in the first place, mediating effects of technologies can go beyond a direct interaction with the mediating technology; secondly, it is more difficult to know what constitutes a mediation process and what does not; an indirect mediating effect is more difficult to identify and even more to anticipate than a direct mediating effect.

Conclusion:
Social impact is developed through social mediations between a social environment and a technology. A social ecological approach can be used to identify characteristic of a social environment that will influence social mediation. For a technology, contextual characteristics need to be identified. Social mediation is a process of direct and indirect interactions with relevant actors in a social environment.

9.3 Anticipating social impact

In the introduction to this thesis, I discussed Norman's criticism (2010) of the way designers performed user-centred research. He argued that designers were unaware of the existing knowledge derived from social sciences. Norman's remark was a confirmation that a social ecological approach might be an interesting option for my research.
However, the social ecological approach is only one step in the process of anticipating social impact. It is not a substitute for research in social contexts. Therefore, I will discuss more in detail how the process of anticipation should be carried out.
In Chapter 2, it was shown how general design approaches should be carried out. The knowledge and understanding acquired in studying users within contexts are not in themselves goals, but insights which should be translated for use in designing and design education, like it is in general design research (Dorst, 2008). Hence user-centred research may be said to consist of a research phase and a translation phase. This implies that understanding social impact will never be a central aim for a designer; rather, it is a way to improve designs. The techniques and approaches derived from this research are meant to enable a designer to include the concept of social impact within a design process. So the research phase offers insights into social impacts; a social ecological framework combined with a check against reality. The translation phase offers insights into social mediations. The construction of social mediations helps in identifying contextual characteristics and interpreting the relation with social impacts.

Analyzing social impacts (research phase)
In Chapter 2, I concluded that a possible way to gain a deeper understanding of the impacts of a product was to shift between a use level and a social level and to focus on broader formulated social goals. In the literature, it was found that research on digital whiteboards and cohousing communities was focused solely on a fixed level; for instance, either on individual use or on a social level[15]. The shift to a different level led to a focus on new information: an individual factor on a use level, would focus on the ability and willingness of people to use a product; an individual factor on a social level,

[15] In scientific research it is common to perform research with specific narrowly formulated research goals. This prevents the determination of social impacts that are not directly related to a research goal.

would be the ability and willingness of people to interact with other people. In other words, shifting between levels changes the content of analysis and observation.
The social ecological framework proved helpful in compiling an overview of influential factors, but did not reveal the kind of social impacts that would take place. To recognize the type of social impacts occurring in actual reality, it is necessary to establish which practices and behaviour have changed, and how, in order to understand the effects of the intervention of a new technology. In Chapter 5, it was defined what kind of information about practices is needed. This approach also turned out to be used to anticipate social impacts in specific social environments.
By simulating practices, social impacts in general social environments can be anticipated. One way to do so (which has been applied in this research) is by the use of *Screenplays*, an approach which was adapted from the Persona approach used to represent end users and their behaviour (Pruitt & Adlin, 2006). A Screenplay also describes different factors of influences from a social ecological framework, allowing variations in individual, social, physical and technical factors to be included in the analysis (see Chapter 7).

Analyzing social mediations (translation phase)
The second phase in the approach is to translate insights about social impacts into new design requirements (see figure 9.2). To specify design requirements based on these insights, it must first be determined which contextual characteristics of a product give rise to which social impact. As explained in a previous section, social mediation patterns must be constructed. A designer can search for alternative specifications in the case of undesired social impacts and increase the importance of a particular characteristic in the case of desired social impacts.
A construction of social mediations can be made by linking the social ecological framework to the observed changes in a social environment. These constructions will be linked to social goals. If a social impact is found to be of importance, contextual characteristics need to be identified.

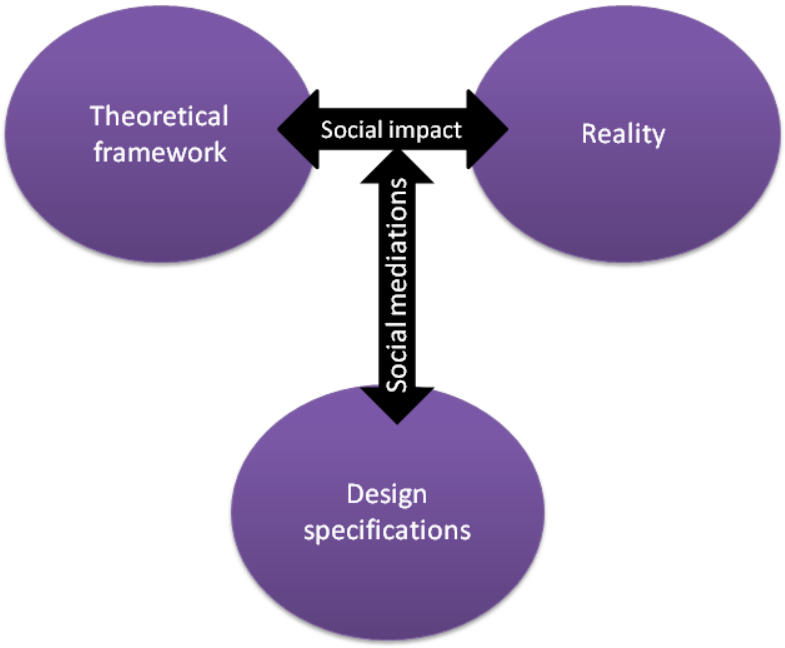


Figure 9.2: the research process for social impact in design projects

9.3.1 The final approach

Two forms of anticipation have been found: anticipation through identification and by means of simulation. It was found that in the case of a specific social environment, such as a cohousing community, it was possible to learn about social patterns within communities. New products could be adjusted to a specified script of a social network. For such contexts, interaction patterns could be identified. However, when introducing new technologies into a generic social environment (such as in the case of the heart manager), it turned out to be more difficult to understand and to take into account all the details of a social ecology. New products are used in all kinds of social environments by a wide range of users. In such cases, simulations of various practices should be performed.
This leads to the conclusion that in a specific environment, the quality of insights help to improve anticipations of social impacts, while in a general social environment (the case of the heart manager), the quantity of anticipated social impacts help to improve anticipations of social impacts.

These conclusions lead to the following approach:

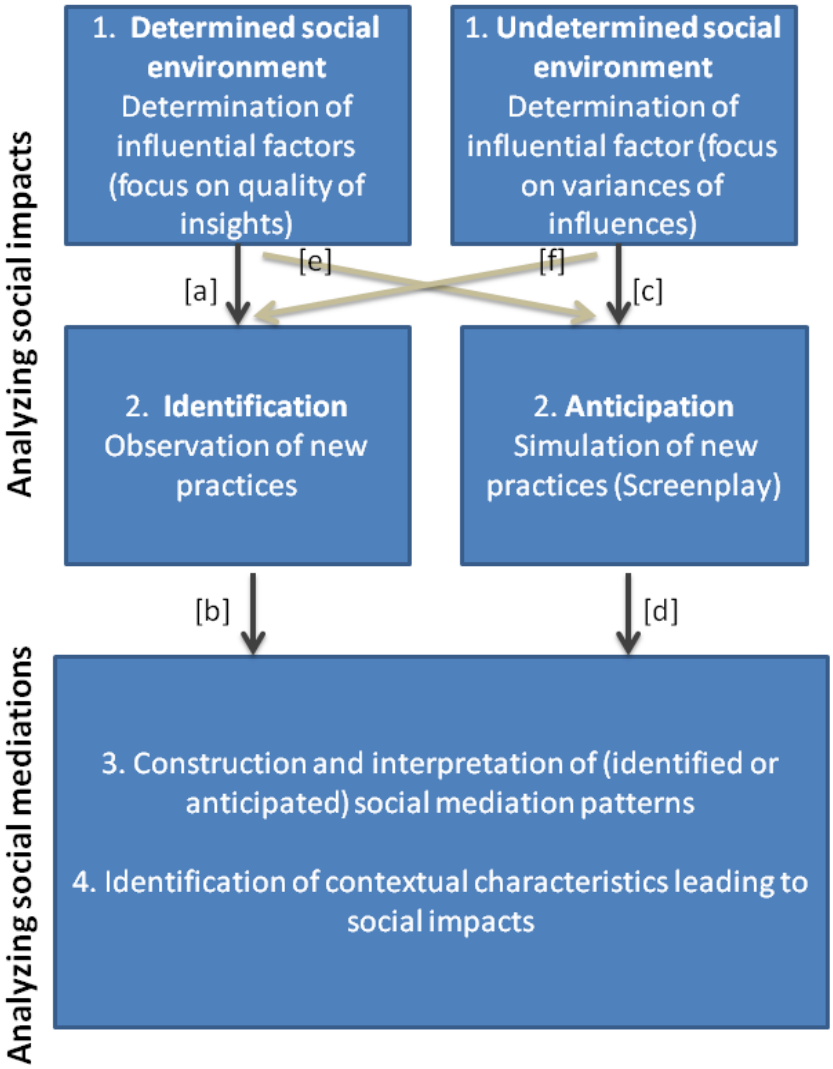


Figure 9.3: the phases in identification or anticipation of social impact in design projects. The research has focused on identification of practices in specific environments and the simulation of practices in general social environments *(a, b, c, d)*. However, simulations can be carried out in specific environments and identifications in general environments *(e, f)*. In future projects, these relations need to be confirmed.

Conclusion:
The original aim of this project was to acquire a better understanding of the impacts of new technologies, in order to prevent unintentional harmful outcomes for the users of such a new technology. In the course of this research, it emerged that conclusions about social impact are also relevant in general design projects. Wherever the consequences of new products affect social networks, such as in an office, school, hospital etc., social impact can be considered a factor of influence.
However, the aim to prevent harmful outcomes is still valid. Consequences of design that may lead to negative impacts for elderly, patients, small children, require extra attention. In the case of vulnerable users, the ethical obligations of designers become even more important.

9.3.2 Visualizing impacts

To research social impact, a shift must be made from the use to the social level. In Chapter 5, it was concluded that traditionally, research is conducted on a single, fixed level, which makes it more difficult to understand impacts of technologies. This was confirmed in Chapter 6. The students who focused on a social level, continued on the social level; the students who were accustomed to working at the use level, also continued at that level. Furthermore, Chapter 8 showed that the students were unaware of the complexity of social environments. If it were possible actually to see a difference between the use and a social level, the students might become more aware of factors involved in a social environment. To this end, the possibilities for designers to apply reality in their design research have been visualized (see figure 9.4). The use and the social level are represented on the vertical axis, while theoretical descriptions of interactions and observations in real practices are represented on the horizontal axis.

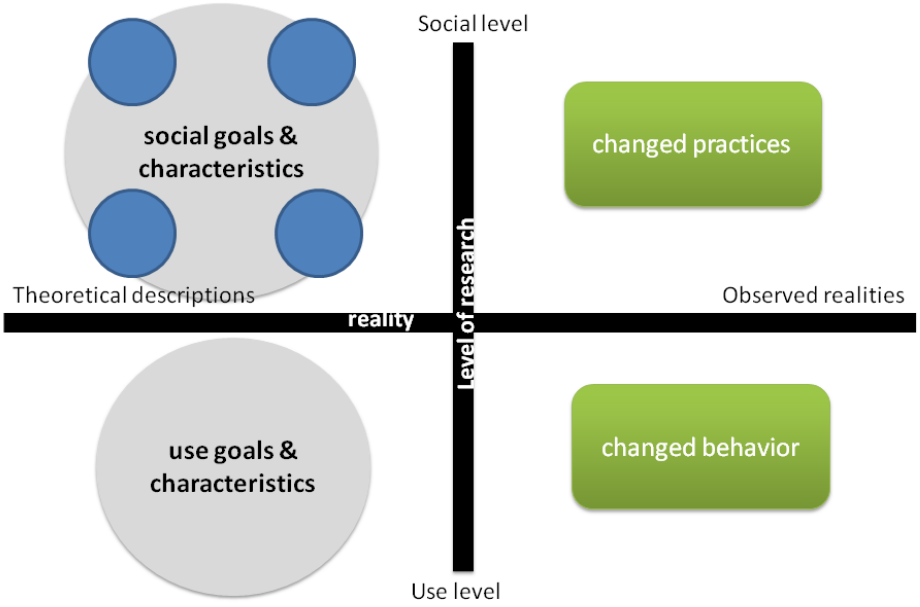


Figure 9.4: a matrix representing the possibilities of a designer to gain knowledge about impacts of new technologies

A designer has several possibilities to understand reality. The empirical study demonstrated that a designer needs to gain a wider perspective on realities. To help a designer to do so, an overview of possible viewpoints on design research has been constructed that contains two dimensions:

First dimension: theoretical descriptions vs. observed realities
Reality can be described from different viewpoints; a theoretical description that has been applied in the empirical research is a social ecological approach, which describes reality as a complex system with several factorial influences. A description of reality is obtained from observations on direct practices in 'real' contexts.
Second dimension: social vs. use level
An analysis of a context can appear on different scales. An analysis on a social level leads to a focus on the influence of a product on interactions between individuals within communal physical contexts, while an analysis on the use level leads to a focus on the direct interaction between a user and a product within its direct context.

This leads to the following four fields:
Social goals and characteristics: theoretical description of a social context
Changed practices: observation of practices in a social environment
Use goals and characteristics: theoretical description of a use context
Changed behaviour: observation of behaviour in a use environment

The fields in this matrix represent possibilities to understand impacts of technologies. On a social level, 'social goals and characteristics' and 'changed practices' represent the necessary content in the case of identification or anticipation of social impact, the fields on the use level are 'use goals' and 'changed behaviour', which can be linked to the impact on users (primary impact).

Discussion of other applications:
In this section, I will discuss whether the matrix can be used to visualize other user-centred approaches as well. Let us recall Sanders' definition of user-centred research (1992), for example and evaluate a number of approaches that are connected with these aims. According to her definition, products should be usable, useful and desirable. The definition and associated approaches with regards to the matrix will be discussed:

- *Usable* refers to a strong and close connection between the functionality of a product and the abilities of an end-user (Kolko, 2007).
  On a use level, ergonomic models (Dirken, 2004)[16] enable designers to perform a theoretical description that can be checked in reality. On the basis of this, translations into user requirements must be made.
- *Usefulness* refers to the match between a system's functionality and the goals envisioned by a user (Kolko, 2007).
  Norman's model offers a theoretical description of reality; it shows the interaction between a product and a user. In reality, the human-product (computer) interaction also needs to be observed in a specific context.
- *Desirability* is associated with emotion, that a product may successfully fill an emotional or subjective niche (Kolko, 2007).
  Another kind of user-centred research discussed in this thesis is ethnographic research. This can be performed on different levels. Ethnographic research is known for collecting rich detailed data about implicit aspects and processes of the context (Courage & Baxter, 2004). Theoretical descriptions can be deduced from gathered data, which might lead to the formation of new theories.

[16] For instance the human-product interaction model (Dirken, 2004, p. 73)

All three approaches show a different way of using theoretical knowledge and empirical research for user-centred research. In ethnographic research, this implies that outcomes are directly related to user requirements. Theoretical outcomes of research are not the aims of a designer; therefore, it is unlikely that theories will be formulated from ethnographic research in design research. Hence ethnographic approaches (as suggested by Brown) focus on observed realities and translate results of research directly into design specifications. This leads to a unidirectional analysis, which is difficult to validate.
The examples used for research on usability and usefulness are in line with the social impact approach, but the focus of research is limited to the use level of a product. Observed realities can be linked to theoretical interaction models, although the direct aim is to translate insights into design specifications. It is, however, possible to anticipate which factors of reality need to be understood and it is possible to validate outcomes with insights from, for example, human factors.

This leads to a more generic matrix, in which the relations between the components of the matrix are illustrated:

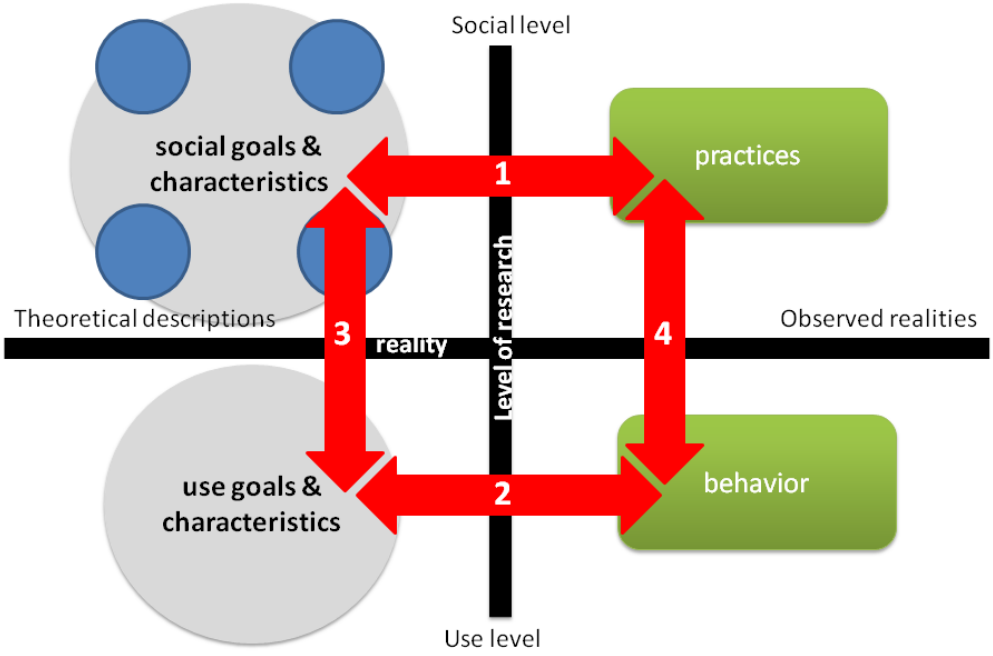


Figure 9.5: the interdependent relations between the components in order to gain knowledge about social impacts

The four interdependent relations represent the relations between the components of the matrix:

1. Analyzing social environments.
2. Analyzing use environments.
3. Analyzing the relation between interaction models on an individual level and models on a social level.
4. Analyzing the relation between social practices and individual behaviour.

The first, describing the relation between a social ecology and changing practices has been the central theme of this research. The second relation, which describes the relation between use and user characteristics and behaviour is a focus of current user-centred design approaches.

The third relation and the fourth relation have been identified in this research, but may need to be further investigated in future research. The third relation presents the relation between social interaction models and individual interaction models. It would be interesting to learn more about, for example, the balance between goals of usability and goals of social wellbeing.
The fourth relation presents the relation between new behaviour and new practices. It would be interesting to understand the interaction between individual behaviour and social practices. I can conclude from my analysis that there is a relation, but how these changes develop in reality was not the subject of this research. Perhaps the developmental models explained in the Digital Whiteboard research in Chapter 3, such as the Concerns Based Adoption Model, could be used to gain insights into the development of changes in behaviours and practices.

Conclusion

So, social impact can be anticipated and a visualization of how social-centred research should be carried out has been provided. This answers the second research question; how a designer can anticipate social impact. The next research question that was formulated was how social impact can be managed in design environments. In the next section I will draw conclusions on this subject.

9.4 Managing social impact

In Chapter 8, an analysis of the consequences of social impact for design contexts was performed. Three subjects were discussed. First, it was established that insight into social impacts will have an influence on user-oriented research. The conclusion was that this should be transformed into social centred research. Secondly, to assess a new functionality for a new design, it must be established how new specifications of a product can be specified. If social impact is implemented as an influencing factor, it might influence the design of goal process. And, finally, it was concluded that social impact produces a new vision on disruptiveness and it needs to be established how disruptiveness will be dealt with in the future.

Social centred research

Usability has long been an important goal of designers. Unfortunately, usability focuses solely on individual needs of, for example, senior citizens. This narrows the view on how the elderly can be facilitated with the help of technology. Some technologies may place the elderly in a passive role and in the end lead to inactive, unhealthy humans. If a designer seeks to activate users from the perspective of social innovation, an expansive view of the context that needs to be changed is required.
Another argument that is followed from this research, is the fact that it has been shown that it is rather difficult for designers to understand social impacts of new technologies. This, of course, counts for users as well. For instance, the teachers that use a whiteboard have only a limited view on how whiteboards have influenced their classroom interactions. So, another form of activation may become part of social innovation as well; to make users aware of the consequences of the use of new technology. If teachers would have been more aware of the social impacts of whiteboard, this impact might have been differently. Users may need activation; to become more aware of their own influence on the technology that surrounds and influences them.

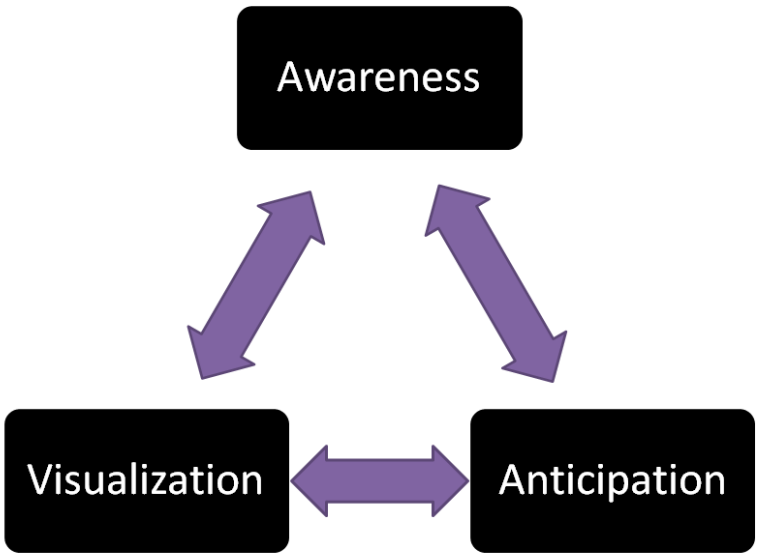
Increased attention for social innovations shows that designers' aims are shifting from an individual perspective towards a social perspective. Therefore designers need approaches that support this shift. The social impact approach aims to contribute to the further development of social innovations with the help of tools and methods.
The social impact approach is focused on the identification of consequences. How intentions can be identified for new products remains to be investigated. A focus on consequences, however, provides information about the possibility of intentions being reached.

Design specifications
The anticipation of social impact is a means to evaluate functionalities of a new product. It is comparable with attempts of mechanical engineers to evaluate specifications of new products. However, there is a big difference. Mechanical engineers implement unintentional consequences of new technologies as part of their standard procedure, while social impacts are not. Unlike mechanical malfunctions, the consequences of social impacts are not directly related to a new technology. A designer is not directly confronted with unwanted social impacts. It is therefore important that a designer is made aware of the need to incorporate anticipation of social impacts into a design process. To improve this awareness, a working model has been developed (see Chapter 8.3).

Social disruptions
Social changes can be enabled with the help of technologies. Disruptiveness has always been associated with social impact, as shown in the example of the shift from mainframe computers to personal computers, which has led to new working practices. In healthcare, a change is needed in healthcare practices. The social impact of technologies could serve as a boost for a new way of working. This research has explored how such impacts can be identified and anticipated and therefore how these can contribute to a careful and controlled implementation of social innovations.

9.4.1 Implementation
In the evaluation of the awareness working model, it was found that it was difficult for students to anticipate impacts in a social environment. The students only had a limited view of the complexity of practices. It was concluded that for students to become aware of social impact, they should perhaps learn about the complexity of practices first. The first idea of the awareness model was to use it as an indicator for designers to determine if they need to implement social impact in a design process. So it was meant as a starter.
Maybe in a professional environment and with the use of practitioners that have more insight in social practices, the model still may be used as a starter for a new project. However, this has not been examined yet.
So, depending on the target group that is using the social impact approach, the sequence of tools that will be applied differs. The use in an educational environment may start with an analysis of social ecologies and observation of practices as a starter (step 1 and 2 of the anticipation model), while in a design context, the awareness model can be applied as a first step.

Figure 9.6: the relation between the tools that have been developed



The three instruments that have been developed are related to each other. In figure 9.6, the relationship between the tools is visualized. This also shows that there is no defined starting point for research on social impact. However, it is clear that all three instruments have a different function for a designer. The awareness model has been created because designers are not automatically aware of social impact in a design context. The visualization model has been defined to show designers possibilities for social centred research and to make them understand the difference between user-centred and social centred research. The working model for the anticipation of social impact has been defined to enable designers to evaluate the characteristics of a technology to determine its impact. They can choose functionalities that support a desired social impact and eliminate functionalities with unwanted impact. In table 9.1, the various functions of the tools are described. In this research the relation between the different tools has not been analyzed yet.

Tool	Function	Question of a designer
Awareness	Evaluation of a new technology or concept	Will my product have social impact?
Visualization	Conceptual model for the research approach	How do I have to perform my social centred research?
Anticipation	Identification/simulation of social impacts and contextual characteristics	What functionalities do I need to choose for my product?

Table 9.1 tools within the social impact approach

In summary, the social impact approach fits within social centred research approaches in design contexts. It is difficult for designers to become aware of unintended social impacts. However, social impacts are found to be an important reformer for social changes.

9.5 Reflections on the research approach

In Chapter 2, the Design Research Methodology of Blessing and Chakrabarti (2009) to distinguish the stages in the research has been used. The DRM approach focuses from the start on improving and understanding design practices. Although I have not exactly followed the approach of Blessing and Chakrabarti, the research steps were applied according to their format.

The research started with a focus on social environments. Initially, design contexts were not integrated in research. This means I had a different starting point from design research that focuses from the start on the question of how designers could improve work methods. But, as the project progressed, designers and their context engaged attention and became involved in the research. So, the concentric model (figure 9.7) visualizes the approach of research well.

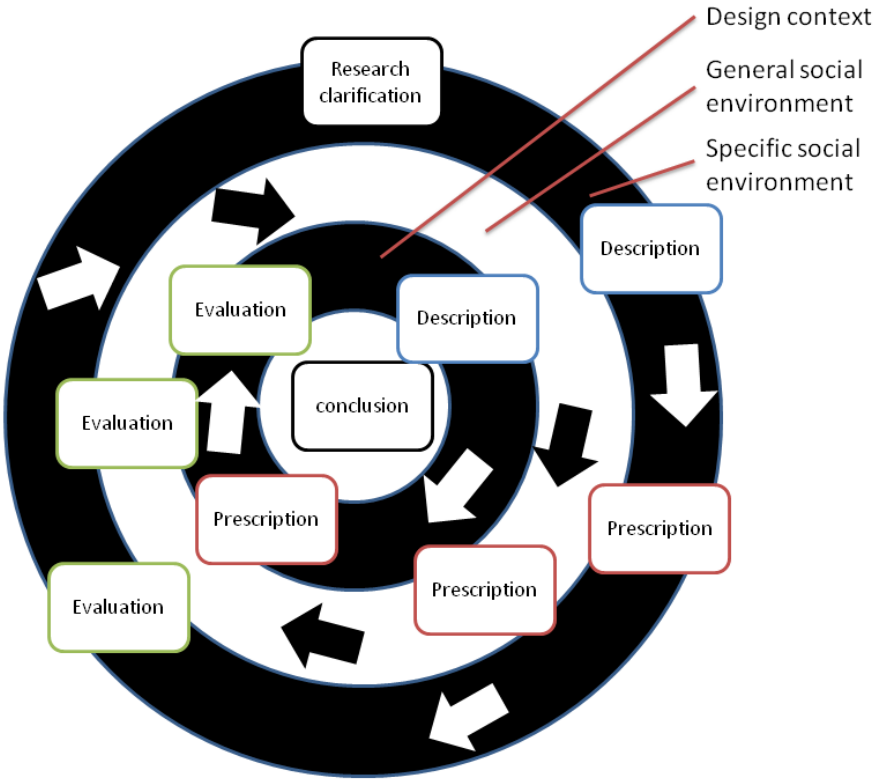


Figure 9.7: concentric approaches, adapted from Poelman (1998)

The research strategy followed was a transformative procedure in which the researcher uses a theoretical lens as an overarching perspective within a design that contains a mix of methods (Creswell, 2008). This had consequences for the way in which the research was performed. A combination of methods was used to gather evidence about the phenomenon of social impact, although the overall approach has been qualitative, because of the search for variation instead of validation. A variety of methods was used to learn about the effectiveness of the methods for the identification of social practices. It was learned that an intervention applied in the case of 6.2 did not lead to sufficient information about practices. This approach contributed to the insights needed for the instruments that have been developed.

In table 9.2, the research methods are linked to the corresponding study.

Chapter	*Observation*	*Semi-structured interview*	*Multiple choice*	*Diaries*	*Intervention*	*Persona/ Screenplay*	*Scenarios*
Study in 3	***X***	***X***	***X***				
Study in 4.3	***X***	***X***					
Study in 4.4	***X***	***X***		***X***			
Case in 6.1		***(X)***[17]				***X***	***X***
Case in 6.2		***X***			***X***		
Case in 7.3						***X***	***X***
Evaluation in 8.4		***X***					

Table 9.2: applied research methods

The cases were carried out with students. This was done because students are a major target group for the use of this research. They are the ones that have to apply new knowledge in design contexts. Yet, because the problem of social impact applies in all kinds of projects related to social innovations, the relevance of this research extends beyond designers only. Additional research, however, can and will lead to further improvement of the instruments that have been developed.

9.6 Recommendations

The exploration of social impact as described in this thesis has combined three main fields of research: social science with the use of the social ecological approach; technical philosophy with the use of technical mediation theory and design research with the use of theory about user-centred research and product innovation. For all three areas new insights have been gathered. The social ecological approach has been used in a new context and has been found to be useful for theoretical descriptions of reality. The mediation theory of Verbeek (2006) has been extended with the concept of social mediation. And for design research three new instruments for designers (usability researchers) have been developed:

- a working model for the identification and anticipation of social impact;
- a visualization tool to understand possibilities for analyzing impacts;
- a support to become aware of social impact.

The evaluation of the working model to anticipate social impacts in specific social environments was formulated in Chapter 5 and evaluated in Chapter 6, in two cases. The working model to anticipate social impacts for generic social environments was defined in Chapter 7 and evaluated in a case about ambient technologies.

[17] If students did have experience with brokers through internships, they did not need to interview brokers

These insights into social impacts became a starting point for the creation of new knowledge with relation to social impact in design contexts. The influence of insights into social impacts on user-oriented approaches, the formulation of design specifications and dealing with disruptiveness was discussed in Chapter 8, and has led to the creation of a working model with guidelines for designers. This model was evaluated, which led to new insights about the cohesion of the different tools within the social impact approach.

Some recommendations:

- The social context observed within this research focused on particular social environments of cohousing communities and elementary schools for reasons of controllability and feasibility. The influence of social impact in general social environments needs to be further examined.
- This research has focused on the consequences of a technology on practices in a social environment and has made it possible to identify contextual characteristics of an intervening technology. However, the consequences of social mediations for a technology have not been taken into account. This influence, which is called domestication, might be interesting for future research.
- The relation between passivication and activation of users has been briefly discussed. Passivication may be related to usability, while activation is related to social innovation. This relation needs to be examined further.
- I have concluded that design principles need to be dynamic instead of static. The consequences for design contexts are not clear yet and need to be examined further.

The research questions which were formulated have been answered. However, the explorative character of this research has clearly raised more new questions than it has answered. Having started as a usability expert with a focus on the use of products, I have made a personal shift to the social level of research. I realize, therefore, that this thesis is only a starting point for the development of tools and knowledge with regard to social consequences of technologies and the way a designer should become responsible and active in this field.

I started this thesis with the assumption that a designer is morally responsible for social consequences of design and should be enabled to anticipate social impacts. Hopefully my research will contribute to discussions within the field of designers on the role of social impacts in design.

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Next to work she enjoys travelling, reading, yoga and hiking. Jantine is married to Oege and has two kids: Freerk and Minke.