ADVANCED DESIGN METHODS

for successful innovation

Design United

Design United is the platform for Dutch Research in Design of the 3TU Industrial Design programmes. It combines the academic power of the field of Industrial Design and strengthens the innovative force of Dutch industry.

During the last forty years, the young field of Industrial Design has developed into an academic design discipline which combines knowledge from a wide range of fields and places the user at the centre of the design process. The designer no longer focuses exclusively on the quality of the interaction between user and product: increasingly, designers are confronted with the design of complex systems comprising many products and services. Given the increasing complexity of social issues, designers play a vital and central role in design driven innovation. This requires knowledge: methodology, tools and new concepts concerning users, technology and business aspects.

By bringing different disciplines together, Design United is improving the overall quality of research. Education and supervision of PhD students is harmonized, knowledge management is organised and large research projects are jointly initiated and carried out.
By involving the professional field and incorporating social issues in the research programme, the products of research are much better aligned with current industry reqirements. Two-way communication with industry also strongly contributes to the opening up of design knowledge.

Design United has initiated the following activities:
- Charting knowledge and opening up scientific experience, including examples of running and finished research projects, through the webportal and publications;
- Coordination of research topics and cooperation in large projects with societal, industrial and scientific partners;
- Active organisation of contacts and knowledge dissemination with industry and designers through events like symposia and round-table discussions;
- Annual exhibitions and congresses based on the results of Design United research programmes.

ADVANCED DESIGN METHODS
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Recent methods from design research and design consultancy in the Netherlands

ADVANCED DESIGN METHODS

for successful innovation

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Acknowledgements

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This book has the simple and straightforward aim of helping organisations adopt advanced design methods, thereby making them better equipped to deal with dynamic environments. As a 'hidden agenda', the authors and editors would like to stimulate interaction between academics and practitioners. After all, that's Design United's mission. This should lead to greater insights into the actual implementation of advanced design methods and to more intensive collaboration when defining research challenges and developing new research methods in the future.

Many individuals and organisations have contributed to this book. I am grateful to the reading committee of practitioners, who advised us on the selection of methods and on how to describe them in this book. They helped make this book attractive and useful for their colleagues in the fields of product development and innovation management. They were always eager to remind the academic authors of what practitioners really do!

Furthermore, a scientific editorial committee with representatives from the three technical universities, consisting of Frido Smulders and Rick Schifferstein (Delft University of Technology), Mascha van der Voort (University of Twente) and Elke den Ouden (Eindhoven University of Technology) was instrumental throughout the process in discussing the contents of the book and selecting and briefing the authors. It was a real pleasure to work together with all of you in the making of this book. The collaboration between academics from the different universities felt completely natural.

I would like to express my gratitude to Agentschap NL, in particular to Joop Postema and Michiel de Boer, first for sponsoring many academic design research projects, and second for supporting the production of this book, both in terms of funding and in terms of bringing together relevant stakeholders. Their patience and support has been exceptional and beyond expectation.

Bart Ahsmann from the Delft University of Technology has provided a wide range of support activities, varying from arranging meetings, arranging the finance, to taking care of the proof reading and the aesthetics of the book. With Bart on board we have been able to make continuous and solid progress on the book.

Finally, my thanks to the authors of each of the chapters of this book. In most cases they are those who developed the advanced methods themselves, and who have now helped both designers and practitioners by making their knowledge and insights accessible.

I am grateful to have had the opportunity to contribute to the collaboration between the academic design schools in the Netherlands in my former position as Dean of the faculty of Industrial Design Engineering in Delft. Even more, I am extremely proud to be able to present the fruit of this collaboration: a clear overview of advanced design methods that has the potential of making many individuals and organisations more successful in achieving their goals.

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Content

introduction

01.
Advanced Design Methods

Authors
Cees de Bont, Frido Smulders

Introduction   In the last twenty years, major technological, geo-political, economic, social and environmental developments have led to structural changes in many disciplines, including that of design. These changes seem to be occurring at an accelerating pace. Many organisations and individuals are facing increased complexity in their working and social lives. Designers no longer simply design artefacts: they have to think of combinations of products and services, or even develop entire systems. In the same period, designers have broadened their scope from adding economic value to commercial and public organisations to providing a wide range of economic and social values for all

kinds of organisations. New opportunities for value creation have emerged. In order to deal with this increased complexity, design as an activity has become more advanced in its methods, and designers increasingly take central positions in innovation projects to connect professionals working in different disciplines.

In many disciplines it is taken for granted that academic research is conducted with the aim of increasing the knowledge basis and understanding of real phenomena in that field. Everyone is aware that a great deal of research in the healthcare related disciplines is conducted to combat life-threatening diseases. Similarly, it is common knowledge that many industries tap knowledge from academic research. Often there is a one-on-one connection between the type of industry and the contributory scientific disciplines. To illustrate this point, the oil industry is closely related to the geo-physical sciences, the aircraft industry is connected to aerospace engineering, the food industry to chemistry, and the financial sector to business economics and accounting.

In contrast, for design, product development and innovation, no single discipline is the dominant provider of scientific knowledge. Many disciplines, from science (physics), engineering (mechanical engineering), design (industrial design) and social sciences (psychology, economy) contribute to product development and innovation. Some of these

scientific disciplines, in particular those in the field of science, are closer to the process industry and to process innovation, whereas engineering and design are often closer to the production of goods and services and to product innovation.

Whereas scientific research has longstanding traditions in science and engineering, in design this tradition is less well established. In the past, most graduates from design schools were not confronted intensively with scientific research during their studies. Much of the design knowledge and expertise was built up and made available by practitioners who lectured at the design schools. Nevertheless, over the last twenty years, we have observed that scientific research in design is growing at a much faster pace.
Nowadays, in particular in the design master's programs, students are more aware of, and even take part in academic research. The number of PhD students at academic design schools has grown sharply in recent years and new academic journals have appeared, for example, *Co-Design* and the *International Journal of Design*. Gemser et al., 2012 recently

published a list of quality academic design journals. Academic conferences in design are becoming more mature, for example the International Conference on Engineering Design, Design and Emotion, Tools and Methods of Competitive Engineering, International Association of Societies for Design Research, Computer-Human Interaction, to name but a few. Many PhD projects in design and many scientific publications report on the development of new design methods.

In the field of design, the Netherlands is a much respected country, comparable to other leading countries like Italy, Finland, the UK, Denmark, Sweden, USA, Korea and Taiwan. TU Delft has been an established and internationally renowned design institute for many years; in the last ten years the technical universities of Eindhoven and Twente have also started to contribute to design education and design research. The three Dutch academic industrial design faculties have been extremely active at international design conferences and have produced many papers for the international academic community. By selecting the most promising, well-researched methods from these three Dutch institutes, this book presents the outcomes of more than a hundred man-years of academic design research and about sixty man-years of strategic design consultancy.

At the same time, in the last ten to fifteen years, alumni from the faculty of Industrial Design Engineering in Delft, the oldest and largest academic design school in the Netherlands, have become more active in the field of strategic design and innovation consultancy, specifically investigating and developing new methodologies to be applied in these areas. Some of these methods have also been integrated into the

design school teaching programmes and have been published, for example Buijs & Valkenburg (2005), Roscam Abbing (2010) and Den Ouden (2011).

In Northern Europe, many universities have adopted a structured approach to design education. As part of this tradition, design schools have adopted the textbook on design methods written by Roozenburg and Eekels (1995). Students of industrial design engineering are trained to apply design methodologies. A recent illustration is the book 'Product Design' by a team of design educators at the University of Twente. In addition to the students, practitioners have started to recognize the practical value of design methods. This stimulated teaching staff at TU Delft to develop the Delft Design Guide. It covers a large collection of methods taken from design practice, design teaching and from the literature. By teaching these methods over many years, better classifications, better instructions and better examples have been developed. The Delft Design Guide is a practical guide for both students and practitioners.

Whereas the Delft Design Guide aims to give a complete overview of the basic methods relevant to all phases of the product development process, the purpose of this book is to make practitioners in product development and in innovation management aware of recent academic research that has resulted in advanced design tools and methods. This book neither aims to be complete in covering all advanced design methods, nor in covering all phases of the product development process. It, instead, reflects the strategic repositioning towards the fuzzy-front end of product development of the research programme that has been

running in the Netherlands over the last decade: Integrated Product Creation and Realization, initiated by Agentschap NL. This strategic positioning formed the cornerstone for the scientific research programme for the Dutch creative industries (CRISP) that was initiated by the three entities of industrial design at the three technical universities in Delft, Eindhoven, Twente and the Design Academy in Eindhoven.

The methods presented in this book are taken from these three faculties of industrial design and together they represent an important state-of-the-art overview of advanced design methods developed by design researchers and design consultants in the Netherlands. The methods are not described in the traditional scientific sense, they are richly illustrated with examples to facilitate the adoption and use of these methods in practice.

We focus on research methods that have been investigated, developed and tested in industry by researchers and senior members of staff working at the three design faculties. This underlines the collaboration between the three Universities of Technology in the Netherlands (3TU) and specifically the three design schools that are organised under the 'umbrella' of Design United, which is a platform for interaction between these design schools and industry.

This book aims to stimulate and facilitate the adoption of these advanced methods. We are certain that the correct uptake of these methods will help many organisations, both large and small, to become more successful in product development and in innovation management. In addition, the use of these advanced design methods by industry will help researchers to improve these methods and develop new ones. Be aware that applying advanced methods may not always be straightforward. Design problems vary and will require, amongst others, contextual information in order to determine the best way for implementation. The target group for this book is therefore not only designers. Since product development and innovation management involve a wide spectrum of disciplines and related organisational roles and functions, this book is aimed at a broad range of professionals, including those involved in product planning, marketing, strategy, R&D, manufacturing and design.

Design: changing perspectives

"Design", as noted by Heskett in 2002, "is the human capacity to shape and make our environments in ways that satisfy our needs and give meaning to our lives." Heskett further elaborates on the definition by distinguishing between design as a noun and design as a verb. Design as a verb, the activity that we are interested in, is often described as a goal-directed process consisting of a series of analytical and creative activities. Let's consider some perspectives on design as an activity. It will become clear that the activity of design in industry has changed a great deal over time, moving from the pure functional design of the past to the value-based design of today.

product

user
product
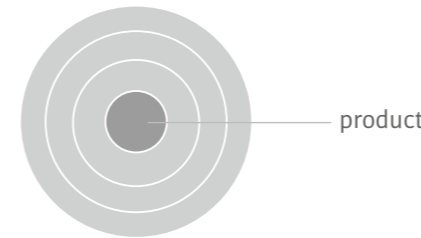
At the start of academic industrial design programmes in the Netherlands in the mid-sixties of the twentieth century, the main focus of design was to support the industry in developing products. In those days, households adopted many
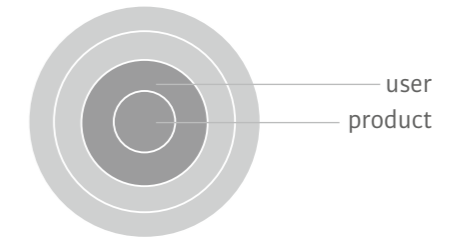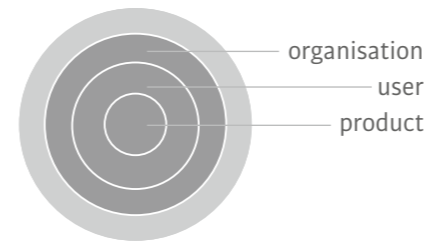
new electric products, for example washing machines, irons, and vacuum cleaners. These and other products helped to reduce the amount of time spent on household chores (De Rijk, 1998) and offered people a wider perspective

became more important to enjoy the way the functionality was delivered and what it did to its possessors in terms of experiences in the widest sense (Pine and Gilmore, 1998). The notion of experience was also picked up by the services industry, willing to provide a better service, or in other words: experience, to their clients. Some companies even combined products and services, like the Dutch Railways NS with their bicycle rental service 'OV fiets'. The most successful company to do so, in terms of generating market value, is Apple, starting with the iPod and iTunes.

Not just the experience of using, but also that of being seen with a particular branded product, which is all about the expressive quality of brands, started to play a major role in purchasing decisions. The brands of the products and services enabled people to demonstrate to which social group they (wanted to) belong. Branding and brand management started to become very popular in academic research on marketing (e.g. Keller, 2003) and as a topic at business schools, and much later at some design schools. Some leading brands like Gucci, BMW and Bang and Olufsen successfully made the experience of possessing and using their products part of their brand identities. Many companies maintain a portfolio of brands (e.g. Unilever). Their design and communication activities are geared towards distinctive brand experiences that strengthen brand identities. Design methods are applied to support organisations in managing these brand portfolios.

Through advances in technology, products became more intelligent. This helped to generate exciting user experiences, but also confronted consumers with difficulties in using these advanced products. It became more difficult to anticipate

on the world, for example radio and television. From the early days of design, it was considered important that users would be capable of using new functionalities. The dominant theoretical perspective in the industrial economy that evolved from this over time is that of user-centeredness. Designers primarily concentrated on the product, its functionality and its users. The functionality of new products was based on an understanding of (functional) user needs.

In the last decades, many western consumers have achieved high levels of material welfare. Buying is no longer simply about obtaining a purely functional product. Most branded products deliver well on their core functionality, and it is clear that products that do not achieve this, are becoming rare. Instead of focusing on the functionality per se, it
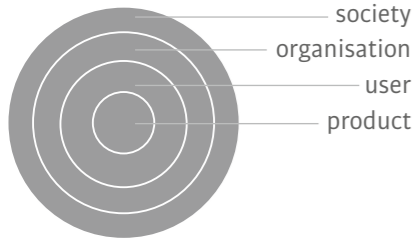

organisation
user
product

which kinds of functions (or features) would actually be used. So designers were challenged to help out in reducing these uncertainties when developing new products, and to support decision-making in the development process in order to avoid user complaints later on. Many different professionals take part in the development of intelligent products. In particular, the (embedded) software component grew in importance. This increased technical and organisational complexity led

to the need for advanced design methods to ensure that professionals from different backgrounds could still operate as a productive team.

In large parts of the world, like China and Brazil, substantial groups of consumers are only recently progressing to a financial situation in which they can afford luxury products and brands. In societies that have already been affluent for years, two dominant dynamics came into play at the beginning of this century. The first is that new values started to become important, such as authenticity and responsibility. Design for sustainability, a theme which has been in existence for many years, has really grown in importance, and has grown beyond the notion of environmental-friendly products. Many companies adopted a societal perspective that incorporates the ecological footprint of products and services. Value for society is about collective values, beyond those of specific individuals or organisations. Increasingly, for-profit organisations are in the process of supporting societal values above and beyond merely generating income and maximising profit. This new orientation is of growing relevancy to attract and keep talented staff and to be successful in the marketplace. Even in highly materialistic societies like Dubai and Hong Kong, organisations and individuals sponsor universities, art, hospitals, etc. There is an increasing world-wide trend that consumers require commercial organisations to engage with their social and physical environment in a different way, one that goes beyond paying mere lip-service to Corporate Social Responsibility.

The second dynamic is related to the sharp changes of the world economy caused by the faster pace of change and the

design: FABRIQUE photo: Jonathan Vardy

with the development and delivery of services. This situation requires organisations to take a broader perspective, beyond the confines of their own organisations. Many commercial organisations have started to work together with other organisations, for example from the public sector, to better understand and address combinations of social and material needs. Sometimes, different commercial organisations team up to create innovative propositions together. See for instance the increased attention being paid to open innovation and networked innovation, e.g. Chesbrough (2003), Christensen (2006) and the subsequent world-wide focus on business model design for business model design, e.g. Ostewalder & Pigneur (2010).
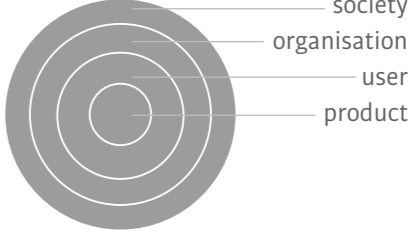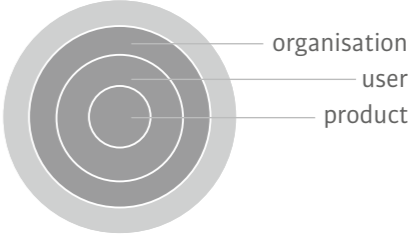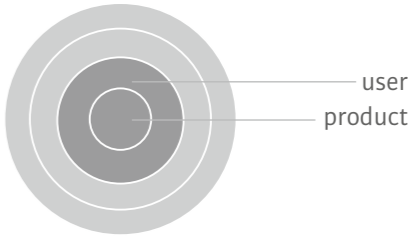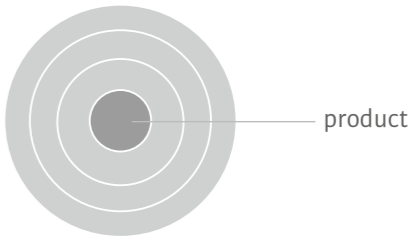
Public organisations have a certain role in a social network. Just think of a major airport like Schiphol Amsterdam. In order to attract more passengers, the airport needs to attract airliners to carry these passengers to the many different destinations, to offer parking facilities, shopping areas, connections to other transport modalities, safety procedures, etc. An innovation, for instance, directed at a faster check-in procedure, will involve many stakeholders (e.g. passengers, shopkeepers, immigration officers, etc.). It implies potential benefits to many, but it also requires those affected by these new procedures to consider new ways of working and collaborating.

Changes in society and in the ways companies run businesses have an impact on what designers do and are expected to do. Designers increasingly not only set out to create new products and services, but they also want to have an impact on human behaviour (e.g. in relation to fitness and exercise and to

food intake). Designers are involved in many of these kinds of innovation activities. At Delft they started an Institute of Positive Design, directed at behavioural change. Several design schools in the world are following this trend, including the School of Design in Hong Kong that has opened a design institute focused on social innovation.

The hype and world-wide attention for design thinking, applying designerly approaches to all kinds of wicked problems that go far beyond the traditional field, supports these observations. The CEO of IDEO, Tim Brown, wrote an article on this topic in Harvard Business Review (Brown, 2008) showing that design thinking has much to offer in relation to this wider perspective on design. Design academics and design consultants work hard to develop advanced tools, methods and approaches to support organisations when dealing with these new and additional complexities. In this way they help them define new opportunities and stay valuable and relevant in their business. Examples of methods and approaches are: design for society, multi-stakeholder analysis and collaborative design.

To summarise, we have seen the field of design moving from one dominant focus (product and user centric design) to encompass new (organisation-centric design) and additional foci (society-centric design) without losing grip on or disregarding the first ones. For contemporary design, all foci are equally important. It can be stated that organisation-centric design incorporates user-centric design and that society centric design incorporates both user-centric and organisation-centric design, considering design as a process of value creation that overarches all these former perspectives.

society
organisation
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product

parallel effect of increasing technical and societal complexity. This has forced companies to reconsider their own strengths and weaknesses. A wider range of competences seems to be necessary to remain a leading organisation, often combining development and manufacturing of products

product

user
product

organisation
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product

society
organisation
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product

Many authors have noted the importance of value creation for design. Recent work by Den Ouden (2011) distinguishes between four levels of value in the context of innovation that support what we have discussed so far. These are: value for users, value for organisations, value for ecosystems and value for society. Value for the ecosystem is either about users, organisations or society. That is why, in this book, we concentrate on three levels. To rephrase product development in terms of value creation we see the following: development of artefacts and services is clearly connected to the creation of value for three levels of stakeholders: users (e.g. pleasure or a healthy lifestyle), organisations (e.g. more income, a more positive image) and society at large (e.g. environmental impact & less waste).

How to continue?

Further reading

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– Liedtka, J. and T. Ogilvie (2011). *Designing for Growth: A Design Thinking Tool Kit for Managers.* New York: Columbia Business School.
– Eger, A.O., M. Bonnema, E. Lutters and M. van der Voort, (2012) *Product Design*, Eleven International Publishing
– van Boeijen, A.G.C., Daalhuizen, J.J., Zijlstra J.J.M. and van der Schoor, R.S.A. (eds.) 2013, *Delft Design Guide.* Amsterdam: BIS Publishers.

Value creation on three levels
Structure of the book

We have seen that design can be regarded as a process of value creation for all actors affected by the design, be it a product, a service or a combination thereof. For this book we have chosen to focus on the level of the user, the organisation, and society. We have named these: user-centric, organisation-centric and society-centric. Hence, the three sections of this book. For each of these levels, we describe research-based methods that have recently been developed, tested and validated.

PART 1
User centric

PART 2
Organisation centric

PART 3
Society centric
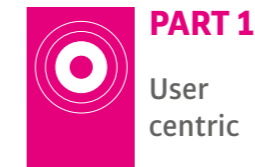
PART 1 User

User-centric value creation

As discussed in the Introduction, all of the value perspectives are still relevant today. As a result, a wide spectrum of methods are currently still being used. The main reason for this is that, even today, product function is still relevant, as are brands and experiences. Experience design can be seen as a further development of user-centred design. All these different values can be important to users at the same time. A user might be interested in a pleasurable experience, e.g. when buying a game console, whilst other users may be interested in new functions of existing products that facilitate being in-touch with people at a distance, e.g. Skype. Users can be interested in saving money by using more efficient climate-control systems or in saving the planet by driving an electric car. Which values are important not only differ between the

type of user,they also differ between periods, for example as as a result of economic conditions, societal values and the availability of technologies. Design-for-Usability and Experience Design are considered important methods for generating user value.

Part 1, user-centric section includes four chapters: participatory design, scenario-based design, experience design and design for usability.

The first chapter brings the user into the design process. User involvement and participatory design in particular can be seen as ultimate forms of user-centred design. However, users are different from designers in their thinking about new products and services; they are often not aware of what they are looking for. The challenge then is to find means of uniting the participating users with the

designers. This chapter discusses the various forms of, and the tools needed to achieve this close collaboration and make the user perspective of value for the design process.

The second chapter introduces a method of using scenarios in product design. It shows how scenarios can effectively be used to provide insights into how products can or could be used. The method describes how these use-scenarios can be applied by development teams as inspiration, communication and evaluation tools.

The chapter on experience design extends the notion of usability by addressing the explicit development of experiences that users have while using the product or service. The method takes into account the context in which users will be using the product. Contextmapping allows for the discovery of hidden knowledge related to the specific use contexts. The method supporting the development of the user experience has three categories of activities: one to 'understand' the current situation including its context, one to 'envision' the future

situation, and one that supports the 'creation' of the new product including the experiences it will evoke in use.

The usability chapter is the final chapter in this cluster. It explicitly focuses on how to incorporate usability-related decision-making in the entire product development process. The chapter makes clear that this focus not only affects the designers, but also requires the organisation to adopt an integrated usability-centred approach. It addresses the major challenges product development teams and their organisations encounter with respect to addressing usability issues. The method presented here is a comprehensive approach that covers the planning, the decision-making and tools selection. By including a focus on organisational decision making, this chapter already clearly touches upon aspects of organisation-centric value creation.

PART 2 Organisation

Organisation-centric value creation

Creating value for organisations is in line with the mission of organisations; they seek innovations that help them to achieve the goals and objectives that are in line with their values. For-profit companies strive for other values than not-for-profit organisations. Some organsiations use brands (Unilever has Dove and Ariel among many others) whilst others use organisational entities (Philips distinguishes between Healthcare and Consumer Lifestyle) to manage a portfolio of products and services. The brands are the engines generating revenue and profit for the commercial organisations.

Many organisational entities (marketing, finance, technical development, etc.), in many cases supported by external organisations, collaborate in generating innovative products and services to support the brands. As a result, a multitude of interfaces (often referred to as 'boundaries') exist between departments with actors having different functional backgrounds, which gives rise to many potential misunderstandings. Only when these actors operate together well, can exciting new products and services be developed that meet consumer needs, can development costs be kept under control, and can the introduction windows be met.

Value for organisations is achieved by brands and their products that perform well in markets. A prerequisite for this is that the supporting innovations should be conceived and delivered in a cost-effective and timely manner: this requires multi-disciplinary collaboration. This section addresses two important methods that deliver on the organisational values: Brand-driven innovation and the collaborative process of mirroring. The latter method aims to improve the boundary-spanning practice.

Brand driven innovation (Chapter 6) is, in essence, based on the understanding that, in order to innovate meaningfully and sustainably, organisations need a deeply rooted and shared vision. This chapter shows how visions are created and how they become actionable. It paves the way to working across organisational and disciplinary silos. The chapter shows that the brand of the firm can be a valuable internal driver instead of simply being an external messenger. Transferring the brand into a driving factor for innovation requires two nested sets of complementary activities: inside out and outside in. Central to this process is to make the relationships between the organisation and its customers explicit. In fact, brand-driven innovation combines a user-centric approach with the values of the organisation and those that are delivered through its brands. Only through a true understanding of customer motivation related to a brand, can its values and promises be created and delivered successfully. Building on the directions to further strengthen the brand, development teams work on projects to conceive and deliver innovative propositions.

The second chapter in Part 2 (Chapter 7), introduces Mirroring as a method for designers to improve spanning disciplinary, hierarchical and organisational boundaries during New Product Development (NPD). The NPD of complex products requires many different actors to work together in order to be able to create a new and complex product. Mirroring, in other words, supports the process of creating a better understanding of the constraints and abilities of other disciplines, and facilitates the team to think collectively when solving design problems.

PART 3 Society

Society-centric value creation

In this section, we go beyond the value creation for the organisation, and move to a much wider perspective on value creation by including two aspects of the social dimension in the innovation equation: society and the eco-system. Not-for-profit organisations are often geared towards a value that is relevant for society (e.g. Amnesty International or Greenpeace) instead of value through goods for individual consumers. This type of value generation for society is not limited to these organisations only. Increasingly, companies in the profit sector appear to be interested in utilising their capabilities beyond the generation of income, profit and shareholder value. An example of this is TPG, which has been involved in solving logistic problems for food-related disaster relief in deprived areas. Another example is PepsiCo, who are

trying to support a healthy breakfast for young people around the globe. An explicit focus on sustainability, which seems to be more and more common in all kinds of organisations, is society driven and delivers society relevant values that go beyond the values for the user.

Society-centric value creation includes developing the ecosystem around a specific innovation. It considers the network of different organisations that each create part of the value for the end user whilst at the same time creating value in order for them to survive. The ecosystem is to be seen as a network of actors and parties with nested and integrated business and revenue models.

The two chapters in this part of the book integrate societal values and ecosystems by taking the recently introduced perspective on innovation as a process of creating shared

value for people, organisations and society. Since this is a relatively new design perspective, methods have not yet fully crystallized. However, some promising approaches have been developed to support designers and organisations in this domain.

The first chapter (Chapter 8) takes the perspective of creating meaningful innovations by considering innovations as being social in nature as they affect a much larger number of stakeholders than just the consumer. This perspective requires all these stakeholders (or their representatives) to collaborate to bring the different elements of value creation together. The chapter proposes a value framework that helps to reduce the increased wickedness of such collaborations by explicitly addressing societal, economic and user challenges. The value framework therefore integrates views from economy, ecology, psychology and sociology. The use of the framework in workshops facilitates the process of creating shared value. This chapter describes methods based on: user value perspective, organisational value perspective and societal value perspective.

The second chapter (Chapter 9) adds to the idea of socially balanced innovations by addressing the process of designing whilst being part of the ecosystem. The chapter discusses the challenge of addressing the complexity of designing new ecosystems. While the first chapter in this third section discusses the creation of meaningful innovation, the second chapter discusses the complexity of the design process in collaboration with all the stakeholders that represent the ecosystem.

We end this book (Chapter 10) by discussing some recent developments in the field of design methods. In this chapter we classify different types of academic design research and discuss how we as academics set our agenda for scientific research. This final chapter also provides a sneak preview into future publications.

PART 1

user-centric design methods

02.
Capturing use: user involvement and participatory design

Authors
Jos Thalen, Julia Garde

Introduction

According to the User Centred Design (UCD) philosophy, prospective end-users should be given a central role in a design process. The foremost purpose of including users in the design process is to get better insights into future use situations in order to design products, services or forms of organisation that meet the users' needs. There are numerous tools and methods that promote a specific implementation of UCD. These differ in the way they involve users (e.g. from users as designers to users as concept testers) and in the design activities they target (e.g. early design phase activities or detailed design phase activities).

In this chapter we focus on one specific form of active user involvement known as participatory design. Active user involvement aims to give users an active role in product design in order to produce insights into users' needs, their practical knowledge and into the use situations that products are used in. Participatory design is a specific form of user involvement that serves a democratic ideal by accentuating the aim of giving citizens or workers a voice in design decisions that influence their lives. The use of special tools and techniques enables users to take an active role in designing and experiencing product concepts revealing covert or subconscious user needs. In this way users can apply their practical knowledge, and complex use situations can become more concrete.

Challenge

UCD tools and methods can be characterised by two properties, namely the design activities they support, and the role end-users play during these activities. The diagram in *figure 1* uses these properties to illustrate the position of active user involvement and participatory design within the field of UCD methods. The horizontal axis outlines the project phases in which the methods can be used. The vertical axis outlines the intended level of user involvement achieved with each method.

The two bottom rows of the diagram represent 'traditional' UCD methods in which the roles of designers and users are quite distinct; designers generate solutions for users based on explicit knowledge. This knowledge can be gathered through ethnographic research such as interviews or surveys with the user, or by observing users during product use. Users are the objects of study and, during usability testing, the testers of solutions. These techniques are currently in common use in the product design industry. Analysis, design and evaluation activities as part of these methods are mostly conducted by professionals for or together with users.
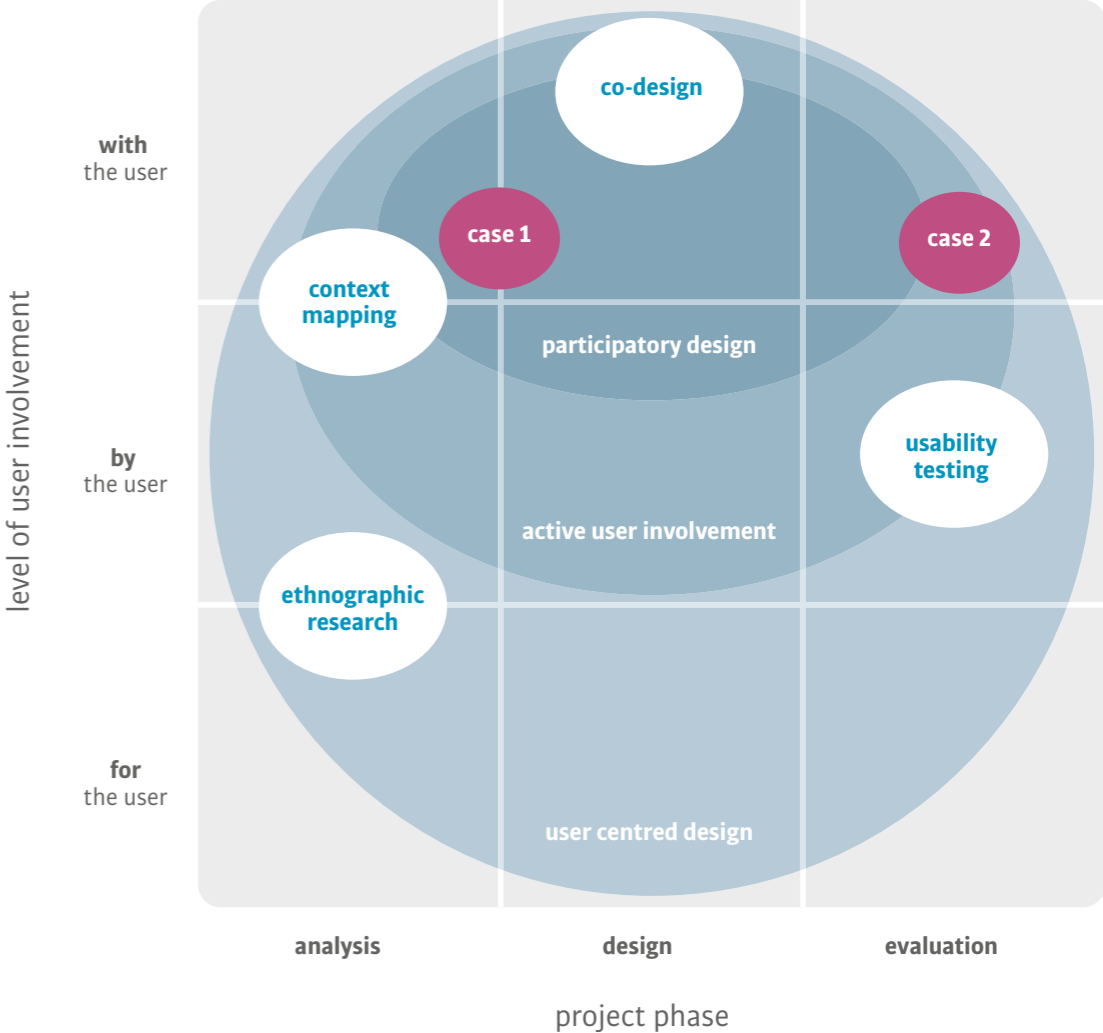
FIGURE 1 *relation between user centred design, participatory design and the case studies presented in this chapter*

There are however several challenges in product development that cannot be addressed by these traditional UCD methods:

- **Gathering rich user insights** - Traditional marketing tools do not always result in the desired level of user insights as, for instance, they focus on quantitative data rather than in-depth qualitative data. To obtain rich qualitative data, users can be more actively involved in analysis activities in order to provide detailed insights into the current use context, use problems and user needs. An important advantage of active user involvement compared to less active user involvement methods, such as ethnographic studies, is that users are involved throughout the iterative loops of design projects. In this way, designers are able to obtain feedback about their interpretation and application of user insights at different stages in the design process.

- **Acquiring experts knowledge** - When designing for professional use situations with which designers are not familiar, for example within the healthcare context, the designer's lack of practical experience needs to be compensated. In this case, a company can involve users in analysis, design and evaluation activities. Involving people with a large 'repertoire' of practical experience in the product development process can decrease the number of use problems in the resulting products.

- **Early validation of user requirements** - If a company aims at a (non-incremental) product innovation and needs to validate concept directions with users, traditional usability testing takes place too late in the development process. Therefore, to evaluate breakthrough product concepts, the company can involve users in early concept evaluation to verify that they are heading in a promising direction.

- **Obtaining a multi-perspective review** - If users with a variety of roles are involved in the use of the same product, or if the use of the product takes place at different times and places, use situations can become complex. Often, the various roles of the users result in different or even conflicting requirements. User involvement helps the designers gain insights into different perspectives and in balancing conflicting requirements: Involvement of the different users in joint user sessions can help users and designers exchange and understand the diverse requirements, discover conflicting requirements and, as a group, negotiate prioritisation of the requirements.

- **Gaining Commitment** - Involving users in the design process can help designers gain user commitment for prospective changes, which is of value in design projects that imply substantial changes for the users in, for example, the way they execute their work.

In *figure 1*, the top segment represents active user involvement and participatory design methods that have been developed to address the above-mentioned challenges. Active user involvement methods have become more broadly applied in practice over the last ten years. Pioneers in this field (as described by Wakeford in 2004), include design consultancy IDEO, who are well known for their design approach of user involvement in the analysis phase, and Philips, who employ the LivingLabs approach.

Participatory design has its roots in the Scandinavian workers unions of the 70s, where it was used for the design of software and organisational structures with the goal of representing the interests of workers in the design process. Since then, Participatory Design has found its way into other fields such as civic participation, healthcare design and architecture.

Compared to UCD and active user involvement techniques, the broad adoption of participatory design in industry has been moderate. This is often due to practical reasons, as there is no homogenous community that can be represented, nor is there a clearly definable group of users to attend to. Furthermore, there seems to be less need for democratic participation in the design process of consumer products, as users have the option of 'voting' by either buying or not buying the product.

Method

The field of active user involvement is too broad to be captured in a single method or technique. A number of methods cover different parts of the spectrum, each with its own focus or interpretation of active user involvement and participatory design (Kensing and Blomberg, 1998). The following characteristics can be used to differentiate between the various methods.

- The type of stakeholders involved (e.g. customers, end-users or decision makers)
- The number of stakeholders involved (e.g. one-on-one interviews or role-playing in group sessions)
- The type of relation between the stakeholder and the product (e.g. professional end-user vs. randomly chosen prospective end-user)
- The project activity in which stakeholders are involved. Involvement can be limited to a specific activity phase (analysis, design or testing), or applied throughout the project.

Despite the variety of methods and their implementation in relation to the above characteristics, most of the methods and techniques share one common goal, which is to gain access to the user's tacit and practical knowledge:

Tacit knowledge is 'what people know without being able to articulate' (Spinuzzi, 2005). Compared to explicit knowledge, tacit knowledge provides a holistic view of, for instance, the usage or use context of a product, rather than an explicit functional definition of a particular product or activity. Tacit knowledge cannot be transferred in writing, it can only be experienced by 'doing', for example by experiencing an activity. Specific design techniques help with utilising this type of knowledge in the design process by letting participants 'do' things, i.e. build, and test new designs, instead of describing them.

Practical knowledge is knowledge about how things are currently done and about use problems, based on a repertoire of experienced and memorized use situations. This knowledge can be accessed by the users to foresee problems and opportunities which a designer, without this repertoire, cannot anticipate. Therefore users' practical knowledge is valuable for the design process, especially when developing products for a user group that is clearly identifiable, for example in the professional market. A wide range of methods

and techniques are available for designers to elicit this type of knowledge from users, a selection of which are outlined in the next section.

Tools and Techniques

Active user involvement methods help end-users express and analyse their current product use and use context and, subsequently, let them conceptualise and reflect on future use situations. In order for end users to share their tacit and practical knowledge with a design team effectively and efficiently, an appropriate means of communication has to be available. However, communication between users and a multi-disciplinary design team is challenging for both sides. While designers and engineers are trained to communicate and work in a multi-disciplinary environment, users are usually not. Therefore, it is difficult for members of the design team to find the right questions for prospective users and formulate them in a way that the answers reveal useful design information, as end-users are typically not able to translate their current habits and routines into concrete user requirements or new design opportunities.

Furthermore, many active user involvement methods provide so-called 'boundary objects' (Star and Griesemer, 1989). Boundary objects are (in this context mostly physical) objects that are common enough for all the participants from different (professional) domains to relate to. The boundary objects thereby improve the communication in a group, circumventing the need to uncover and discuss the meaning the objects have to each individual. By using boundary objects, participants can communicate with each other while each participant remains within his or her own knowledge domain.

Active user involvement methods employ a range of tools and techniques to facilitate communication between end-users and the design team. They are often practical and action oriented, encouraging participants to describe and explain their actions. Designers can subsequently use this information to improve the product. Specific artefacts like physical product mockups, card sets or virtual prototypes are used to reduce the threshold for users to engage with the tools. As there are many different techniques for active user involvement throughout the design process, this section presents an overview covering generic groups of techniques that can be used in the analysis, design or testing phases. These generic techniques can be further customised to fit specific applications.

Card sorting

An example of a practical and action oriented technique used in the analysis phase is card sorting. Card sorting works with card sets that depict or describe product features or tasks. Groups of users are asked to organise or sort these cards in predefined or self-chosen categories. By doing this, users provide the design team with insights into the way they organise aspects of the use situations or features of the product (*figure 2*). The design team can then react by organising product features in a way that match the user's preferences or experience (Nielsen & Sano, 1995).

Task analysis

Task analysis techniques are used as an analysis tool for exploring current use situations or to 'design' ideal use situations in the design phase. Several tools focus on task analysis. A simple example is the 'collaborative users' task analysis (CUTA) approach (Lafrenière, 1996) which is based on the 'Collaborative Analysis of Requirements and Design' CARD technique (Muller, 2001). CUTA uses paper cards (task cards) that have to be filled in for every task in a product use situation. This helps users to sort tasks they wish to achieve. Participants then generate a task flow, i.e. a use procedure, using the separate task cards. This facilitates the recording of action sequences by making previous steps continuously visible for all participants. Additionally, it supports iterative task flow development, as it is easy to rearrange the task flow.

Role-playing

Role-playing, in the form of theatre techniques, or playing out actions in miniature environments (Urnes et al., 2002) work by mimicking current (analysis phase) or future (design phase) use situations. The use situations are played out by utilising the users' own bodies to 'act' in theatrical manner, by using toy figures in a miniature environment (*figure 3*), by using avatars in a digital virtual environment, or even by applying combinations of these three techniques. A physical or digital product prototype can play a part in these mimicked use situations and can evolve throughout the various stages of development (*figure 4*).

In theatre techniques (e.g. Sato & Salvador, 1999) professionals play out use situations and a panel of users can react to these and change the use situations 'on the fly' by suggesting alterations to the play. In user role-playing, on the other hand, users themselves play out situations and use their own bodies to mimic actions and movements.

FIGURE 2 *Card sorting with users to explicate use procedures and product requirements*

FIGURE 3 *Toys can be used to act out scenarios. Here Lego figures are placed on a floorplan to explain workflows in a building*

FIGURE 4 *low fidelity mockups used in role-playing*

The use of a miniature environment offers users a lower threshold, whilst providing a more defined 'setting' for the use situation (e.g. a doll house or a map). Users move play figures in order to play out situations instead of playing them out by themselves. These figures are 'physical, symbolic representations that allow a person to move back and forth between a figured (imagined) world and the real world' (Urnes et al 2002, p. 187). Furthermore, they work as boundary objects (Star and Griesemer, 1989) because the physical game elements make it easy to exchange information between domains and anticipate the use situation.

Props & building blocks

Techniques that focus on mimicking use situations occasionally work with 'props' (Brandt & Grunnet, 2000). A prop can be any physical object, for example an existing product or abstract building block, which is assigned a role in the use situation as a new product with specific functions *(figure 5)*. Usually, a choice of several props are offered to users who then explore the chosen prop by mimicking the use situation. Applied in this way, props work as inspirational material.

A more focused approach that also works with physical objects representing future products, is the use of 'tool boxes' (e.g. Sanders & William, 2001). Tool boxes offer a choice of building blocks to enable users to easily build representations of products that ideally support their needs.

Scenarios

Another technique common to active user involvement is the use of scenarios. Scenarios are rich descriptions of use situations containing one or more actors, their goals, the 'product', the context in which the use situation is taking place, the actions an actor takes and the events he or she has to deal with during their actions (see also Chapter 3: Scenario based design). Scenarios, if validated by the users, provide a realistic and concrete use context which users themselves can utilize to evaluate design concepts. They can be documented by written stories or by the use of storyboards. Users can be involved in scenario techniques by letting them create the scenarios, by consulting them to verify scenarios created by another party, or by acting out scenarios. Acting out scenarios with a –sometimes self-
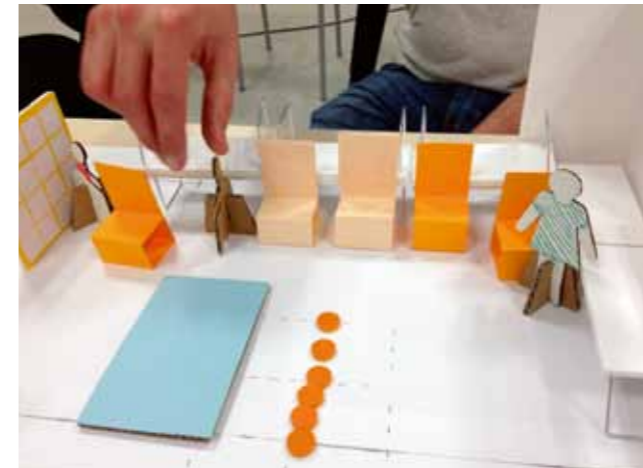

FIGURE 5 *props and building blocks*

developed-, configurable prototype of the product helps the users to anticipate the consequences of their design decisions (see role-playing).

Virtual Reality

In addition to low fidelity tools like board games and cards, user involvement techniques can be supported by high fidelity tools like virtual reality (VR). VR allows end-users to experience products and use contexts that do not (yet) exist, or to which end-users would not be normally exposed (e.g. dangerous or remote locations). Traditional examples of using VR to support active user involvement in product design include the use of driving simulators to evaluate drive support systems or the use of 3D virtual environments (e.g. in a CAVE[1]) to immerse prospective users in a future use context (Jimeno & Puerta, 2007). Recent developments in VR hardware and software have significantly increased the accessibility of VR in terms of reduced costs, improved usability and available support. Emerging techniques such as augmented reality (a technique that merges real-life information, from for instance camera images or videos with virtual information from 3D models), and multi-touch displays enable untrained end-users to actively participate in the evaluation and generation of product concepts.

[1]   A CAVE (CAVE Automatic Virtual Environment) provides an immersive 3D environment in which users can virtually walk around and interact with virtual objects.

Cases

In the following sections we present two case studies that illustrate different methods of active user involvement in early stages of the development process. In the first case study, forty participants were selected to represent the larger group of prospective users. The group played an active role in generative design activities, thereby making this a participatory design project. In the second case study, end-users evaluated product concepts at a very early concept testing phase, by acting out future use scenarios in a virtual environment.

Participatory Design using a Miniature Environment Tool

One of the challenges in user involvement in design projects is enabling users to experience the consequences of the design decisions they make. This case study describes the application of a scenario and task flow based design tool in a Participatory Design (PD) project in healthcare. The chosen set-up triggers the participants to empathise, design and play through new use situations and thereby discover the consequences of their changes.

Aim
This project was performed for a large regional Dutch hospital (620 beds) moving to a new hospital building. The special challenge was that the new building only has single rooms, while in the current hospital patients are cared for in one, two, and four person rooms. This will be the first exclusively single room hospital in the Netherlands, so there is no precursor to learn from. This change will have major consequences for the hospital staff's daily work routine. Moreover, the organisation of hospital visits and catering will change dramatically and the hospital management would like to have a nearly paper-free hospital, including digital patient records. Generally, digital technology will play an important role and will be used to track people and material. The major changes that lie in store for the hospital imply that the way nurses and ward assistants work and the use of materials must also change. The envisioned changes and associated challenges of designing a new way of work long before the new building is finished, made the case ideal for the application of participatory design.

The project involved the redesign of work organisation concepts for ward nurses with regard to (1) ICT & ward communication, (2) material logistics, (3) catering and (4) nursing task flow & visiting policies for the general wards. The project aim was to develop new concepts for the nurses' work organisation including the distribution of tasks and responsibilities and the development of requirements for auxiliary products such as material trolleys and digital appliances. Generative PD workshops on the four different topics were set up. The centre-piece of the workshops was a design tool that supports the generation of complete care task flows by the participants themselves.

The 42 project participants were mostly nurses and ward assistants who were selected to work in the future hospital, hence they are the *actual future users*. Furthermore, stakeholders with a specialist role, for example from the ICT department and from the facility management team, took part in the workshops. The workshop participants had the task of developing nursing workflows and product concepts, and evaluating these in a scenario context, hence d*esign and evaluation* of concepts was done by the future users themselves.

Tools & Techniques
The tool applied was developed to enable users to invent and design a usable new work procedure and to include *different*

stakeholders at the same time. In this way, the effect of changes in one user's domain of responsibility on others could immediately be discussed, resulting in a clear overview of work procedures and the consequences of these changes to this procedure. This triggers participants to empathise the new situation and to include auxiliary products that might be involved in the procedure.

The tool is based on a combination of task cards to generate a work task flow, similar to CUTA (Lafrenière, 1996), and a miniature environment (e.g. pivot game, Urnes et al., 2002). Both components have their own objective but also serve as mutual verification tools in the following manner. The task flow generation helps to capture work organisation concepts

in a structured and detailed way by filling in task cards which focus on chronology, time management and staff deployment. The task cards contain fields for describing the task, the person or group who perform the task, and the place in the hospital where the task is performed (e.g. in the patient room or in the staff room), thereby enabling participants to generate a task flow.

However, the task flow component of the game does not allow for planning the logistics of people and material, and might, due to its high level of abstraction, not stimulate the participants to consider all aspects of work. Therefore, a miniature environment game component was added. The miniature environment provides a hands-on experience

that clarifies logistic problems and helps participants to imagine the task flow in a realistic hospital setting. By acting out a defined task flow using play figures, the task can be assessed, optimised and verified. The figures depict people with different roles, trolleys and appliances. A miniature environment game has the ability to bring together people from different backgrounds because the figures make it easy for them to exchange information and oversee the situation.

Deployment
The project started in the summer of 2011 with a series of visioning workshops with the goal of bringing together visions and possible threats. This was followed by a series of design workshops employing the task flow and miniature

environment tool. The project closed with a series of evaluation workshops.
In this section we present the design workshops. This series consisted of workshops with four different topics. Each topic was worked on in two groups of five to six participants. First, a 15 minute presentation about boundaries and (e.g. technical) project tasks was held in order to inform the participants of the status of the building project and open them up to general possibilities. Then participants played out the current nursing procedures for the early nursing shift using board game figures on a large architectural plan of the new wards: the miniature environment (figure 7). The participants tried to react to problems they encountered with the new ward arrangement by creating a new task flow for the situation using task cards (figure 8).

FIGURE 7 participants engaging in the miniature environment game

FIGURE 8 task flow generated by task cards

FIGURE 9 miniature environment game board with playing figures depicting staff and trolleys and 'problem cards' (red)

The session continued with the addition of a new element. For example, in the ICT & communication workshop, mock-ups of ICT appliances like tablets and headphones were used whilst playing out the scenarios, to explore the advantages and disadvantages of the new functionality, ergonomics and size of different products as shown in *figure 7*. Furthermore, 'product cards' assigned to different products and used to note product requirements were available in every session.

Next, the newly developed task flow and product configuration was tested by playing out the new task flow with the miniature environment and altered if problems were detected or new ideas were added. When the participants had decided on a task flow and a combination of appliances and, in some sessions, rules and responsibilities, the chosen set-up was put through a 'stress test' using problem cards prepared by the project management team in advance (*figure 9*). The cards described possible problem scenarios and participants were asked to discuss their resolution in the context of the invented procedure and products.

Results

After some hilarity about the game figures, participants soon became absorbed in the development of the task flow and the accompanying requirements. The results of the workshops comprised:
- new task flows for the nurses
- the definition of product requirements for hard &

software (example: every nurse needs a handheld device the size of 'half an i-pad', and a headset in order to communicate, read and alter patient information)
- assignment of responsibilities (example: nurses get an extra task in managing visitors in the new visiting concept and more household–related tasks must be handed over to ward assistants)
- new visiting rules (example: for visitors who are not close family and want to stay overnight)
- follow-up questions for the building project (example: where can the anti-decubitus mattresses be stored?).

This case illustrates several key PD issues in generative group sessions:
- The documentation of results was built into the game by the use of different types of cards and other play material. This helps to address relevant questions and to document all the outcomes without putting the facilitator under additional strain.
- Sometimes the generative sessions do not result in (only) the expected outcomes. Be open to any additional outcomes such as follow-up questions and be sure to document them. The additional information provided by participants may prove to be very valuable to the project.
- The presence of specialists from the ICT department and facility management was of great additional value to the workshops in this case. The specialists could answer questions about (technical) possibilities, costs and the current state of the plans for the new hospital.

In addition, the specialists were able to gain insights into the work practice on the wards which they could then apply in their work.
- Be sure to invite all relevant stakeholders to a generative session, not only the prospective actual users. This provides additional information and allows alternative viewpoints, challenging the view of the actual (future) users. However, when working with groups with a strong hierarchy, placing the different users and stakeholders in one group can be tricky. Taking turns and assigning clear roles can prevent over-participation from those participants 'on top of' the hierarchy.
- Providing the participants with a structured game and an assignment gets them engaged and helps them work towards solutions. In this way loose, unfocused discussions are mostly avoided.

Facilitating User Involvement through Virtual Reality

This second case study was carried out for a company involved in the design and development of printing systems for the professional market. Though the end-users of this product are typically trained printer operators, designing an appropriate user interface is challenging, both because of the technical complexity of the machines, and because of the various use contexts in which the products are used. The use context influences the interaction between the operator and the printer; ambient noise may distract the operator, or the operator may be involved in other tasks than printing.

Given the influence of the use context on the interaction with printers, designers should take it into account during the design and evaluation of the user interface and interactions. However, the dedicated usability lab currently used by the company for this purpose does not represent a realistic use context; it is an empty room with a clinical appearance, while a real use context typically consists of a crowded print shop where phones are ringing and customers are demanding attention.

Aim
The primary aim of this case study was to improve the experience that end-users have while they are involved in the evaluation of new printer (interaction) concepts; they

should feel 'at home' while operating a printer. The case study demonstrates how Virtual Reality (VR) technologies can provide a flexible and realistic use context. VR technologies create an alternative reality in which worlds, objects and characters can be experienced that may not (yet) be available in reality. This means that before creating physical product prototypes, end-users can experience virtual prototypes and provide designers with insights and product improvements at an early stage of development. Furthermore, the use context provided by the virtual environment is flexible (it can be adapted to match the use context of different end-users), controlled (designers can decide what does or does not happen in the use context), and realistic.

Tools & Techniques
Over time, many VR technologies have been developed that can be used to create different forms of 'virtual environments', ranging from mixed and augmented reality environments (in which real-life and virtual information is merged into one world) to fully virtual 3D environments, for instance using CAVE systems. For the current case study a 3D environment was created called the Virtual Printshop (*figure 10*).

The Virtual Printshop consists of a digital 3D printshop environment in which an end-user can walk around using a first-person perspective (similar to normal first-person games). Standard mouse and keyboard controls are used to navigate through the 3D environment. The environment is

FIGURE 10 *the real printshop (left) and the virtual printshop (right)*

FIGURE 11 *three paper tray design alternatives that were evaluated in the virtual environment*

interactive in the sense that the end-user can virtually operate a printer, for example turning it on and off, or adding new paper. Furthermore, several context elements add to the sense of realism, such as ambient sounds (phones ringing, people talking), and a queue of people waiting for their print job to finish. An existing printshop was used as a reference for creating virtual models of office furniture, machinery, layouts and room decorations.

Deployment

During a test session, three design alternatives for a new paper tray were evaluated. The alternatives represent various positions and opening mechanisms of the tray (*figure 11*) The topic was chosen because it covers two relevant design

aspects, namely physical interaction between end-users and the product (i.e. end-users have to be able to reach the tray), and interaction between the user interface and the tray (i.e. the user interface should inform end-users about an empty paper tray). Participants evaluated the paper tray concepts by acting out use scenarios in the virtual environments (*figure 12*).

The scenario starts with a printer running out of paper. One of the printers in the environment stops printing, which is indicated by the appropriate visual and auditory cues; the paper stops rolling out and the printer stops making noise. The participant is asked to collect a new pack of paper and re-fill the paper tray. To do so, the participants use mouse

FIGURE 12 *designers using the Virtual Printshop during a test session. The photo shows the virtual environment (1) and the designers controlling it (2)*

and keyboard controls to navigate to the storage cabinet, retrieve a pack of paper and walk back to the printer to refill the paper tray. This sequence was repeated for each of the three different tray concepts and could be changed while using the virtual environment. In order to reach the different tray alternatives, the participants had to (virtually) lean forward and/or bend their knees. After refilling the tray, the printer would resume printing.

While acting out these scenarios, the virtual environment provided several cues and events to simulate a realistic use context; a queue of customers grew whenever the printer was idle, a phone would ring occasionally, and other office machinery, such as cutting machines, plotters and printers made continuous noise.

Results

The case study illustrates how virtual reality can be used to represent the use context. *The Virtual Printshop* provided participants with an elaborate and realistic use context which made them 'feel at home' and allowed the evaluation to extend beyond the product to an interactive workflow evaluation. This provided the designers with more detailed insights into how the products will be used in future use situations, and consequently helped with selecting the most appropriate paper tray concept. When using VR for facilitating user involvement, the following guidelines should be taken into account.

- Do not aim to create a 1:1 copy of the real world; it was found that even with a lower level of detail, participants

still recognise a use context, as long as there are sufficient references to the real-life environment (e.g. a chair with a characteristic design, or a specific poster on the wall).
- Make use of available hardware; off-the-shelf hardware (e.g. high resolution beamers, 3D displays or motion trackers used in game platforms) provides a good starting point for virtual reality applications.
- Make use of available software; 3D product models (e.g. CAD files) available within design departments can be re-used in virtual reality applications to save time. Furthermore, online model repositories such as Google's 3D Warehouse provide a large number of generic objects.
- Virtual reality should not be considered as a replacement of established methods or techniques; it can be used as a means to facilitate communication, for example, within scenario generation or scenario re-enactment activities.

While this case study demonstrates a very specific application, the idea of enriching use contexts through virtual reality and the application of these use contexts in workflow evaluations is also valid in other design areas. An example is the layout of machines in a factory; the layout affects various user groups, including machine operators, maintenance personnel, cleaners and other factory employees. When designing a new factory layout, a virtual environment can be used to let the different end-users experience and evaluate the prospective situation.

Benefits and limitations

As has been illustrated by this chapter and the two cases, user involvement has several benefits:

- **Facilitation of communication between designers and end-users** - The two case studies illustrate different ways of actively involving end-users in the early stages of the design process. Both approaches use particular boundary objects (the means that transfer knowledge between different domains) to facilitate communication between designers and end-users.

- **Access to tacit user knowledge** - In the first case study, the task cards and the miniature environment enable participants to express their routines and explain workflows in their own words, thus providing access to tacit knowledge that would otherwise not be available to designers.

- **Access to practical user knowledge** - In the second case study, participants were provided with a virtual representation of a familiar use context. This enables participants to explain issues and opportunities for product concepts in relation to their own practical knowledge and use situation.

- **Generation, evaluation and optimisation of task flows** - Both methods are applicable to design projects that look into the generation, evaluation and optimisation of task flows. The tools enable end-users to explain how different locations, tasks, events and stakeholders

affect their workflow. However, similar applications can be found in the lay-out and the development of task flows for factories, shops and (public) buildings such as libraries. The impact of active user involvement extends beyond these applications. A list of references is provided at the end of this chapter.

- **Gaining user commitment** - Including users in the change process in organisations or in the public sphere helps to gain user commitment for prospective changes. Involving users in product development, if executed in a way that both parties benefit from the cooperation, can create a positive bonding of (future) customers with a company or a brand.

The two case studies presented in this chapter cover only a small part of the range of methods and techniques available to implement active user involvement or participatory design. Depending on the practitioners' requirements and prior experience with UCD, these or other methods may provide a starting point for increasing the level of user involvement. Some of the methods outlined in our 'Methods' section are particularly suited to starting with active user involvement and participatory design because of their low fidelity nature, such as card sorting and task analysis. Others, such as scenario re-enactment and the use of virtual reality, have a higher threshold for applying them in an existing process, and may require professional (technical) support.

Additional limitations that should be taken into account when applying active user involvement are:

- **Time** - Preparation of prototypes and the organisation of involvement sessions can be time consuming. To execute user involvement sessions, a single organiser or a small team is needed. The organisers need expertise in facilitation and observation techniques. Once defined however, a single set-up can usually be re-used for several sessions. The case studies show that involving users requires appropriate practical and organisational preparation. Even for a low-fidelity approach, as applied in the first case study, the researcher needs to prepare the cards, the miniature game and organise the session itself. When using high-fidelity boundary objects, as in the second case study, additional time and effort is needed to prepare the digital models and the virtual environment. To increase the sustainability of these methods (and save time in the long run) it is therefore useful to create relatively generic boundary objects e.g. anonymous miniature figures and objects rather than case specific figures. When using VR, the underlying structure of an application is often re-usable, once equipped with case specific assets for example avatars and object models.

- **Finding 'the right' users** - It can be difficult to find the right participants, as what is 'right' depends on the project goal. In some cases, any participant will do, but usually 'open-minded' participants are preferable. Some researchers argue the advantages of involving 'lead-users' in product development (von Hippel, 1986), referring to those users who face needs of a target group earlier than the remainder of the group, and who are independently able to contribute to finding solutions to these needs.

- **Finding willing users** - In design projects without a pre-defined group of actual future product users, it can be difficult to find willing participants. In these cases the researcher probably has to decide on whether and how to compensate participants for their engagement. If participants are actual future users, they will profit simply by improving the product, and sometimes the experience of participating itself is set up to make it worthwhile, but otherwise some kind of reward might be necessary. However, when rewarding participants with gifts, their motivation might change towards extrinsic motivation and thus the extent of their engagement might suffer.

- **User's knowledge and attitude** - Another challenge is to anticipate the users' point of departure concerning their knowledge and state of mind. It is necessary to know what they know about a project, product or possibilities in order to create a situation of meaningful involvement. This becomes even more crucial when participants have aversions against a brand, a product or change in general. While it is not always possible or desirable to resolve these conflicts, being aware of them is important.

- **Degrees of Freedom** - Determining the degree of freedom for a generative session is an important aspect to consider. Depending on the anticipated type of product innovation (i.e. incremental innovation, platform based innovation or break-through innovation), an appropriate degree of freedom should be maintained during user involvement. If every possibility is left open, this might result in unfeasible concepts, but neither does the provision of too many constraints lead to innovative concepts. The

degree of freedom can be 'enforced' by the method (i.e. by specifying or restricting the type of tools or props used in the method) or by a skilled session moderator.

- **Confidentiality** - Including external participants in product development bears the danger of leaking confidential information about the company's developments and innovations to the competition. If design information is confidential, a company therefore needs to carefully consider whether to involve users in the design process. Information-leaks can be prevented by contracts with the involved users. Alternatively, product substitutes or simplified versions of products could be used when involving users.

Key insights

- Users can be actively involved at various stages of the design process, including analysis, design and evaluation activities;
- User involvement methods provide a common language between designers and end-users, using scenarios and practical action-oriented tools, and allow designers to tap into users' tacit – and practical knowledge;
- User involvement sessions require thorough preparation and experience with facilitation and observation;
- User involvement is especially useful for complex use situations and designing for unfamiliar or specialist target groups.

How to continue?

Further reading

For further information on user involvement and participatory design in the development process of products and services, we recommend the following publications:

– Bødker, K., F. Kensing and J. Simonsen (2004). *Participatory IT Design. Designing for Business and Workplace Realities.* Cambridge, Massachusetts: MIT Press.
– Sanders, E. B.-N., E. Brandt and T. Binder (2010). A *Framework for Organizing the Tools and Techniques of Participatory Design.* In: Proceedings of the 11th Biennial Participatory Design Conference, p. 195-198. Sydney, Australia: ACM.
– Simonsen, J. & Robertson, T. (2012). *Routledge International Handbook of Participatory Design.* London: Taylor & Francis.

Websites

– www.repar-project.com/subprojects/my-research/ 'Facilitating User Centered Design through Virtual Reality', part of the REPAR project
– www.seriousplay.com
– www.maketools.com

03.
Exploring future use: scenario based design

Authors

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Introduction

The future use of products and services will be determined by both their design and the different ways in which they are used. It is difficult to understand and to explore this future use as it is hard to imagine and predict something that is not tangible and has not yet appeared on the market. Scenario based design, as we present it here, supports user-centred design processes that are aimed at developing products and services. Although this methodology has matured in the field of human computer interaction and software design (e.g. Rosson and Carroll 2002), the application of scenarios in product and service design is still at an early developmental stage. Scenario-based design is

a methodology that supports designers and design teams in their creative and reflective activities by providing an explicit means to explore future use. This exploration is achieved by providing flexible and vivid representations of product use - the scenarios - that support how the desired future use can be imagined, and stimulate reflection on product and service ideas with regard to how they are used in different situations. Apart from its advantages, in regard to exploring future use, scenario-based design also supports the communication that takes place with the various stakeholders regarding the evaluation of product use. Since scenarios can serve as a common language that everyone can understand, irrespective of their backgrounds, they create a common ground so that a discussion can take place among the various stakeholders concerning the current and future use.

Scenario-based design is a general term that applies to many different techniques aimed at the generation and application of scenarios. This chapter does not intend to give a complete overview and description of these techniques, but instead it presents a general framework in which these techniques can be placed. Where applicable, the chapter indicates how it is related to other methods described in this book.

Challenge

Usability and user experience depend on both a product's characteristics as well as the situation in which a product is used. A compact camera might be very usable when used by an experienced user to take snap shots when sightseeing in a foreign city, but it is less practical when used by a skier who wants to take pictures of fellow skiers on the ski-slope, or for taking pictures of yourself together with friends at a party. In order to anticipate use-related design issues in the design process, it is important to understand the use situations or scenarios in which the products will be used, and how the product can lead to desirable future use (van der Bijl - Brouwer and van der Voort 2009). Since the scenarios in which products are used are both uncertain and extensive, a dedicated approach is needed which takes these use scenarios into account during the design process.

One method that is often employed to anticipate use during the design process is to build prototypes and then to have different users test them, preferably in different contexts of use. However, this is an expensive and time-consuming process. Although scenario evaluation generally leads to a less valid result than prototype testing, its flexibility allows for early and quick explorations of future use practice. Therefore, scenarios can accelerate an iterative design process. As such, they serve as a valuable addition to prototype testing.

Another design challenge is that the communication about how products should be used is often cumbersome, particularly in large, multi-disciplinary design teams. Usability experts tend to present their findings regarding user data

and test results as text-based reports. Unfortunately, when presented in this way, relevant design information is not always assimilated by the designers who have to apply this information when drawing up their solution proposals (Fulton Suri and Marsh 2000). Scenarios can better support the communication process regarding product use: as scenarios are easy to understand, regardless of the reader's field of knowledge or background, they can serve as a 'common language'. They can be used to communicate the design problem and the solution's anticipated effects on product use, with users within the design team as well as with external stakeholders.

Method

What is a scenario?

The use of the word scenario originates from the *Commedia dell'arte* in which the scenario was an outline of the play that was literally pinned to the back of the scenery. In general, the term is used to refer to an imagined course of action, event or situation. In the context of design, a scenario is an explicit description of the hypothetical use of a product or service. Such an explicit representation of product use can involve a narrative, storyboard, animation, role-play or any other representation that shows the interaction between a specific user and a specific product in a specific context of use. Just as a sketch represents a possible future product, a scenario can be considered as a sketch of possible use. The scenarios that we refer to in this chapter should not be confused with the macro scenarios which form the basis of scenario

planning and which are aimed at exploring future scenarios on a societal, economic and political level so that strategic decisions can be made.

Scenarios consist of several elements (Rosson and Carroll 2002). They include a 'starting state' (*figure 1*), consisting of an actor with a certain goal with regard to a certain product in a setting. The setting consists of all context aspects that can potentially influence the interaction, such as the physical environment, and objects and individuals within that environment. For example, the starting state of a scenario could be that a hypothetical researcher named Julie (actor)
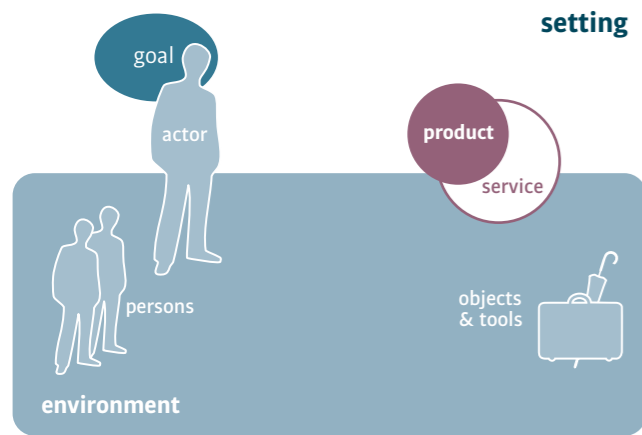
wants to give a presentation about one of her recent studies (goal) at a large conference (setting). The presentation is in a large conference room. The audience is still entering the room (setting) as she starts to use the presentation microphone (product).

The plot of the scenario unfolds when the actor starts to perform activities aimed at achieving his or her goal, when the product responds to these actions and/or when outside events (changes in the setting) trigger or interrupt the interaction between the actor and the product (*figure 2*). For example, Julie puts the headset on her head and tries to
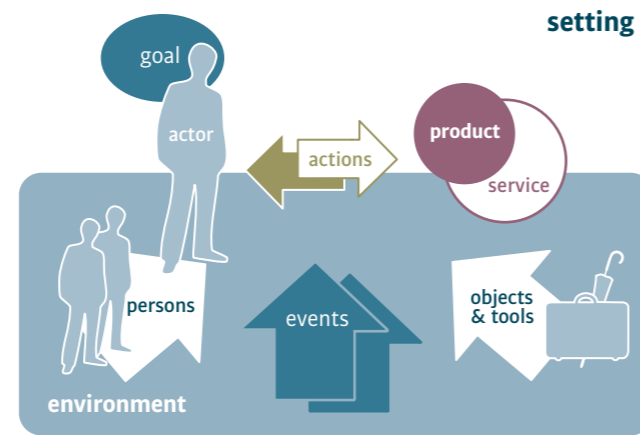
attach the transmitter to her dress. Since this does not work, she puts the transmitter on the table in front of her. She then pushes the on/off button (user action). A small light starts to burn on the device (system action). Then a conference organiser asks her if she has any questions about the device (event). When Julie tries to explain that she does not know how to attach the transmitter, she finds out that the whole audience can hear what she is saying because the microphone has already been turned on. She then tries to find the mute button (new goal).

To conclude, a scenario should be accompanied by a description of use issues (*figure 3*) which can provide input into the (re-)design of a product. These issues can relate to user experiences that should be improved or retained, to usability qualities (effectiveness and efficiency), or to other higher level qualities that need to be optimised such as performance. For example, in the above-mentioned scenario, one issue that emerges is that the presenter is not happy because she does not know how to attach the transmitter to her dress. A design project could then be aimed at creating a presentation microphone that is easy to attach to different types of clothing. Thus, the scenario presented here with its accompanying use issue can serve as a 'user requirement' for the product or service to be designed.

What is scenario-based design?

Scenario-based design is a generic term for techniques that make the use of a product or service explicit (or more generally, the full-life cycle). In line with a scenario
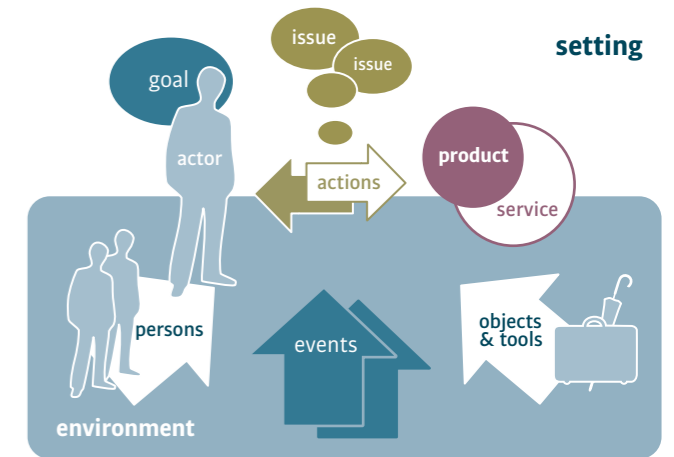
classification proposed by Nielsen (1990), we present different purposes and sources of inspiration for using scenarios below.

Purposes of scenarios in product and service design
Scenarios can be used for different purposes during the design process:
• A thinking tool for designers to explore possible uses
• A frame of reference to evaluate solution proposals
When used as a thinking tool, the scenario allows designers to explore possible uses. This means that, based on assumptions, designers think up different ways in which either current

FIGURE 1 *the starting state of a scenario consists of an actor who represents the user, a goal, a product or service and a setting*

FIGURE 2 *the plot of the scenario unfolds when the user performs actions to achieve his or her goal, when the product responds to the user's actions or other triggers, and when events occur such as changes in the setting. Scenarios show all of these elements in an integrated way*

FIGURE 3 *each scenario results in a number of issues that can provide input when deciding how to (re) design a product, for example with regard to improving usability or user experiences*

products or designed products might be used. Thus, scenarios are able to create different problem spaces in which a product can be designed or in which it is possible to reflect on what the possible consequences might be for the different solutions.

The second purpose of scenarios, is that they are meant to serve as a frame of reference for evaluating possible solutions. A proposal for a design can be compared to a scenario to make decisions on its appropriateness with regard to how the product is used. In this case it is particularly important that the scenario is a valid, preferably verified, representation of possible future use.

Sources of inspiration for scenarios
The inspiration for a scenario can come from several sources. It can be based on a designer's ideas and/ or on empirical research. This can differ depending on the elements of the scenario. For example, the elements of the setting can be based on observations concerning the actual use environment, whereas the characteristics of the actor and the plot and the issues of the scenario are based on the designers' ideas. When the aim is to create valid scenarios, such as when the scenario is used as a frame of reference for evaluations, the scenarios should be based more heavily on empirical studies. However, when the aim is to explore use, empirical evidence is less required.

In a 'future scenario' the current product (or lack thereof) is replaced by a future product. A new product or tool implies that the actions of the user to control the product can also change. Future actions will therefore often depend on the designer's assumptions. However, involving users in evaluating or even creating future scenarios will help to ensure the validity of the actions. The other elements of the future scenario will often remain the same when the scenario considers a redesign of an existing product (incremental design). When a product is brand new, in the sense that no current solutions exist, the other elements will be more difficult to analyse and one should be careful in making assumptions about these elements. Early prototype testing in the field is then necessary to investigate the appropriateness of the solution for the assumed future use situation. If the product is to be introduced in the distant future, it is also necessary to make an analysis of trends which might influence the future context of use (e.g., Van der Heijden 2005; Hekkert and van Dijk 2011).

Scenario types
We can distinguish different scenario types with regard to their content. The scenario of the presentation microphone mentioned in the example above, is a description depicting the current use of a presentation microphone. This type is therefore called 'current use scenarios'. This type is also referred to as 'actual practice scenarios' or 'problem scenarios'. These scenarios are mostly used as a frame of reference for evaluating solutions.
A scenario can also describe possible (near) future use, which means it describes the interaction between a user in a certain setting and a new design proposal for a product. The level of detail of the scenario depends on the level of detail of the design proposal. The scenario therefore gradually develops from a representation of the use of a 'black box' (future use scenarios) to a more detailed description of the interaction

with a detailed design (interaction scenarios). Future use scenarios can be represented as ideal future scenarios when they are used to communicate the envisioned use of a design proposal, for example to the client. They should be accompanied by 'possible problem scenarios' which show which other effects the new solution might introduce in critical situations. By only using ideal scenarios or 'rosy stories', there is the risk that possible undesirable side-effects might be overlooked (Anggreeni and Van der Voort 2008).

The diversity of actual and possible uses may often result in the creation of a large number of scenarios. An explicit representation regarding the variability of probable future use situations allows designers to reflect on these use situations. However, working with too many scenarios can hamper communication and overcomplicate the design process. Therefore, it is useful to select the most relevant scenarios from the pile of scenarios that have already been created. This is particularly true when scenarios are used as a frame of reference or as a communication tool. In keeping with Cooper (1999), we distinguish 'frequent use', 'necessary use', and 'edge case' scenarios. The idea is that the product will succeed or fail in its ability to handle frequent use and necessary cases, whereas edge case scenarios represent the interactions that are neither necessary nor frequent and that do not require careful design. Frequent scenarios form the primary uses that will occur, typically with the greatest frequency. For the presentation microphone, frequent use will include putting on the headset by a presenter such as Julie, turning on the device and talking through the microphone. Necessary use scenarios include all actions that must be performed in order for the product to be effective, but which are not performed

frequently. For example, the installation of the presentation microphone on the speaker system is not done frequently, but is an important scenario to take into account in design. The product development team decides what the edge case scenarios are. For example, an extreme scenario regarding the use of the presentation microphone might be when someone who is wearing a fancy dress has problems putting on the headset. The development team should then decide whether they want to accommodate this scenario when designing their product or not.

Scenario techniques for exploring possible uses

The first purpose of scenarios that we discuss is the use of scenarios as a thinking tool to explore the possible uses of either current or future solutions. Design is often represented as a co-evolution of problem and solution (e.g. Dorst and Cross 2001). This means that the problem is defined and refined together with the solution. Scenarios provide a means to represent this 'problem' with regard to product use. The flexibility of a scenario allows for easy adjustment, just like a sketch of the solution. Furthermore, the concreteness of the scenario stimulates thinking about what might happen when a certain solution is introduced to different use situations.

Role-playing and scenario games
Scenario thinking can be executed simply as a writing exercise by filling in the different scenario elements based on assumptions, and imagining how they could come together in a plot. However, additional techniques are available to further enhance this creative process, including role-playing and

scenario games. In a role-play, the designers act out a certain scenario in a real or simulated setting to explore different plots. In scenario games, a similar approach is followed with the difference being that the scenario is played with miniature figurines in a miniature environment ('pivoting', Urnes, Weltzien et al. 2002). *Figure 4* shows an example of a scenario game. In this case, the designers explored the use of a navigation device by skiers in a skiing area. The setting was represented as a simple sketch of the environment on a flip-chart. Small figurines were used to walk through a journey of a skier and think about how the navigation device could be used during different stages of a ski tour. The bright pink sticky notes were used to note possible issues of usability or user experience.

FIGURE 4 *design students explore several scenarios in which skiers might use a navigation device in a scenario game*

The Envisioning Use technique

One technique which is specifically aimed at exploring possible uses when collaborating together in a product development team, is the 'Envisioning Use Workshop' (van der Bijl - Brouwer, et al. 2012). This technique has successfully been applied in many cases in design practice. In this workshop, all the members of a product development team come together and share ideas about product use. Participating in the workshop together has the advantage that the technique does not only result in a large collection of scenarios, but that it also leads to a 'shared vision on product use' within the product development team. In the technique, scenarios are explored based on a 'remembering', 'imagining', 'experiencing' and 'envisioning' step. Scenarios are represented by noting the most relevant aspects of the scenario (use situation aspects) and resulting issues on 'sticky' notes and organising them in a 'product use mind map', which is formed using a wall of flip-charts.

In the **remembering step**, story-telling is used to gather stories of actual product use as experienced by the designers themselves or in cases where they have observed others. Stories differ from scenarios in that they are representations of real product use as opposed to hypothetical product use. They support scenario exploration because they can serve as a trigger for creating associations which in turn lead to other possible scenarios.

In the **imagining step**, the association process is further stimulated by providing participants with images of random people and use contexts and having them think about possible ways in which these people might use the product

within specific contexts. For example, in an Envisioning Use workshop about the use of the presentation microphone, participants were provided with pictures of random presentation environments and random presenters (*figure 5*).

In the **experiencing step**, participants select two or three scenarios and either role-play them or act them out in a scenario game such as the one described above. *Figure 6* shows an example of the experiencing step in which two designers act out a scenario in which the use of a presentation microphone by two consecutive presenters is demonstrated.

Finally, in the **envisioning step**, designers come up with solutions to fit the scenarios and show how the solution should be integrated into the chosen scenario. A convenient way of doing this is to generate quick mock-ups and show the scenario in another role-play. Another way of envisioning use is to have participants write down the desired future scenarios in which the solution is represented as a black box. The combination of steps stimulates association from stories to scenarios and from scenario elements to complete scenarios. It has proven to be a valuable approach in quickly generating and exploring a wide variety of scenarios. The technique

FIGURE 5 *in the Envisioning Use Technique, random images are provided to stimulate designers to explore different scenarios*

FIGURE 6 *a role-play (within the Envisioning Use Technique) in which designers explore a scenario for a presentation microphone in which a presenter hands over the device to the following presenter*

includes additional steps aimed at targeting, clustering and questioning the generated representation of product use, so as to make the developed scenarios more usable during the following stages of the product development process. Further information on these steps can be found in the workshop manual (van der Bijl - Brouwer, Boess et al. 2012).

When exploring scenarios, it is always necessary to maintain a critical view on how a scenario unfolds, while, at the same time, making positive issues explicit. Thus, the design process can be aimed at eliminating the problems as well as keeping or enhancing the positive issues.

Scenarios as a frame of reference for evaluations

In the previous section we showed how scenarios can be deployed to explore use. These explorations were based on the knowledge and assumptions of the designers themselves. To ensure valid insights into what possible effects a product or service design might have on product use, other applications of scenarios are necessary. In this case, the scenarios are used as a communication tool. Techniques for this kind of scenario-based design are aimed at discovering valid scenarios. The ideal outcome is that final scenarios reflect the actual future product use. Thus, they can serve as a frame of reference for evaluating solution proposals.

As mentioned previously, some scenario elements can be based on facts while others are still based on assumptions.

For example, in a scenario which describes future use, the setting and user characteristics might be factual, whereas the expected interactions and resulting issues are based on assumptions. Use tests are then necessary to verify those interactions and resulting issues. The generation of valid scenarios can therefore be an iterative process.

To obtain valid current or future scenarios, it is necessary to involve users to gain insights into the different scenario elements and to find out how they are woven together. Many different approaches and techniques can be employed to achieve this. We distinguish between approaches with regard to the extent to which users are involved in the generation of scenarios. Users can be directly or indirectly involved: in participatory scenario generation, scenarios are generated jointly with users; in indirect participatory scenario generation, designers create scenarios themselves, based on several analyses of the scenario elements, and then they have these scenarios validated by users.
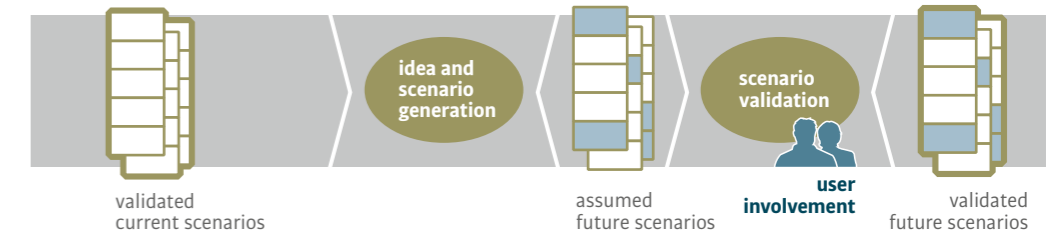
Indirect participatory scenario generation

The scenarios created by designers in this type of scenario generation are not wholly based on imagination, but they can be inspired by different analysis techniques. For example, interviews can be used to gain insights into user goals and user characteristics, field observations can be used to gain insights into the aspects of the setting, and actions can be analysed by means of card sorting (Muller 2001) or by means of observation of current use. The subsequent information gathered on the scenario elements can be used to generate current use scenarios by designers. These scenarios first need to be confirmed by users to verify if the elements have been realistically integrated into the scenario, and then to verify

FIGURE 7 *schematic overview of how valid scenarios can be composed by involving users indirectly in the scenario generation process*

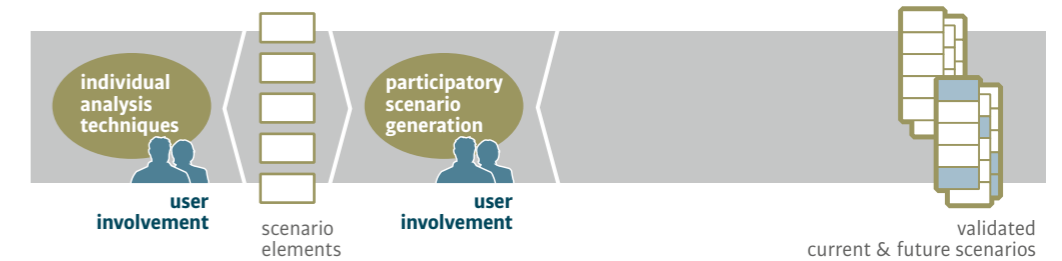**indirect current scenario generation**
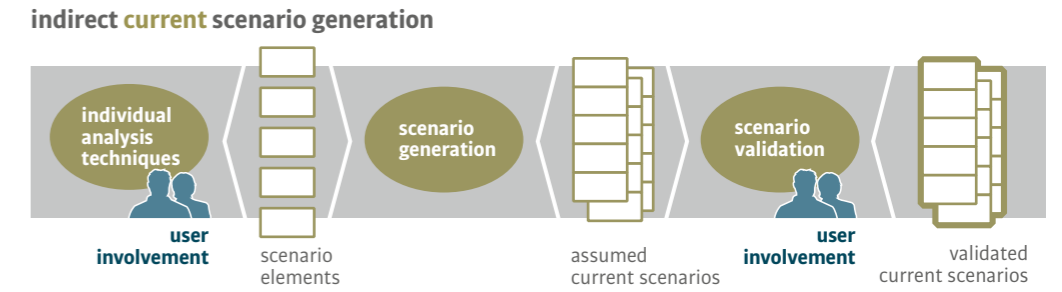
indirect future scenario generation

FIGURE 8 *schematic overview of how valid scenarios can be composed by involving users directly in the scenario generation process*

direct current and future scenario generation

explanation of icons
current scenario generation

future scenario generation

individual current elements of a scenario (user, goal, setting, actions, events, product)

set of integrated current scenarios **without use issues**

set of validated current scenarios **with use issues**

individual future elements of a scenario

set of integrated future scenarios **without use issues**

set of validated future scenarios **with use issues**

the scenario issues/ qualities (*see figure 7*). The latter implies that end-users or other stakeholders are asked about the positive and negative issues (problems) of the scenario in order to decide which direction to pursue in regard to the choice of design. Confirmation can be agreed by having end-users read or look at the scenarios and asking them for their opinions in an interview or survey.

Indirect participatory scenario generation can also be used to evaluate proposals for solutions with users. Designers create these future use scenarios by means of integrating solution proposals into the confirmed current scenarios, such as the situation described previously in the section on 'exploring possible uses'. The scenarios are then shown to end-users to discuss the probability and desirability of the future use scenario (*see figure 7*). Naturally, prototyping and user testing are necessary in order to gain more reliable insights into the probability of the scenario. However, in early design phases, this scenario approach is an efficient way of obtaining user feedback on a large variety of possible scenarios.

Participatory scenario generation
In the above-mentioned approach, users are passively involved so that the scenarios created by the design team can be confirmed. This approach may need multiple iterations if scenarios turn out to be unlikely or undesirable. A more effective approach may then be to involve the users actively in the generation of scenarios. This can be aimed at both current and future scenarios (*figure 8*). When creating future scenarios, the approach may be considered as a form of 'participatory design' (see Chapter 2 on User involvement

and Participatory design). In a 'participatory scenario generation sessions' participants generate scenarios in a role-play or a game-like setting comparable to the scenario explorations used by designers, as discussed in the previous section. In a role-play, users act out either a current or desired scenario in a real or simulated setting. In a game, a miniature environment can be used in which users walk through a defined scenario with figurines.

General remarks regarding evaluative scenarios
In the previous section, we discussed the different ways of obtaining valid scenarios that can be used to evaluate solutions. Naturally, these different approaches can be combined. A participatory scenario generation session might lead to producing initial ideas for a solution which, in turn, could be further elaborated on by the designers at a later stage. Additional scenario confirmation steps might then be necessary in order to evaluate the use of the detailed solutions. In this way, the scenarios evolve in an iterative process.

When prototypes are created, the scenarios can be used to set the test conditions for user tests. For example, the necessary use and frequent use scenarios can be selected to decide on test participants, test setting and tasks. The user test can then be employed to verify the designs as well as use scenarios. If there are too many necessary and frequent use scenarios to evaluate, it is useful to make a further selection of scenarios based on criticality - the extent to which severe consequences are expected, and novelty - the familiarity of the design team with the scenario.

Since the scenarios described in this section serve as a frame of reference, they are similar to the use of requirements. A scenario can be used to elicit these requirements, by making desired or undesired scenario issues explicit. The disadvantage of using requirements for evaluating solutions in regard to product use is that they do not show the underlying background of the requirement. We therefore recommend that the requirements be represented together with the related scenario(s).

Cases

In the following section we present two cases in order to illustrate the two approaches. Case 1 illustrates the use of scenarios as a thinking tool to explore possible uses. Case 2 shows how scenarios can be used as an evaluation and communication tool.

The compact photo camera

This first case illustrates the application of scenarios to explore the use of a (design of a) compact photo camera. When applying the Envisioning Use Technique to a design case, the following use scenario was explored.
In the 'remembering' step of the workshop, one of the participants shared the story that he liked to take pictures of his girlfriend and himself including a specific object of interest, for example the Statue of Liberty while visiting New York City. He liked the type of pictures taken in that way (a positive issue). This scenario was further explored with the other participants in the 'experiencing' step of the workshop: the role-play. They used an existing type of compact camera to play the scenario. *Figure 9* shows this role-play in which one of the participants acts as the Statue of Liberty to represent the setting. The

drawing and key words form a simple representation of the scenario.

The participants then evaluated the role-play. One of the negative issues that were identified is that the second person in the picture does not know where to position himself. This led to the generation of the following current use scenario:

Current use scenario
John and Marc want to make a picture of themselves and the Statue of Liberty. Marc takes his compact camera and, holding it backwards, tries to aim it at himself, John and the statue. John cannot see where he should position himself to be in the picture. When the picture is taken, they evaluate the picture on the camera screen. John is unhappy that he is hardly visible in the picture.

The team then thought up solutions for improving the current situation. *Figure 10* shows one of the solutions that they came up with; a camera with a separate wireless screen. It also shows one of the participants presenting the solution to the other participants in the 'envisioning' step of the workshop.

The other participants then critically explored the use of the solution by imagining how it would be used. This led to the generation of the future use scenario shown below.

This example shows that making use explicit in scenarios - in this case by means of both (pictures of) a role-play and a narrative -, allows for the consequences of a certain product to be explored in different use situations, while at the same time forcing designers to critically reflect on the solutions generated with regard to product use. Creating and

exploring use scenarios together as a design team results in a shared view within the product development team on what the desired scenarios of product use should be.

Future use scenario (possible problem)
John and Marc want to take a picture of themselves and the Statue of Liberty. Marc takes his compact camera with detachable screen and aims it at himself, John and the statue. John holds the screen in his hand to see where he should position himself to be in the picture. When the picture is taken they evaluate the picture on the camera screen. John is unhappy as he wasn't looking at the camera lens, but instead he was looking in the direction of the detachable screen.

- take picture of oneself with Statue of Liberty
- two friends on a city trip in New York

FIGURE 9 *designers explore a scenario which depicts the use of a compact photo camera during a role-play*
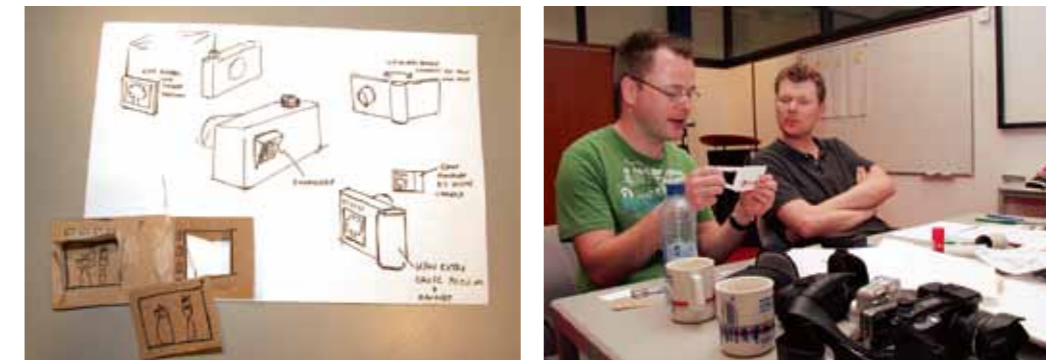

FIGURE 10 *Results of the envisioning step in which designers think up solutions for the compact camera scenario*

Bartender – client communication

The second case concerns the design of a system to improve the communication between bartenders and clients in a noisy and busy bar. In this case, scenarios were used to generate a realistic view on both current and future use which could serve as a frame of reference for solution evaluations. *Figure 11* shows a schematic representation of the approach used by this team. They applied an 'indirect participatory scenario generation' approach to obtain valid scenarios and applied 'scenario exploration' to generate solutions.

The team started with interviewing bartenders on what their goals are when communicating with clients and what possible events occur during this communication. An important positive issue is that bartenders like the social aspects of communicating with clients and do not want to have it replaced by an automated system. Furthermore, they visited a number of bars to observe this communication process (actions), the bar environment (setting) and the current means of communicating. They combined these insights with their own experiences as bar visitors to generate a multitude of scenarios. A part of one of the scenarios is shown below.

The team then visited several bartenders and showed them the scenarios for confirmation (scenarios as a communication tool). The bartenders thought that being able to maintain an overview at the bar and see which customers should be served

Assumed current scenario
.. By now the bar is getting quite busy. A customer walks towards the bar and appears to want to order a drink. Peter asks him what he would like to order. The customer wants to reply, but Peter can't hear him over the enormous amount of noise and music. He asks if the customer could repeat the order. This time Peter manages to hear a little bit more and with the help of fingers he also manages to get a number. Now it is getting really busy at the bar. People are trying to cut the line, and doing anything to get attention first. It's almost impossible to maintain an overview when it's this busy. So Peter decides to help the nearest person, unless he is sure someone else was first. One of the most important things is to keep calm and exude a confident attitude and not to become stressed.

next is an undisputed quality a bartender should have. It is not something that should be 'solved' by a new system. Since communication problems are not always in the hands of the bartenders, they agreed that improvements could be made in this area.

The confirmed scenarios were then used by the design team to further explore future use scenarios. They did this by playing the scenarios in a simulated bar environment and introducing different concepts by means of simple mock-ups. Pictures of the role-play were made to represent the scenario. *Figure 12* shows one of the product ideas. In this scene, a sign language is introduced for ordering drinks. The general idea is that there is a list available in the bar with signs for certain drinks. Customers use their fingers and hands to indicate what kind and how many drinks they

FIGURE 11 *indirect participatory scenario generation*

want. While playing this scene, different problems arose, such as communication about the price and communication about unusual drinks such as mixed drinks.

All of the different role-plays that were acted out with the different concepts were translated into narrative scenarios. A part of one of the scenarios for the sign language concept is shown on the opposite page.

Finally the scenarios created in the role-play were shown again to the bartenders and to customers for confirmation. The concept that appealed the most to the bartenders was the sign language, because it took into account the necessary social aspect of communication. However, the possible problems that were anticipated by the designers with this

concept were also confirmed by the bartenders, particularly on extremely busy nights. Another - less social- solution was accepted by the bartenders for this critical scenario.

Although hardly any effort was required from the bartenders with regard to being involved in the design process, the scenario approach led to valuable feedback. This low level of involvement also enabled several bartenders to be contacted so that their opinions could be obtained about the ideas that had been generated. The advantage of scenario communication over just simply interviewing bartenders on a representation of the solution, is that the scenario allowed to bartenders to imagine how they would use the system in the future, and whether that matched up with the ideal scenario.

FIGURE 12 *designers explore different solutions for bartender-client communication in a role-play*

Assumed current scenario

.. By now the bar is getting quite busy. A customer walks towards the bar and appears to want to order a drink.
Peter asks him what he would like to order. The customer replies using sign language. This really helps in an environment with an enormous amount of noise and loud music.
Then a rather small girl walks towards the bar and appears to want to order a drink. Pete only slightly bends over to indicate she can order. She almost screams the order towards him. "Wow", he thinks as his ears are ringing, that wasn't really necessary. The other way around is what is much more difficult. He prepares her drinks. The crowd is really getting a bit pushy. The busy serving hours have started. "That's 12 euro 20 please", he indicates to the girl as he puts her drinks in front of her. But she does not seem to understand him. "What?" she screams as she leans over the bar lifting her feet off the ground. "12.20 please!" Not sure if she has understood him properly, she shrugs her shoulders and gives him a 20 euro note. Then Peter realises that he has made a mistake. It's actually €13.40 because the wine has gone up in price. He gives her €6.60 change in return. The girl obviously doesn't understand it anymore. She tries one more time to ask what the price was, but they have a hard time communicating. Finally, slightly annoyed, she shrugs her shoulders again and disappears into the busy crowd with her friend and their drinks. "If only she had made more of an effort to learn sign language, then taking this order would have been much easier", Peter thinks.

Benefits and limitations

The cases show how scenarios can be used to support the exploration of future use. The flexible and vivid character of scenarios support the designer's thinking process when it comes to imagining desired future use and reflecting on the consequences of design proposals for products and services. Furthermore, scenarios are very easy to understand. This enables scenarios to be used as a communication tool in the process of evaluating product and service solutions with different stakeholders. The simplicity of creating scenarios makes it a relatively easy technique to apply in product development processes. However, generating valid scenarios requires an investment with regard to studying the different scenario elements. A difficulty of scenario based design is that endless scenarios can be imagined and too much time might be spent on finding the 'right' scenario. However, a focus can be achieved by targeting specific user groups, goals and use situations based on the criticality and frequency of the defined use scenarios. Working with scenarios confronts design teams with the uncertainty that is inherently part of user-centred design. Nevertheless, it is better to be aware of this uncertainty and to have the opportunity to share it, than to ignore it.

Key insights

- In scenario-based design, product use is made explicit in scenarios to allow for the communication, exploration and evaluation of the effects a solution will have on the future use of products and services.

- Role-playing and scenario games can be employed to explore the opportunities and limitations of possible future use scenarios.
- When applying scenarios as a frame of reference for the evaluation of solutions, it is important to ensure the validity of the scenarios.
- Valid scenarios can be created by means of (indirect) participatory generation techniques in which users are involved in creating the scenarios.

How to continue?

Further reading

An easy first step in applying scenario-based design is to organise a half-day Envisioning Use Workshop at the start of or half way through a current product development project. The Envisioning Use workshop manual (van der Bijl - Brouwer, M., S. Boess, et al. (2012)) offers guidance on how to set up this kind of workshop. You can download this manual at www.designforusability.org/results/methods-tools.
For further information on the application of scenarios in product and service design we recommend the following publications:
- Rosson, M. B. and J. M. Carroll (2002). *Usability Engineering: scenario-based development of human-computer interaction.* Morgan Kaufmann.
- Anggreeni, I. and M. Van der Voort (2008). *Classifying Scenarios in a Product Design Process: a study towards semi-automated scenario generation.* Proceedings of the 18th CIRP Design Conference 2008. Enschede, The Netherlands.
- van der Bijl - Brouwer, M. and M. C. van der Voort (2009).

Participatory Scenario Generation: Communicating Usability Issues in Product Design through User Involvement in Scenario Generation. Design Principles and Practices: An International Journal 3(1).

Websites
- A design firm that makes extensive use of scenarios and personas is Cooper.
  www.cooper.com/#approach:scenarios
- The 'usability case library' gives detailed descriptions of several scenario-based design cases provided by companies and organisations, as background information to the book Usability Engineering by Mary Beth Rosson and John Carroll (2002). The website focuses on scenarios for Human Computer Interaction:
  ucs.ist.psu.edu/
- Related to the use of scenarios, storytelling can be used to share information within a design team or even between end-users and designers. One example of this approach can be found at: www.hcdconnect.org/methods/storytelling-with-purpose.
  HCD (human-centred design) Connect, an IDEO initiative, provides a toolkit with multiple methods to make design processes more user-centred.

04.
Designing for user experiences: contributions from contextmapping

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Introduction

In saturated consumer markets, consumer choices often depend on subtle product differences that contribute positively to their user experiences. Hence, it is important for designers to be able to create products that elicit different experiences. In this chapter we discuss a design approach that takes the creation of specific user experience as a starting point. The approach aims for improvement beyond product functionality and user friendliness in order to make products that really fulfil important, often latent needs in people's lives. Experience-driven design involves determining what experience to aim for and, subsequently, to design something that will evoke that experience.

In order to design for experiences, designers need thorough insights in everyday user experiences. Therefore, we also discuss a procedure that can be used to obtain this type of rich user data: contextmapping. Contextmapping was developed to obtain tacit knowledge about the everyday context of product use. The basic principle of contextmapping is that everyone is an expert of his/her personal experiences. Users are encouraged to document parts of their lives, and their experiences serve to inform and inspire the design team.

In this chapter, we provide a more detailed discussion of the theoretical background behind user experiences, the way in which experiences can be studied through contextmapping, the principles underlying the experience-driven design approach, and we present a design case in which these approaches were used to develop a modular rest unit for a hospital room.

Challenge

In today's consumer markets where many products offer similar functionalities, product usage and purchase are increasingly dependent on whether a product or service offering is able to elicit a distinctive and desirable experience. For instance, when consumers want to buy a chair, they can choose from an almost infinite number of chairs with different purposes and in different price ranges. Hence, it is important for designers to make chairs that stand out against their competitors in order to get noticed. In addition, the chairs should clearly communicate what they have to offer: whether they want you to relax, whether they want you to feel comfortable, or whether they want to support you during your work. Even within these categories, designers can try to create different experiences that appeal to different audiences: Do you want users to relax in a cocoon that makes them feel totally protected, so that they can fall asleep? Or, do you want them to feel supported during relaxation, so that they feel refreshed after sitting for a while? Or, do you want them to relax so that they get closer to their partner? Each of these relaxation experiences asks for a different type of chair.

What is an experience?

Although a person's experiences are personal and subjective and cannot be observed directly, we can obtain information on experiences from people's actions, behaviour, facial and bodily expressions, and their verbal accounts. This has taught us that people's experiences are complex and multifaceted phenomena. For instance, several qualitative dimensions can be distinguished in experiences, such as (e.g., Brakus, Schmitt & Zarantonello, 2009; Hekkert & Schifferstein, 2008; Vyas and van der Veer, 2006):
- a sensory dimension with visual, tactual, olfactory, gustatory, and auditory perceptions and aesthetic evaluations
- an affective dimension including emotions, feelings, and moods that are evoked
- an intellectual dimension containing cognitive associations, thoughts evoked and meanings activated
- a behavioural dimension consisting of actions towards, with, or evoked by a design

Although these dimensions may be distinguished theoretically, in practice they are highly interdependent and tend to occur simultaneously.

Besides these qualitatively different aspects, experiences also vary on the intensity dimension, implying that some experiences may be perceived as more or less intense, weaker or stronger, and may vary in the impact they have on someone (Brakus, Schmitt & Zarantonello, 2009). Furthermore, experiences of user-product interactions are known to be dynamic: typically multiple stages can be distinguished in these interactions. In addition, the time before and after an event may change the experience of the event. For instance, prior experience with a product may change its experience at subsequent encounters. In addition, after a person has stopped interacting with a product, reflecting on the event may still change its experience (e.g., Law et al., 2009).

In addition to the different components that can be distinguished in an experience, the user experience is also likely to depend on a person's internal state (e.g., needs, motivation, mental and physical resources) and the context in which the product is used (Law et al., 2009). This context can involve the physical environment, the task setting, the technical and information context (e.g., availability of network services), or the presence of other people (Roto et al., 2011). For instance, the interactions with people during the acquisition or use of a product are likely to have an impact on the subjective experience (e.g., Brakus et al., 2009).

Studying user experiences

Experience-driven design typically involves extensive analysis of user behaviour and underlying motivations. Ideally, the designer would like to get under the user's skin as much as

possible in order to predict future users' responses to the design. A designer should not just focus on the physical aspects of the product, but should be able to understand how the user will react to these aspects and which types of responses the product is likely to evoke in the existing usage situation. Hence, a deep understanding of the psychology of the potential user and detailed knowledge of the context in which a product or service is presented is required. In many cases, everyday experiences are not general or uni-dimensional, but need to be carefully tailored for a specific context and may subtly vary in character over time.

In a contextmapping study, contact with the participating users is intensive and personal. Contextmapping studies tend to focus on everyday situations, where the product only plays a minor role. Instead, the majority of attention goes to the physical, social and cultural context and the user's state of mind (Sleeswijk Visser, 2009). By gaining deep insights into these contextualized experiences, designers can create products and services that fit into and enhance peoples' daily lives. The metaphor of using a route map can be used to highlight the way that designers navigate through the terrain of user experience: the map does not provide a fixed route, but encourages discovery (Sleeswijk Visser et al., 2005).

Because people are often unaware of many aspects that influence their experience, contextmapping uses generative techniques to encourage them to document parts of their lives and experiences. Participants explain their creations to designers or researchers and these data are then shared with the design team. Contextmapping aims to inform and inspire design teams to ensure a good fit between the design and the use of a product in people's everyday lives. Typically, users will not be involved in the

creative stages of the experience-driven design process, because involving users at this stage may decrease the innovativeness of design solutions (e.g., Candi et al., 2010). However, users may once more be involved during the evaluation stage, in order to evaluate the outcomes of the creative processes and to fine-tune the details of the final design.

Method

Designing for an experience

Experience-driven design or 'design for experience' intends to evoke a particular user experience in a specific usage context. Although user experience may be considered to some extent in most design projects, in experience-driven design the user experience is the focal point. Envisioning what experience to design for and understanding how design can evoke that desired experience requires a thorough understanding of the intended user and the context in which he or she operates, as well as appropriate techniques to generate and test concepts. This design approach opens up new ways for radical innovations that go way beyond the obvious: Designing new and innovative products that nevertheless capture a sense of authenticity.

Designing for user experiences involves at least two important challenges. The first challenge is to determine what experience to aim for, and the second is to design something that is expected to evoke that experience. Desmet, Hekkert & Schifferstein (2011) have identified 14 ingredients that characterise many experience-driven design processes on the basis of their experience in research and design projects. These 14 ingredients have been
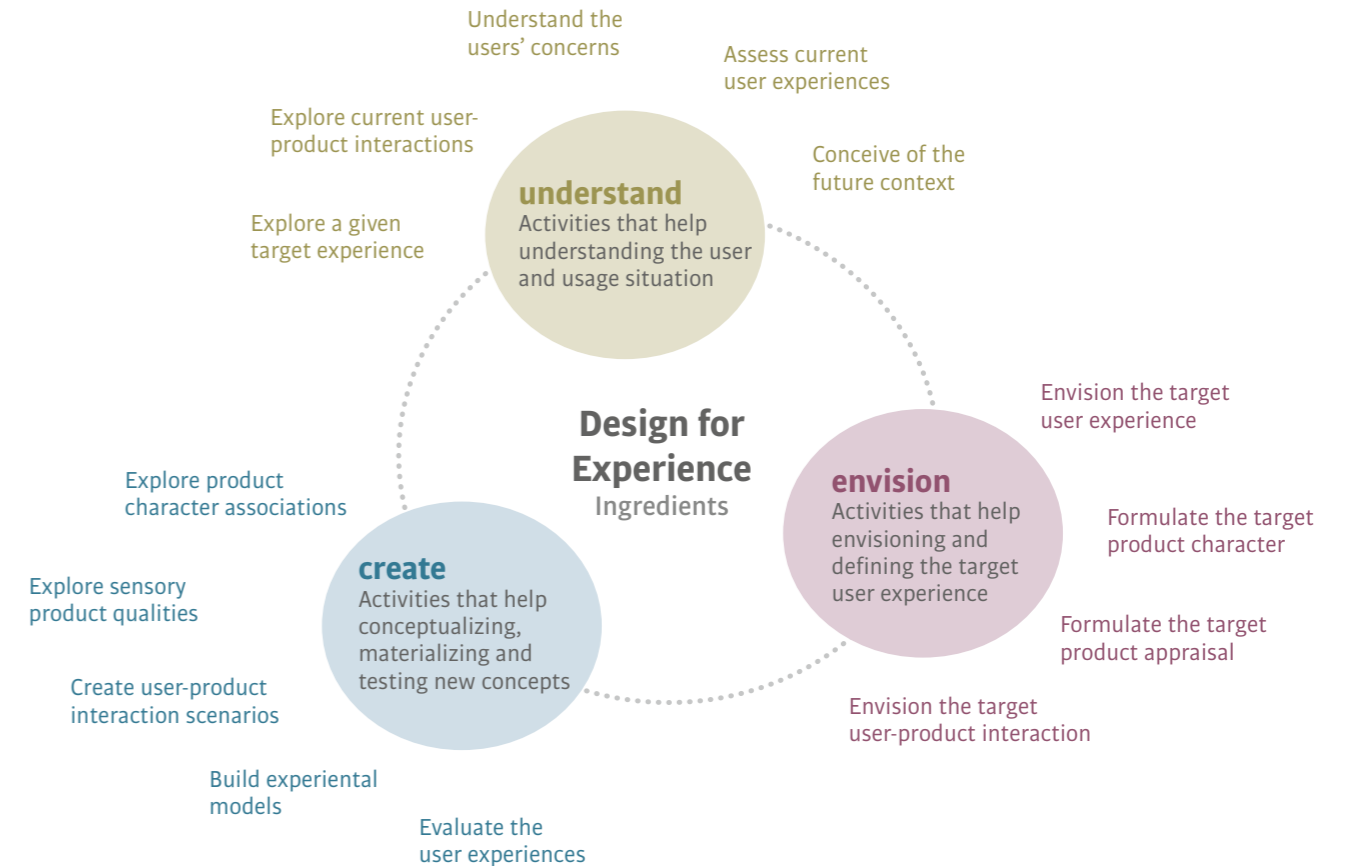
FIGURE 1 *ingredients of experience-driven design processes (adapted from Desmet and Schifferstein, 2011; copyright Eleven International)*

loosely divided into three categories. The 'understand' category represents activities that help designers understand the current situation and empathize with the intended users. The 'envision' category represents activities that help designers to envision and define the design intention. The 'create' category represents activities that help designers make the transition from design intention to product design. Some of these ingredients focus on the users and their experiences, some on the interaction between user and product, some on the context in which these interactions take place, and some focus mainly on the product properties (*figure 1*).

The 14 ingredients should be regarded as options: Which ingredients are used, the order in which they are used, and how they are combined into a coherent design project differs between projects, depending on the needs of the designer and the design challenge at hand. The three categories do not presume any order of activities in the design process: The process can start with any of the ingredients, and ingredients from all three categories can be used in an infinite number of combinations.

Contextmapping

Contextmapping is one of several possible methods that can be used to investigate user experiences in design processes. Contextmapping focuses on the 'understand' and 'envision' categories in *figure 1*, but does not necessarily cover the 'create' category. It can help provide understanding of the user in the current usage context and this information can be used to identify the desired user experience. The basic principle of contextmapping is that everyone is an expert of his/her personal experiences and, in that role, can contribute to the design process.

FIGURE 2 *procedure of a contextmapping study, involving designers, researchers and users*

Contextmapping combines several research methods (interviews, observations, generative techniques and elements from probes) in order to generate rich experience information. Generative techniques and probes rely on self-expression of the explicit and implicit knowledge that people have about their everyday experiences. The resulting information consists of stories on how they experience specific situations in their everyday lives. Contextmapping focuses on holistic, general experiences and does not necessarily focus directly on experiences with products or services. For example, in a contextmapping study about contact with relatives, stories about users' mobile phones will not only involve phones that are in use. The stories may also describe having the phone in your pocket or not having it around.

The number of participating users is relatively small (about 10 participants) in order to establish personal contact and to value the personal stories. Contact with the participating users is often quite intensive and personal. With generative techniques, people are invited, encouraged and stimulated to document parts of their own lives and experiences. People are often unaware of many aspects that influence their experience, and through these techniques they are stimulated to reflect in order to become aware of them. Participants make things (e.g., collages) and explain why they made them that way. By giving them tools to express themselves, they generate information about their individual experiences.

Procedure
The contextmapping procedure consists of six stages (*figure 2*). The preparation stage involves setting a well-defined goal, indicating how results will be used for conceptualization, and pinpointing the organisational aspects of the study, such as finding participants and time planning. The sensitization stage is the period before the actual sessions take place with users. Users receive a package with, for instance, a photo camera and a diary, to record some of their daily routines. This supports them in becoming more aware of daily habits and what these routines mean to them, so that they have more knowledge at hand when they participate in a subsequent session.
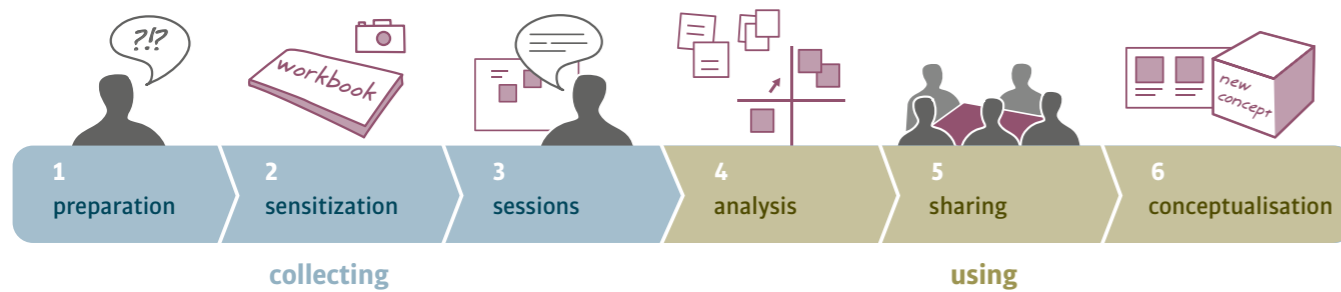

FIGURE 3 *participants create a collage by selecting words and images from a prepared set*

Then, in 1-to-1 interviews or in group sessions (stage 3), participants are asked to explain their creations to the designers and/or researchers and other users and stakeholders, if present. In addition, during the sessions users make things, such as collages (*figure 3*), storylines, and 3D models in which they express their experiences and they present their created artefacts to the group and to the researchers.

In stage 4, the designers and/or researchers analyse the data, and form categories and models which they document for the sharing phase (stage 5), in which these are given to the design team. Data generated with contextmapping can have a number of forms. It typically contains rich and diverse, often very personal, fragments about the participants' everyday experiences (*figure 4*). In the conceptualization stage (stage 6), the results are used as input for creating new concepts.

FIGURE 4 *data from a contextmapping study about retirement. Top: a sensitising package. Middle: observation in the user's home. Bottom: various data sources, including probe materials, collages, and transcripts of interviews*

Healing hospital environment

Although traditional hospitals with white walls and angular shapes may be perceived as clean, efficient, and professional, they do not necessarily provide an environment in which patients feel comfortable. The goal of this project was to create a design that would contribute to patients' healing processes and their feeling of well-being. For the VU medical centre in Amsterdam, Koen Vorst designed a modular rest unit in a short-stay hospital recovery room. Patients stay in the recovery room after they have received heart catheterisation treatment. Hospital intake, including preparation, treatment and recovery, together take no more than one day.

To learn about how people experience recovering in the hospital, the designer performed field research in the existing recovery rooms and interviewed medical staff. Patients in the recovery room only stay there for one day and it is quite intrusive to ask them to participate in a generative session. Hence, in order to learn more about patients' personal experiences, the designer decided to conduct a contextmapping study with other patients who were in hospital for a longer period.

Study

The participants in the contextmapping study received a sensitizing package consisting of various assignments in the form of a booklet and a camera a few days before they were interviewed. They were asked to make pictures and describe their room, what they like/dislike about it, how they feel about it, what they do during the day and how they experience the contact with medical staff and visitors. In the interviews with the participants, the designer first discussed the filled-in booklet and photos with the participant and then asked them to make a collage 'What makes this room MY room'. By using both visual and written material, it was easier for the participant to express him/herself and to evoke personal anecdotes and the perception of their stay in the hospital. After the collage was made, the participant and the designer discussed it. All interviews were recorded and analysed, resulting in four design considerations:

- **Stimulate desirable interaction:** The presence of the nurse and visitors is very important for patients. Nurses and visitors offer social support which can reduce stress. The feeling of being supported is also increased by receiving personal telephone calls, postcards and flowers. In the design of the rest unit, interaction between the visitors and the patients, as well as between the nurses and the patients, should be stimulated.

- **Make the unfamiliar familiar:** Personal objects such as books, postcards, clothes and flowers create a sense of familiarity in the patient's room. Familiarity is hard to achieve in the recovery room as these patients only stay for a single day and do not bring many personal belongings with them. Familiarity might be improved by creating a more home-like environment.

- **Stimulate pleasant distraction:** Pleasant distraction can be achieved by environmental distractions, such as an interesting view, the presence of magazines, a television or a computer, or activities like taking a walk around the hospital and communicating with other patients.

- **Give patients a sense of control:** Giving the patient a sense of control of his/her own physical environment (e.g., temperature, privacy, light, music) is likely to reduce stress and contribute to the healing process. In multi-occupancy rooms, the possibilities of controlling the environment are limited because patients have to consider the wishes of other patients in the room.

Design process

The conclusions from the contextmapping study were used as guidelines in the design phase. In addition, several ingredients from the experience-driven design approach were used in the design process, including the understanding of users' concerns, the exploration of sensory qualities, and the building of experiential models; these are discussed below. The final design consists of a modular rest unit that can encompass a standard size hospital bed. The design includes the ceiling with lighting and curtain, the floor area, and a curved back wall with an integrated closet. As the rest unit is modular, multiple units can be placed in a single room (*figure 5*).

An important starting point in the design process is to select an intended user experience. Because a relaxed patient is easier to treat for a surgeon and is more likely to make a quicker recovery, it was decided to create a relaxing experience for the patients. In addition, the units should communicate the quality of the hospital: patients should have the feeling that they are in good hands and that they are being treated by high-quality professionals.

The contextmapping study provided valuable insights into a number of patient concerns. For instance, the patient's need to feel familiar in an unfamiliar environment was used in the design of the closet: the closet's door is transparent so

that the patient can see his/her clothes. As clothes are the only belongings these patients bring to the hospital, it gives them a more familiar feeling. Another concern involved the need to have a sense of control: the patients' private area was determined by the rounded shape of the floor covering, the curtain rail and the ceiling.

Another outcome of the contextmapping study involved the need for pleasant stimulation. As a result, the possible sensory product qualities of the design were explored extensively. For instance, music was found to create desirable distraction as long as it did not annoy other patients. In the final design, music was provided through a sound pillow, which can

FIGURE 5 *modular rest units designed for VU Medical centre (Vorst, 2008)*

only be heard by the patient in the rest unit, and therefore does not annoy surrounding patients (*figure 6*). In this way, each patient can choose their own type of music without disturbing others. In addition, the effects of light colour, temperature and intensity on the human hormone system were used to help patients relax. Colour temperature reflects the qualitative properties of the light and varies from warm, reddish light to cool, bluish light. Colour temperature and intensity of the lighting system were dynamic and changed during the patient's stay. Hospital staff need the light to have a cool temperature and a high intensity in order to perform their tasks. However, when no tasks are being performed, the system automatically changes to warmer colour temperatures

and the light intensity decreases gradually over time to allow the patient to relax.

Experiential models were also developed: full size prototypes were built to test whether the intended design goals were met. User tests with these prototypes showed that the design was indeed experienced as relaxing. Especially the music, the bright colours and the curved shape of the back wall were aspects mentioned by patients as being very comforting and relaxing. However, not all patients enjoyed the privacy: some would rather have had more contact with the other patients in the room. In addition, some practical issues arose, for example the lack of space around the bed,

which hindered hospital staff during their work.

This project shows an experience-driven design process - including contextmapping and prototyping – that focuses on understanding current experiences and creating desirable experiences. The VU medical centre was enthusiastic about the design and recognised the added value of the design solutions. Unfortunately, the modular rest unit has not been developed further due to changes in the hospital building plans. Nonetheless, the project demonstrates that the experience-driven approach can result in original and engaging designs that help support important life processes, such as improving the healing of patients.

FIGURE 6 *loudspeakers in the pillow allow the patient to listen to his preferred music (Vorst, 2008)*

Benefits and limitations

Both contextmapping and experience-driven design are based on scientific insights and empirical studies, and they have been improved over the years in academic and design practice. It is often difficult to find empirical evidence that demonstrates the benefits of applying methods at the fuzzy front end of product development. These methods are used for inspiration, fuelling the design process and it is sometimes difficult to trace exactly where key insights came from. Benefits often mentioned include changing the mindset of the employees within the company. Managers use success stories from other projects in which user research led to successful products on the market as evidence for their contribution. Another way to show their value is not to aim for directly visible results in financial terms at the end of a design process, but to cut the process up into a set of smaller stages, and evaluate parts of the process separately with a combination of qualitative and quantitative measures (Manschot & Sleeswijk Visser, 2011).

At first sight, the outcomes of contextmapping studies may not seem earth-shattering. Clients may have the idea that some results are quite obvious, but this is also the strength of the method: by carefully studying every aspect of day-to-day user-product interactions, all aspects that are relevant to the user are noted. Although they may seem quite obvious, our experience teaches us that companies tend to overlook some of these basic qualities of their product offerings and, thereby, tend to have blind spots to their customers' needs. Covering all user needs in their new design often gives them competitive advantage in the consumer markets.

Using contextmapping is most advantageous if a project is in the pre-conceptual or conceptual stage, where there is still a great deal of room for finding new opportunities. Apart from insights for the target project, contextmapping can yield a diverse range of outcomes, including personas, strategies for innovation, new views on market segmentation, and original insights for other innovation projects. In order to make optimal use of these possibilities, it is important that the project is broadly supported within the client's organisation. In addition, the outcomes have the greatest impact if they can be linked to other available (e.g., quantitative) user data and can be directly applied in the design process.

Although only a limited number of users are typically involved in contextmapping studies, carefully selecting the respondents for the study makes sure that their responses are largely representative for the target group. Involving more users typically does not lead to a wider variety of insights. By carefully addressing user needs and wishes, contextmapping devotes research attention to understanding the deeper needs of the user. This requires substantial investment in relationships with research participants. Also, throughout the 'understanding', 'envision', and 'create' stages of experience-driven design, this careful consideration of user needs and wishes requires the designer to make careful, precise considerations. This asks for precision, accuracy, an eye for detail, nuance, and user empathy, often resulting in a time consuming and abstract process.

As a consequence, it can take quite some time before a final result can be presented, and partners in a project may become anxious as they miss concrete results. Nonetheless, experience-driven design does not need to result in lengthier development processes than other approaches, because the formulation of a clear design statement incorporating the targeted user experience focuses the remainder of the development process, facilitates decision making and typically requires less ideation cycles.

Usually professional support is recommended for these types of projects as the skills to conduct this type of research and these design projects develop through practice. It is often not the resulting general picture, but the nuances that determine the success of a project.

Key insights

- User experiences can form the starting point for innovative design processes.
- Experiences are multifaceted, dynamic, and they depend on a person's internal state and on context.
- Contextmapping can provide the user insights that are needed as a basis for experience-driven design.
- Contextmapping focuses on investigating holistic, general experiences, whereas the experience-driven design approach focuses on creating a desired experience.
- Experience-driven design projects may differ in the number and types of ingredients.
- User input is not necessarily beneficial at all stages of a design project.

How to continue?

Further reading

- Desmet, P., Schifferstein, R. (Eds.) (2011). *From floating wheelchairs to mobile car parks: A collection of 35 experience-driven design projects*. The Hague: Eleven International.
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Websites

- Experience-driven innovation: www.expdi.org
- Contextmapping: www.contextmapping.com
- Delft Institute of Positive Design: studiolab.ide.tudelft.nl/diopd/
- Encyclopaedia on interaction design: www.interaction-design.org/

05.
Organising for product usability: a comprehensive approach

Authors

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Introduction

Manufacturers are increasingly confronted with complaints from consumers that are not related to technical or functional product failures, but to a mismatch between the use intended by the manufacturer and the actual product use. For many electronic products, consumers often are unable to work out how the products they own should be operated. Manufacturers should improve their product development processes by paying more attention to usability-related decision-making.

This chapter addresses the major challenges encountered by product development teams and their organisations with respect

to usability issues. The tools presented will help you to reveal how usability issues are currently handled in your organisation and to develop strategies to improve them. It introduces tools that cover the incorporation of usability aspects during the planning and execution of the development process and shows how these can be implemented in an organisation. We focus on electronic consumer products, however the tooling presented can be equally relevant and applicable to other complex consumer products.

In-company case studies were conducted in order to gather insights for the development of new methods and tools. The methods and tools we describe have all been recently developed and tested. Nonetheless, they are still in an experimental phase and have not yet been widely adopted.

Challenge

In the past, product returns and complaints were largely due to technical failures (quality or reliability issues). Nowadays, products are often returned by consumers that contain no technical defects. Over time, companies have become better

and better at managing product quality, and until the late nineties, the number of product returns decreased (Den Ouden, 2006). However, from then on, the number of product returns has been on the rise (Brombacher, 2005). For instance, Den Ouden et al. (2006) noted that in 48% of products returned, no technical fault could be detected. In 2007, this

'no-fault-found' category was estimated to be 68% of returned electronic consumer products, and the cost for product returns in the US market alone was put at $13.8 billion (Steger et al., 2007).

The high number of product returns is partly attributed to people not understanding how to use a product properly and therefor concluding that it does not work, and the fact that consumers are dissatisfied with the product as it did not meet their expectations (Den Ouden et al., 2006). Hence, one of the strategies to deal with this rise in returns is to improve a product's usability (Steger et al., 2007). Usability is typically defined as 'the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use' (ISO, 1998). Usability is not a product quality that is intrinsic to the physical product: it is a quality attribute of the interaction between a product and its user in a particular environment. In order to find a way to improve products and to decrease the number of product returns, product development teams need to focus on the user in order to understand what users think, feel, and experience when they interact with their products.

Given the large number of usability problems found in recently purchased products, it appears to be difficult to incorporate usability in the design process. Even though there are a large number of methods available for user-centred design (Stanton et al., 2004; Wilson, 2010), the usability of many electronic consumer products still leaves a lot to be desired. Real day-to-day product development is messy (at best) and the effectiveness of usability testing methods should not only be considered from a theoretical perspective,

i.e. how good the methods are in uncovering usability problems in a controlled situation, but also from a pragmatic standpoint, i.e. how effective these methods are when applied in product development practice.

Involving practitioners
In order to provide designers and product developers with tools to improve the usability of products, the three Dutch technical universities have joined forces in the 'Design for Usability' programme funded by AgentschapNL. The aim of this programme was to improve the usability of electronic professional and consumer products by creating new methodologies and methods for user-centred product development, which can be applied in practice. The programme used a practitioner-oriented research approach, implying that interviews were conducted with usability practitioners and experts, in addition to exploring and reviewing the extant literature. In addition, a major part of the data collection was conducted through case studies in product development practice. Furthermore, researchers conducted feedback workshops with practitioners and verified their interpretations and conclusions with the programme members.

In this chapter, we present an integration of four projects that formed part of this programme. The projects were performed by each of the four authors individually and focused on a specific part of the product development process. We selected these research projects specifically because they all focused directly on improving the development process: each project proposed a tool or approach that can be readily applied in a company context. For the other projects in the programme,

we refer to van Eijk et al. (2012), van Kuijk (2012), and the programme website www.designforusability.org. In order to help practitioners make better use of these methods and tools, we have integrated the outcomes of the four projects, which may differ from the individual presentations found elsewhere.

Methods and tools

The methods and tools developed in these four projects all concern embedding a user-centred attitude in product development processes. The first two tools help organisations become more sensitive and responsive to usability issues. The third tool helps organisations develop a structured user-centred design approach. Lastly, an additional toolbox facilitates the selection of specific design methods that can help organisations to embed this approach.

- The workshop **Revealing Unawareness in Design Practice** (Harkema, 2012) provides clarity on the organisational sensitivity to usability. It centres on identifying the blind spots and distortions that occur during decision-making with respect to usability in existing product development processes. It focuses on organisational weaknesses in identifying the usability issues as a result of unawareness. The reflection on a product development project helps to identify the influencing factors on decision-making and thereby the points for improvement for future projects. The Revealing Unawareness in Design Practice workshop is a tool that can be performed with designers, developers, product managers, and others.

- To ensure the development of products that meet user expectations, the user-centred focus should become an integral part of a company's product development strategy. However, a company's organisation induces both barriers and enablers for the implementation of a usability strategy. The card set **Recommendations for Usability in Practice** provides further insights into these organisational barriers and enablers. In addition, it provides recommendation on how to deal with them. These recommendations describe best practices for organising the user-centred product development process, its team and the management thereof.

- The **UCD Kick-off tool** supports the implementation of a user-centred design (UCD) approach in the organisation. Based on the identification of usability issues to be addressed, the UCD Kick-off tool supports product development teams in specifying a detailed plan of approach for a specific product development project. The tool can be applied at the start of and throughout every new project, in order to ensure an effective and efficient user-centred design approach for the development project at hand.

- A specific step of the UCD Kick-off tool involves the selection of appropriate design methods and tools. The **UCDtoolbox** can be both a source of inspiration and a practical support tool during this selection activity. The UCDtoolbox provides a web-based overview of readily available user-centred design methods, including easily accessible assessments of their potential and their limitations.

Revealing Unawareness in Design Practice: a workshop

The source of usability problems that we are confronted with today can often be traced back to decisions made by those in the organisation who are responsible (financial, quality, marketing, etc.) for the development process. Den Ouden (2006) noted that developers sometimes have a distorted view about the intended product use. However, very little is known about how decisions are actually made in design practice and what influences the quality of usability-related decisions. Therefore, Harkema (2012) investigated design theory and practice to identify these influencing factors. She found out that the context in which the product development activities occur (e.g., time pressure, organisational goals, etc.), has a great impact on the decision making process.

In addition to the context, two other factors have a major impact on decision making: 'uncertainty' and 'unawareness'. Uncertainty can complicate the decision-making process as information can be limited, or the quality of decisions can be low due to lack of understanding. This is more complicated with issues that the organisation is unaware of. Unawareness is probably the most important of these three factors in practice, because it results in unforeseen usability issues. Therefore, Harkema further investigated the nature of unawareness in order to identify what the designer can be unaware of (types of unawareness) and to identify the sources of unawareness.

Unawareness
Designers can be unaware of the lack of required usability information; they may not foresee the consequences of a decision or may underestimate the gravity of the consequences; and they may be unaware that a decision was made if this was done implicitly. These sources of unawareness are termed 'inadequate consideration', 'lack of overview', and 'fixation', respectively (*figure 1*).

It is important to realise that currently available methods for improving usability mainly address 'uncertainty', but overlook sources of unawareness. Hence, it is important to address unawareness in decision making during product development to reduce usability issues. Knowledge about the sources of uncertainty and unawareness make it possible to improve the quality of usability-related decisions, since it makes it possible to decrease the levels of uncertainty and unawareness. Improving the quality of usability-related decisions will, in turn, improve product usability.

Workshop
Harkema (2012) developed a workshop in which the usability-related decisions in a design project are analysed in retrospect in order to provide decision makers with a broader perspective of their own practice field. In this way, designers, developers and product managers can learn to improve their usability-related decision-making in order to avoid similar mistakes in future projects. The workshop guides the participants step by step through the theory of usability-related decision-making, by analysing one of their own past projects. First, participants
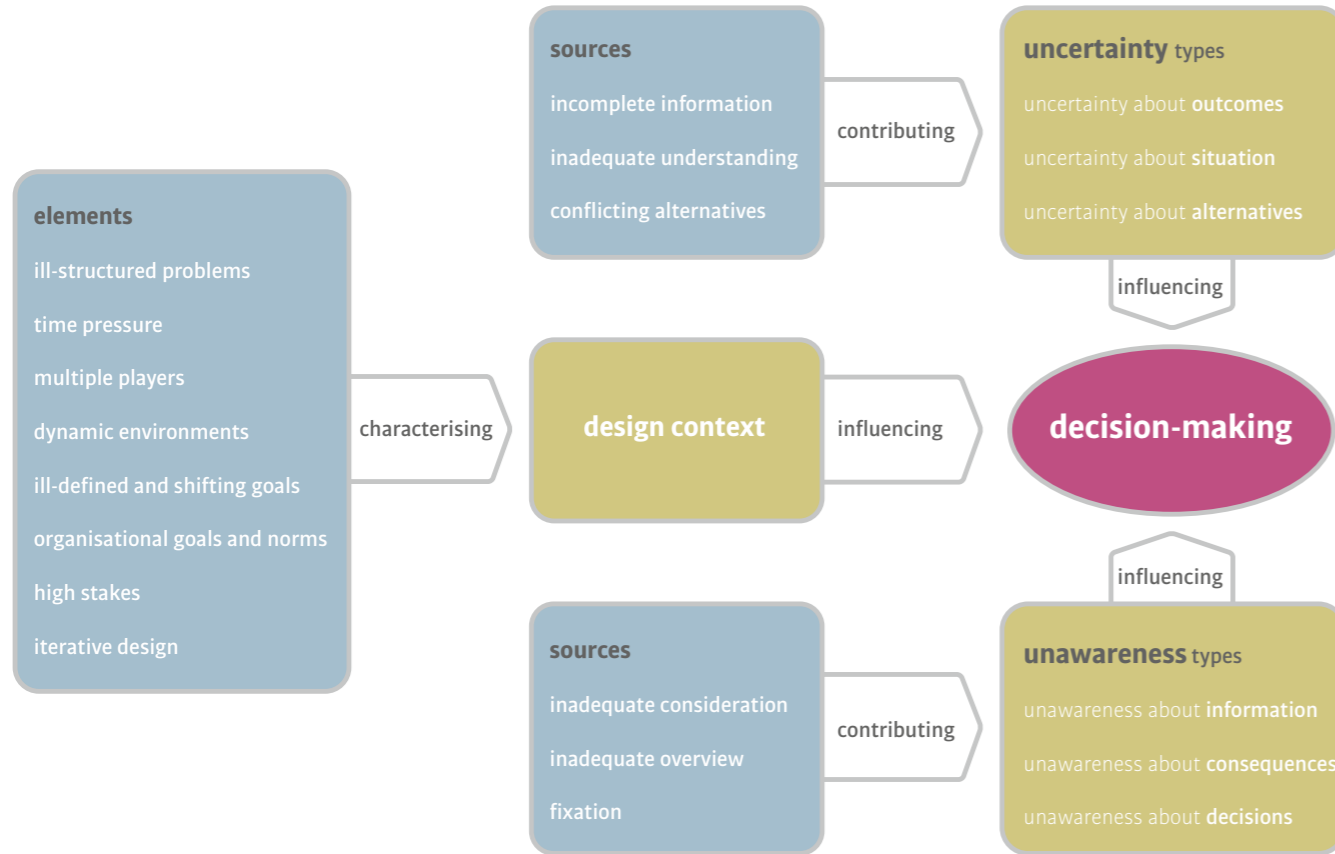
FIGURE 1 *factors influencing decision making with respect to usability issues*
(Harkema, 2012)

select a product with usability problems from their own design projects. After describing one of the usability problems, they sketch a timeline with activities. The decisions related to the described usability problem are added to this timeline. For each decision, the participants then explore whether 'design context', 'uncertainty' or 'unawareness' influenced the decision *(figure 1)* or whether they decided to accept the consequences of the decision: a usability issue. After each step, examples are shared with the other participants. Because the theory can be applied directly to a personal example, participants can quickly understand the difference between the underlying factors. Subsequently, the sources that define the different factors are discussed in detail.

During this workshop, participants reflect on their own projects and learn about usability-related decision-making. Realising and acknowledging the influence of 'unawareness' is the first step towards improving decision-making. The second step is to identify the sources of 'unawareness' in their subsequent projects. After identifying these sources, they can be addressed in following projects, thereby preventing unawareness.

Workshop participants

Recommendations for Usability in Practice: a card set

In company practice, product development is only partially determined by a prescribed process, as the skills and attitudes of the product development team also affect the execution of the individual steps within the process. The properties of the organisation and the market in which a company operates have a considerable influence on the resources available to a development team and the conditions they have to deal with. Furthermore, the increasing functionality and networked character of many new products demand collaboration between development groups that previously were in charge of their own individual products. This requires an integrated organisational approach in which the focus is on the product development process as a whole.

With this condition in mind, Van Kuijk (2010a) identified the factors in a company's context, organisation, team and process that contribute to or obstruct usability-related decision making. He identified these 'enablers' and 'barriers' for usability (Kleinsmann & Valkenburg, 2008) by focusing on the six roles of the actors who were considered to influence usability the most: the product manager, marketing specialist, industrial designer, interaction designer, usability specialist and development engineer. In addition, Van Kuijk investigated the interrelationships of these factors.

Recommendation card set

Van Kuijk's study resulted in a set of 25 recommendations for incorporating usability aspects in company product development processes (*figure 2*). The initial recommendations were published on uselog.com and readers were invited to comment over the course of five weeks. Subsequently, adjustments were made to improve the recommendations. These insights enable product developers to establish or change an organisation so that it will be able to develop usable products (van Kuijk, 2010a, 2010b). In addition, the recommendation cards also describe the underlying, more abstract principles.

The recommendations are grouped according to a categorisation scheme developed in the Design for Usability project (*figure 3*) that shows its primary investigative domains and their relations:

FIGURE 2 *the recommendation card set (van Kuijk, 2010b)*

- **Usability 101:** how to define usability and assess its consequences.
- **Process:** what does a user-centred product development process look like, what methods to apply, and how?
- **Team:** how to assemble a team that is capable of executing a user-centred product development process.
- **Project:** how to organise, facilitate and plan user-centred product development.
- **Company:** how to organise a company so that it facilitates user-centred product development.
- **Market (or Context):** what are appropriate retail and marketing strategies for companies that make usable products?
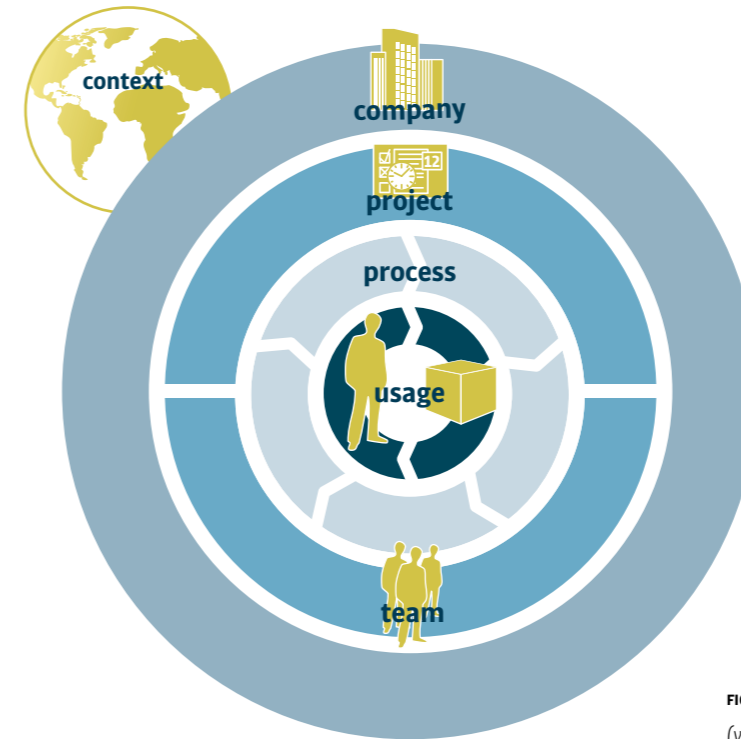

FIGURE 3 *the primary investigative domains of the Design for Usability project (van Kuijk et al., 2012)*
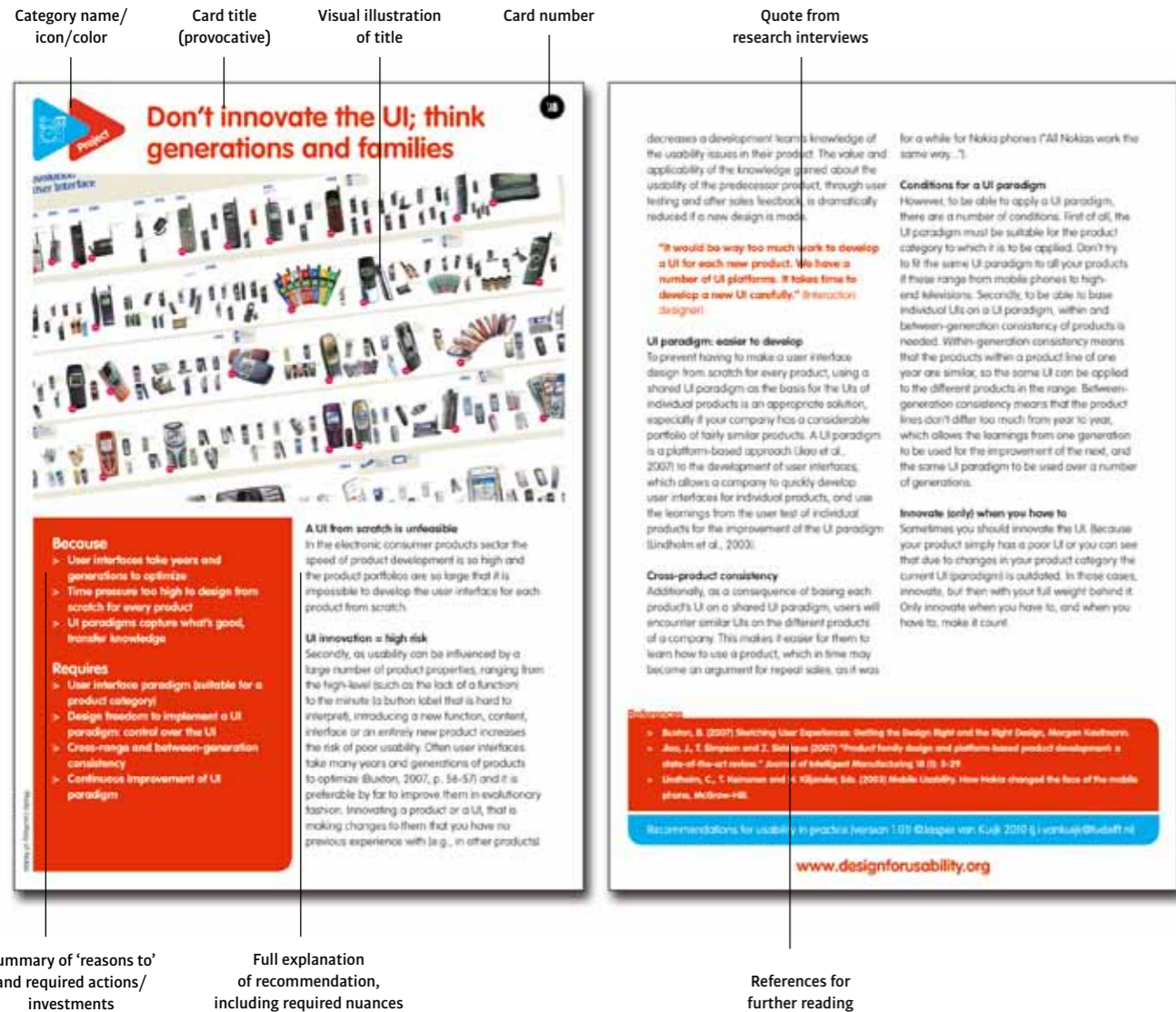
Category name/
icon/color

Card title
(provocative)

Visual illustration
of title

Card number

Quote from
research interviews

Summary of 'reasons to'
and required actions/
investments

Full explanation
of recommendation,
including required nuances

References for
further reading

FIGURE 4 *explanation of the layout of the recommendation cards (van Kuijk, 2010b)*

The build-up of the cards (*figure* 4) includes a provocative title supported by an illustration, a summary of benefits and requirements for acting on the recommendation, and finally an elaborate explanation of the recommendation itself. For a tools/methods card set, the text is relatively lengthy. This was done on purpose as the objective was for practitioners to be able to act based on the information provided, not just to raise awareness. The recommendations range from the very pragmatic and easily applicable (e.g., use guerrilla HCI techniques) to higher-level and challenging (e.g., align the organisation with user needs). As a consequence, the target audience may differ for the various recommendations.

Workshop
In order to promote dissemination and implementation of the recommendations and to collect feedback for future versions, a workshop was developed in which participants engage in a discussion about the recommendations (see box below, How practitioners were involved). Typically, four to five representatives from different disciplines (e.g., interaction design, usability specialist, product manager, upper management) from a single company participate in the workshop. Before the workshop, each participant selects his/her three most and least favourite recommendations and provides a motivation for selecting them. These motivations are discussed, and at the end of the workshop the group tries to reach a consensus on what they believe to be the three most relevant and three least relevant recommendations. Past experiences with the workshop show that it is a powerful means for bringing the differences

in views between disciplines to light, and that the workshop setup provokes highly focused and insightful discussions. The insights generated through the workshop form a common ground and form the starting point for an action plan towards a more user-centred organisation. Because the workshop is simple and the card set is relatively rich in content, the workshop can be executed without an external facilitator.

How practitioners were involved

The research on which the card set is based consisted of three case studies conducted in ten product development groups at large-scale multinational companies, and involved a total of 69 interviews with product developers. In the first study, interviews were conducted in four sectors aligned to the electronic consumer products market: high-end automotive, office coffee machines, fast moving consumer goods, and professional printing. Next, an interview-based case study was conducted at five major international product development groups working at five companies in the electronic consumer products sector: digital music players, mobile phones, navigation systems, washing machines, and climate controls.

The card set in use during a workshop facilitated by the Institute of Design Knowledge in Hong Kong (Photo by HOPF images, © Institute of Design Knowledge)

The third case study investigated the development history of three electronic consumer products within one product development group of a single company: home audio and video. After each case study, a feedback workshop was conducted to verify whether representatives from the companies involved found the interpretations and conclusions accurate and comprehensive. In addition, the recommendations for industry were 'user tested' by presenting them on a weblog and by discussing them in a workshop with 30 product development practitioners from three different companies: consumer and professional electronics, professional printing, and industrial design consulting.

Specifying a detailed user-centred plan of approach: the UCD Kick-off tool

Many complaints concerning use problems find their origin in the organisation of the product development process. Most companies use their own specific product development method on which the user-centred plan of approach for a specific assignment is based. Unfortunately, product development teams often do not have a good overview of what a user-centred plan of approach entails. In addition, team members may have different expectations regarding the characteristics of the product that needs to be developed or development activities that need to be executed in order to assure the usability of the end product. The lack of a detailed and user-centred overview of the approach is bound to result in a product design that does not meet the intended use characteristics.

UCD Kick-off tool

The UCD Kick-off tool (Hoolhorst, 2012a) supports product development teams in systematically specifying a detailed user-centred plan of approach. The tool focuses on the following four areas (*figure 5*):

1 **Stakeholder mapping:** Stakeholders are parties and individuals who have specific interests in the successful completion of a project and who can probably contribute to the course of the user-centred product development process. The UCD Kick-off tool enables the development of a complete, specified and prioritised overview of all stakeholders involved in the project.

2 **Result planning:** A detailed insight into the desired product characteristics, intermediate process results, and contextual conditions is needed to define a user-centred plan of approach.

3 **Development method selection:** Product developers tend to stick to methods they are familiar with, without questioning whether these development methods fit the intended development results. The tool supports explicit exploration and selection of appropriate and feasible development methods.

4 **Development method specification:** Making a detailed description of all required development activities in order to guarantee that the intended development results are achieved during the product development process.

Workshop programme

The UCD Kick-off tool is preferably to be used by core product development teams consisting of the leaders/managers of the departments or disciplines involved, during several workshop sessions, based on the design brief for their assignment. The tool is available as a workshop and is supported by templates (Hoolhorst, 2012b). The workshop consists of 10 steps that are spread over three workshop sessions.

Workshop session 1:

Stakeholder mapping focuses on (step 1) identifying all stakeholders that are relevant to the product development process and (step 2) specifying their interests, particularly regarding product use aspects, as well as their possible
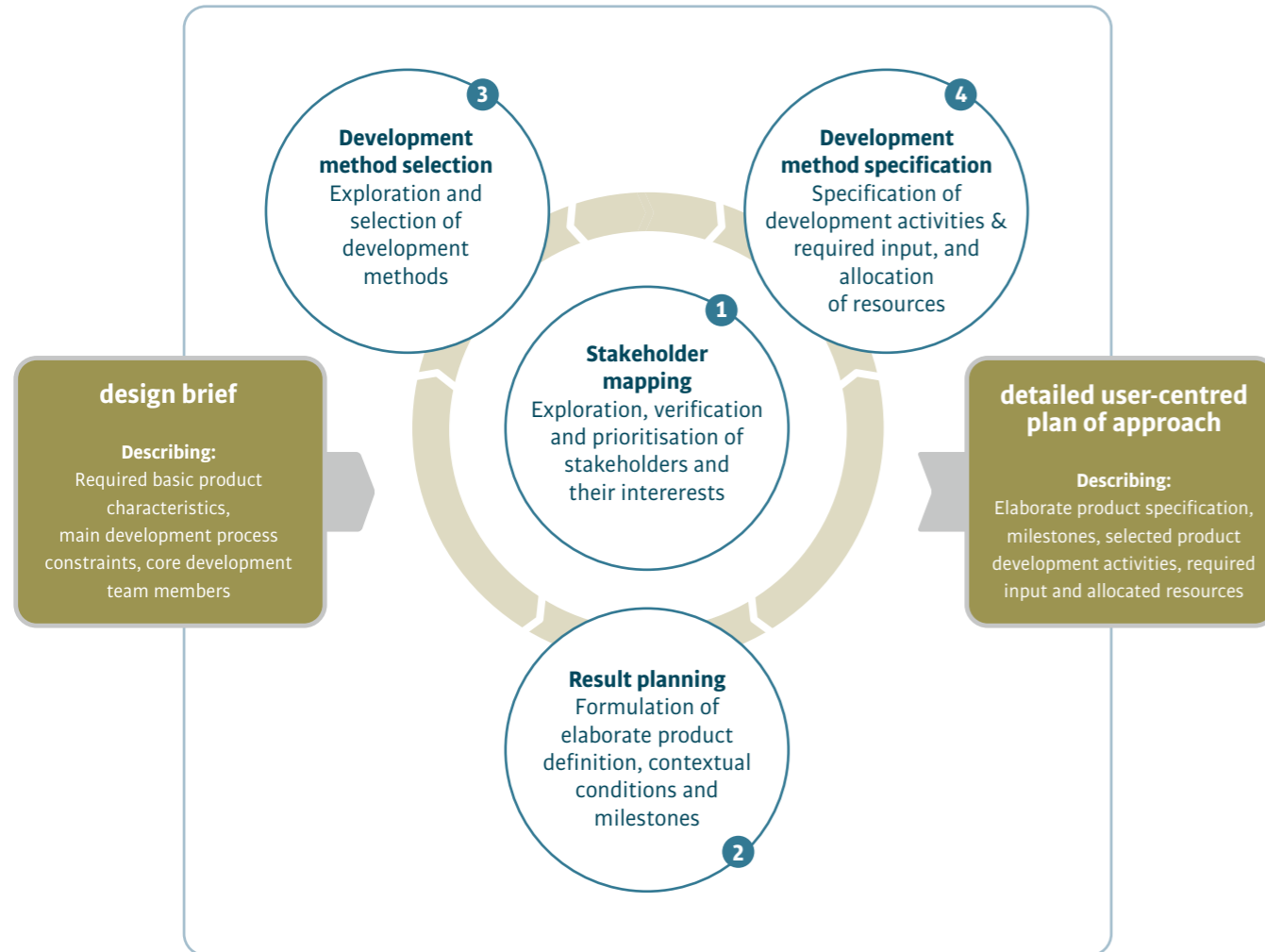
FIGURE 5 *overview of the UCD Kick-off tool's focus areas (Hoolhorst, 2012a)*

contribution in the form of expertise and skills, decision making, equipment, availability and budget. The final step of the workshop session consists of (step 3) prioritising stakeholder interests and gaining insights into conflicting or unfeasible stakeholder interests.
Intermezzo: Possibility to negotiate with stakeholders about their interests.

Workshop session 2:
Result planning and development methods selection aims at (step 4) making a promising combination of minimal stakeholder interests that need to be met. Based on this overview and the promising combination of focus interests, (step 5) product conditions and contextual conditions for the development process can be defined. Next, (step 6) an elaborate product specification is made and (step 7) project milestones in terms of product users, use goals, use environment and other relevant product aspects are defined. This workshop session ends with (step 8) selecting development methods and tools to achieve the defined milestones during the development process.
Intermezzo: Time to prepare (step 9) the specification of the selected development methods in the form of required input, activities and allocation of resources.

Workshop session 3:
Development method specification focuses on the final step of the workshop and addresses (step 10) making and communicating a concrete action plan for the product development process. This detailed user-centred plan of approach describes the required development activities, required input per activity, development techniques and the allocation of resources.

The division into three workshop sessions allows the selection of participants dedicated to the specific goals of each session. Furthermore, the timespan of intermezzos between the workshop sessions can be adapted to the specific circumstances of the development process at hand.

Applicability
The UCD Kick-off tool has the most added value in large user-centred product development projects executed by large (sets of) product development teams. The tool should preferably be used at the start of a project by the complete core development team to systematically define a univocal and detailed user-centred plan of approach. Afterwards, the tool can be used to update and refine this plan based on the intermediate results.

Evaluation of the UCD Kick-off tool in design practice revealed that the tool appeals to both less experienced and more experienced design practitioners. Less experienced project managers use the UCD Kick-off tool as a learning tool, whereas more experienced project managers use the UCD Kick-off tool as a mnemonic to remind them of the aspects which need to be taken into account when defining the user-centred plan of approach. The UCD Kick-off tool thereby supports them when taking more explicit decisions regarding the organisation of the user-centred plan of approach.

Selecting user-centred design methods and tools: the UCDtoolbox

The selection of appropriate design methods and tools is an important step in the plan of approach proposed by the UCD Kick-off tool. Hundreds of UCD methods, tools and techniques have been developed, but these are spread over many different sources, including scientific publications, books and online collections. Product development practice can be extremely hectic and messy (van Kuijk, 2010a), leaving practitioners very little time to explore and find a method or tool that matches their situation. This raised the question of how can we best help designers to quickly find the method or tool they need.

Previous attempts at collecting UCD methods and tools have only been partially successful: the number of methods in the collections is often limited, and they may be displayed or categorised in ways that do not match product development practice (Bevan, 2003; Tidball et al., 2010). In addition, many collections provide little or ineffective guidance for selecting the appropriate method (Bevan & Ferre, 2011; Wixon, 2003) and the method content often lacks practical information to support the execution of the method (Tidball et al., 2010; Wixon, 2003). As a consequence, designers tend to stick to what they know, leaving many potentially beneficial methods unused (Goodman-Deane et al., 2008; Cardoso et al., 2005).

UCDtoolbox
To meet designer needs better, Weevers (2011) initiated the

development of the UCDtoolbox, an online resource which allows practitioners and students to quickly explore and select appropriate methods for UCD. The search for methods is supported by filters created from a product development perspective. The filters, located on the left hand side of the interface *(figure 6a)*, are based on easily accessed, objective information:

- Type of object that is being worked on, for example a physical product, interface or environment
- Goal of applying the method: i) learning about users and their context, ii) synthesizing solutions, or iii) evaluating a design
- Limiting factors and available resources, for example timespan and staff
- Optional criteria, for example desired study location and participant details.

Once a filter has been applied, all cards that are not compatible with this parameter disappear from the population of relevant methods. Simultaneously, the level of detail of the information presented about each method increases gradually along with the size of the method card *(figure 6b)*. This continues until the user decides to stop filtering and take a better look at the method information by clicking on it.

The method descriptions in the UCDtoolbox *(figure 7)* consist of:
- Introduction with description, overview of how the method rates on the selection criteria, possible

outcomes of executing the method, and a slideshow or video
- Examples of how the method was applied provided by users of the platform
- Details with possibilities for customising the method, and step by step instructions
- Downloadable templates to support correct execution
- Discussion area where the method's characteristics, information and use can be discussed

In order to keep the method collection and its descriptions up-to-date for the everyday practice of product development, UCDtoolbox offers an option whereby issues can be directly addressed to the author and the board of reviewers.
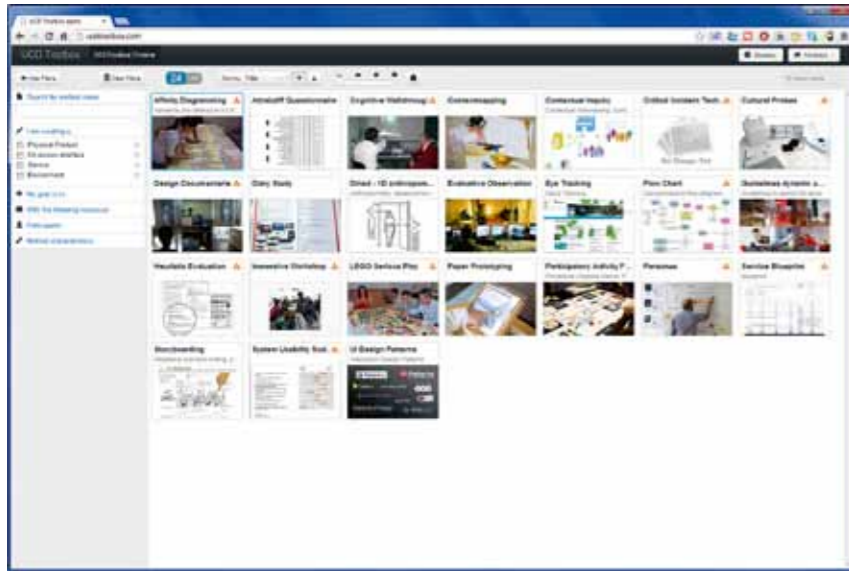
FIGURE 6a *applying filters to the set of method cards in the UCDtoolbox*

FIGURE 6b *as the selected set becomes smaller, more method details are shown*

FIGURE 7 *method description in the UCDtoolbox*

Benefits and limitations

In this chapter, we provide a comprehensive overview of methods and tools that support the incorporation of usability-related aspects in the product development process. These methods were developed on the basis of a deep understanding of the usability problems that consumers are currently faced with. The variety of approaches presented and the corresponding tools cater to different types of companies and to different employees within these companies. Hence, we show multiple routes that all aim to improve the usability of consumer products. Nonetheless, each of the approaches also carries its own limitations.

The workshop **Revealing Unawareness in Design Practice** can be conducted for all kinds of product development practices. However, it is not a tool for use by the practitioners themselves, it is run by researchers for the practitioners. It can either be a short one-hour introduction workshop, or a day-long, in-depth workshop. The workshop is limited to a finished project and the knowledge about the executed activities and decisions made during that specific project.

Van Kuijk (2010b) based the **Recommendations for Usability in Practice** card set mainly on the insights obtained from interviews with practitioners who possess a considerable amount of contextualised knowledge. In addition, Van Kuijk's cases mostly focused on consumer electronics. However, insights from other sources (e.g., documentation and observation) and involving other types

of products and services would help to expand the card set further. Furthermore, with the occurrence of new insights, the card set needs to be regularly updated and expanded.

The **UCD Kick-off tool** provides an extremely structured approach to product development in which the role of usability-related decision making is explicitly considered. Using the tool makes the different stages explicit, provides an overview of the process, and makes the process manageable. However, in some cases, a less controlled process with more creative freedom for the different partners may be more applicable.

The **UCDToolbox** provides a valuable addition to the existing databases and selection tools for user-centred research and design methods. The challenge in this case is to keep the database up to date with the latest developments in the field, and possibly to adapt the selection interface accordingly.

Key Insights

- Many consumer complaints are not related to technical or functional failures, but to a mismatch between the use intended by the manufacturer and the actual product use.
- Making usable products requires an integrated, organisational approach. The ability to conduct a full-fledged user-centred product development process depends on the properties of the team that executes it, the project they work on, the company they work for, and the market that company operates in.
- The quality of usability-related decisions is affected

by three factors: design context, uncertainty, and unawareness. In practice, unawareness is probably the most important factor, because it results in (unforeseen) usability issues. Unfortunately, current methods for improving usability tend to overlook sources that cause unawareness.
- Product development teams often do not have a good overview of what a user-centred plan of approach entails, which is bound to result in a product design that does not meet the intended usage characteristics.
- Awareness of the barriers and enablers for incorporating usability aspects in company product development processes will help improve these processes.

How to continue?

Suggested reading

- Harkema, C.L.E. (2012) *Revealing unawareness in usability related decision-making.* PhD thesis, Eindhoven University of Technology.
- Hoolhorst, F.W.B. (2012). *Structuring user-centred product development processes.* PhD thesis, University of Twente.
- Van Kuijk, J. I. (2010) *Managing Product Usability; How companies deal with usability in the development of electronic consumer products.* PhD thesis, Delft University of Technology.
- Van Kuijk, J.I. (ed.) (2012) D*esign for Usability: Methods & Tools - A practitioner's guide.* Design for Usability.
- Weevers, T. (2011). *Method Selection Tool for User-centred Product Development.* Master Thesis, Industrial Design Engineering, Delft University of Technology.

Websites
- All these projects (and other projects within the Design for Usability programme) can be found on: www.designforusability.org.
- The tools discussed in this chapter are available through: www.designforusability.org/results/methods-tools.
- In addition, you can find short movies of all research projects in the programme on: www.youtube.com/user/DesignforUsability.
- The database of methods supporting design for usability can be accessed through: www.UCDtoolbox.com.

PART 2

organisation-centric design methods
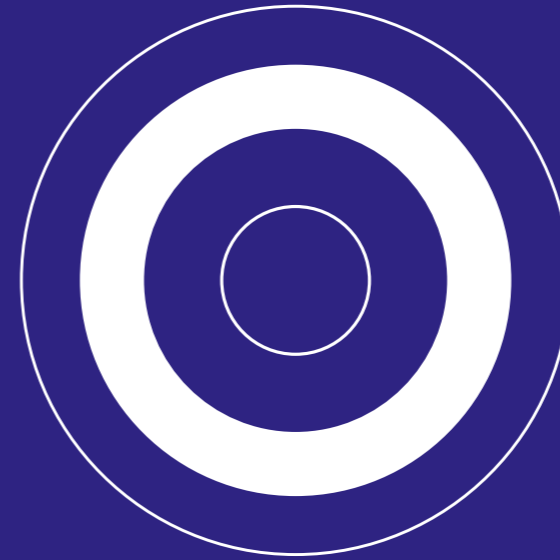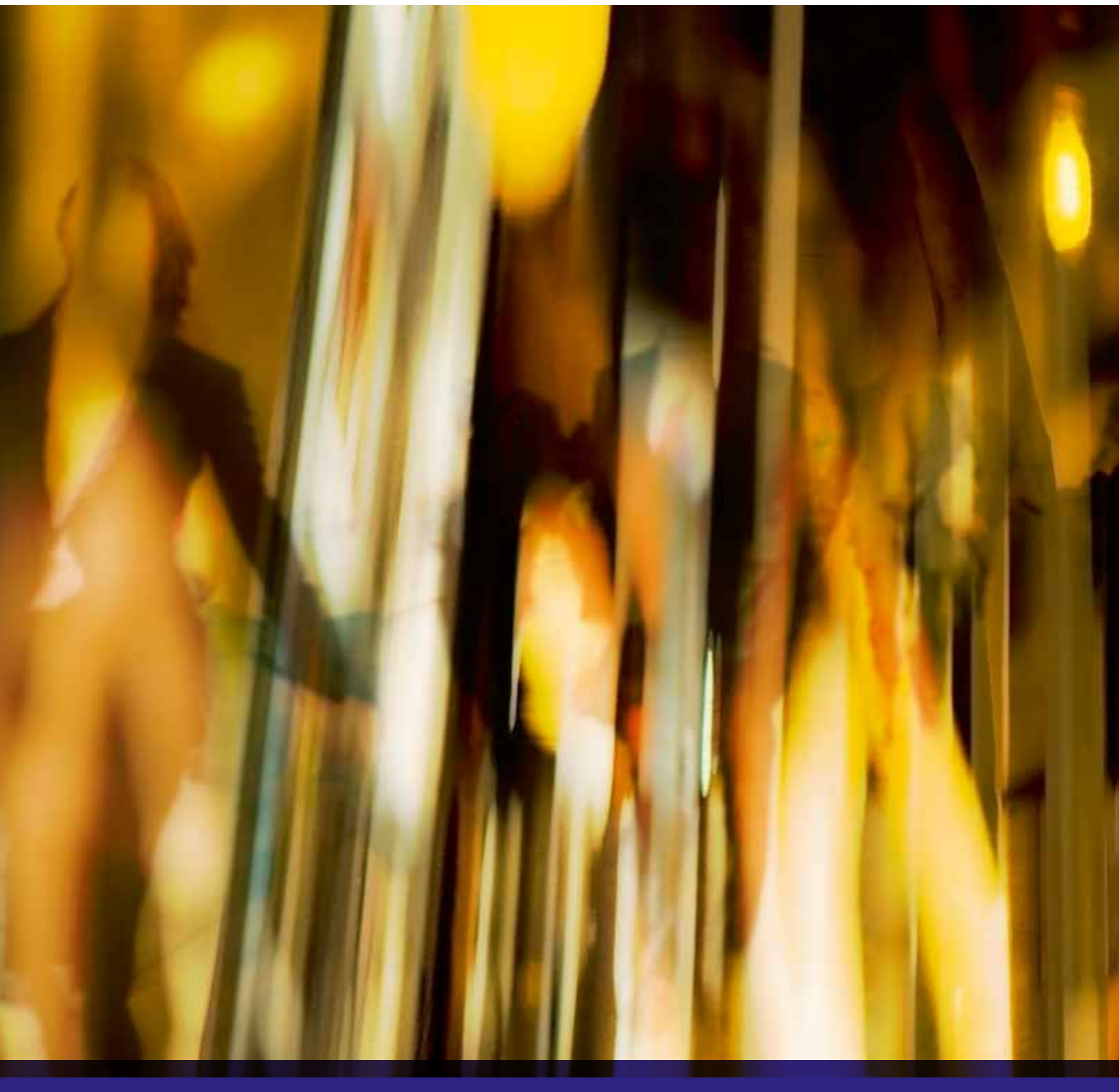
06.
Brand-driven innovation

Authors

Erik Roscam Abbing, Frido Smulders

Introduction

In the previous chapters of this book, we have seen that user-centredness plays a key role in driving design and innovation. This chapter continues to embed user-centredness in an organisational context. It's not only what a user wants that defines how an organisation should innovate, it's also what an organisation chooses to focus on (its vision), what it wants to achieve (its ambition), and what it is capable of achieving (its resources and capabilities) that defines the right course for innovation. In this chapter we propose that for organisations to be successful innovators, these factors be combined and that the brand forms the overarching concept that helps

combine user-centredness (outside in thinking) with organisation-centredness (inside out thinking).

In this framework, a brand can be a very effective driver for innovation. From experience gained in several projects with innovation consultancy Zilver, the brand is the only holistic framework that can be used to combine all the diverse company qualities and contextual attributes (both outside in and inside out) required for radical, meaningful and sustainable innovation.

While existing branding literature focuses on the brand as a construct that is effective in marketing existing products and services, this chapter sets out to add to that body of knowledge by framing the brand as a key driver for creating new products and services. This brings the notion of branding into the realm of innovation and product/service design, where it will play a new, but significant role.

This implies an understanding of branding that is close to the way it was originally intended, it implies an understanding of this brand as driver for innovative growth, and it implies the organisational ability to use the brand in strategy formulation and innovation planning. This chapter includes a case study that illustrates these phenomena.

Challenge

Both academics and practitioners agree that innovation is one of the driving forces of a healthy economy: not to change is to go backwards, growth is inevitable. Although the ethical debate on whether this growth is always sustainable is interesting, this chapter focuses on a different, but similar question: what sets this process of change in motion? What triggers companies to innovate? And, what gives direction to this change?

There are many so-called innovation 'drivers'. A new technology may trigger an R&D department to try to adopt it in new products. A market trend may trigger a market researcher to come up with an idea for a new service to lift on that trend. A competitor's booth at a trade fair may inspire a salesperson to try out a new approach to his/her sales pitch. Innovation can be sparked in many ways, and by many people.

If you analyse what makes you or your colleagues innovate, you notice two things: mostly the triggers come from outside your organisation, and in most cases you weren't actively scouting for that trigger: you bumped into it and reacted, thus innovation is often 'extrinsic' and 'reactive'. Compare this with the way most successful entrepreneurs innovate: they have a vision, an understanding, a hunch, or an ambition that they actively cherish, and they act on it. Their innovation activities are 'intrinsic' and 'proactive'.

The authors of this article and colleagues at Product Innovation Management, TU Delft, believe that a more entrepreneurial approach to innovation has many benefits, for example: reducing risk of failure, increasing time to market, increasing customer satisfaction, and increasing differentiation amongst competitors. One way of adopting a more intrinsic and proactive innovation style is to include the brand as driver for innovation. The brand can be an embodiment of the organisation's vision, ambition, and understanding of changes in the world and, as such, it is a perfect launch platform for positive organisational change and organic growth. Or more simply: you can only jump high if you have solid ground under your feet. In this chapter we discuss how to build a solid platform, and what is required for a successful lift-off.

Method

Theoretical foundations of the brand

We first break down a brand into its components by reviewing its origin and subsequent evolution into the current understanding of the brand construct. In fact we go back to the roots of the brand and from there on show what the brand's value is in business. We contend that all these subsequent values are in fact still delivered by the brand, be it only implicitly. These respective values then provide footholds to start using the brand, not only as a vehicle for marketing communication, but as a driver for innovation. For each of these values, we illustrate what it could mean for current business.

We start at the moment the word brand was used as verb: i.e. for branding livestock in order to indicate ownership. This sign of ownership is still valid for branded products until the moment of sales to another legal party. These days the brand as ownership implies that nobody else may use this brand on any product without it being authorised by the owner.

The value of recognition is the second value hidden in the brand. When product manufacturing was geographically separated from the actual sales, the brand helped to identify a particular entrepreneur or business as the source of the goods. This form of branding can be seen in the use of trademarks. In the near future, when companies are forced to take their products back after the use cycle, the brand as a source gets an additional

dimension: organisations will have the responsibility to take back and dismantle their own branded products.

Not much later, the brand started to represent the functional meaning of the branded product; to indicate its quality and reliability. These brands of products are perceived to embody known quality and reliability without being explicit. In order to achieve this functional value, companies must not only communicate these values, but also live up to them. This implies that they must be well organised and be in control of all their processes, including the quality and reliability of sub-assemblies from suppliers: consistent quality of the operational processes on the one hand and consistent quality of the development processes on the other. Thus, the functional value of the brand is strongly related to the

core competencies of the firm, the owner of the brand. Core competencies as such form an important source of inspiration for new business research and development.

More recently (1950s onward), the brand became endowed with more emotional meaning. Here the value of the brand is important for the user of the branded product in terms of the positive emotional influence the possession and use of the branded product had on its owner. The idea of product attachment (Mugge 2010) is very much related to these emotions. Owners like their products and because of the emotional bonding, they want to keep them for longer periods. But this emotional meaning can also relate to the vision or values of the organisation behind the brand.

This development led to the brand as an indicator for a certain lifestyle. In the 1960s and 1970s, in brand campaigns like those for Coca Cola or Volkswagen, the brand message became almost completely separated from the product attributes. Companies started to realise that the products they developed were mere enablers of lifestyles, and never goals in themselves: you can drink water when you're thirsty and drive any car to get from A to B. Only with Coca Cola do you demonstrate a happy social and active lifestyle, and only with Volkswagen do you show your clever 'European' sense of sophistication and modern living. For companies this necessitated an increase in the understanding of the societal and social role they and their innovations played.

In the 90s of the last century, this development evolved into a more negative manifestation of brand, namely as a façade that companies could hide behind. Under the guise of a 'just

do it' sporty lifestyle, Nike had soccer balls manufactured in India by children in primitive conditions. In her famous 2001 work 'No Logo', Naomi Klein holds this kind of branding responsible for much of the capitalist inequality in the world.

The result of this anti-globalist, anti-corporate, anti-brand movement could be called the age of transparency. Amplified by the rise of the internet, consumers have become better informed and more critical. This helps companies to realise that their brand is no longer a façade to hide behind, but that

it is in fact a lens that amplifies and projects what's going on inside a company to the world. A case in point is the recent strong criticism of Apple's poor manufacturing conditions in China. The Apple brand, like others, is worth so much, that damaging it is the greatest risk a company can take. Building a strong brand in this age implies building a healthy company that delivers what it promises through a culture of ethics and honest development work.

In summary, we see 7 stages of branding:
- Sign of ownership
- Sign of recognition
- Adding a layer of functional meaning
- Adding a layer of emotional meaning
- Adding the notion of lifestyle
- The brand as façade to hide behind
- Age of transparency

By combining these different connotations of brand, we arrive at the following definition: the brand captures how the organisation and its customers understand themselves and each other. It embodies that which is meaningful and relevant to the organisation, its customers and its stakeholders.

Thus, the brand has moved on from being the logo stamped on the product and its packaging, via the brand being that which is advertised and communicated, to the brand being a construct that holistically and contextually represents the organisational vision, culture, values and capabilities. Defined as such, the brand forms the entrepreneurial foundation for new business development.

Scoping our perspective on brand driven innovation

In this section we discuss why the brand is the most complete and useful driver for innovation. This description is based on a number of consulting projects for companies like Virgin Mobile, Philips, Heineken, Mexx, Ohra, Audi, Google, Essent, Ebay and Océ, as well as several graduation projects and educational projects conducted at the TU Delft faculty of Industrial Design Engineering.

Brand driven innovation is based on the understanding that, in order to innovate meaningfully and sustainably, organisations need a deeply rooted and shared vision. This vision helps them do what is required for successful innovation: take calculated risks, envision potential (market) futures, work across silos, and understand what constitutes value to the customer and to the company.

In literature, innovation is typically framed as an inevitable reaction to external change. Examples of external change are: changing market needs, changing legislation, the availability of new technology, changing user behaviour and changing competition. The danger of framing innovation in this way is that it is always reactive, and it is always extrinsically driven. This leads to situations where organisations experience innovation as a strain, something they are forced to do: a necessary reaction in which they are - by definition - always too late.

However, by looking at serial entrepreneurs, successful innovative start-ups and innovative brands like BMW, Google, ASML and Nestlé; innovation is in their DNA. For these companies, innovation is a pro-active process. They do not wait for something in the outside world to change in order to start innovating; they form their own ideas and find their own drivers for change, and innovate on that basis.

In the context of brand-driven innovation, an organisation should try to internalise external drivers and externalise internal drivers. This means looking at internal drivers for innovation from an external point of view (what value does this new technology generate for our users) and looking at external drivers for innovation from an internal point of view (what does this competitor's new move mean if we look at it from our point of view, with our values and beliefs). Brand driven innovation is the culmination of this holistic view on innovation. It frames the brand as the bundling of the various proactive drivers for change an organisation has at its disposal.

These drivers for change are found both within and outside of the company. Innovation is about value co-creation between company and customer. This value is contextual and depends on how well the organisation understands the customer, and how well the customer understands the organisation and its propositions. Therefore, in order to innovate and grow, it is essential to make sense of yourself and the outside world, and how the two relate. This sense making is a process of filtering outside in and inside out information flows to arrive at drivers for change that truly matter for both the organisation and their targeted customer base.

In brand driven innovation, the brand becomes this filter. It is used in a holistic sense as driver, initiator and inspirator for innovation activities because it has this sense-making ability. The reason for this is that the brand integrates the various internal qualities like entrepreneurial vision, organisational culture, core competencies, resources, core capabilities, core values, with external qualities like understanding user needs and motivations, understanding trends, market differentiation, partnerships, distribution channels, and technological changes.

In *figure 1,* we introduce the sense-making lens as a filter and instrument for driving change processes:

The lens:
- filters those internal attributes and events that are relevant for the outside world, before they are projected outward.
- filters those external attributes and events that are relevant for the inside world, before they are allowed inside.

Building your brand lens

This section describes the tools required to build a lens, using both an inside-out and an outside-in perspective. We note pitfalls, barriers and blockers that might endanger the process of creating a brand lens. The lens is built up out of the internal and external brand elements as described earlier. Here we discuss how the lens can be developed in a strategically sound way.

One function of the lens is to make sense of the outside world. You cannot please every customer, you cannot adopt every new technology, and not every new trend is relevant for you. Organisations need to filter out the information that is relevant

Brand as a sense making lens

internal drivers for change
- entrepeneurial vision
- core values
- beliefs
- organisational culture
- core capabilities/competencies
- resources

external drivers for change
- understanding user needs & motivations
- understanding trends
- market differentiation
- partnerships
- distributional channels
- technological changes
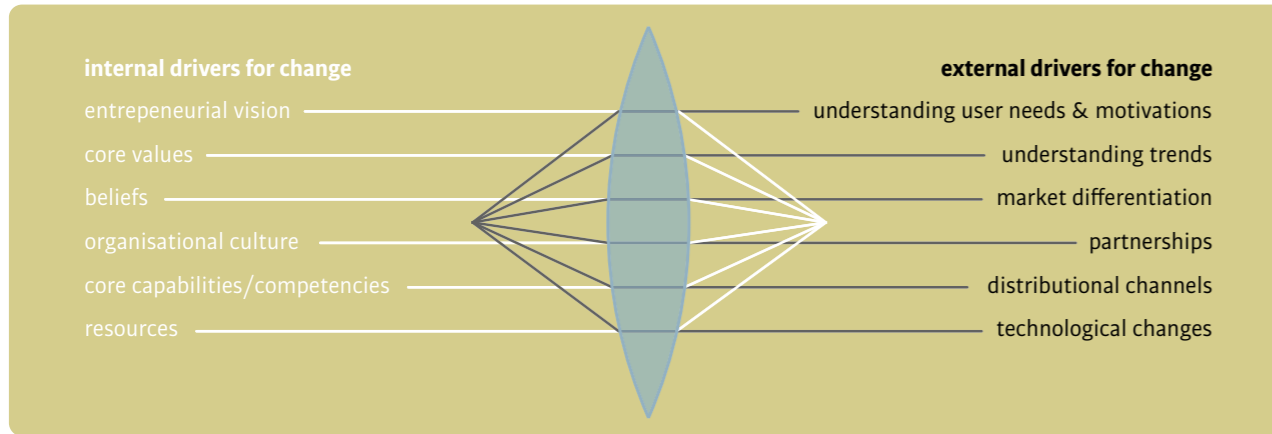
FIGURE 1 *internal and external drivers for change that when bundled form the brand lens*

for them. This requires focus, vision, authenticity and an accurate self-image. The goal is to filter out and focus only on that which is relevant for your business, without remaining stuck in the here and now.

The other function of the lens is to make sense of the inside world. Not everything you do, know, can or want, is relevant for your customer. Here again, organisations need to filter out what is relevant for them. This requires customer empathy and perspective taking (Boland & Tenkasi, 1995). The goal is

to filter out and focus only on that which is relevant for customer and other external stakeholders.

The discussion above shows that the concept of 'the brand as lens' has special qualities in brand driven innovation. In order to create our own brand lens, we need to look closely at these qualities by identifying the function the brand performs in brand-driven innovation, and what this teaches us about the qualities it should have.

If a brand drives innovation, it means that the brand sets a process of change in motion, with the intention of improving a competitive situation and/or creating new value. This implies two things:

1 the brand sets a process of change in motion;
2 the brand inspires this change to happen in a certain direction: something concrete is improved.

In other words, the brand has a process role (1) and it has a content role (2). The process role triggers and inspires change, while the content role gives direction to that change. An example of this is a brand like Innocent Smoothies: the brand inspires constant devotion to the development of new drinks (process), but it also gives direction to the kind of drinks these should be (content), namely healthy and environmentally friendly, and including an element of fun (Roscam Abbing 2010).

In terms of process, the brand has to mobilise people from different departments within an organisation to act on the brand vision, to embark on innovation processes that are supported by a shared understanding and fuelled by a shared ambition. Our research has shown that this kind of process has to be open and inclusive in nature, where the brand is discovered, uncovered, and made explicit in a co-created, bottom up manner. This is different from the traditional way of centralised, top down brand building, and should not be confused with the notion of 'internal branding' (Ind, 2009) which is generally understood to refer to the top down internal 'distribution' of a centrally constructed brand.

In terms of content, the brand has to imbue this process

with relevance and meaning. It must translate the brand's understanding of the inside and outside world into new product and service propositions that bring real value to company and customer. This means that traditional notions of brand content no longer suffice: these are mostly focussed on brand communication and contain notions like 'brand values', 'reasons to believe', 'discriminator' and 'brand target' (source: brand key, Unilever). What is needed in brand driven innovation is content that captures a deep understanding of an organisation's internal qualities and customer motivations, needs and behaviour. These qualities can be found in deep customer insights and an equally deep understanding of an organisation's culture, vision and goals.

A brand that is built on the basis of this process, and that captures this kind of content will form a solid basis for innovation because it is inspiring and challenging, it is understandable and usable, it is relevant and meaningful, and it is authentic and original.

How to use your brand lens:
The brand driven innovation process

Learning to use the holistic perspective of your brand is a situational learning process. In this section we describe the ingredients required to create your own user manual. The user manual consists of the following 4 stages:

1 Co-create understanding of your brand lens.
2 Define your innovation scope and focus.
3 Design new propositions and supporting systems.
4 Implement propositions and adapt the organisation.
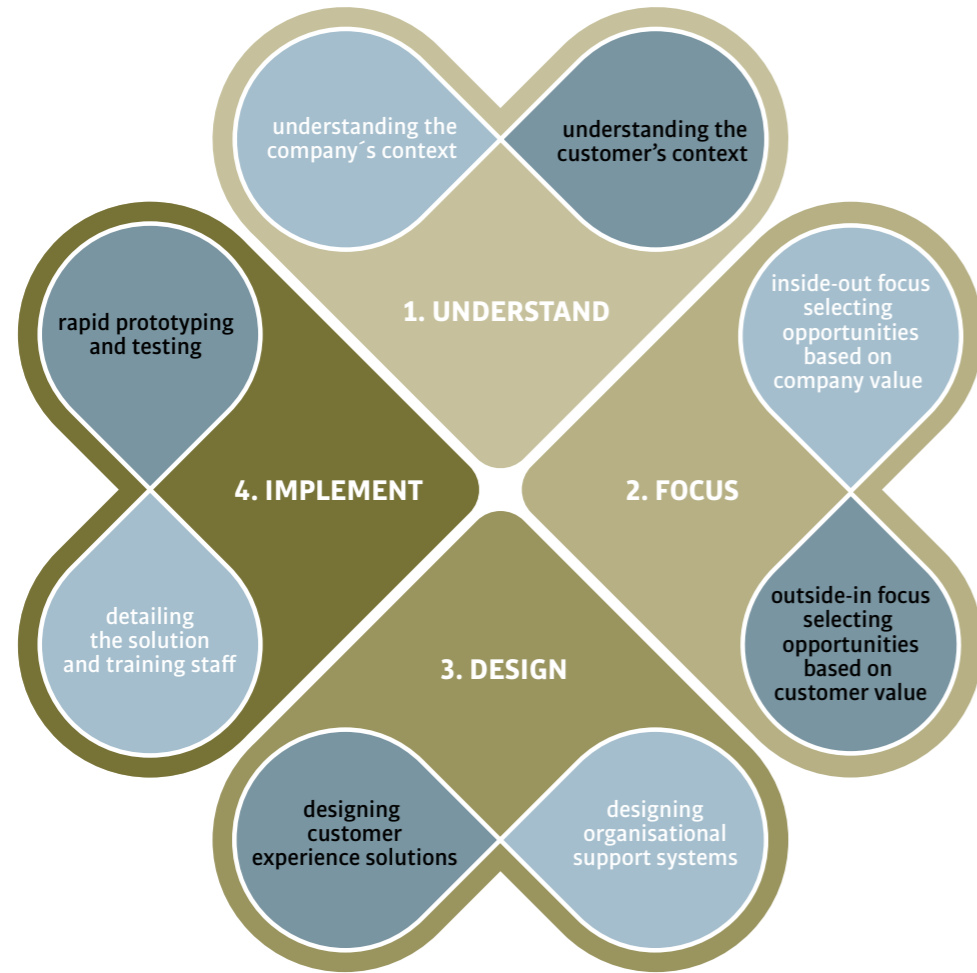
FIGURE 2 *the Brand Driven Innovation process. The 8-shaped loops are iterations between internal and external stages*
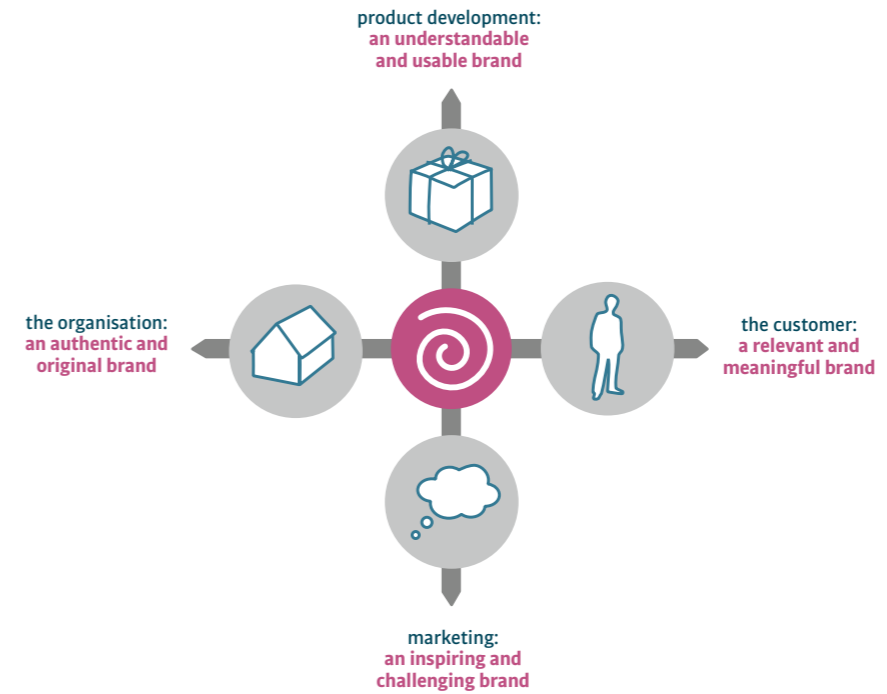
FIGURE 3 *the qualities a brand needs to have for different stakeholders in order for it to function in Brand Driven Innovation*

Stage 1: Understanding contexts

The brand forms the relationship between the organisation and its customer, so we need to start with understanding that relationship. Relationships are based on a shared understanding of value, and a shared vision of how that value can be enjoyed or benefited from. Relationships thrive if the shared understanding grows, and if the opportunities to benefit from that value develop over time. Relationships in which the shared understanding diminishes, or where the

opportunities to benefit from this value decline, grow stale over time. Two rules can be derived from this:

First, organisations have to demonstrate a clear understanding of the people they aspire to do business with and what these people essentially find of value. They also have to possess a vision of what role their organisation can play in delivering that value to their intended users. Second, organisations have to capture this value and turn it into actual propositions (products, services or experiences).

Rule 1 implies a pledge by the organisation to its user group which might be expressed in the following way, '*I understand what you find valuable, I understand my role in delivering that value to you, and I will do my best to perform that role*'. In brand language, this is called 'the brand promise'. Rule 2 implies that the organisation can put this pledge into action; that it can create products, services and experiences of which the user says, '*you have succeeded in delivering what I find valuable*'. In brand language, this is called 'the fulfilment of the brand promise'.

The understanding stage in Brand Driven Innovation is about building a brand promise that encompasses the elements of *figure* 1, embodies the qualities of *figure* 3, and forms the foundation for the stages in *figure* 2. It ends with a solid and shared foundation of norms, values, beliefs and vision, capturing that which is relevant for the organisation, its customers and its stakeholders.

Stage 2: Focus by selecting opportunities
We noted that innovation should not be reactive; it should be proactive, scouting for opportunities for creating new value. In practice, this means that a certain 'willingness to change' must be part of an organisation's culture. This 'willingness to change' requires the shared foundation of norms, values, beliefs and vision that was established in the 'understand' stage. If this is absent, organisations will be unfocussed and confused about their future and proactive innovation will be rare. A firm base is needed for an innovative jump. Sharing and embracing the results from the 'understand' stage, allows an organisation to move on and make choices.

In the focus stage of Brand Driven Innovation, the insights from the understand stage are used to devise an innovation roadmap that pinpoints those domains of innovation that make sense, looking through both sides of the brand lens. In other words, the innovation domains must fit the company's vision, values, beliefs, culture, capabilities and resources. But they must also fit user needs and motivations, trends, market developments, partner needs, channels and available (technological) competences (see *figure 1*).

Focussed innovation means that innovation is not a random search for opportunities that could fuel growth, but a process to create these opportunities using the insights from the 'understand' stage as a guide. This requires a visionary and aspirational mind-set on the part of the innovators. In fact, it may require innovation staff who are less left-brain oriented, technology driven and opportunistic, and more right-brain oriented, people-driven and creative. As Roger Martin so aptly points out in '*The opposable mind*' (2007), this is a new, but upcoming and essential set of qualities in innovation leaders.

Stage 3: Designing the new
Once the innovation focus has been set, the time has come to design solutions that form the actual concrete steps on the roadmap. This entails the design of solutions that fulfil the brand's promise by creating value for users and the company. Again, this means that these solutions must be assessed through both sides of the lens, as they must bring the relationship between the external and the internal world to life. To summarise, the designed solutions must be authentic for the organisation and relevant for the customer.

In order for innovation to meet the expectations of users that were set by the brand promise, it has to break free from the notion that innovation is limited to the domain of products. As Pine and Gilmour point out in '*The experience economy*' (1999), we live in an age where a great deal of economic value is created by services and experiences. Even when products still form the core business of an organisation (e.g. Volkswagen), these products cannot be seen independently from the services and experiences that surround them (i.e. for Volkswagen; dealerships, maintenance, financial services, parking and car-sharing services, and AutoStadt in Wolfsburg).

Also in this stage, organisations should not forget to design the internal support systems that are required to bring the designed products and services to market. These support systems can be delivered by IT (e.g. data warehouses or web applications), human resources (training and capability development), contact centre (call, web or chat support) etc. In designing internal support systems, it is vital to align all stakeholders to deliver the newly designed products or services. This alignment benefits enormously from the work completed during the understand and focus stages.

Stage 4: Implementing the new
In Brand Driven Innovation, as in other innovation approaches, execution is key. Most organisations have plenty of ideas. What is usually missing is the framework to choose the right ideas and the methodology and stamina to bring them to market. The implementation stage of Brand Driven Innovation is focussed on making sure that good solutions reach the market quickly, and on ensuring that staff are ready to deliver what

was intended. Obviously, this is not where it ends. Because the innovation process has been structured and focussed, the results can be assessed critically: have we reached our goals? is the solution successful in the market from a feasibility, viability and desirability point of view (Brown 2009)? But most of all, is it successful from a brand fit point of view? Does it fulfil the brand promise, making the solution unique to the organisation and highly relevant to the customer?

Implementation of products that are part of integrated experiences or product service systems, like many contemporary products, require touch point orchestration (Roscam Abbing 2010). This means that the different contact points the customer meets when using the product service system over time (the customer journey) should be aligned in order to provide a consistent and engaging experience. When renting a Volkswagen for example, the website, the rental location, the desk personnel, the pick-up staff, the forms and the car itself are the touch points that should all contribute to a branded experience that breathes the Volkswagen brand.

This kind of touch point orchestration can only be based on a brand that has the qualities we described earlier, both in terms of process and in terms of content.

Insure*, a Dutch insurance company

Insure is a Dutch insurance company. Insure is a direct seller, which means they do not operate via insurance intermediaries. Insure's sales channels include corporate collectives (TU Delft for example), the Insure site, comparison sites, and their contact centre. Over its 50 year history, Insure has evolved as a no-nonsense insurer that focuses on quick and effective service.

In 2012, Insure faced increasing price pressure, new legislation and the growth of online sales channels. Insure's customer experience and brand manager felt that a lack of insights in the customer experience outside of the main touch points and contact moments withheld the company from improving the customer experience and developing relevant services.

In this context, Insure was interested in brand driven service innovation, "how can we enhance the entire insurance customer journey with relevantly differentiated services, and provide customer experiences that meet user needs and bring our brand proposition to life?" Insure asked Zilver Innovation, a boutique consultancy from Rotterdam that specialises in Brand Driven Innovation and was founded by one of the authors of this chapter, to help them find the

for reasons of confidentiality a fictitious name was chosen for the company in the case study.

answer. In a 6 month project, they conducted qualitative customer research, stakeholder analysis, and an audit of existing customer intelligence data. Based on the insights that emerged from this work, a customer journey map of the entire customer insurance experience was developed, including the rationale to choose the best focus areas for improvements. These were those areas that needed improvements most, held the most room to bring the Insure brand to life, and showed the highest business potential.

A brand and insight based set of design principles helped internal teams develop new services and customer experience improvements for these focus areas. The four stage process depicted in *figure 2* was followed and is described below.

Understanding how users experience insurances: studying the 7daysinmylife.com user diaries

Stage 1: Understand

Methodology
First, to get a grip on the issues and topics that are at play in the organisation, several key project stakeholders were interviewed. At the same time, Zilver made an audit of relevant presentations and documents that circulated through the organisation pertaining to customer experience, brand, customer satisfaction and service innovation. This together formed the internal loop of stage 1.
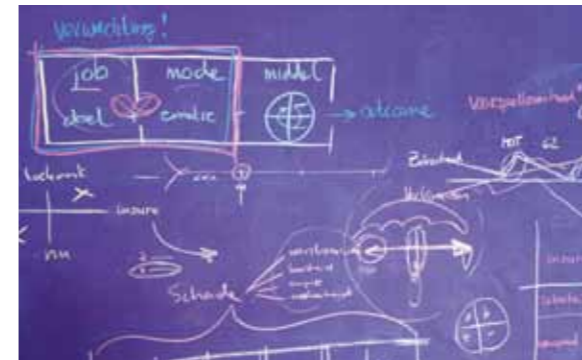
In the second, external loop we applied deep qualitative research to acquire insights into the context of insurances is the lives of customers. The consultants chose to use 'context mapping' as their research approach (Sleeswijk Visser 2009)

Getting a grip on emotional drivers in the customer journey: how do experiences relate to expectations?

and 7daysinmylife.com as sensitizing tool. 7daysinmylife. com enabled insurance customers to keep a diary for a week, based on open questions that helped them reflect on and express their own feelings with regards to insurance, security, risk, and the role of insurances in their daily lives. The questions were developed by the research team to gather deep customer understanding of the customer journey and its various emotions and motivations, as well as to assess the meaning of Insure's brand values in the customer's daily life.

After having completed their diaries, the team visited customers at their homes to interview them, using the diary to open the conversation. The team also used these home visits to gather as much photo and video footage as possible

Indicating the difference in customer satisfaction in different parts of the journey

and to get a deeper understanding of the customers' emotions and motivations.

Result

The first loop results provided a clear understanding of the organisation and its key issues. These gave guidance to the customer research in the second loop. The 7daysinmylife diaries are richly written and illustrated diaries that contain large quantities of rich customer data. The home visits offered relevant and inspiring audio and video material that helped to bring the organisation even closer to the customer. These exercises polished the brand lens.

Stage 2: Focus

Methodology

In order to become completely immersed in the research data, the diaries, photos and interview transcripts of each participant were printed and hung up on the walls of a workshop space. In addition, the research team listened and/or viewed all the audio and video material to capture the most important or interesting quotes. Discussions on what to capture and what not were part of the process: they sharpened the focus. Zilver then organised a number of team immersion and analysis sessions: in these sessions various client stakeholders jointly went through the data and mapped their findings through exercises such as clustering, connecting, enriching and visualising data from the study. This effort led to a deep understanding of Insure's customers and how to serve them

better, culminating in 4 focus themes that form the core of what Insure stands for. These themes can be considered to be the brand focus, seen from the customer's side of the lens.

We then examined (using the results from the insight mapping from 7daysinmylife) what possible steps a customer would go through to acquire and use an insurance product (the customer journey). All possible steps were mapped consecutively and each stage of the journey was enriched with insights, issues, themes and ideas for improvements. In addition to this more qualitative approach, Zilver also used the quantitative data that Insure possessed. Working closely with Insure's business intelligence team, a metrics dashboard was built that indicated which stages of the customer journey required the most improvements, and which stages held the most value.

Result

Analysing, clustering and interpreting customer data through the brand's lens led to insight themes (the brand focus) and (design) principles which formed a basis for the development of new customer-oriented brand based products and services. These were captured in the form of a rich visual overview of possible interactions and touch points between customer and organisation, a customer journey map. Each visual overview is however only a snapshot. Customer journey mapping is a way of thinking about customer relationships that can involve the relevant departments within an organisation when working together on continuous improvements.
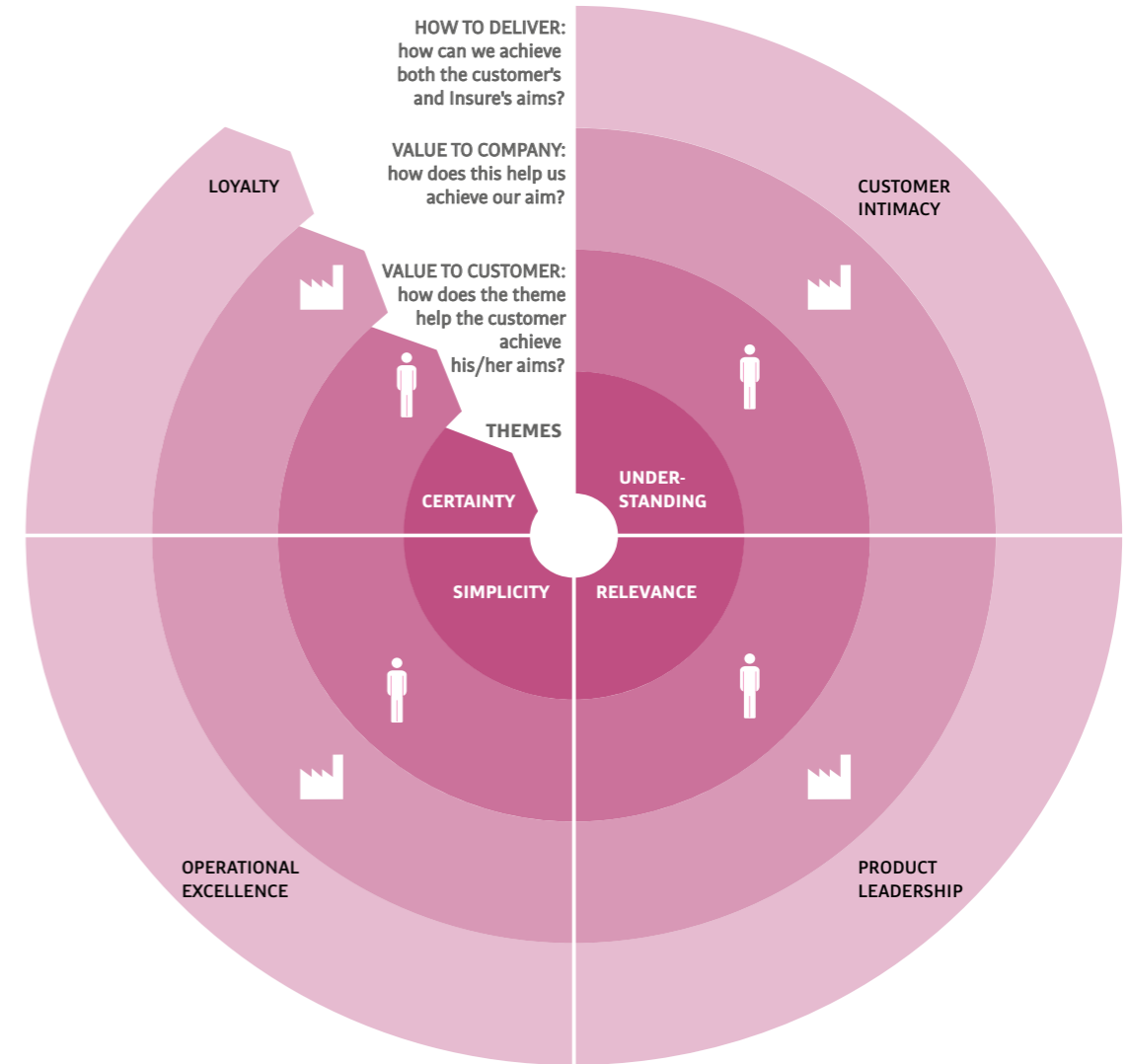

FIGURE 7 *value for the user and value for the company in different stages of the customer journey*

Stage 3: Design

Methodology
In this stage, a so-called customer journey lab was set up. This was an open space in the Insure office in which all data, insights, themes, design principles and the customer journey maps were displayed. Everyone in the organisation was welcome to drop by and be inspired by the results of the understand and focus stages. In addition, various departments - including marketing, retention, webcare, branding and customer intelligence – were led through the data, insights and customer journey and invited to share their own insights, reactions and ideas. These sessions formed the basis for commitment to the projects results.

Generating ideas is an on-going process and, throughout the entire project, potentially great ideas were put forward. In addition, idea generation workshops were organised with staff from a number of departments to generate and build on ideas from the richness of various perspectives. Importantly, the consultants kept to the background in these ideation sessions, offering Insure staff the tools and methods to apply their expertise to the research data and to turn insights into solutions. For example, a concept development framework was used to turn ideas into concepts that were viable, feasible, desirable and connected to the brand. This framework ensured that the ideas generated were in line with the focus themes and specific areas of the customer journey. An ideas competition ('the voice of INSURE') where different teams competed for a prize was another way of accelerating the ideation process and to get commitment from as many different internal stakeholders as possible. The prize was awarded by the management team and consisted of time and budget to take the winning idea to the next level of execution: a business case and a prototype.

Result
The strong visual and inspirational character of the research material and the resulting themes, principles and customer journey stimulated and challenged employees from different departments within the organisation to actively develop improvements and new services. This facilitated the process of spreading the customer journey insights and brand driven innovation approach within the organisation. Moreover, the discussions with the departments led the core team to new insights and a deepening of the way the brand and the customer insights were brought to life in the customer journey. This has led to new service concepts and customer experience improvements that are brand driven, meet the needs of the customer (desirability), that offer a solution for the right focus areas (viability), that have support within the organisation, and can be executed (feasibility).

Stage 4: Implement

Methodology
To effectively implement concepts, support, creativity and realism are required. At this stage it is therefore important to work with interdisciplinary teams to join forces when rolling

The customer journey lab at Insure's headquarters

Studying service design principles

out a concept in the organisation. In addition, management involvement is essential to get the implementation of new concepts on the agenda and to link new Key Performance Indicators (KPIs) to the new initiatives. An effective way of accelerating the implementation of new or improved services is rapid prototyping: to try ideas out in a 'quick and dirty' fashion with a select group of customers and to use their feedback to make quick rounds of improvements. Obviously, this requires some courage and creativity, but the effect on time to market and first mover advantage is considerable.

During the implementation of new services and service improvements, it is important to design the right way of measuring success. This requires a constant audit of efforts against original goals. The consultants and Insure used the design principles in combination with a specifically designed metrics dashboard to help Insure stay on brand track, keep their eye on the customer, and align the business case.

Result
Due to the efforts of the interdisciplinary teams and support from the management team, the project resulted in a number of business cases for new services. At the time of writing, the most promising concepts have been prototyped, tested, and fine-tuned by experts within the organisation. Slowly, Zilver has taken a step back, leaving responsibility to the organisation to implement what has been learned and developed. This presents a challenge that is inherent to the process of Brand Driven Innovation: outside experts can help an organisation polish their lens and take a well-focussed look

Service design template

Customer journey info graphic depicting all the synthesised results of the desk research, interviews and workshops

at themselves and their customers. They can help build ideas and concepts and they can even provide the frameworks for implementation, but they cannot do the work. They have to step back and hand over responsibility to the organisation. That is the moment at which deeply embedded understanding and actionable guidelines prove their value. They enable the organisation to keep on going without outside help. But one major challenge always remains: organisations tend to be so busy with short-term issues that it is hard for them to spend concentrated time on long-term innovation. However, the approach to Insure's challenges described in this chapter has given them the insights, the tools, the sense of urgency and a view of what might be possible in the future, enabling them to form a solid foundation for brand driven innovation.

Benefits and limitations

Brand Driven Innovation is an effective innovation strategy, however it does have limitations (Roscam Abbing 2010):

- It requires a brand that is defined and understood in such a way that is suitable as a driver for innovation;
- It requires a market situation that provides room for this particular type of innovation. (Roscam Abbing and van Gessel, 2008).

FIGURE 16 *a matrix of innovation strategies based on innovation potential and brand usability*

The first of these is what we refer to as 'brand usability'. Brand usability is the extent to which the brand is understood and appreciated by the marketing and innovation stakeholders like, designers, developers, engineers, R&D staff, management; and the extent to which it has sufficient depth, breadth and authenticity to inspire meaningful innovation. The second is the organisation's innovation potential: the extent to which an organisation has room in its competitive field for the proactive creation of meaningful new value. *Figure* 16 combines these two axes in a matrix of innovation strategies.

If brand usability is low and innovation potential high, i.e. a recently established (fast growing) company, an organisation should work on its brand before using it as driver for innovation. It should look for opportunities for innovation based on other drivers like market potential, technology, core competences, in combination with user trends and needs. It would be smart for this type of organisation to use these innovations to build their brand and to increase brand usability. This process could be called 'innovation driven branding': the innovation is a foundation to build the brand on, instead of the other way round.

If innovation potential and brand usability are both low, an organisation will not have the luxury of being able to use its brand as driver for innovation, nor will there be enough 'free space' to innovate. The company will need to grasp any opportunity for innovation it identifies, regardless of what drives it, hence the term 'opportunity driven innovation'.

Low innovation potential and high brand usability might

offer opportunities to make strategic moves to increase the potential for innovation, by diversifying into new product groups or by linking the brand to a different product category. This strategy requires careful consideration of the possible options because of their long-term impact.

If innovation potential and brand usability both are high, brand driven innovation is the innovation strategy of choice. However, be aware of what other innovation strategies have to offer and perhaps combine your learning with the benefits of brand driven innovation. A great deal can be learned from the (online) debate on user driven innovation (UDI) (see e.g., Prahalad, 2004, 2008 and Von Hippel, 2005). In UDI, the wishes and needs of the user are central, and the organisation needs to adapt to the user, not the other way around. Where brand driven innovation looks at the relationship between the organisation and the user (=the brand) as driver for innovation, in some situations this relentless focus on the user is needed. Another school of innovation talks about Design Driven Innovation (e.g., Roberto Verganti's 2009 book of the same title) where innovations are not a reaction to outside changes: they create opportunities and new markets through design and entrepreneurship. This strategy is very close to brand driven innovation, but it greatly depends on the presence of a visionary design leadership. In some cases, design driven innovation can be an inspiring strategy to follow. And, sometimes 'good old technology' can still lead the way: if you have a great new invention or technology that no-one else has and that your users will find valuable; by all means, leverage it!

Key insights

- The brand is usually framed as a vehicle to market existing products and services. This chapter presents the case that the brand is a solid driver for creating new products and services.
- When imbuing the brand with the various meanings it has had over time, it becomes an overarching construct that combines outside-in thinking with inside out thinking.
- Meaningful and effective innovation combines user centeredness (outside-in view) with organisational vision, ambition and organisational resources and capabilities (inside-out view).
- In 'traditional' branding, marketing communication creates a brand promise. In brand driven innovation, innovation and design fulfil this brand promise.
- Brands that are suitable as drivers for innovation satisfy certain characteristics regarding their content, form and process.
- Innovation can be triggered by external and internal drivers. External drivers have to be internalised, while internal drivers have to be assessed from an external point of view.
- Brands can be seen as sense making lenses through which external influences become relevant for the organisation and internal influences become relevant for the customer.
- Brands are boundary objects between an organisation and its customers, but also between its marketing and product development departments.
- The brand driven innovation process consists of four

stages: understand, focus, design, implement. These stages are cyclical and iterative and each consists of an internally and an externally oriented part.

How to continue?

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07.
Mirroring: the boundary spanning practice of designers

Authors
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Introduction

The development of products and/or services often requires large, multidisciplinary teams in which specialists provide expertise, simultaneously. These specialists inside New Product Development (NPD) teams often find it hard to understand each other, as they use different jargon, have different views on the subject in question and deploy distinctive tools. This results into to boundary forming within the team.

One of the specialists is a designer, who focuses on the usability and experience of use of products. In our studies, we found that designers have a boundary spanning capability in teams and

organisations. Designers continually translate technical choices to the realm of product and/or user by means of expressive representations of the product. These representations are communicated in a language understood by all and this enables the other specialists to reflect on their choices and those of others, i.e. cross-disciplinary. We have named this capability 'mirroring', because the process of translation of technical choices to consequences for product/user is like placing a mirror in front of the specialists, enabling them to reflect. Yet designers are not explicitly assigned the role of boundary spanners, nor are aware of this capability. It is their practice that enables them to span boundaries.

We describe two case studies where explicit mirroring process are shown to span complex boundaries, not only between specialists but also between organisations. Awareness of the mirroring process as well as the (visual) means deployed enhances boundary spanning. In this way, mirroring is a fruitful method for enhancing innovation and collaboration in organisations and multi-disciplinary teams.

Challenge

Products like printers, cars, medical equipment, or ICT equipment are extremely complex and are not the fruit of a 'lone innovator'. These products require a wide range of specialised knowledge and know-how that typically is distributed over many actors. One of the actors in NPD teams is a designer, a role that we focus on. In line with other chapters in this book, we define design as devising products (tangible and/or intangible) in which human needs, likings, tasks and particularities are placed centrally. Thus, a designer is a role inside an NPD team that focuses on the product's usability, experience of use, meaning attribution, and elicited emotions of users. In order to develop a unified and coherent product, in addition to designers, a range of specialists need to work together and integrate their knowledge: engineers, planners, physicists, and marketers. Yet, this collaboration is not simple.

Complexity is mostly handled by disaggregating the product into separate modules and parts. Subsequently tasks are assigned to specialists, enabling companies to make full use of their skills. A consequence of this division of work is that it becomes difficult to maintain an overall view: who ensures that an integrated product is created in which all parts fit seamlessly without redundancy? Also, problems are seldom confined to one part of the product and are seldom mono-disciplinary. While developing the product, challenges will emerge that require the combined expertise of several specialists. For example, the cooling of a product requires electrical engineers to decide on fans, mechanical engineers to position these fans, software engineers to provide the
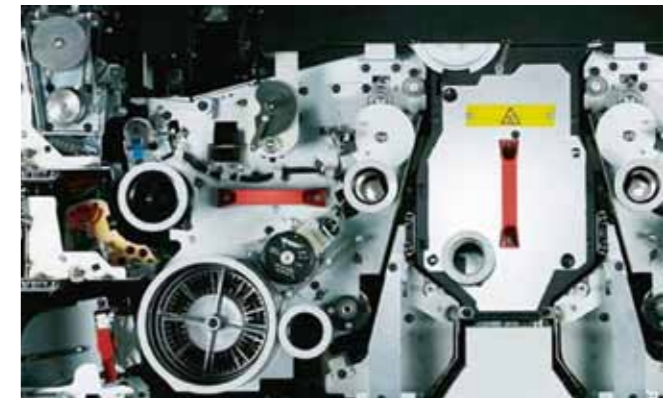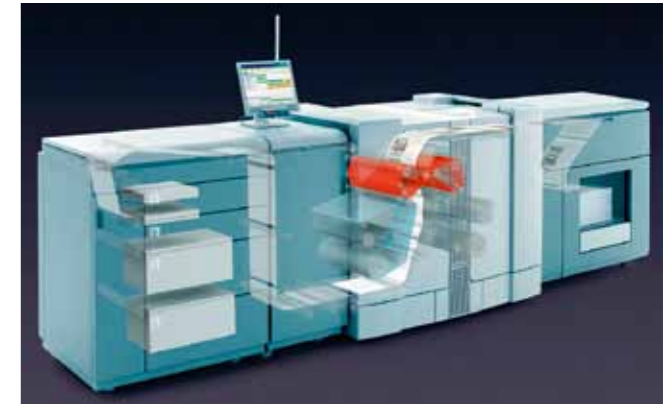
FIGURE 1 *the complex interior of a production printer: an integrated result of the work of a team of specialists*

software, and designers to provide slots in the covers for the supply of air. But who needs to act if parts still run to hot, contrary to all expectations?
Thus, many problems in multidisciplinary NPD can be named 'in between' problems, as these problems reside in or even

stem from the combination of choices of specialists together. Resolving these problems requires specialists to 'think collectively' as a team, which is called 'team cognition' (Salas & Fiore 2004; Stompff 2012).

Boundaries

The word 'team' suggests a group that know each other and work together well. However, in multi-disciplinary NPD teams, its members may find it hard to understand each other. For example, technology developers may find it hard to understand the problems of production technicians, and vice versa. Or marketers may find it hard to understand what engineers are worried about, and vice versa. Team members can experience boundaries at any point in time: imaginary, felt demarcations between specialists, departments or functional units. Across these boundaries, team members find it hard to make sense of each other's messages, situations and challenges.

To explain the nature of a boundary, we have adopted a practice-perspective. A 'practice' is a sociological notion that broadly refers to what people do, including their activities, the tools they use (e.g., CAD or spreadsheets), the vocabulary they have, how work is organised, and even social identity. People that share the same practice are part of communities of practice (Lave & Wenger 1991). Within practices, knowledge is easily shared: one software engineer can easily grasp and evaluate the work of another software engineer. The large community of Linux developers is a good example, where complex applications are created by people who do not know each other.

However, sharing and spreading knowledge across practices is difficult. The specialists may deploy entirely different vocabulary and tools, and team members no longer understand each other. For example, for mechanical engineers a technical drawing is self-explanatory, but for marketers it is just a large drawing with many lines in distinctive thicknesses. Thus, knowledge sticks to particular practices (Carlile 2002) and practices inevitably result in troublesome boundaries. But there are more causes of boundaries. First, a boundary may be caused by sub-teams at different locations. In this case, team members cannot see each other and are not aware of what the others are up to, even if they share the same practice. Sometimes these sub-teams are dispersed across the globe. The team members are confronted with time-zones, different first languages and diverse cultures. Second, organisational boundaries may exist: parts of the product are developed by suppliers or by strategic partners. Different corporate cultures and ICT-systems do not favour smooth collaboration, let alone trust issues. These organisational boundaries may cause considerable problems as demonstrated by the case of the Boeing Dreamliner. Third, there may be a transitional boundary to the downstream operational processes. The ramp-up of the manufacturing activities needs to be coordinated in parallel with the final NPD-activities. The aims and scope of interest vary considerably between development and manufacturing.

Global NPD has many benefits and is widely practiced. For example, vulnerable strategic alliances are started, so that technology and ideas are bought to access and integrate specialised knowledge; this is often called 'open innovation' (Chesbrough 2003). But in these alliances, boundaries are

omnipresent. It is hard to name the group of developers a 'team', as the members entirely lack a shared context, deploy disparate methods and tools, and speak different first languages. Effectively, the team members are a group of strangers. Consequently, many mistakes occur: the boundaries cripple efficient and effective product development. Put differently, spanning boundaries is an important challenge for managing product development.

Method

As a result of our research activities on designers embedded in NPD teams, we discovered that designers have a boundary spanning capability. Put more precisely: their practice of designing is a boundary spanning practice; a capability they are unaware off. We have called this boundary spanning 'mirroring'. In order to explain the concept, we first explain how, in general, boundaries are spanned: by means of a joint practice.

Joint practice

Regardless of the boundaries, specialists inside an NPD team need to align and coordinate their activities into a unified whole: the product. Yet nobody can truly oversee every aspect. Thus, each specialist must know or find out how their work is related to the work of others. People establish and learn about these relations by means of their joint practice. As discussed before, a practice is what people do. Thus, a joint practice is what team members do together. For example, building and

testing an integrated prototype with all disciplines involved. While team members integrate their work and test it by means of the prototype, they learn swiftly what 'works' and what does not. For example, although a mechanical engineer may not understand software code, he has no problem in understanding a malfunctioning prototype and sensing there is something wrong with a software release that was just installed before. The prototype is part of all practices, and thus part of the joint practice.

The word 'joint' has been chosen deliberately, as opposed to 'common' or 'shared'. The prototype is not a pre-existing object. Rather, it is an object resulting from joining all the separate pieces of work of team members into a whole. This joining of the pieces is done by team members themselves, whereby each team member dynamically adapts his/her activities to those of others. Even though each team member contributes by means of their specific knowledge, they take the aims of others into account. Stated differently: the team members fit their activities mindfully into the whole: carefully, critically, consistently, purposefully and attentively. The activities of team members interlock, and a joint practice is constructed.

Joint practice concerns things and events that can be observed by all, and several ingredients can be named that constitute effective collaboration. The most well-known is shared vocabulary. In teams it is not hard to find specific words that are meaningful to all involved, but that are meaningless for others. For example, team members refer to a 'toothbrush problem', a problem that has nothing to do with brushing teeth. Yet, inside the team everybody knows what it refers to, enabling discussions on it.

Another ingredient are boundary objects (Star & Griesemer 1989). These are objects that are meaningful for different specialists and thus span boundaries, such as an integrated prototype. That does not imply that this integrated prototype has the same meaning for all involved. Each specialist has distinctive activities in relation to the prototype and is concerned about specific aspects. The prototype is 'plastic' enough to adapt for use and interpretation in distinctive practices, yet robust enough to maintain a common identity across practices. A third ingredient are boundary events. Some events are witnessed and experienced by many team members. If a prototype suddenly breaks down, it is an extremely meaningful event for all involved - enabling boundaries to be spanned. Here again, the event does not necessarily hold the same meaning for all involved. The last ingredient discussed here are boundary spanning roles. These are assigned liaison roles with whom everybody interacts, such as a project leader, and thus span boundaries. This ingredient has received the most attention of all in the literature.

Figure 2 depicts a model of joint practice. It shows two sub-teams, e.g. engineers and production technicians. Within these teams the actors communicate. However, between these two teams hardly any communication can be observed. In the middle, the joint practice of two sub-teams is depicted. These distinct disciplines perform their own activities and subsequently produce specific objects as a result of these activities. If these activities or objects are observable by all, they can be interpreted by other disciplines for their consequences. Some of the activities or objects become part of the joint practice, as these are meaningful for all team

members. Joint practice 'sits' amidst the team members, it can be observed and interpreted by all. Joint practice enables both sub-teams to align and coordinate their activities, despite the boundary.

Note that what is meant with a boundary object can vary considerably in literature, varying from a sketch to a prototype. Tangible 3D boundary objects seem to be a class on their own. Above all the interactions of team members with these (often full size) objects enable spanning difficult
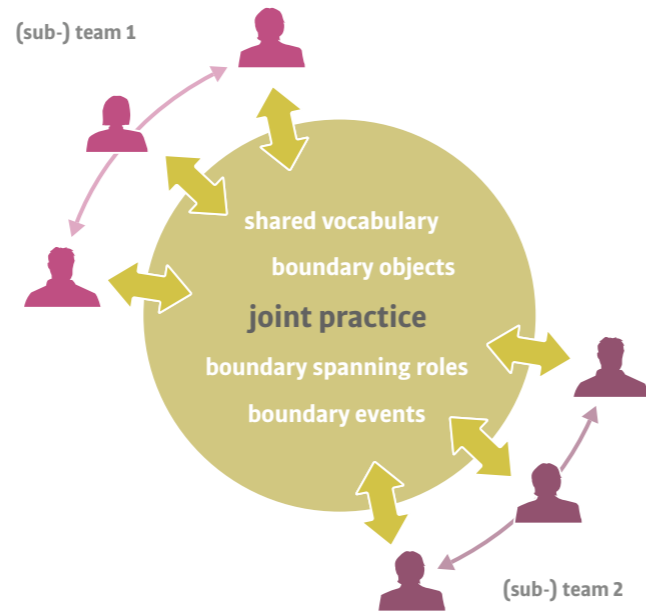

FIGURE 2   *the ingredients of joint practice.*

boundaries, and interactions must be considered quite literally. Team members smell motors that run hot, and thus realise that the cooling fans are not working appropriately. They have prototypes on their desks to 'feel' if mechanical parts are working well. They hear parts break while doing tests, halting all activities to limit damage. The point here is: these sensory experiences are relatively the same for all involved and thus provide a common ground for spanning disciplinary boundaries. In *figure* 3 it can be seen how a team of developers interacted heavily with an integrated prototype in order to evaluate some problems. By doing so, they discovered an additional problem: that users do not like sitting on their knees while doing maintenance. Experiencing 'sore knee' themselves was the trigger that led to solving this new problem.

Mirroring

Designers make a specific contribution to the joint practice in teams. Designers will frame any topic they encounter as user-centred and 'outside-in'. With outside-in, we mean that designers zoom out from local problems to the level of the product as a whole. They continuously translate what they see and/or discuss into the realm of the eventual product, how it will be used and how it will be experienced. For example, if a problem is discovered with a part that runs too hot, designers will discuss the consequences for a user, asking, 'will people be startled, when they touch the part or the environment?' Possible solutions are also discussed from a user perspective, 'if we put cooling fans and ventilation slots over here, the user will experience streaming hot air'.
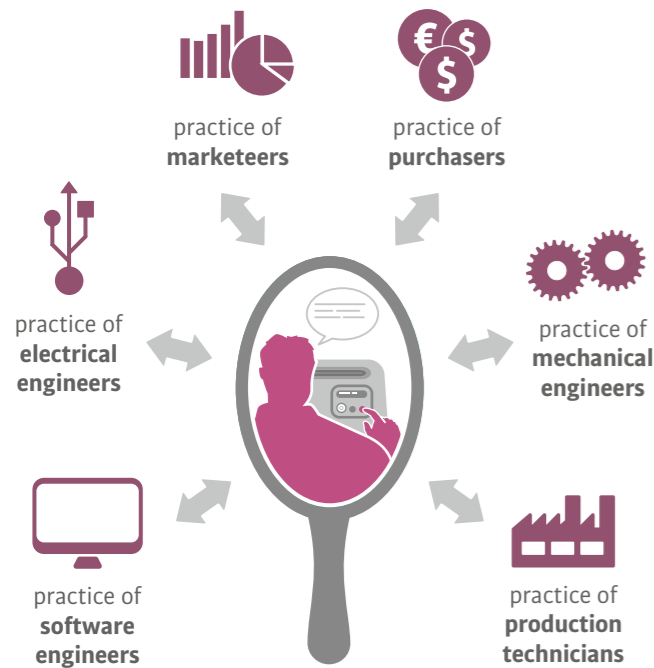Designers are also capable of expressing what they interpret by

means of easy to grasp representations of what the product will be. For example, they sketch what a product may look like as they conceive it, enabling others to 'get the picture' as well. Designers may create tangible models that people can feel, hold, walk around, or sit on, providing a rich source of sensory experiences. Or designers may produce demonstrators of user interfaces of a software program, enabling others to 'play around' and learn what the (final) product is about.

The point being made is that designers 'speak' a language that is understood by all, including specialists who may have a hard time understanding each other. Designers interpret and translate technical choices into the realm of product and user, expressing it by means of vivid sketches or rich vocabulary. The artefacts of their work are easily understandable by all, regardless whether one is a developer, a marketer or a production technician. This provides a common ground: all involved seem to understand the consequences of technical

FIGURE 3   *bodily experiences as a common ground*

Mirror
showing product and user

practice of
designers

practice of
marketeers

practice of
purchasers

practice of
mechanical engineers

practice of
production technicians

practice of
software engineers

practice of
electrical engineers

FIGURE 4 *mirroring: translating technical choices into the realm of product and user*

choices of a specialist, if these choices are translated to the realm of the product/user, see *figure 4*. Project descriptions need compelling images of the intended product. Presentations to top management often includes visits to design studios to experience a 1:1 model of the intended product. Software developers discuss potential scenarios by means of use cases and sketches of interface screens. We named the boundary spanning capability of designers 'mirroring', because the translation of technical choices to the realm of product/user is like holding a mirror in front of the specialists: a mirror that shows the consequences of technical choices and enables reflection on these choices, cross-disciplinary. The designer's artefacts are communicative and can be grasped by anyone. These are means that are often expressive, compelling, coherent, elegant, and unified. It is as close as one can get to experiencing the actual product. For example, experiencing a demonstrator of a user interface of a new software application is a far more powerful means of learning about the future product than a list of requirements.

Mirroring provides a solution for a fundamental problem in NPD, namely: the intended product is more or less unknown to team members, above all in the infancy of the NPD project. Still, each team member needs to 'know' what the product 'is', as this knowledge shapes their individual choices. The problem is: *how can team members know what the intended product is, until they see what they create together?* Already in early phases of an NPD project, designers produce objects that show what the product might be. These are a valuable addition to the prevailing requirements and project definitions, also for stakeholders. For instance, designers create 'paper prototypes' to get a feel of dimensions, enabling

others to get a feel as well. Some examples of these early designer interpretations are shown in *figure 5*. These are tangible objects that can be experienced by all. An interviewed project leader understood the value of these artefacts of design well, *"we are still learning what the project is about. (..) We need to have a [1:1] model of the product as soon as possible, so that we can invite everybody around it…so that everybody knows what we are doing in the first place"*.
These objects provide a macro view: the product is represented loosely and appealingly, capturing the essence rather than the details. For example, sometimes hand drawn sketches of the product serve teams better than photorealistic renders. The sketches seem crude, but correctly depict what was agreed on and are sufficiently to-the-point to 'get the picture'. Weick called this the charm of the skeleton, arguing that "there is a sense that unfinished designs have more vitality than do finished designs" (Weick 2004: p.43).

The above may suggest that mirroring is an activity prior to other development activities, namely drafting a vision that subsequently is 'executed'. However, we consider mirroring a process parallel to other development activities in multidisciplinary teams. Designers continuously interpret what others do and produce expressive visual means of the product. This enables others to reflect and discuss across disciplines, which leads to adapting their choices. Consequently, what the product will be is also constantly adapted to the latest insights. These 'designerly' representations of the product are a team effort, a result of ongoing interactions between designers and others. In time, the representations become a genuine mirror, a mirror that shows the whole, rather than the parts. Mirroring should be conceived as a process of continuously redrafting what the product will be, in increasing levels of detail.

FIGURE 5 *objects developed by designers in the infancy of NPD projects*

The boundary spanning practice of design

In short, mirroring hinges on the abilities of designers to (1) frame any problem 'user-centred and outside-in' and (2) to express their interpretation well by means of compelling representations. Intriguingly, in the literature and also in the cases presented below, a designer is seldom a nominated boundary spanner; the only known exceptions are Hargadon & Sutton (1997) and Perks et al (2005). A liaison role is generally associated with e.g. project leaders or managers. Also in design literature, teams and boundaries are never mentioned, let alone boundary spanning. It seems that designers have no formal assignment to span boundaries, and also are unaware of their boundary spanning capabilities. One explanation is that it is not the designers themselves who facilitate boundary spanning in organisations. It is their practice of designing that enables this: the practice of translating technical choices into product proposals by means of sketches; the practice of making models and demonstrators that can be interacted with; the practice of 'talking products and users'.

Still, we believe that a more structured process of mirroring might help organisations to span the challenging cultural and/ or organisational boundaries mentioned earlier. This insight has led to several experiments at the R&D of Océ Technologies (Stompff 2012), a large provider of printing systems for professionals, and nowadays part of Canon. Two cases are described. The first concerns spanning an inter-disciplinary boundary: specialists found it hard to align their activities on a difficult topic. The second case concerns an inter-organisational boundary: two organisations that hardly knew each other and where different first languages were a serious issue.

Spanning inter-disciplinary boundaries

Printers are complex technological products and still break down every now and then, requiring interventions by the users. These interventions are called ORE (Operator Recoverable Error). A problem for designers when developing an adequate ORE is that there are hundreds of possible errors, incited by technological failure, environmental conditions, or human errors. Each of these possibilities must be envisioned beforehand, assessed for its potential implications and a cross-disciplinary scenario developed for solving it, including foreseeing the activities of a whimsical user. Consequently, the team of developers involved with ORE need to 'think collectively' and collaborate closely in order to develop ORE.

A boundary between specialists

A serious boundary was identified between the hard- and software specialists. In interviews, team members discussed their work and the relations with others. As many team members were interviewed, each with their own distinctive network, it was possible to map the work-relations inside the team. Specialists involved with hardware, like mechanical engineers, mainly mentioned other hardware related specialists. Likewise, specialists developing software were mainly involved with other software related specialists. Across this boundary, little interaction was observed and team members even found it hard to recall the names of others. They could not explain well what the others did.

They deployed distinctive prototypes. They even used a subtly different kind of language. Whereas hardware related engineers refer to a "wobbly part" and an "emergency brake", software engineers tend to discuss the same topics by respectively "error code 6639" and "halting behaviour".

Figure 6 characterises this boundary by means of a 'paper path' in a printer. On the left, the practice of mechanical
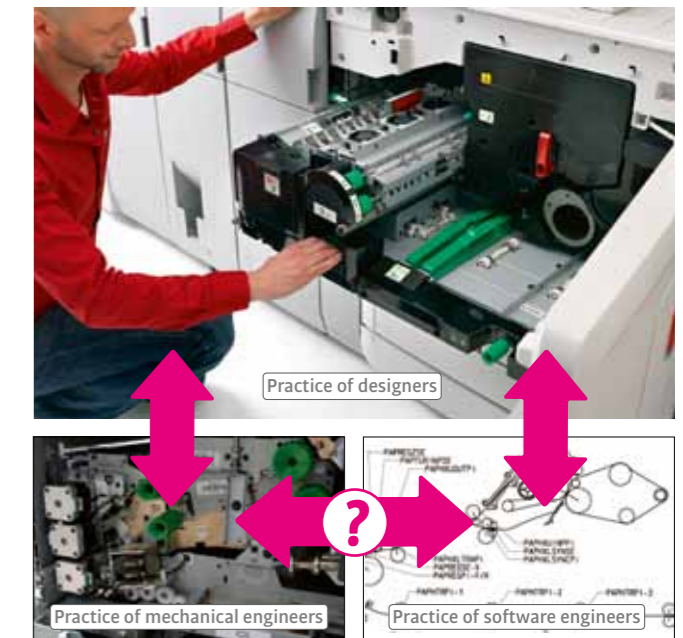

FIGURE 6 *three representations of the practices of mechanical engineers, software engineers and designers*

engineering is represented by a prototype showing the printer-chassis, with parts, paper-guides, motors and the like. Mechanical engineers cannot do anything without CAD and prototypes that are often built by themselves. They are concerned about robustness, cost and tolerances. On the right, the practice of software engineering is shown by means of a schematic depiction of the same paper path. It shows distinct sensors and motors by means of their 'software' names and is used to describe behaviour as, "IF PAPHXLSYNSE IS LATE, THEN..". Software engineers read code as it if is a newspaper, are concerned about bugs, and plan activities by means of releases. The mechanical engineers and software engineers had entirely distinct practices, to the extent that they hardly mixed socially, although they were co-located.

Mapping complex relations via the world of product/user

In the case described above the boundary was spanned, amongst others thanks to the activities of designers. This can be seen in an analysis of the interviews, as designers were named by all specialists, and were quite evenly distributed. Yet the designers had no formal boundary spanning role: it was their practice that enabled the team to span the difficult boundary, as the designers continuously mirrored the activities of both hardware and software engineers. How was this mirroring done?

FIGURE 7 *the map developed for the recovery of paper jams showing the relations between the world of hardware, the world of software and the world of users*
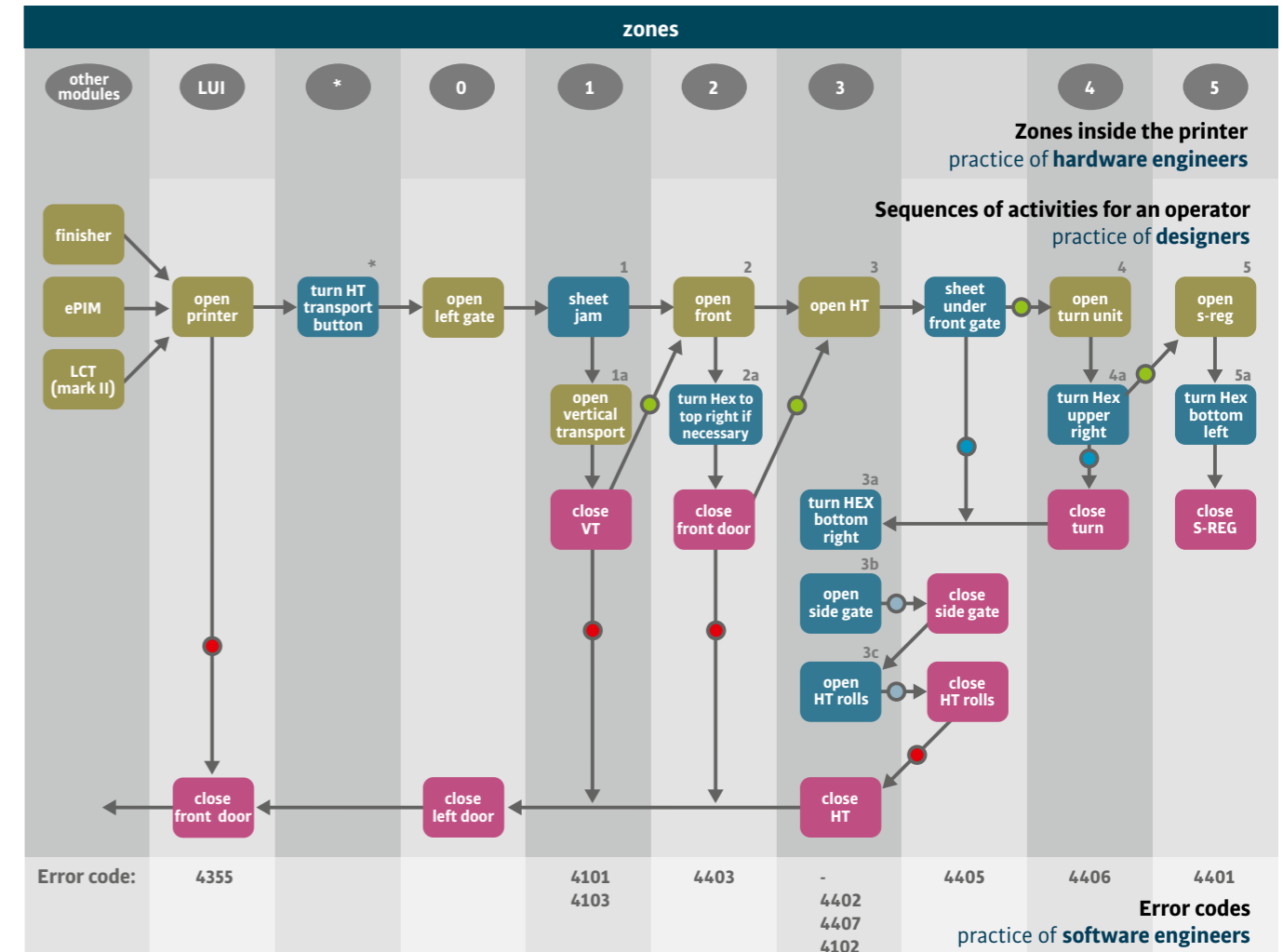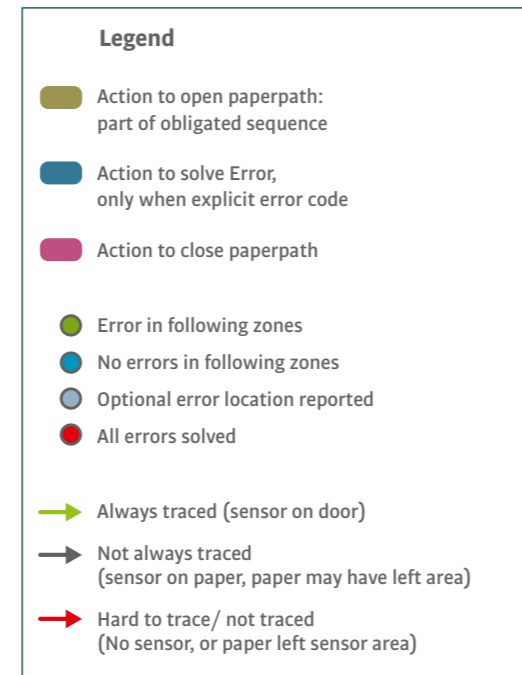
Talking products and user
The designers tended to 'talk products and users' for any topic they were involved in i.e. user-centred and outside-in. For example, in a team meeting that was analysed and in which many specialists participated, we observed that nearly half of the things that were said by designers were related to user and usability. They translated what they saw or heard into terms related to the product, how it would be used and how it would be experienced. Even when a electro-motor is discussed, they noted how a user would experience the sound. This contrasted sharply to other specialists, who much less tended to discuss the user or usability, if ever. The impact on the meeting was that 'talking products and users' enabled all involved to discuss and reflect on cross-disciplinary problems and solutions.

Developing a joint representational space
A typical ORE problem is that it concerns a sequence of activities of product and user together. Developing ORE is like designing a choreography for the user and product. However, for this choreography, no representational space exists that includes the physical world of steel and plastic, the invisible world of system behaviour, and the human world of operators; let alone a representational space that enables a swift comparison of alternative proposals. A specific 'map' was developed for ORE, starting from the world of product/ user (*see figure 7*). It shows an overview of the sequence of user activities and the relations with hard and software. Alternatives could easily be sketched and evaluated. It was

possible to map the error codes of software on the same map, just as it was possible to co-develop the user-accessible areas being developed by the mechanical engineers. Most importantly: specialists could reflect on the cross-disciplinary consequences of technical choices. If a mechanical engineer needed to adapt a part, the consequence for the user and subsequently for the software could easily be instilled. Eventually it resulted in a jointly developed sequence, depicting all the possible error scenarios and activities that operators had to perform in one visual.. The map turned ORE into a coherent and unified whole, integrating the work of several specialists.

Role play
Team members experiencing a multi-disciplinary problem conducted small role plays using prototypes or other representations. Step-by-step, the team members explained what the user was expected to do and how, as a result of technical choices. The other way round, by exploring the consequences for the user, many technical choices were (radically) adapted. Designers played a pivotal role in this role play thanks to their ability to envision the consequences of technical choices for the user.

Spanning inter-organisational boundaries

The second case concerns spanning an organisational boundary. The problem is no longer the lack of joint practice between highly specialised disciplines, but simply that the members are spatially, temporarily and culturally separated. This case shows that the process of mirroring can be extended to management level.

Eliciting a product story

Just before starting customer trials of a large NPD project, Canon acquired Océ. As a result, an important partner withdrew from the co-development, effectively crippling the NPD project. A small team, including two designers, was assigned with one goal only: convince Canon that the NPD project should continue, and how Canon subsidiaries could fill the gap. Stakes were high as, without this commitment, a huge investment would be trashed. Time was limited to three weeks to develop a so-called product story: a plausible and coherent narrative explaining what the product will be, charging it emotionally and persuasively. At Océ, a product story rationalises what the project is about, serving as the go-between with the development team and other stakeholders, e.g. in business units or manufacturing. Eliciting a product story involves articulating, sharing and synthesizing knowledge that is dispersed across R&D, marketing and other departments into a unified whole. The

process was divided into two steps. A few workshops were first conducted to make sense of the main benefits of the product at hand. It resulted in a captivating small story of what the project was about. Second, much time was spent on developing representations to show the product story in a compelling way. Due to language differences, visual means were considered pivotal, and included movies, animations and compelling imagery (*figure 8*). Even though time was limited, a convincing story was created. The negotiations were successful, developments could continue and the product was launched in September 2011 (Océ VarioPrint DP line) as the first co-developed product with Canon.

The art of mirroring

Quintessentially, this case describes another mirroring process: the team explored what the product might be from a user/customer perspective and expressed it persuasively using visual means. They deliberately showed people, even in technical overviews, so that others would get a feel of the dimensions and see the project from a user perspective. However, they did not only develop representations of the product: they created representations of the product story, including explanations of technology and the business case. Three reflections on this process are discussed below.

Developing a story in hindsight
Why was a product story necessary, even though the project was nearly finalised? Could the team not show and

tell what they were developing? To start with, the situation included many questions and new information, leading to ambiguity. The partner that withdrew confronted the team with many white spots in the product and many unanswered questions. Also, the team had to extrapolate what others could possibly contribute. The knowledge that was needed to make sense of the situation was inevitably dispersed among team members. For example, senior management knew about the newly established relations with Canon, marketers had the latest market information, and the technical developers were aware of the project status. As a first step, the team had to create a new, coherent and plausible story.

The means are the story

Another learning-point is that the message conveyed cannot be seen apart from the medium chosen. The choice of how to represent the intended product is not arbitrary at all. A carefully composed list of 'objective' requirements often leads to long negotiations on details whereby the 'big picture' is lost. A spreadsheet showing potential profits may lead to a focus on cost and profits only, rather than what the product is. An impressive technology demonstration may lead to overly optimistic planning. A beautifully crafted 1:1 model may possibly 'blind' stakeholders to issues of costs.

Thus, the means chosen to 'tell a story' is a decisive choice to frame the topic at hand in a specific way. All media have their own specific properties that enable expression, highlighting how the product should be interpreted. It requires skills to express the product, and it requires sensitivity to the means deployed to know what representation best fits the context. It puts the focus on matters like wholeness, elegance and aesthetics. Visual means are not simply a way of capturing and telling a story, such as compelling movies, smart animations or a great photo. Visualising cannot be done subsequent to composing a story, as a means to illustrate the outcome. Instead, developing the visual is part and parcel of the process of composing the product stories. Visualisations are not the illustrations of an outcome of a process: visualising is the process of making a story itself.

The need to 'talk visuals'

Visualisation is important for NPD teams and is even more important when teams are spread across the world and/or distinct organisations. It will be no surprise that a greater emphasis on visual communication is required, especially in cases of language differences. However, visualisation is not merely about translating and communicating ideas and problems. Rather, it constitutes joint practice that enables teams to align activities, even beyond what the visuals are about. Visualisations partly replace tangible prototypes that team members can gather around, mitigating the imposed burden of not seeing and experiencing what others are doing.

FIGURE 8 *examples of visualising a product story: (1) movie, (2) animations, (3) photo-realistic renders and (4) overviews*

Benefits and limitations

Designers, as team members of multi-disciplinary teams, seem to be largely overlooked. There is a vast body of literature on NPD and/or innovation, but 'design has been largely absent from theory, teaching, textbooks, and research' (Hobday et al. 2011: p.5). Intriguingly, this is no different the other way round. In the popular magazines, books, and scientific publications on 'design', multidisciplinary teams are often missing. This chapter has looked at the contribution of designers to organisations when they are part of teams, and provided some new insights.

The first insight is that the practice of designers is a boundary spanning practice for NPD teams where troublesome boundaries exist. This is conceptualised as mirroring. This can be briefly explained as an ongoing translation of what the team does into representations of the product that are easily grasped by all involved. This enables the team members to reflect on cross disciplinary issues. Although designers mainly focus on usability and experience of a product, experiments show that it is possible to leverage this capability to a strategic level.

Secondly, the studies provide some practice-based insights on 'design thinking'. There are different schools of thought about this popular concept which can lead to confusion. Most writers focus on understanding how designers think and do, with the aim of educating others to become a design thinker. Mirroring first of all shifts the focus from what designers do and think, to the contribution of designers **interacting** with others. Rather than discussing how others can learn to think as a designer, the concept of mirroring discusses how

teams benefit from interactions with designers. Mirroring also highlights the practice of design, including aesthetic visuals and tangible models, the way how designers talk about products and users, and the characteristic outside -in orientation to problems.

A limitation of this method is undoubtedly that the image in the mirror of design is by no means neutral. It inevitably includes the aims of designers, overemphasizing issues like usability or aesthetics. This can aptly be named the 'concept car fallacy'. For example, an extremely appealing design study may lure teams into developing a product in which the balance tips over to 'designerly' aims. The implication is that designers need to become aware of way they shape the mirror. As an example, an interviewed project leader at Océ mused that *"this artist's impression gave half the business unit a wrong impression about what they could expect. I suspect that some of them framed it in and stuck it on the wall above their beds (..). Maybe less flashy images would have helped in this stage."* Another limitation is that our focus has been oriented towards designers. It remains uncertain whether other roles could have similar mirroring capabilities, for examples project leaders or product managers, or whether the concept of mirroring can be translated to methods that can be taught to others. Put differently, it is unknown whether mirroring can only be attributed to the design profession.

Key insights

- Designers who are part of multidisciplinary NPD teams have an additional contribution beyond the aims of design. The practice of designers spans complex boundaries in teams.
- The boundary spanning capability is conceptualised as 'mirroring': interpreting and translating what the team does into expressive representations of the product that are easily grasped by all involved. This enables others to cross-disciplinary reflect on their choices.
- Mirroring should be conceived as an ongoing process of redrafting what the product will be, rather than visualizing a concept that needs to be executed.
- The means deployed to visualize strongly shapes subsequent discussions, and thus one needs to be aware of the means deployed.
- Designers seem to be unaware of their mirroring capability. However, this may require a somewhat different approach to their work.

How to continue?

Mirroring is an new concept. It does not focus on what designers do or on design methods as such, but on designers as actors in teams. This has hardly been studied, and consequently, not much literature is available yet. The list below includes a number of articles and books that discuss interacting designers.

Further reading

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– Perks H, Cooper R & Jones C (2005), *Characterizing the Role of Design in New Product Development: An Empirically Derived Taxonomy*. Journal of Product Innovation Management, 22 (2) pp.111-127.
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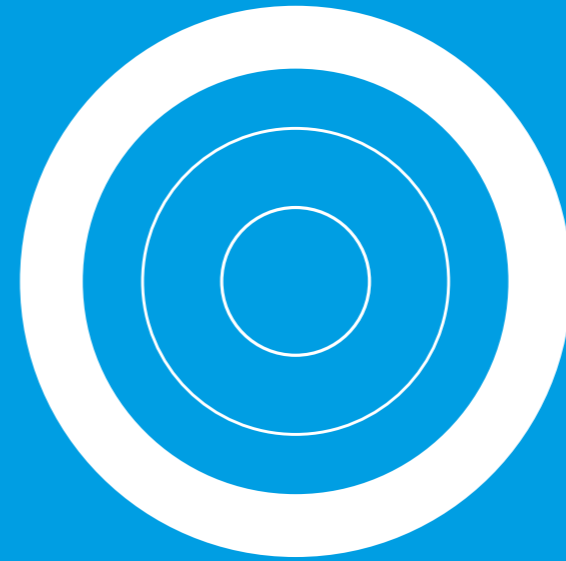– Weick KE (1995), *Sensemaking in organizations*. Sage (USA).

Websites

– www.designinteams.com

PART 3

society-centric
design methods

08.
Creating meaningful innovations: the value framework

Author
Elke den Ouden

Introduction   The world is currently facing a number of tremendous societal challenges for which traditional approaches to innovation no longer work. We're squandering our planet's resources and violating nature. In the pursuit of wealth, people at all levels take decisions that seem to mainly address their own interests. So pessimists warn us: we're racing full speed ahead on a dead-end track. However, optimists view the abundance of opportunities that these multiple crises bring as a way to really make a difference; not just for philanthropic actions, but for sound business. This chapter addresses social-centric value creation and shows how societal challenges provide opportunities for meaningful innovations.

The Value Framework is a method that supports the creation of shared value for people, organisations and society. When designing solutions for societal challenges it is important to understand the issues at a user level, organisational level, as well as understanding the context at societal level in an extended network of stakeholders. No organisation has all the relevant knowledge and experience available itself, so collaboration is needed between different organisations: public and private, non-profit and for-profit, large and small etc.. The Value Framework combines different perspectives on value from economy, psychology, sociology and ecology, and visualises opportunities for value creation. The method can be used in brainstorming sessions with stakeholders to define new value propositions, as well as to analyse the value of initial value propositions and enrich them. It can be applied within a company to increase the value of ideas, and design consultants can also use it to support their clients in bringing an integrative value perspective when innovation requires collaboration with multiple parties.

Challenge

What's different when tackling societal challenges, compared with traditional, engineering design or business challenges, is that they require a more holistic view of how the solution needs to be defined. A traditional engineering or design problem can be solved at the level of a product. Although this can still be a challenging task due to contradictory requirements, the solution can usually be found within the scope of the product itself, and so the lead engineer or product manager can take the decision by himself. Likewise, a business problem at the level of a company and its market can usually be solved within the scope of the decisions that a manager can take. But finding real solutions to societal challenges requires the consideration of aspects that cross the boundaries of a single decision-maker. It requires knowledge at the level of the user of the prospective products and services, the level of the organisation that will bring these products and/or services to the market, the level of the ecosystem that links the various products and services to their users and other stakeholders, and the level of society that will reap the benefits of the solution. At first sight this may look like an insoluble problem, but in fact societal challenges provide tremendous opportunities for business (Porter & Kramer, 2011). And, as many examples have proven, societal challenges do not necessarily require huge investments. Just to give one example: Nobel peace prize winner Muhammad Yunus started Grameen bank with microloans to women making bamboo furniture with just US$ 27 out of his own pocket. It is now a multimillion-dollar business.

Social innovations are motivated by the goal of meeting a social need. They aim to fill the gap between what there ought to be, between what people need and what they are currently offered by governments, private companies and non-governmental organisations (Mulgan, 2007). Social innovation brings new ideas that improve quality of life for society as a whole. This differs from business innovations, which aim to create profit for a specific company. Yet the concepts overlap and social innovation provides opportunities for business to work hand in hand with improving quality of life: the business potential is real. Social innovation goes beyond corporate social responsibility programmes, as these often focus on reducing the ecological footprint of the company, or doing a charitable favour to society. Social innovations look for real business opportunities in the links between the challenges society has and emerging technological developments, making new solutions feasible that were previously beyond imagination. It is linked to 'design thinking', as designers of social innovations apply design capabilities to address these grand societal challenges.

Stretching the business perspective

For companies to be successful with social innovations, they need to stretch their business perspective. To make an impact on a societal level, a compelling offer is required that can be used extensively over an extended period.

For example, to tackle obesity among children, we could launch a game that requires them to be physically active.

But, it can only be a success if these children do indeed remain more physically active over a longer period of time and eventually lose weight. So it's not enough to just sell these products, they also need extended usage to provide longer-term societal benefit. To achieve that, the game, in this example has to create sustainable behavioural change in the children using it.

Therefore, what's needed is to aim higher than just providing partial solutions which will never radically impact societal challenges. We need to change the behaviour of as many people as possible to make an impact. Energy scarcity cannot be solved just by a few people who drastically change their behaviour, nor can it be solved by everyone doing just a little. To change people's behaviour on a larger scale, we need to provide solutions that they love to use. Using the product or service should provide a positive experience; one that persuades them to use it more often, over a longer period of time. Therefore it is linked to the user perspective in design, but this time with an extended scope. The change has to be permanent; if it is only temporary and not sustained, then it does not really contribute to the transformation.

Social innovations also require an extended view of the business case. As in any innovation, the business case should be sound, so the company gets a return on investment within a reasonable timeframe. But the business models should also enable a long-term sustainable solution. This is needed for the continuation of the present offering on the market, as well as providing sufficient resources to invest in new innovation projects. Moreover, as the company is often dependent on a wider range of stakeholders for the innovation to be

successful, the business case also needs to provide value for the extended ecosystem (see chapter 9).

Value creation

So, to summarise the above: meaningful innovations that tackle today's societal and economic challenges must create value, not only for their users and the organisations that market them, but also for society as a whole. Value is the crucial term here. A common language is needed that allows people from different backgrounds to participate in creative sessions to define new value propositions for meaningful innovations. In this way, knowledge of the user and what is needed to provide a compelling proposition is combined with insights in the mechanisms of society and the financial structures that provide the business environment. This combined view is needed to create innovations with a lasting impact.

The Value Framework has been developed as a tool that integrates views from different scientific disciplines. As mentioned in the introductory chapter of this book, it is important to distinguish the level of value in the context of social innovation: value for users, value for organisations, value for ecosystems, and value for society. Meaningful innovations provide value for all levels at the same time.

The Value Framework provides a platform for discussions with people from different backgrounds. The framework can be used to:
- map the current understanding of societal issues in their

context and identify gaps;
- generate ideas for new value propositions;
- enrich value propositions with the help of the different perspectives.

Societal challenges are typically 'wicked problems': a class of problems which are ill-formulated, for which the information is confusing, for where there are many clients and decision-makers with conflicting values, and for which the ramifications in the whole system are thoroughly confusing. Dealing with wicked problems requires paying special attention to understanding the nature of the problem itself (Martin, 2009). Since the problem cannot be fully understood in isolation from 'the solution', it is natural that solution conjectures should be used as a means of helping to explore and understand the problem formulation. The problem and the solution co-evolve (Cross, 2006). The Value Framework supports this process by providing a common language to discuss different perspectives.

Method

The Value Framework (*figure 1*) has been developed as a tool to support the process of creating shared value for multiple stakeholders with meaningful innovations. The framework combines different value perspectives in one model. The bottom half of the figure lays the foundation for value creation. Each of the social sciences – economics, psychology, sociology and ecology – is indicated on a radius, together with the value concepts for each level. The top half of the figure indicates how addressing all four levels can create shared

value. An innovation is considered meaningful if it addresses the four levels from all four perspectives; in other words, when a positive check is made for all the items stated in the framework.

A number of steps have to be defined for this process. Before explaining the process of using the framework, we have described the different sections of the framework to improve understanding.

Economic view

Economics is the branch of knowledge concerned with the production, consumption and transfer of wealth. It studies human behaviour in relation to scarce means. Aristotle defined economy as, 'the art of living and living well', however its general focus in the past decades has been reduced to 'the art of money making' (Cruz et al, 2009). The definitions of value that economics use can be translated into four economic value concepts that form part of the value framework:
- **Value for money:** the economic value of a product or service for users, who strive to achieve the maximum exchange and use value for their money.
- **Profit:** the difference between the cost incurred in developing, producing and delivering the product or service (man, machine, material) and the income an organisation can gain from the product or service: a positive figure is required for long-term survival of any organisation (profit and non-profit).
- **Stability:** providing financial stability for the stakeholders in the ecosystem to allow adaptation to changing external
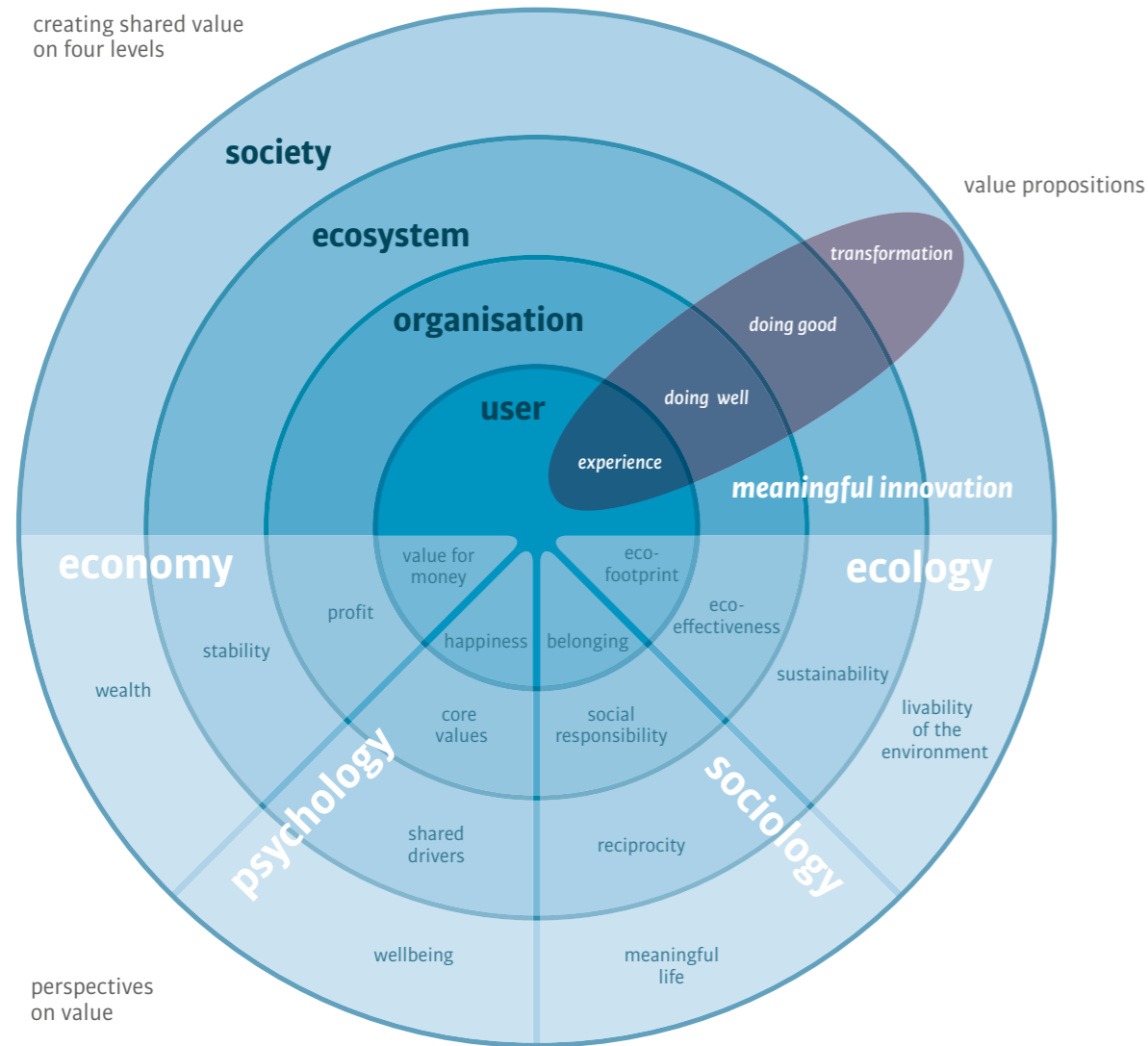
FIGURE 1 *the Value Framework (Den Ouden, 2012)*

conditions in the market and society as a whole, as well as internal change such as the exit of one of the participating organisations. The resilience of an ecosystem is a key success factor in the long run.

- **Wealth:** a flourishing society is a rich society built on economic activities that result in a high Gross Domestic Product. A wealthy society is able to provide its citizens with good healthcare, education and infrastructure, thereby contributing not just to the welfare but also the wellbeing of the people. Economic value is an enabler for psychological, sociological and ecological value.

Psychological view

Psychology is concerned with the study of the human mind and its functions affecting behaviour, and with what makes life worth living. Values in the psychological perspective define what people strive for – the human values (Rokeach, 1979) – as well as how these influence their behaviour – the motivational values (Schwartz, 1996). The definitions of value that psychology uses can be translated into four psychological value concepts:

- **Happiness:** happiness is the most inclusive merit for measuring an individual's psychological wellbeing (Veenhoven, 2010). The ultimate aim of meaningful innovations is to improve the user's overall life satisfaction. Users will eventually change their behaviour when new opportunities for reaching prioritised latent values are available, so it is important to address the values of users and communicate these clearly to support adoption and extensive use of the solution, thereby

increasing overall happiness.
- **Core values:** the core values of an organisation represent its overall reason for being, and provide the motivation for its management and employees to contribute to the creation of value with a narrow or wide scope.
- **Shared drivers:** to be successful in delivering benefits to the members of the ecosystem, it is important that they share the mission of the ecosystem as a whole, and agree on the drivers that rule decisions. Ecosystems adapt dynamically to external and internal events and, over time, the mission of the ecosystem may also evolve; the shared drivers are therefore not a fixed set.
- **Wellbeing:** the term wellbeing came into use as a contrast to the idea of simple 'economic welfare'. Wellbeing of people is very much influenced by society, because society provides the reference for people to judge their individual situation, including cultural aspects.

Sociological view

Sociologists and anthropologists generally speak of social or cultural values as mechanisms of solidarity and collective identity. The focus is on groups of people and their social relationships: it is in relationships that things (products and services) take on value (Graeber, 2001). The definitions of value that sociology uses can be translated into four sociological value concepts:

- **Belonging:** sense of belonging is an important parameter in people's happiness. People identify themselves with groups that provide the context for the attribution of meaning (e.g. heirlooms in a family context, or products

related to specific events, like the 'Make Poverty History' white wristbands). People use products and services to express the group to which they (would like to) belong. These mechanisms can influence the speed of adoption of innovations positively and/or negatively.

- **Social responsibility**: a broad concern with the ultimate results of an organisation's behaviour on society (people and planet). What is considered as social responsibility is culture dependent.
- **Reciprocity**: members in the ecosystem are mutually interdependent and can only have fruitful relationships if they all contribute to and benefit from the system. Reciprocity means that, in the end, all members contribute from their own strengths and competences, and are paid in return in a value that is of worth to them (money or other types of value).
- **Meaningful life**: value at the level of society from a sociological perspective translates into living a meaningful life. Wellbeing increases when as many people as possible contribute to a greater cause from their own strengths in a meaningful way. Society provides the bigger picture, and the reference to which the individual can contribute.

Ecological view

Value in the perspective of ecology considers the earth as a whole, with humans just being part of a larger ecosystem. This creates a more holistic view of values, covering not only the social relationships of people, but also their relation with their physical surroundings. The definitions of value that ecologists use can be translated into four ecological value concepts:

- **Eco-footprint**: each person requires a certain amount of biologically productive land and sea area to generate the resources he/she consumes, and to absorb the resulting waste. By selecting products and services, users define their ecological footprint (Gatersleben et al., 2002). Meaningful innovations could contribute positively to reducing users' average footprints.
- **Eco-effectiveness**: eco-friendly innovation at an organisational level. The importance to organisations of embarking on the 'green' journey is not just to avoid the risk of being labelled as 'polluter', but also to create a positive agenda for goods and services that incorporate social, economic and environmental benefits (Braungart et al. 2007).
- **Sustainability:** acting with sustainable values cannot be reduced to a simple checklist: it requires thinking and behaving in a way that literally sustains the world around us, the community, the planet, and the relationships with generations to come. It requires an ecosystem that shares the values of transparency, integrity and shared responsibility (Friedman, 2009).
- **Livability of the environment:** the importance of natural surroundings for human health and wellbeing, and the physical beauty of nature. Preserving nature to increase the livability of the environment has to be part of innovation. But it can also provide inspiration for meaningful innovations.

Steps in creating shared value

The Value Framework can be used to evaluate ideas for innovations at all four levels from all four perspectives. In this way insights are gained into the elements that are addressed, and those that are overlooked. It serves as an analysis and inspirational tool to increase the value of a proposition.

A number of steps can be defined for this process (*figure 2*).

1   **Diagnose value gaps / New opportunity**
    In this first step, the Value Framework is used to make a

map of the current understanding of the societal issue in its context. People from diverse backgrounds, bringing different experiences and knowledge, are invited to a workshop. The Value Framework is then used to analyse which of the value concepts are addressed by current solutions. The process of developing this map triggers the identification of gaps that provide opportunities for new value propositions. The process may also start without an explicit analysis of the value gaps, but directly from an
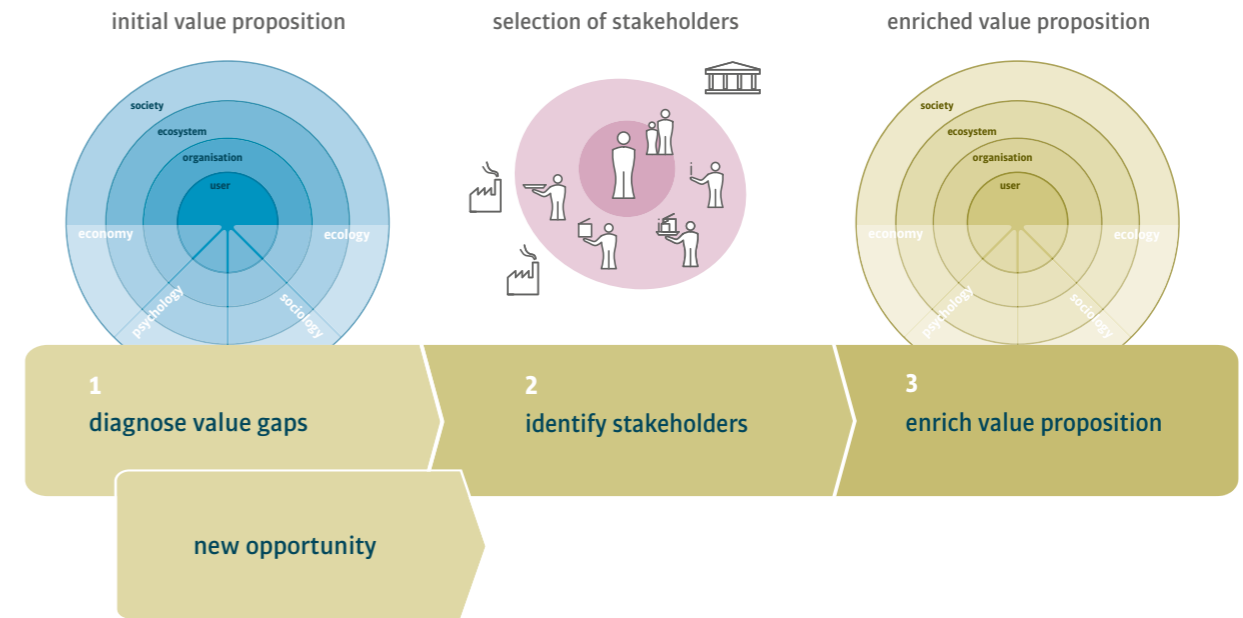

FIGURE 2 *steps in creating shared value*

idea for an opportunity. At the end of step 1 an initial value proposition is available.

2 **Identify stakeholders**
Once an initial value proposition has been defined, the stakeholders for the innovation are identified (see also chapter 9). These stakeholders cover the four levels of the Value Framework: user, organisations, ecosystem and society. The stakeholder selection is crucial to the success of the innovation.

3 **Enrich value proposition**
Representatives of the selected stakeholder groups are then invited to a workshop in which the value proposition is discussed and enriched. The Value Framework is used to provide a common language to discuss the different perspectives and to integrate different views into one value proposition that provides shared value to all the stakeholders.

Lighting in an ecological zone

An example of a project aiming to create shared value is the design of a lighting solution along a bicycle path through an ecological zone in Veldhoven, the Netherlands. The municipality of Veldhoven asked THE LUX LAB Lighting Design to design a solution using state of the art technology.

The fact that the bicycle path crosses an ecological zone poses a challenge to the design solution. To prevent disturbance of the flora and fauna in the ecological zone, it would be preferential not to install street lighting. However, as commuters and school children heading home use the path intensively, the municipality decided to place street lighting to ensure the safety of the users. THE LUX LAB acknowledged the existence of the different stakeholders in this project and decided to design for the triple bottom line of 'people-planet-profit'.

The role of the designer in this project is to understand the needs and requirements of the different stakeholders, and to integrate seemingly opposing needs into a solution that is attractive to these stakeholders. The proposed solution uses different lighting settings, varying in colour and intensity at different times to accommodate the different stakeholders needs. *Figure* 3 shows the design sketches for the lighting settings. In the early evening the path is intensely used by commuters, particularly children heading home. This was
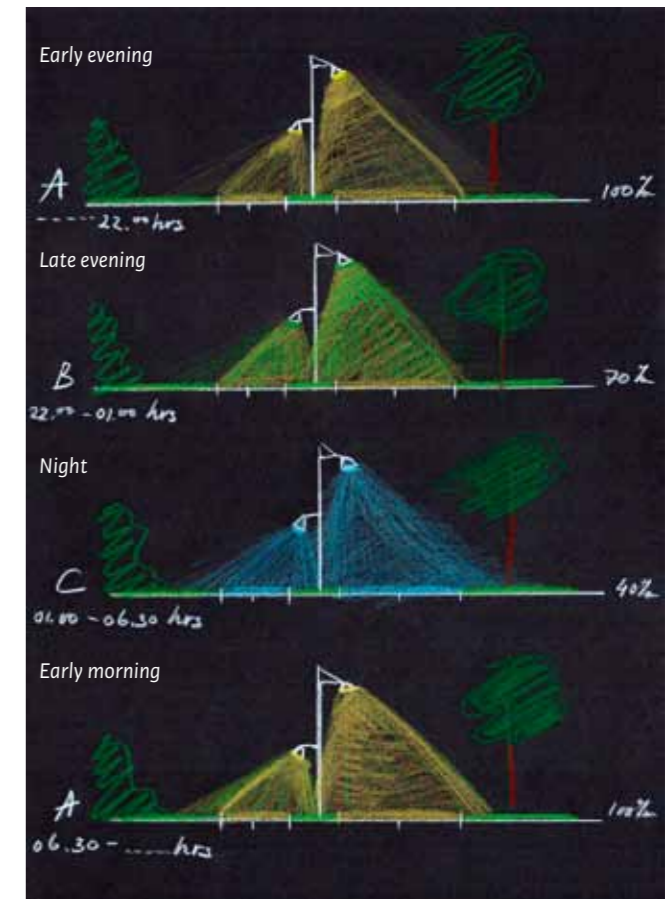

FIGURE 3 *design sketches for the lighting scenarios* (THE LUX LAB, 2010)

FIGURE 4 *steps to come to an enriched value proposition*

FIGURE 5 *stakeholder map*

the reason for lighting being installed in the first place. Cyclists' feelings of comfort and safety are increased with more light, as people need more light as the sun sets. Thus warm white light at a normal lighting level was proposed for this time of day. Later in the evening as traffic ceases, the light dims to a less disturbing level for animals and plants, but still providing good visibility for cyclists. The yellow-greenish light offers good visibility at significant lower energy use caused by LED efficiency in this colour range combined with the high sensitivity of people's eyes to these wavelengths. During the night, as there is hardly any traffic, the wild life becomes the most important

stakeholder. Therefore, the light is dimmed to the equivalent of 'full moonlight', which does not disturb animals and at the same time requires significantly less energy while remaining aesthetically pleasing. In the morning, a bright cool white lighting setting is used to increase alertness of the cyclists.

The solution is very different from what is currently available, so for the stakeholders to be able to judge the concept they have to be able to imagine it. Typically in this project, as in many social innovation projects, there is high uncertainty in desirability, technical feasibility and/or
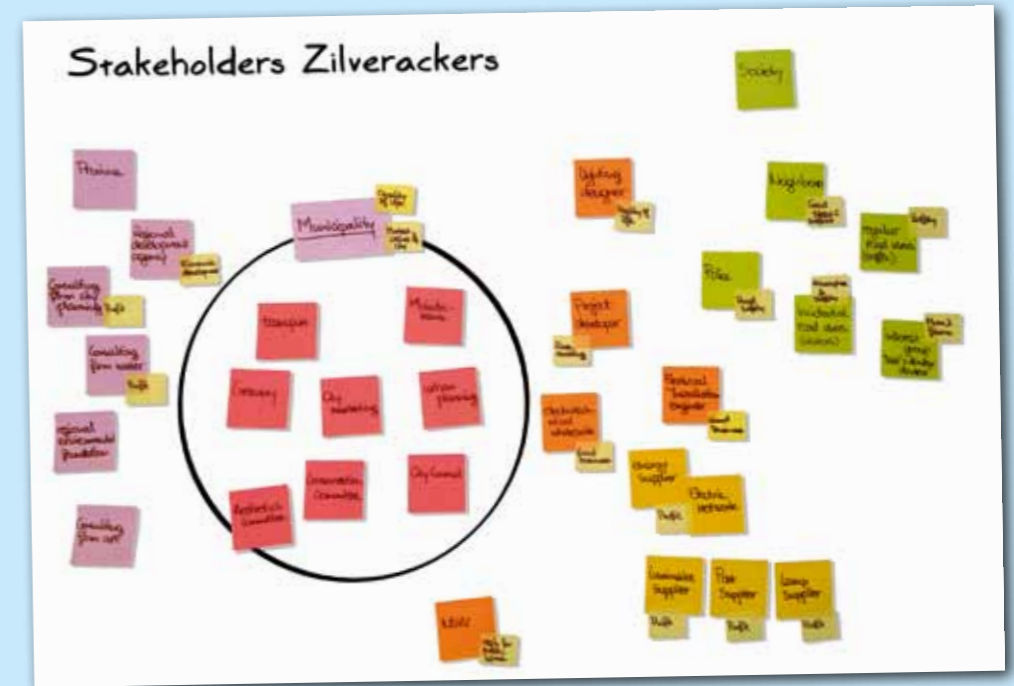
economic viability. In this process, experimentation is not just trial and error; it is a process of experimental design and exploration through successive approximations of the solution. It was decided to conduct reflective sessions with stakeholders as part of the design process (Hummels & Frens, 2008), using the best approximation possible to enable meaningful discussions with different stakeholders at an early stage. Together with the Intelligent Lighting Institute of Eindhoven University of Technnology, an

approach was developed to explore the desirability of the proposition with multiple stakeholders, and to use the results to enrich the value proposition (*figure* 4).

One of the foremost difficulties in co-reflecting on radical innovations is to ensure that the participants understand the concept. For this specific concept there are two specific challenges: 1) the lighting concept and its associated values are mostly intangible and therefore difficult to assess; 2) the

concept itself makes use of dynamic lighting settings for which people have no previous reference. To make a first iteration in the design process, a demonstrator was created, in which the settings for early evening, late evening and night were shown in darkened corridors. This allowed people to experience the lighting levels and assess the concept. Although there are still limitations to the experience when compared to installing prototypes at the actual site along the path, it was the closest feasible approximation, both economically and time wise. The demonstrator was used to collect feedback on the desirability of the proposition from the relevant stakeholders and to facilitate a discussion on the validity of the lighting solutions in the surroundings of an ecological zone.

To identify the stakeholders to be invited, a map was made of the stakeholders related to the project, as shown in *figure* 5. Creating this map gave insights into which stakeholders are actually involved with the project. It also showed that it is sometimes necessary to take a deeper look into an organisation to collect different viewpoints, for example the municipality has many different departments with different ambitions that are connected in different ways to the lighting design. It was decided to invite representatives from the municipality, neighbours, local police, and an environmental organisation as well as different users: school children, athletes who use the path for their weekly running exercise, and the elderly. In the discussions with the stakeholders, the entire concept was evaluated together with its intended context.

The discussions highlighted a number of key characteristics of the concept: its impact on ecology, social safety, energy efficiency, atmosphere, promotional value and costs (purchase and maintenance). The aspects identified in the workshop are plotted on the Value Framework, as is shown in *figure* 6. The discussions with the lighting designer, municipality, researchers and lighting supplier resulted in the most important driver for them to contribute to this project, being to jointly pursue the dream of creating an innovative solution that could prove to be of real value to a higher cause; improving quality of life with a sustainable, pleasurable and safe outdoor environment. All of them contributed to the process with extra time and resources outside their regular work-related responsibilities.

The most important observation from the discussions was that, although stakeholders were fairly positive about the concept as a whole, the ranking of the key parameters for further development of the concept differed significantly (*figure* 7). Interestingly, the users group indicated energy efficiency to be the most important parameter, whereas the municipality indicated this to be the least important. This seems to indicate that users expect municipalities to find a good balance between energy efficiency on the one hand, and social safety and ecology (care for flora and fauna) on the other hand.

The discussions did not really reveal any issues with the concept, so the value proposition in itself did not change as a result of the workshop, but it resulted in a better
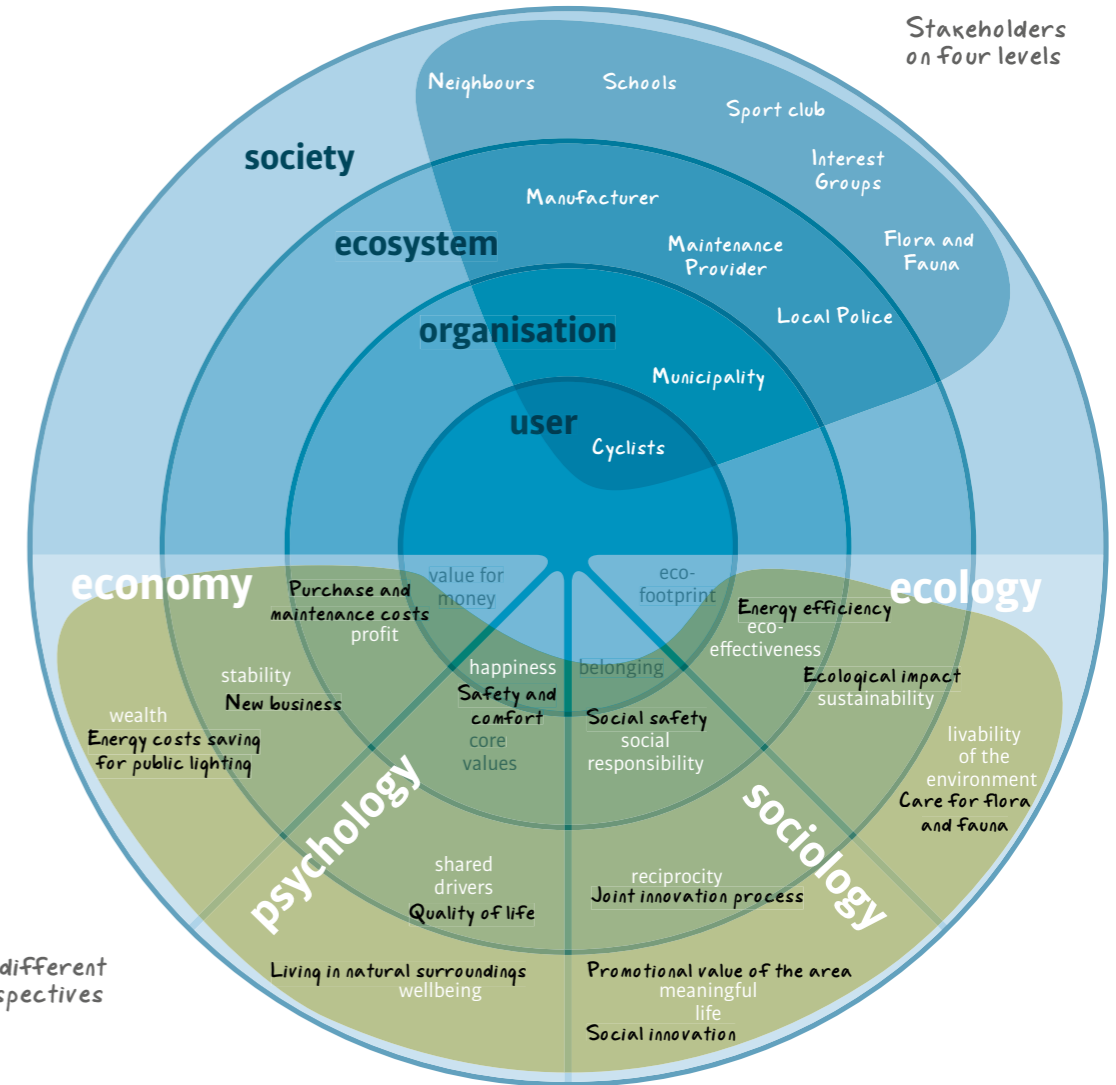

FIGURE 6 *initial value assessment of the proposed design solution*

understanding of the value of the concept from different stakeholder perspectives. This shared understanding of value was required to further proceed with the project. The next iteration required a significant investment from the manufacturer to develop the specific luminaires and produce prototypes for onsite testing. One supplier was very interested in contributing to the shared driver of improving quality of life, and a joint innovation project that addressed social innovation in this way, as well as seeing economic value in this new business proposition. As this case study shows, it is possible to combine a sound economic perspective with a higher cause.

	Police	Supplier	Environmental organisation	Users	Municipality
Ecology	4	3	1	3	2
Social safety	1	2	2	2	1
Energy efficiency	6	4	3	1	6
Atmosphere	2	1	4	4	3
Promotional Value	5	6	5	5	5
Purchase and maintenance costs	3	5	6	6	4

FIGURE 7 *overview of the ranking of key parameters (Den Ouden et al., 2012)*

Benefits and limitations

The method is particularly useful in early discussions on potential new value propositions. This is especially true if more people are required to combine experience and knowledge to create a deeper understanding of the issues relating to a societal challenge. A common language and joint reference is crucial to avoid a Babylonian confusion of tongues and misunderstandings.

Not all organisations will be ready to embark on social innovation; it requires an open mind-set and the ability to cross boundaries.

The method itself can be applied with various levels of rigour. The Value Framework can be directly used with the short explanation given here. It may in this way trigger some initial new lines of thinking. But when a deeper understanding of the different perspectives of value is required, we recommend delving deeper into the theory using the suggested reading list at the end of the chapter.

The Value Framework helps to identify and increase the value of propositions for social innovations. We therefore recommend using the method early in the innovation process. The application of the method itself does not require significant time and resources. In a few sessions it is usually obvious whether an opportunity can be found for creating shared value.

Key insights

- There are good business opportunities for social innovations.
- There is great value to be captured if you look beyond monetary value.
- An open mind-set in discussions with stakeholders enables integration of ideas and value from multiple perspectives.

How to continue?

Further reading

For more background on the method:
– Den Ouden, Elke. *Innovation Design – Creating Value for People, Organizations and Society.* Springer Science+Business Media, London, 2012.

For more information on business transformation towards social innovation:
– Brand, Reon, and Simona Rocchi. *Rethinking value in a changing landscape. A model for strategic reflection and business transformation.* A Philips Design paper, 2011.
– Ellis, Tania. *The New Pioneers: Sustainable business success through social innovation and social entrepreneurship.* Wiley, London, 2010.
– Porter, Michael E., and Mark R. Kramer. *Creating Shared Value.* Harvard Business Review, January 2011.

For more information on design thinking for grand challenges:

– Cross, Nigel. *Designerly Ways of Knowing*. Springer, London, 2006.
– Martin, Roger. *The Opposable Mind. How Successful Leaders Win Through Integrative Thinking*. Harvard Business Press, Boston, Massachusetts, 2007.

Websites

– www.taniaellis.com
– www.youngfoundation.org
– www.designthinkingnetwork.com

09.
Designing new ecosystems: the value flow model

Authors

Elke den Ouden, Rens Brankaert

Introduction

Social innovations seek to create new value propositions that provide a solution for a societal challenge. As societal challenges are often quite complex, in many cases no single person or organisation has all the knowledge required to create the desired solution. Collaboration between different organisations is required to combine different expertise areas and experiences into a new value proposition. Moreover, the resulting value propositions are often a combination of products and services from different organisations, rather than a single product or service. Hence, apart from the products and services themselves, a total ecosystem needs to be designed. This should include all the

relevant social and economic actors required for a successful launch of the 'product' on the market, as well as provide for sustained service in the long term. The design of the ecosystem needs to ensure a return on investment of both tangible and intangible value for all the business parties and other stakeholders involved.

This chapter introduces the Value Flow Model as a method of identifying the relevant stakeholders and the values that are important to each of them, and to balance these values in the total system. The method has proved valuable in enriching value propositions, as well as in gaining commitment from the different business actors to make the investments required for implementation.

Challenge

Social innovations pose a number of additional challenges when compared to more regular innovations. As discussed in Chapter 8, for social innovations to become successful, it is not sufficient to define a good value proposition, but the innovation needs to create shared value. Moreover, social innovations are hardly ever developed by a single organisation. This is not completely new, as many commercial innovations are brought to the market by a network of suppliers, for

example the iPad and its range of accessories is sourced by a range of different suppliers, its Appstore which offers a vast range of apps from software developers, and the wifi-hotspots provided by many ICT providers. But what makes social innovation different is that the network consists of even more diverse parties - not just businesses - each with its own raison d'être and expectations.

The term ecosystem is increasingly used to emphasize the fact that innovation is no longer an activity that organisations work on in isolation. Many innovations are combinations of products and services in a larger system, involving different organisations. Ecosystems aim to bring together those organisations and stakeholders that affect or are affected by the innovation. The purpose of the ecosystem design is to ensure that the innovation will sustainably deliver the intended value to all members of the ecosystem. These members can be many different types of organisations: profit and non-profit, public and private, industrial or regulatory, large and small, or even individuals. Each has a specific role in the ecosystem: for example supplying part of the innovation, advising users, providing maintenance services or approving a new product or service. Ecosystems stretch beyond the traditional supply chain, the supplier-customer network or the 'extended enterprise'. Ecosystems include all stakeholders that have a direct or indirect role in the various phases of the innovation: definition, creation, realisation and extension.

From value chain to value networks and ecosystems

The linear model of the value chain with a series of suppliers and customers no longer fits the new economies of knowledge and transformation. Knowledge, competences and relationships are more important than just the supply of materials and goods, which is why value networks or value constellations are becoming the dominant model (Norman & Ramirez, 1993). In these networks, organisations also exchange less tangible values such as knowledge, information and reputation. Together they achieve greater value than they would be able to achieve on their own, but it requires mutual commitment and mutual dependence to create inter-

organisational systems that promote the creation of value (Blankenburg et al., 1999).

Emergent value networks are formed by negotiations of interests and positions; this is a dynamic process. This is also a complex process due to the potential conflict of interests between the organisations involved which are often from different sectors. In the early phases, the process is even more complex due to the inherent uncertainty about user needs and behaviour. The design process then becomes an iterative process in which the user needs are elicited by 'proposing' innovations and improving them where needed. For the actors in the emerging business ecosystem, this uncertainty limits their ability to secure good starting positions in the ecosystems. More traditional companies that are used to linear supply chains often find it difficult to accept these new levels of uncertainties and to start collaboration if their position is not secured.

The term ecosystem stems from biology, describing a natural unit consisting of different parts, interacting to form a stable system. Ecosystems are both resilient structures that are able to adapt to changes in the environment, and fragile structures that can collapse if changes occur. The analogy with the business world is remarkable. Like business networks, biological ecosystems are characterised by a large number of loosely interconnected participants which depend on each other for their mutual effectiveness and survival. And, like business network participants, biological species in ecosystems share their fate with each other. If the ecosystem is healthy, individual species thrive. But if it is unhealthy, individual species suffer deeply.

For social innovations, the ecosystem is built around a new value proposition and not necessarily around an existing organisation, so it is solution-driven rather than company centred. Offerings from different companies are combined to present value-creating solutions to customers (Adner, 2006). In the creative process of designing a new value proposition and its accompanying ecosystem, different scenarios are explored and the parties involved in the development of the value proposition and value network that creates the ecosystem are not fixed members of the system. During the process, parties may decide to opt out as increasing insights make it clear that there is not sufficient value for them. New parties can also join because they bring relevant knowledge, experience or technology. Although these networks do not require a hierarchy, they benefit from a connected leader with a long-term visionary approach. He or she achieves buy-in from the relevant stakeholders, thereby creating value for all and inspiring people to act according to the 'vision'. Individual and collective interests should be aligned, and a 'win together' approach is used in strategic partnerships and in connection with society at large (Van Marrewijk, 2004).

Business in ecosystems

The strength of a value network is determined by the added value it provides to its customers compared with alternative solutions, and by the commitment of the members. Life in a network is both interesting and complicated, as it places the actor in a number of intricate paradoxes (Hakanson et al., 2009):

- **Opportunities and limitations.** A network is both the

source of life for a company and the cage that imprisons it. The network provides the bundle of different new and existing technologies that is necessary for any innovation. Yet at the same time, the network acts as a brake on innovation because of the investment in existing ways of working.
- **Influencing and being influenced.** A company is both the determinant and the outcome of its relationships and what happens in them. This emphasizes the importance for each company to manage all of its interactions carefully, and for each individual to interact self-consciously.
- **Controlling and being out of control.** The more a company achieves control, the less effective and innovative the network becomes. When a company takes a self-centred view of the network it will fail to understand the perspectives of others, their motivations, resources and understanding, and this will hamper the interface between the well-being of others and itself.

Increasing numbers of companies are starting to realise that they are members of networks. Their activities are influenced by other firms, designers, publishers, users, showrooms, events, artists, design services, suppliers, education, research and other industries (Verganti, 2008). In turn, they also influence the activities of others. However, in ecosystems there is real interdependence of the members. Ecosystems only function effectively when all actors who are crucial to the delivery of a product or service are 'healthy'. Weakness in any domain can undermine the performance of the whole system. Members of an ecosystem share a common fate: they rise and fall together (Iansiti and Levien,

2004). For example, even if Nokia delivers fully functional mobile phones to end-users, they will not able to use them to their full potential if the telecom provider Vodafone has problems with its network. The value capturing process will then be severely affected.

The long-term sustainability and stability of the ecosystem as a whole depends on aspects like these. The interdependence in the ecosystem also means that the motivations of the members should be aligned, and reciprocity in value exchange should be achieved by the members in order to survive as individuals in the system. The role of the ecosystem in the creation and realisation of social innovations is to ensure that its members can keep providing value for all the stakeholders, despite inherent changes and dynamics that occur over a longer period of time. The ecosystem is able to play this role well if the common goal is aligned with the shared drivers of the members (see also the ecosystem level in the Value Framework in Chapter 8).

For social innovations, it is important to design the ecosystem including all the relevant actors required for a successful launch of the innovation on the market, as well as for sustained service in the long run. The design of the ecosystem needs to ensure a return on investment of both tangible and intangible value for all the business parties and other stakeholders involved. The Value Flow Model supports this process by visualising all stakeholders and the value flows between them, and by facilitating the discussions on balancing the value in the ecosystem.

Method

The Value Flow Model was developed as a tool that integrates a number of existing tools ('ingredients') for use in networked innovation, such as those by Allee (2008) or Gordijn et al. (2000). It provides a coherent view of how the value proposition is created from complementary offerings from different organisations, and how the related value flows through the ecosystem.

It visualises specific interactions in the network to provide a perspective for understanding value-creating roles and relationships, and offers a dynamic view of how both financial and non-financial assets are converted into value. The main elements of the model are the actors who play the different roles in the ecosystem and the value flows in the ecosystem. *Figure 1* shows a part of a Value Flow Model.

Some roles are obvious: customers and users of the value proposition are at the centre of the model as they are the targets of the innovation process; without them recognising the value proposition has no meaning. By first of all focusing on customers, the network of collaborating actors can maximize the value for the customers. It is similar to making the cake as big as possible before starting to divide it. For the business actors there are a number of roles that need to be played to get the total ecosystem working. The complete list of roles is shown in *figure 2*.

The second element of the Value Flow Model is the flow of value between the actors: this indicates the transactions that take place between the customers and the different actors.

These transactions cover goods and services, money and credits, information, and intangibles (such as reputation or experience).

Value flow transactions:
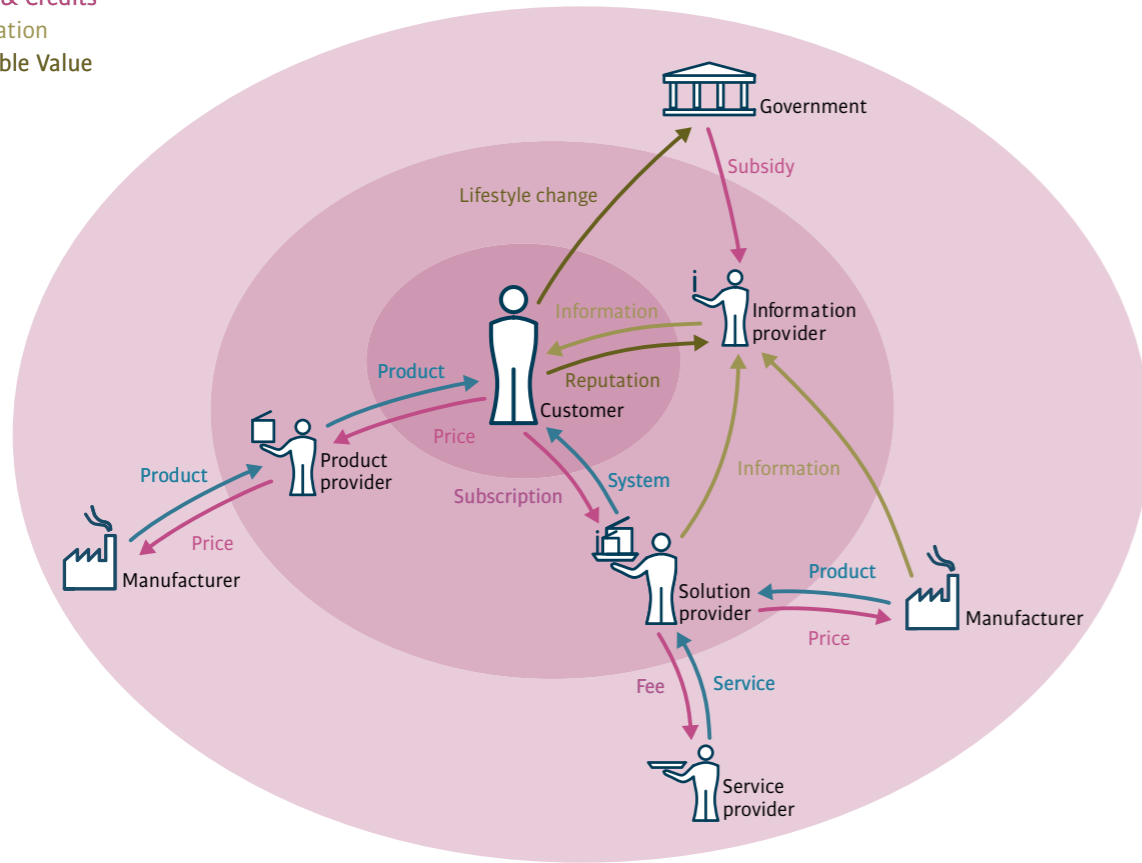
- → Goods & Services
- → Money & Credits
- → Information
- → Intangible Value

FIGURE 1 *the Value Flow Model*

Customer	Users, buyers, co-creators: the target of the new value proposition who receive the value but also may contribute by co-creating or delivering information.
Provider of systems	Business actors integrating different goods and services (their own and from other providers) into a complete system and providing those directly to the customers.
Provider of goods	Business actors providing physical goods directly to the customers, either as part of the core value proposition or complementary goods.
Provider of services	Business actors providing specific services in the value proposition or generic services, such as billing, financial transaction management, logistics and delivery, customer care or service management in direct contact with customers, either as part of the core value proposition or complementary services.
Provider of content	Business actors creating content and providing it directly to customers.
Marketing & communications	Business actors who are dedicated to the commercial communications and marketing activities to promote the new value proposition.
Godfather	Person with political influence who can shield the project from undesirable intervention, especially when the project is scaling to a size where it could disrupt or throw unwelcome light in prevailing socioeconomic or sociopolitical realities.

Enabler	Delivering goods or services to the providers that help enable the delivery of the service, but is not part of the offer to the customer (e.g. providing an infrastructure e.g. an online latform, arranging security and privacy, approbation). Auxiliary enablers, such as e.g. utilities, are also essential to the entire ecosystem, but are not included in the Value Flow Model.
Financier	Investors, who enable the development and implementation of the new value proposition with financial support.
Intermediary	Business actors like retailers, brokers who have direct contact with customers in selling products and services of other providers, they may provide a context and lead the choreography of the contribution of the other business actors.
Supplier	Delivering components (hardware or services) to providers of goods or systems that will be integrated and delivered to the customers. Suppliers do not have direct contact with the end-customers.
Competitor	Competitors can be important allies in building legitimacy, creating demand and supply of new technologies in radical innovations.
Government	Governmental organisations are often required to obtain approval before market introduction, but they also may be instrumental for obtaining subsidies.

FIGURE 2 *roles in the business ecosystem (Den Ouden 2012)*

Steps in designing new ecosystems

The process of designing new ecosystems involves a number of steps. This will rarely be a tidy, sequential process; it is more likely to be highly iterative, however, for the sake of clarity the process is described as if it is a sequence of steps. *Figure 3* shows the five steps which are described below.

1 **The process starts** with the initial value proposition. Once there is an idea for a meaningful innovation that creates shared value (see also Chapter 8), the process of designing the new ecosystem starts.

2 **The second step** is to select parties for a further ideation process to enrich the value proposition. These parties are invited to a workshop where the initial value proposition is presented. The participants are then invited to share their opinions, knowledge and experience, and translate the input into in aspects that need to be addressed to make the innovation successful.

3 **The third step** is to identify the most important stakeholders and their interests: what could their motivation be to actively support the innovation.

4 In **the fourth step**, the relevant roles are defined and the value flows indicated. In this step it is important to create the first complete version of the Value Flow Model. The motivations of all stakeholders need to be addressed and there should be a positive balance between the investments and the returning value for all relevant stakeholders. The in and outgoing value can be of a completely different nature: goods, money, information and intangible value can all be part of the transactions. Hence this check on balance is not simply a mathematical exercise. The best way to check the balance is 'if it feels good'. Intuition and gut feeling are better judgment criteria in this respect than trying to put a monetary value on intangible value. The perceived balance needs to fit with the motivations and values for the actor.

5 **The last step** in the process of making a Value Flow Model is to divide the roles among organisations that see a good position for themselves in the new proposition and ecosystem. This selection is purposefully set at the end of the design of the ecosystem, as experience shows that the creative process of finding a better proposition often stalls when companies and organisations start to view it from their own perspective and try to secure a role that fits with their business too early. Once they see the role, they aim to influence the value proposition to make it best fit with their current business models and product or service portfolio. This turns the process around from 'outside in' to 'inside out', and often the wider perspective of value for different stakeholders is lost. In this step, the roles are divided among participating organisations to achieve the creation of the complete new ecosystem.

The steps are described as if no ecosystem exists. In reality, various parts of the ecosystem already exist, and some parties may already be working together. The reason to start with a clean sheet is that we aim to bring as much value for the user and society as possible, and would like to keep the mind-set as open as possible during the process. That is why roles are defined in step 2 and only linked to actors in step 5. The Value Flow Model was specifically developed to visualise the ecosystem during its development, and to support all steps of the process.

orientation & inventory   **building the ecosystem**

1	2	3	4	5
initial value proposition	select parties for ideation & enrich value proposition	identify stakeholders and their interests	define roles & value flows	select parties for realization & implementation

value flow model to visualise ecosystem
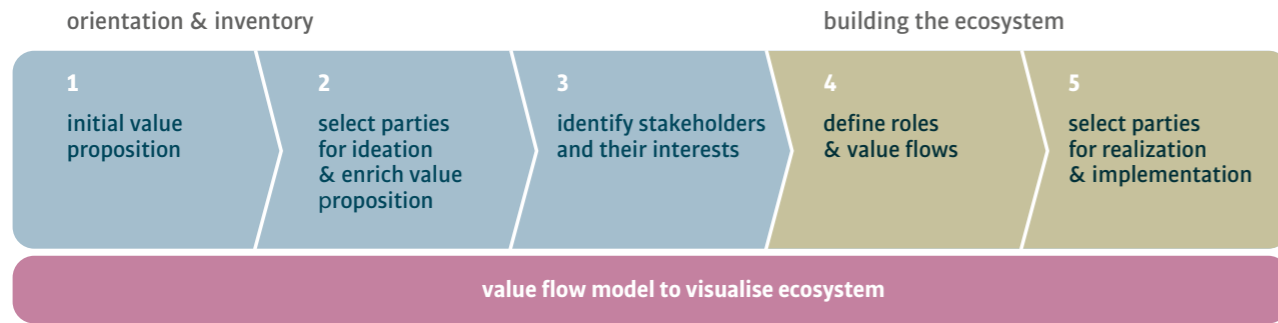
FIGURE 3 *steps in designing a new ecosystem*

Light for Dementia

An example of a project in which the design of an ecosystem was crucial to make a success of the innovation is the 'Light for Dementia' project. The project aims were to develop a lighting solution for people living with dementia. Dementia is a growing concern: the number of people suffering from dementia is increasing rapidly as a result of the aging population. At the same time, there is pressure to reduce health care costs by having patients stay longer at home. Dementia is not only a burden for the patient; as the disease progresses it also places an increasing burden on caregivers. No less than 98% of the caregivers of dementia patients suffer from physical or emotional problems or fatigue. One of the problems of dementia is that sufferers sleep poorly at night and sleep during the day. This causes stress for the caregivers: they become anxious about the nights and thereby suffer from a lack of sleep themselves. Over time they often can no longer cope with the situation, and the patient needs to be moved to institutionalised care.

In institutionalised care situations, experiments have been done with lighting solutions to improve the circadian rhythm of people with dementia. These experiments have shown significant effects on sleep quality and mood, as well as on the rate of cognitive decline, which appeared to be less than in the control group. However, no experience has yet been gained with a similar solution for patients still living at home. Thus the initial idea for this project was to create a lighting solution

for people with dementia that can be used at home. As in many solutions in the healthcare environment, the Light for Dementia proposition requires collaboration from many organisations to make it successful. To gain an understanding of the potential ecosystem for this project, the Value Flow Model was used.

The first step was to create an understanding of the dementia process and the stakeholders involved. For this purpose a patient journey in the form of an interactive experience flowchart was made (figure 4). The flowchart integrates the user/patient perspective, the care expert point of view, and the process logic of the progressing disease. The possible routes for people diagnosed with dementia are diverse. The coloured lines give examples of three personas representing likely scenarios of the dementia process:

· **Joop: an ideal patient.** He goes to the doctor to discuss symptoms early, accepts the diagnosis and follows all the advice he gets. His caregivers try to understand the situation, and provide the best support possible.
· **Willem: a doom scenario.** He is rebellious; he typically ignores symptoms, does not accept the diagnosis and disregards advice. His caregivers are not able to influence him either.
· **Toos: a single person**, living on her own, going through the dementia process on her own and all the trouble this adds, such as not being aware of symptoms and having difficulty coping with the effects of the disease.

In the interactive flowchart, short stories and short video clips of interviews are included to provide a perspective of what the

patients experience. This flowchart served the important role of bringing together the bits and pieces of information from different experts into one total picture, which then enables discussion and debate. The complete interactive flowchart can be found on www.rensbrankaert.nl/flowchart/.

FIGURE 4 *patient journey dementia – visualisation to support a shared understanding among all stakeholders (Alblas & Den Ouden, 2011)*

In the second step, an analysis was made of the relevant stakeholders related to the Light for Dementia proposition. The result of this analysis is shown in *figure* 5. Based on the overview, several stakeholders were invited to a workshop: representatives from the municipality, care providers, the patient association and industrial companies. The participants mapped the value flows and created different business scenarios.

During the discussion on the value flows, it became clear that in addition to placing the system at the patient's home, it could also be an option to position it at a place the patient frequently visits (e.g. ambulant care) or to create serviced apartments specifically for dementia patients and their family. The value proposition in these cases can be different, as the accepted costs may also be different. This triggered a discussion on different scenarios for the business models. If the resulting product is sold on a business-to-business market to organisations providing ambulant care or to the owners of serviced apartments, a simple business model with a one-time commercially priced payment might be feasible (as plotted in *figure* 6).

When considering a consumer market, this business model is an unlikely scenario. In the Netherlands, where most healthcare costs are covered by patients' health insurance or governmental support, not many patients are willing to invest in healthcare devices. So the financial flow then has to include (partial) reimbursement, as shown by the red lines in *figure* 7. Another option is that, instead of buying the solution, patients

Legend :
- ● Direct customer or user
- ● Potential payer
- ● Indirect beneficiary
- ● Disbeneficiary
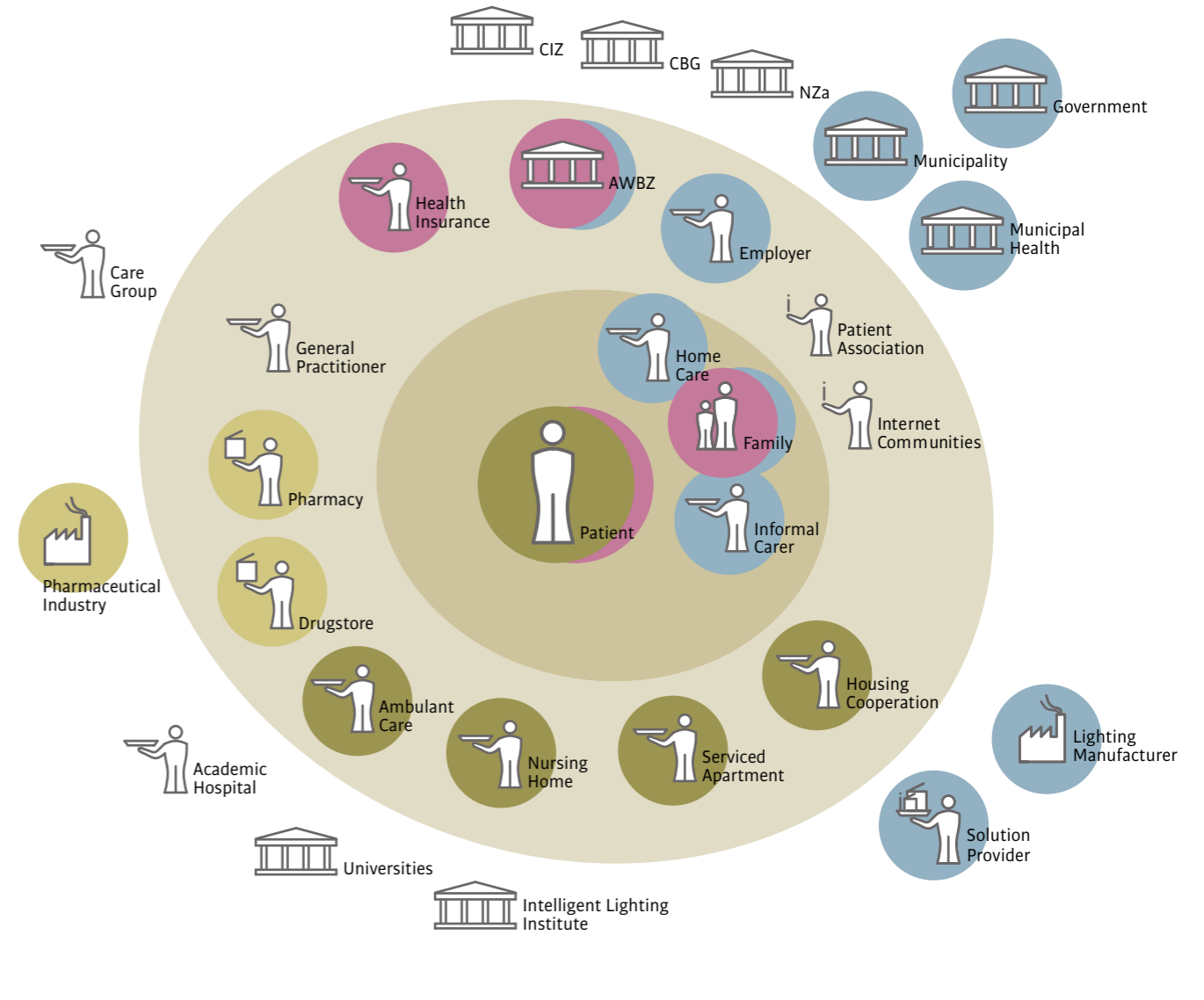
FIGURE 5 *stakeholders in the Light for Dementia proposition*

Legend :
→ Goods & Services
→ Money & Credits
→ Information
→ Intangible Value
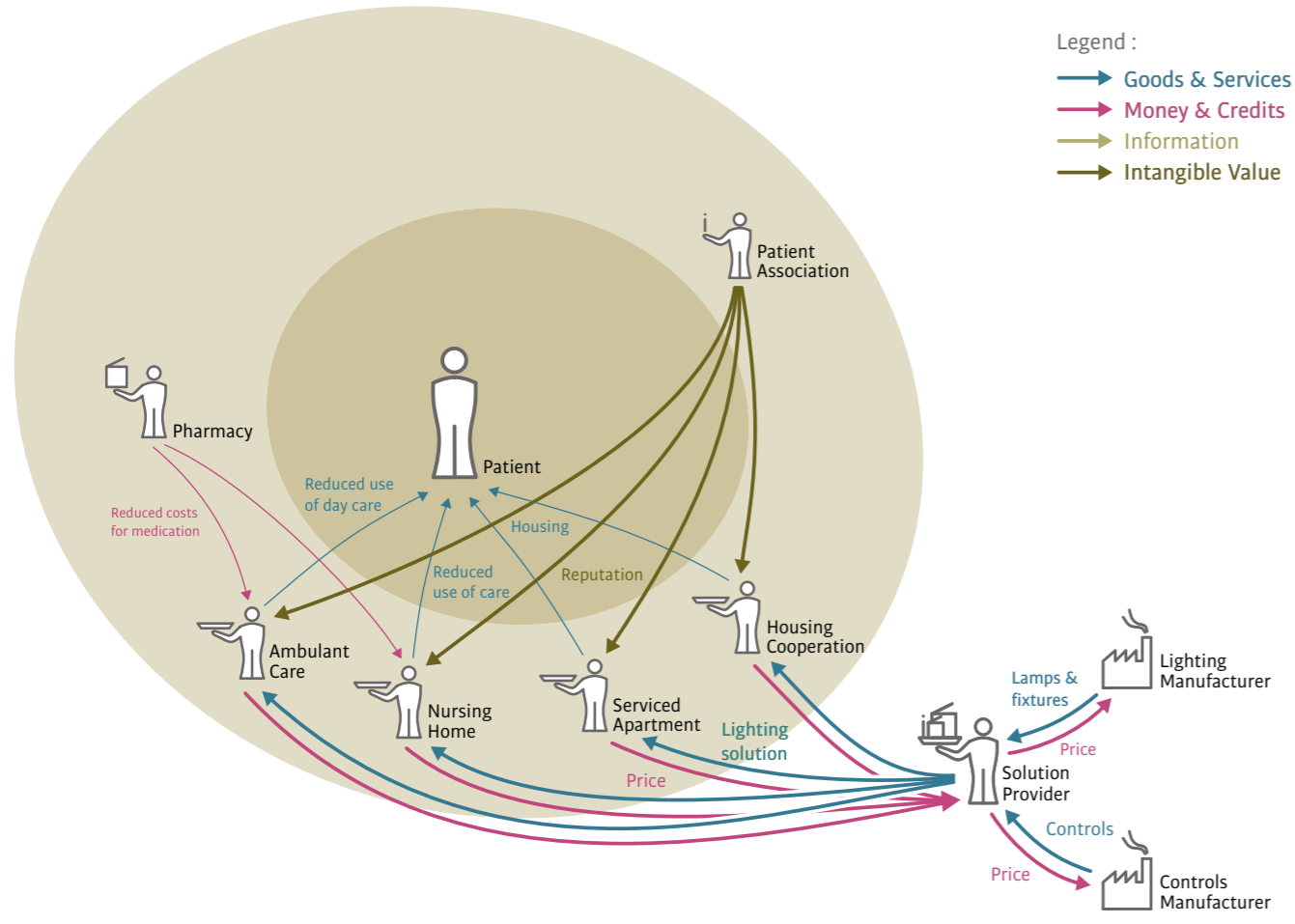
FIGURE 6 *value flows in the ecosystem for a business-to-business solution*

Legend :
→ Goods & Services
→ Money & Credits
→ Information
→ Intangible Value

New role: **Entrepeneur**
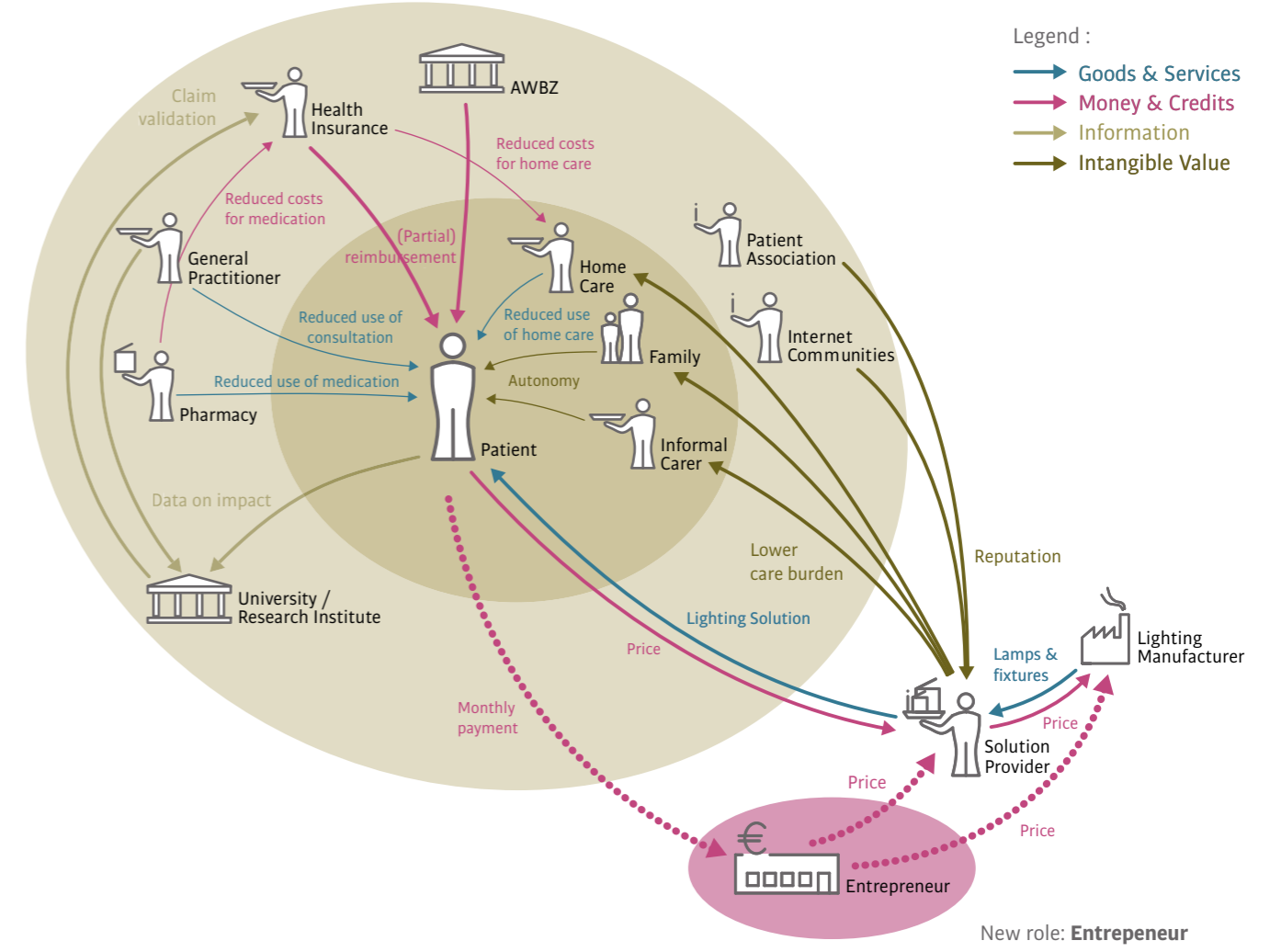
FIGURE 7 *value flows in the ecosystem for a consumer solution including different business models*

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can rent the system for the time they need it. In this case an additional role needs to be added to the ecosystem: the role of an entrepreneur who is willing to finance this solution, see the dotted red lines in *figure* 7. This might increase the willingness of patients to adopt the solution.

The discussion on the active involvement of the insurance companies then triggered a need for information flows. For solutions in the healthcare domain, it is often important to have solid claim validation processes implemented. If the solution has a proven effect and integral healthcare costs are decreased, insurance companies are willing to reimburse the costs for their patients. As this solution was not yet proven in home situations, the claim validation process had

to be started as well. The light brown lines in *figure* 7 show the information flows in the Light for Dementia consumer solution.

The next step was to identify the intangible value flows. For some stakeholders, like the care providers, intangible value is of great importance: e.g. the quality of life for patients and their social support system. Also the reputation that their institute gains in the perception of the patient association is an important value, see the dark brown lines in *figure* 7. The discussion on intangible value also triggered a discussion on the value of the solution beyond the currently plotted stakeholder network: for informal caregivers that suffer from fatigue there are hidden costs resulting from their absence

from work or additional healthcare costs. In the next phase of the project, the hidden costs and value for those stakeholders will also be explored (e.g. the value for the employers of the family members providing care for their dementing parent, and running the risk of having to ask for sick leave). Insights into these hidden costs might lead to new business models and opportunities for solutions.

Figure 9 shows two scenarios for selecting roles in the Light for Dementia project. The first scenario is that the lighting manufacturer sticks to a traditional business model of selling systems. In the second scenario, the company realises that, to make this innovation successful, it will have to provide an installation service and opportunity for patients to lease

the product. Instead of the 'traditional' product seller, the company then becomes a total solution provider for its customers.

This last step completes the first iteration of the design of the value proposition and new business ecosystem. In this project this first iteration gained sufficient commitment from the relevant stakeholders to invest in the actual design and realisation of the solution and to start up a pilot study.

The following stage of the process is the creation of an environment to evaluate light innovation proposals in a realistic setting. An experiential design landscape (Van Gent et al., 2011) for dementia care will be developed at
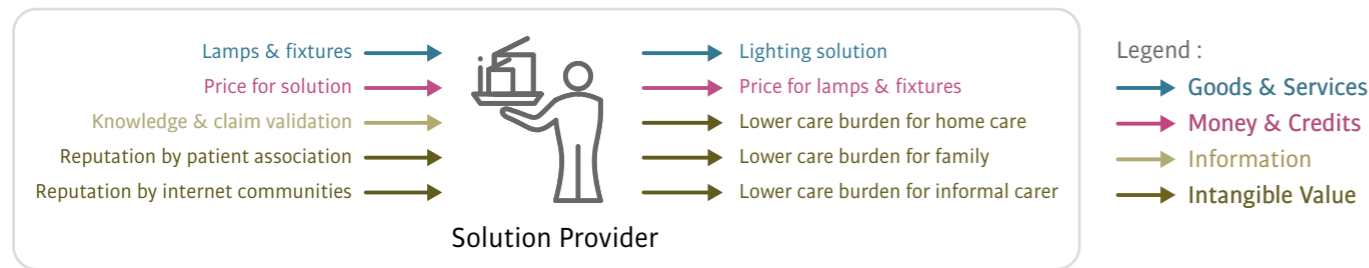

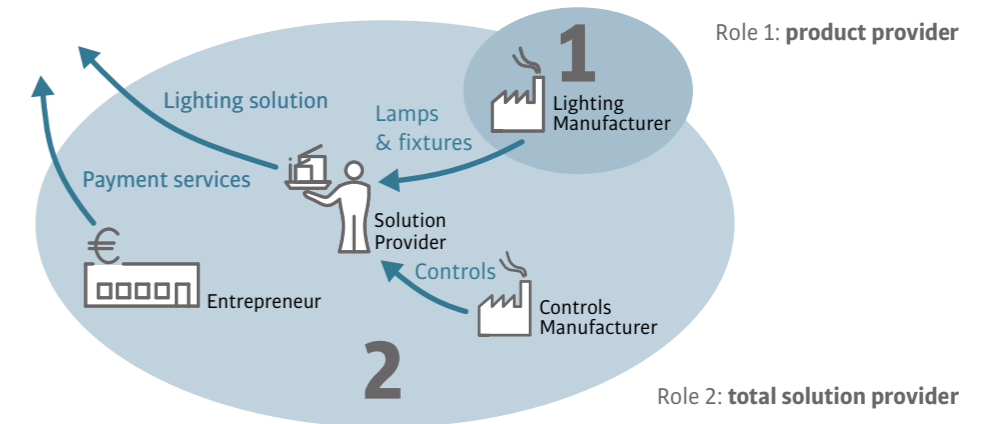FIGURE 8 *check on reciprocity, using the example of the Solution Provider*

FIGURE 9 *selecting roles: two scenarios*

the geriatric department of a mental hospital in Eindhoven, the Netherlands. In this landscape, real patients and other (relevant) stakeholders will be introduced to prototypes of the innovation. Several iterations are required to develop solutions and match the value proposition with the needs experienced by people living with dementia, and to set-up a co-creation structure.

The evaluation in a real-life setting is necessary to gain stakeholder commitment to the validation and realisation process of, in this case, lighting solutions for dementia and their caregivers. *Figure 10*, shows how several designs were developed progressively in this set-up, with different goals for each incremental step.

As can be seen in the figure, the developmental process of an innovation concludes with a societal business case as end goal. This provides an indication of the value in society and includes a plan for the realisation of the new business ecosystem. In this set-up, we want to go through different cycles of evaluations with stakeholders and create a platform from which we can develop and build new innovative solutions together with the required ecosystem.
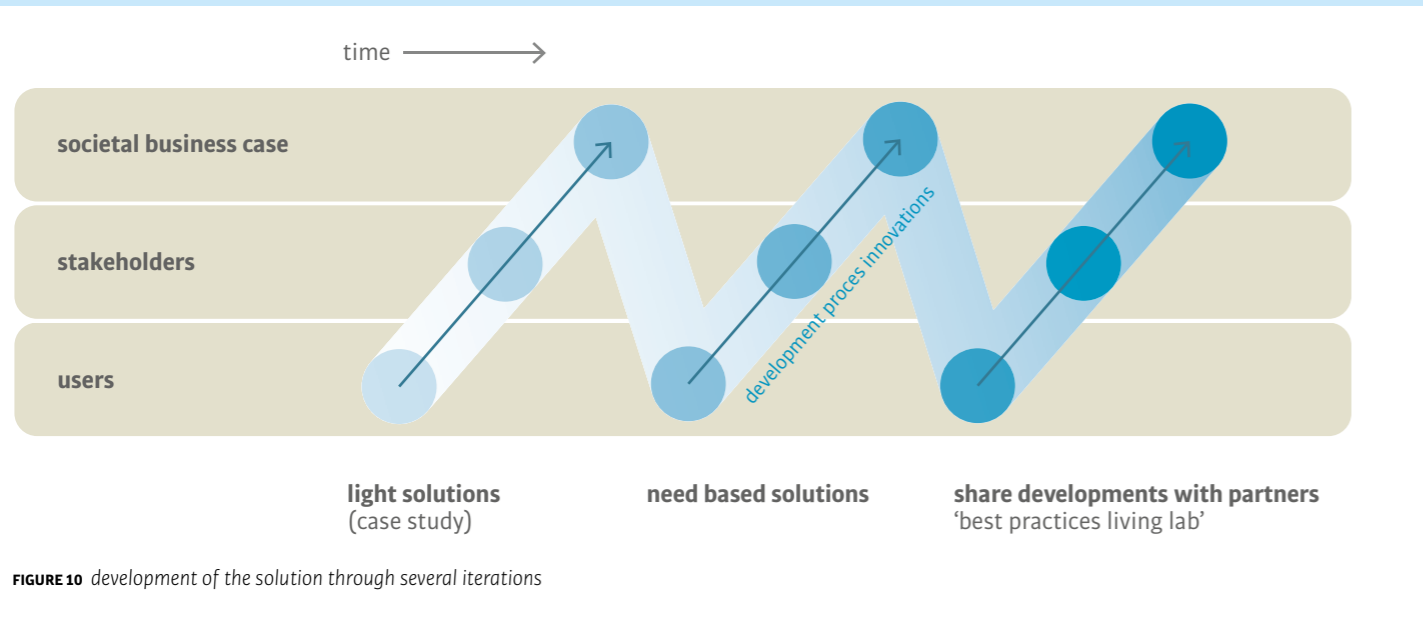

FIGURE 10 *development of the solution through several iterations*

Benefits and limitations

The Value Flow Model is particularly useful in early discussions on value propositions that require the collaboration of many parties, each with their own motivation. It helps by visualising all the relevant stakeholders and aims to satisfy their varying interests. By placing the user in a central position, it supports the continuous focus on the value of the innovation for the user. However, by adding the societal aspect of the proposition, it also helps to address a higher level of value.

Not all companies will be ready to embark on social innovation. The process requires an open mind-set and the ability to let go of established product and/or service portfolios and business models. This process achieves the best results when the value proposition is defined and enriched (making the cake as big as possible) and only then, working out the division of roles. Organisations seeking direct links with their current business often struggle with this process.

The Value Flow Model aids the design of new ecosystems for social innovations. This is a highly uncertain process where the aims, input and gains of the collaborating parties are not clear up front. This requires flexibility from parties involved in the ecosystem. As insights progress and the value proposition is adapted, some parties realise there is insufficient value for them and they may opt out of the collaboration, and new parties may enter.

Key insights

The Value Flow Model helps:
- to map the relevant stakeholders
- to identify their drivers and motivations
- to define value flows (goods & services, financial, information, intangible)
- to analyse the value flow model on completeness, feasibility and scalability
- to balance value for the individual stakeholders
- to plan for implementation
- if an innovation requires the participation and commitment of a number of stakeholders, and not just the product service system but also the ecosystem and the value model need to be designed.
- when an overview of value transactions makes it possible to evaluate whether relevant stakeholders have a sustainable business in the ecosystem.
- when it is important to design the system based on actors and roles, and to divide the roles among the organisations at a later stage. Otherwise, the creativity to find the best solution from differing viewpoints is hampered as organisations stick as closely as possible to their current business models, products and/or services.

How to continue?

Further reading

For a more detailed description of the method:

– Den Ouden, Elke. *Innovation Design – Creating Value for People, Organizations and Society.* Springer Science+Business Media, London, 2012.

For more information on business in networks and ecosystems

– Adner, Ron. *Match Your Innovation Strategy to Your Innovation Ecosystem.* Harvard Business Review, April 2006.
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– Moore, James F. *The death of competition: Leadership and strategy in the age of business ecosystems.* HarperCollins Publishers, New York, 1996.
– Iansiti, Marco, and Roy Levien. *The Keystone Advantage: What the new dynamics of business ecosystems mean for strategy, innovation and sustainability.* Boston; Harvard Business Press, 2004.
– Iansiti, Marco, and Roy Levien. *Strategy as ecology.* Harvard Business Review, Vol. 82, No. 3, 2004, pp.68-78.

For more information on experiential design landscapes:

– Van Gent S.H., C.J.P.G. Megens, M.M.R. Peeters, C.C.M. Hummels, Y. Lu and A.C. Brombacher. *Experiential design landscapes as a design tool for market research of disruptive intelligent systems.* Proceedings of the 1st Cambridge Academic Design Management Conference, 7-8 september 2011, Cambridge.

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– www.businessweek.com/innovate/NussbaumOnDesign/archives/2008/12/innovation_is_d.html
– www.innovatedementia.eu
– www.boardofinnovation.com

epilogue
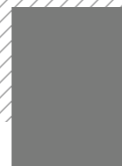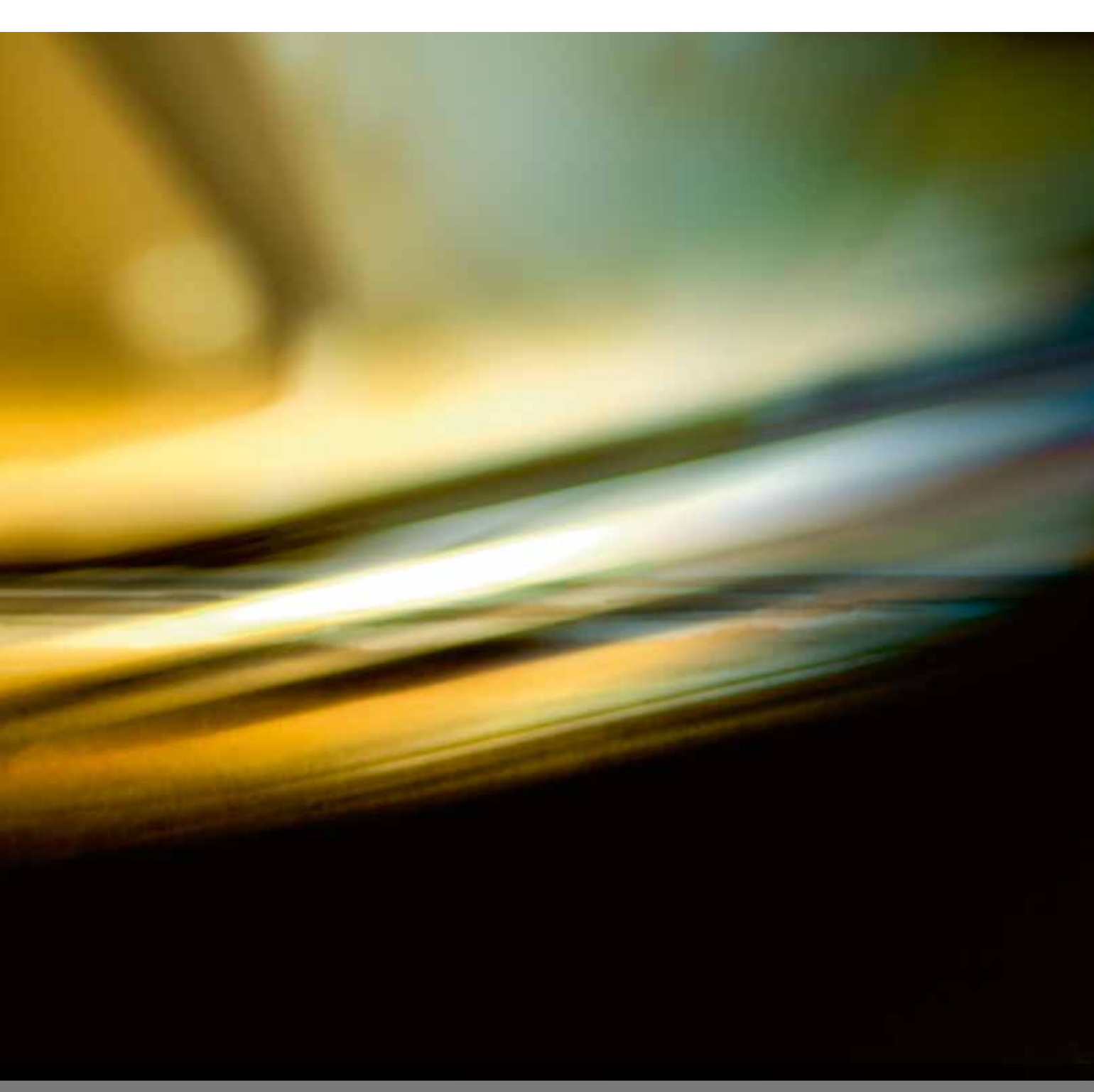
10.
Design Research: purpose, dynamics and progress

Authors

Frido Smulders, Cees de Bont

Introduction

In this chapter, we take you on a journey into our world of design research and show you what we do, why we do it and what we achieve. Some of these results have been presented in other chapters of this book; others may form the subject of future books, written by Dutch researchers working together on projects that are part of Design United, the collaboration between the university-based design schools.

The first part of the chapter provides insights into the current status of university-based design research. In the second part, we introduce the major steps taken in the history of design research.

These form stepping-stones, allowing us to zoom in on recent developments, in turn, these may form a bridge to a next book.

The chapter ends with a 'final chord', that moves the reader from the challenging world of design research back to the similarly challenging world of business. As an encore, it includes some thoughts aimed at helping you embark on the process of implementing some of the tools described in this book; a process we call 'innovating innovation'.

Lastly, we trust that the book, and this chapter in particular, will awaken your interests in design research.

Challenge

In this section we discuss the research challenges that we, as academics, have in the field of design. It is It is worthwhile reflecting on why universities conduct research in the first place. Although opinions differ on this, our view is that the primary task of universities is to transfer scientific knowledge to society. The most common form 'chosen' by universities to fulfil this task is by educating students, making them knowledgeable in the domain of their studies, and then sending them out into society to apply in practice what they have learned. From this perspective, the educational process forms the primary process of a university.

Scientific research is our R&D-department. By conducting research, we renew and improve the content of our educational programmes and processes. Research output in the form of books and articles, contains new knowledge and in general disseminates research findings amongst the scientific community, and thereby indirectly to society.

In addition, valorisation processes form an alternative route to achieving knowledge transfer. Writing books like this one, publishing articles in professional magazines, post-academic education, applied research funded by external parties and supporting entrepreneurship in the form of new ventures; are all valorisation activities that similarly aim to transfer scientific knowledge to society.

Because we need to stay in close contact with sociuety, our main challenge is: conduct the right research! This involves composing well-balanced research agendas to serve the societal and economic needs of society.

Let's have a quick look at what scientific research actually aims to achieve. Scientific researchers, as discussed by De Groot (1994), Dorst (2008) and others, embark on activities that, roughly, follow the sequence: observe, describe, understand, explain, predict and prescribe (*figure 1*). These research activities aim at forming theoretical explanations of real world phenomena and, based on these, developing methods and tools that are of value to those applying them in society or business. For instance, scientific research in many of the engineering fields has resulted in handbooks with methods for dike design, aircraft design, bridge design, et cetera that prescribe the way these objects should be designed and engineered. These handbooks provide prescriptions like, 'if you are in situation x then do y for resolution'. In figure 1, the research activities on the left side of the curve have a fundamental orientation, whereas the research activities on the right have an applied orientation. In general, on the left side the aim is to build theories and on the right side to test them. Depending on goals and situational factors, researchers choose a suitable research approach from a large array of research methods. It is interesting to note that, under the right conditions, design approaches and product designs are increasingly recognized as viable scientific research methods. Sometimes a complete design and prototype is needed to form the proof of a complex set of scientific hypotheses. Consider for instance the design, engineering, building and testing of the Ampelmann as a PhD-research project (Cerda Salzmann 2010), which made "Offshore access as easy as crossing the street" (ampelmann. nl). The hypothesis is too complex to test on the constituting sub-hypotheses. Instead a full fledged prototype was needed to test the predicted behaviour.

The logic behind this sequence in *figure* 1 is as follows. You cannot prescribe a way to handle a situation if you cannot predict the effects of of what you prescribe. These predictions are based on explanations rooted in a fundamental understanding of the related phenomena. For researchers, this implies that they must have observed and described the relevant phenomena as found in empirical reality. Between these steps, activities like experimenting, testing, proving, etc. aim to validate the intermediate results. However, sometimes it takes many generations of researchers to prove hypothetical predictions: for example, it took 75 years before we were able to prove the existence of the Majorana particle, first predicted in 1937. But also, if theoretical predictions prove to be wrong or inadequate in practice, we have to return to research aimed at additional or deepened understandings and explanations.
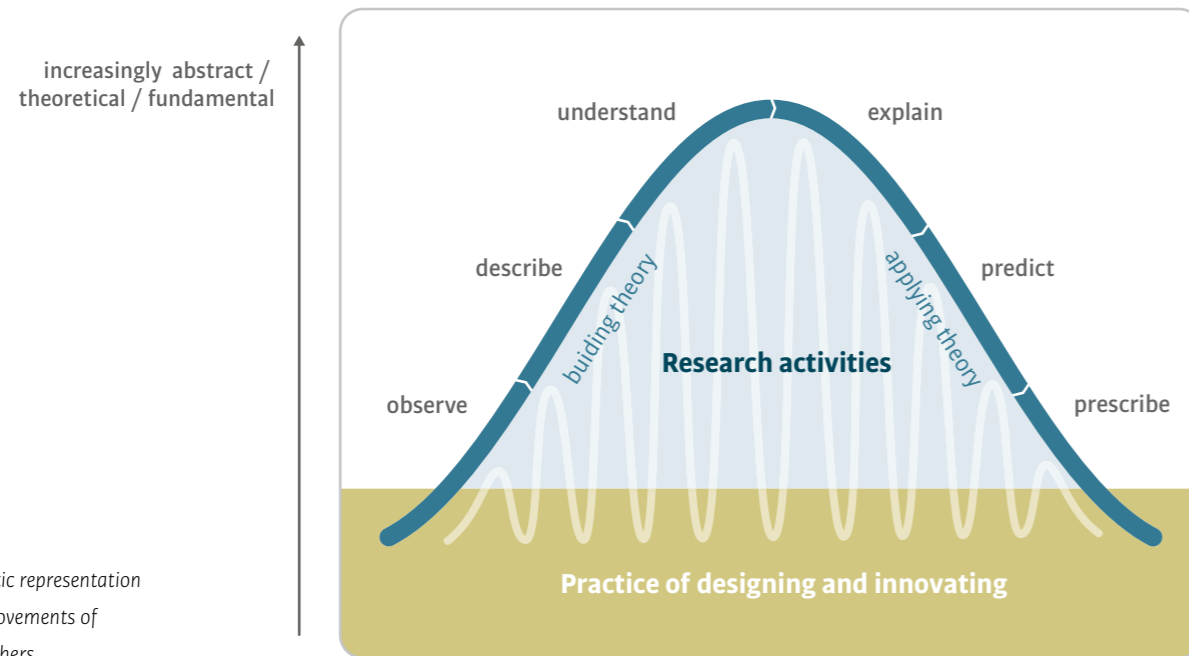
FIGURE 1 *schematic representation of the generic movements of scientific researchers*

Consider the period of design and engineering of 'black aluminium' airplanes during the change over from the use of monolithic aluminium to the application of black carbon fibre composites. Parts were engineered applying aluminium based knowledge but were subsequently constructed in composite material. To prevent simply substituting one material for the other, new handbooks were needed to help engineers fully utilise the unique properties of these new materials.

The field of design, similar to that of its larger 'brother' innovation, has as yet only built up a modestly sized fundamental knowledge base, especially if we consider design

in its industrial context and as being part of overarching innovation processes. There is still ambiguity in the scientific literature between what design and innovation actually are. Contradictory findings by researchers have lead to multiple explanations, indicating that we need to dig deeper to more fundamental levels of understanding. In professional practice this ambiguity is one of the explanations for why the success rate of product innovation is still fairly low. Companies simply cannot predict the success of their design efforts, and hesitate before embarking on even more disruptive design and innovation journeys, or see their efforts end in feelings of despair. In contrast to physics, there is no single fundamental law or set of explanations that governs design and/or innovation. We as researchers need to aim for more robust and integrated explanations of the phenomena of design and innovation.

Design and innovation are multi-disciplinary fields. In practice, as well as in academic research, a range of disciplines are involved: arts, design, ergonomics, a range of engineering disciplines, economics, psychology, ethnography, business, marketing, management, et cetera. All of these contribute to the field of design in differing ways: from fundamental insights to methods and tools based on these fundamental insights. Design theories and design methods, therefore, are formed by integrating theories from the contributing fields. New insights from one of these fields, e.g. psychology, may have considerable impact on existing theories or methods and thereby necessitate additional applied or deepening research in design. Similarly, developments in the practice of design

may initiate new research programmes, for example the current research programme aimed at advancing the Creative Industries (CRISP) that looks for approaches for generating new consumer experiences through combinations of products and services.

Of course, the design field is continually moving forward, providing new challenges for researchers, new tools to be developed, unknown territories to be described, and phenomena to be understood and explained. There are many subjects with which we can fill our research agenda. However, we have limited resources and need to make the best choices, leaving us with the question: How does the 'right' research get into our research agendas?

Design research portfolio

Research conducted by academic-based designers results in knowledge that is then transferred to students. On graduation, these young designers have to be able to successfully apply the assimilated knowledge in their practice. For knowledge to have an application value, universities need to conduct research focused on supporting and/or resolving societal/industry relevant issues. So, researchers need to be able to relate to society, or more specifically, to design related companies, and find out what future needs these companies have in our domain. However, future (latent) needs, are often not easy to articulate and define. What does industry need in order to become more proficient or competitive in the future? How do these needs relate to industry design and innovation processes?

We describe four ways of composing a society and industry relevant research agenda:

1 Collaboration with practice

Firstly, research that is based on close collaboration with design practice. Chapter 6 introduces the Brand-Driven Innovation (BDI) method that was initiated in practice and has been further developed and refined in many industry applications. Although academics, design researchers and graduating design students were involved in its development, the programme was not initiated at a university. BDI 'came to life' in a co-evolutionary process, whereby industry needs and design consultants' solutions evolved over the course of many projects, ultimately resulting in the proven method of Brand Driven Innovation. Exactly why this method works and which theories from organisational psychology and other social sciences lie behind its success at deeper scientific levels, has yet to be researched. Such may perhaps sound 'un-scientific', but this is not the case: in the field of design and innovation, academic research often follows on from the advanced practice of leading professionals.

2 Industry needs

Secondly, research can be inspired by industry problems. In this case, researchers purposefully and systematically search for the most urgent design problems. This can be likened to market research conducted to identify consumer needs; we also conduct research in industry to identify its problems and needs. For instance, the increased focus on the user is a result of industry observations: think of the difficulties many consumers face while using products. This is not because the product's ergonomics were ignored by designers, but because

of the complex, at least in the eye of the user, use-structure, designed, engineered or programmed by its developers. Research in this field has resulted in new methods and tools, some of which are presented in this book in the section on user-centric research. The trend towards an experience economy has stimulated research aimed at uncovering methods and developing tools that support designers in their pursuit of design solutions that evoke the experiences sought for.

3 Trends & developments

Thirdly, our research agenda is based on worldwide trends and developments, for example the increased attention being paid to sustainable products and businesses, new ways of business modelling, and the trend towards collaborative and open innovation. On design level, for instance increased attention to lean product development, rapid prototyping and 3D-printing. In contrast to solving current industry problems, these trends and developments provide opportunities for research projects that aim at the development of methodologies that lower the thresholds and risks for industry to follow up on these trends. In addition, this may lead to new and better processes for developing new market propositions, including: higher speed, higher efficiency and lower risk. Examples are present research projects on open innovation, product-service systems (CRISP) and design for sustainability. The new, broadly defined areas like design and health care (e.g. ageing), design and new energies, design and mobility, have also become part of our research agenda. These global areas could typically be put on the map by national and international (EU) research funding organisations.

4 Fundamental

Finally, our research agenda is composed of projects that result in a deeper and more fundamental understanding, ultimately aimed at the creation of actionable theories/ models/tools with reliable predictive power. As mentioned, the fields of design and innovation are still in search of fundamental and integrated theories. If we regard design, as well as innovation, as natural phenomena that are part of human nature, as has been seen throughout history, then the day-to-day practice of design and innovation is a step ahead of what we know or are able to put in theories and models. Readers may think that researchers should just listen carefully to what best practice practitioners say, observe what they do, write this up and tell it to the students. However, this would be too simplistic. Scientific research is not just a form of story-telling. Stories are anecdotal and require deeper theoretical scrutiny in order to arrive at knowledge that has explanatory power and predictive value. Researchers therefore need to investigate 'best practices' across (many) successful cases to build and test fundamental theories robust enough to arrive at the predictive power sought after.

Never copy the leader

A well-known case is provided by Toyota. Other car manufacturers failed to copy Toyota's best-practice innovation processes. What actually happened was that they didn't fail to copy the explicit parts of the Toyota practices, but they failed to take the non-described and implicit parts of Toyota's practice into account. No academic researcher will ever be able to describe any design & innovation practice in sufficient detail as to form a 'ready-made recipe' that can be applied elsewhere. It is a little like the famous expression, 'never change a winning

team': one simply doesn't know what exactly causes the team to win and therefore is afraid to throw the baby out with the bathwater. It is the tacit dimension not just of one person, but that of the whole team: they together know more than they can tell, to paraphrase Michael Polanyi. Similarly, in innovation practice, designers do not exactly know what contingencies related to their own context need to be taken into account in order to make the best practice work satisfactorily elsewhere. As in the Toyota example, every car manufacturer is different so this requires any practice, method or tool derived from Toyota-specific processes to be adapted to the peculiarities of their own situation. This necessitates a deeply rooted and fundamental understanding of the related design and innovation phenomena.

Scientific research on design and innovation goes beyond the bare description of what works best in practice, and aims, using theoretical frameworks, to create a solid foundation by understanding and explaining what is observed. Therefore, academic researchers listen and observe very carefully and analyse what practitioners say and do.

Design and innovation processes, for a large part, thrive on implicit and tacit knowledge, that is, the knowledge that practitioners have but which they are not able to easily verbalise *(figure 2)*. In order to develop our research agenda in this way, researchers need to base their observations on that same practice. Another option is to ask practitioners to partly become researchers and collaborate with the scientific community; this helps them to explain and create new insights for this community. In Chapter 7 we present a study where academic researchers collaborated with practitioners to discern a framework on team cognition. This would not
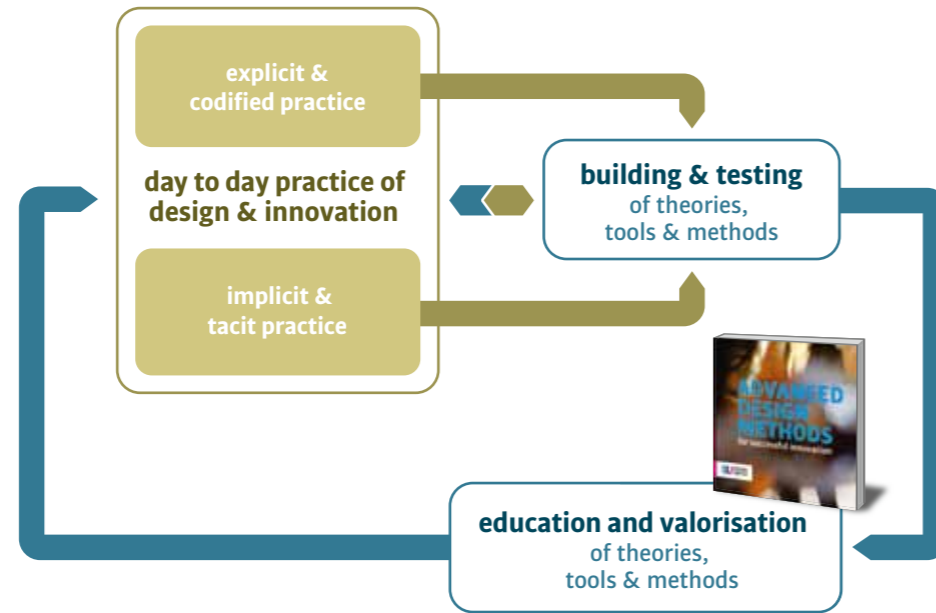
FIGURE 2 *development of theories, tools and methods in close collaboration with industry. (Smulders & Schuffelers 2013)*

have been achievable without the practicioners' participation, as only they had the deep understanding of the content, so that, with the support of academic researchers, they were able to explicate part of their tacit/implicit knowledge. *Figure 2* shows how academic researchers in the field of design and innovation work in close collaboration with practice to develop and test theories, tools and methods. Transfer to industry through education and valorisation on a larger scale

will happen after these theories, tools and methods have reached a certain level of robustness.

In this first section, we have demonstrated why academic design researchers conduct research, and how an academic research agenda is formed. This provides the background to the next section, where we present an overview of past research developments in our domain.

Earlier design research

The founding of the Design Research Society in 1962 can be seen as the start of design research as a building block for the practice of design. In the 1960s, it became evident that designers no longer could rely on their competences related to design of product, hardware and form; they also had to take human needs into consideration (Bayazit, 2004). This observation initiated the subsequent spread and expansion of design and innovation related research activities. In *figure 3* we have aimed to create an overview of research foci that can be identified in academic literature. This overview is by no means exhaustive or complete; it just aims to support the overview of earlier design research discussed here. On the left side we see research with a more singular focus whereas towards the right, we identify more extended could identify more extended or integrated foci. For instance, the social dimension of design, which will be addressed later, includes the process as well as the designer and other related stakeholders. Therefore we see this as extended foci. Similarly, under the extended foci we see 'design beyond design' as a research theme. Here, design processes and design theories, identified within single focus research activities, are applied in areas beyond the traditional field of product design. Consider for instance the application of design thinking to societal issues.
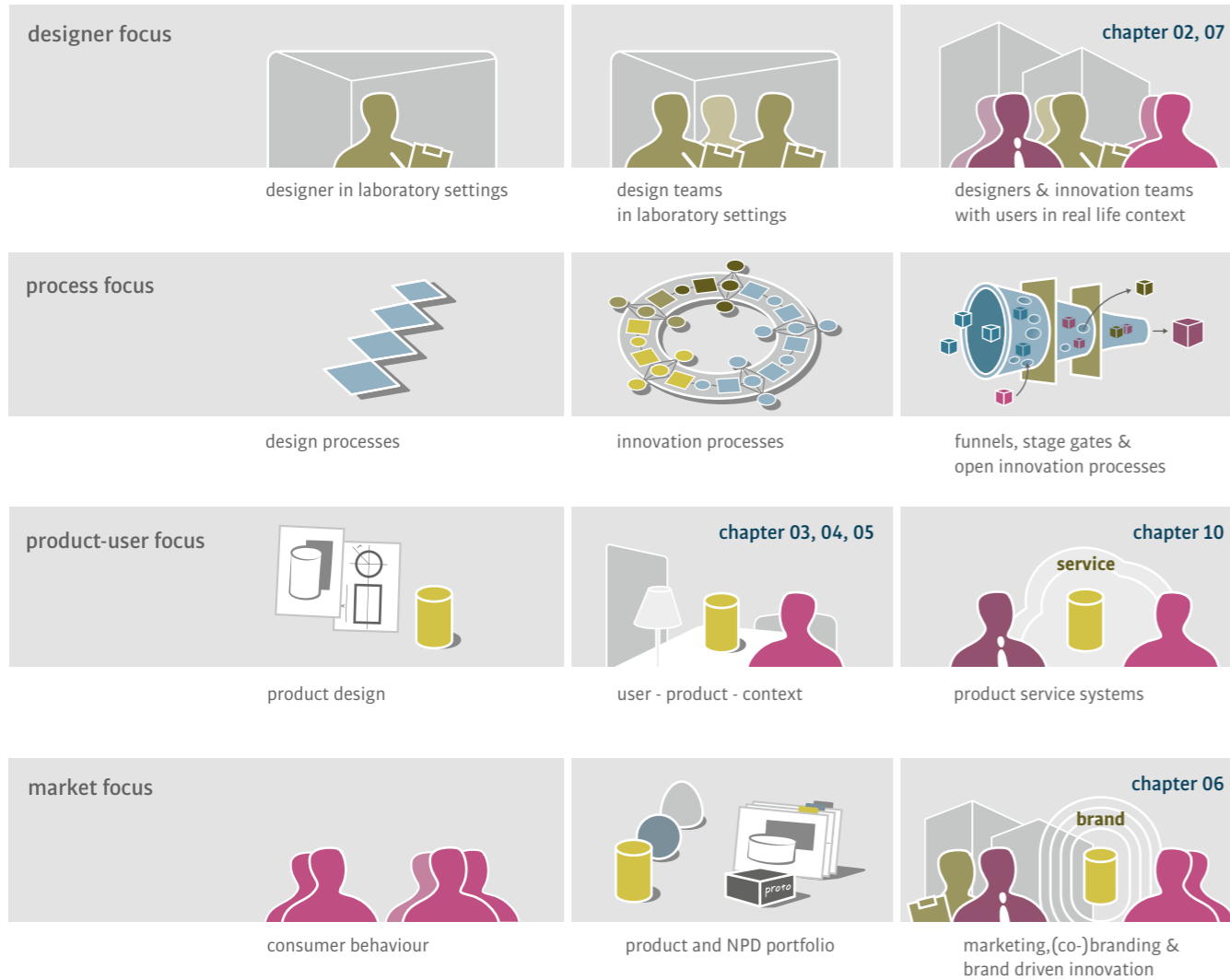
In the early days, design processes were described from a process perspective in step-by-step approaches, being the steps necessary to create the new product. It soon became apparent that design was more than art, and that products needed to be manufactured economically. In the

70s, engineering approaches became more sophisticated and design for manufacturing and assembly strategies were researched and developed. Similarly, the rapid adoption of mass-produced products by many different types of consumers called for research that focused on product-user interactions, e.g. ergonomics. People with different physical abilities all needed to be able to use these products. Ergonomics, in turn, led to user-centric design as user-centric design as described in this book, without decreasing the focus on ergonomic research.

The oil-crisis in the 1970s can be seen as a turning point in industry, and resulted in the end of product and technology push strategies. Manufacturers needed to make both strategic choices as well as listening to what consumers really wanted. This initiated a large number of of additional research streams, for instance, the development of methods and tools aimed at consumer and market research to identify consumer needs. The insight that 'new products on the market are the tangible result of company strategies', led, in the early days, to investigations in the area of product portfolios, which in turn have led to the research on product development portfolios we see now (Kester 2011).

In the 1970s and 1980s, it became important to hit the market fast and on time. Research investigating organisational issues of product development also started in this period. It is not surprising that the largest association of academics and professionals (3500) in this area, the Product Development Management Association (PDMA) was founded 1976. Around that time, products no longer simply sold themselves: market research, consumer behaviour analysis and marketing became

single foci

designer focus

designer in laboratory settings

design teams
in laboratory settings

chapter 02, 07

designers & innovation teams
with users in real life context

process focus

design processes

innovation processes

funnels, stage gates &
open innovation processes

product-user focus

product design

chapter 03, 04, 05

user - product - context

chapter 10

service

product service systems

market focus

consumer behaviour

product and NPD portfolio

chapter 06

brand

marketing,(co-)branding &
brand driven innovation

FIGURE 3 *research foci in design & innovation research*

extended foci

chapter 10

discipline A

discipline B

discipline C

social dimension of design & innovation

chapter 09, 10

networked innovation and ecosystem design

chapter 08, 10

society
ecosystem
organisation
user
economy
ecology
psychology
sociology

design beyond design: value & frame creation

part of design related research activities in the 80s. One of the leading academic journals in this field, the Journal of Product Innovation Management, was initiated in 1984. At the same time, design processes were increasingly described as being part of innovation processes. The Delft Innovation Model (Buijs 2012), well known in the Netherlands, is typical of them and originated in the early 1980s. The stage gate and funnel models, combining process and management theories, are widely used throughout the world. The latter has recently been enriched with notions of open innovation, where companies make their boundaries much more permeable allowing knowledge to flow in or out in the form of licenses or joint ventures.

In parallel, the design theorists focused on studying designers and architects in action, and were able to describe and better understand the process of developing the product itself. These studies stimulated the emergence of academic journals like Design Studies and Design Issues in the late 1970s and early 1980s.
On the product side, increased complexity called for integrated research approaches, combining the various engineering disciplines of computer engineering, electronic engineering, and mechanical engineering. Research efforts focused on CAD-CAM integrations, modularization, mechatronics, reliability and systems engineering, thereby combining the product and process focus.

Increased environmental awareness initiated a stream of research in the 90s that combined the product and process focus. These environmental issues started to 'invade' the design research domain, in themes like Ecodesign and

Design for Sustainability. Initially, these issues were related to decreasing the environmental impact of products. This was followed by replacing products by services (e.g. car sharing services) and, currently, the environment has become embedded at the system level, initiating research related to products and services at strategic levels of organisations or its ecosystem.

Another development initiated in late 90s, and one which is gaining momentum, is the realisation that the variables that influence the design practice cannot be sufficiently modelled in laboratory settings. Researchers started to realise that they could no longer neglect the real life context of design. Although in the 80s, design first became to be seen as a social process, it took until the 90s to start research aimed at describing and understanding design beyond the single designer. Initial research focused on teams of designers in laboratory settings to identify elements of the social dimension of design. Design research that focused on how to interact with users was initiated in the late 90s and at the start of this century (Chapter 2); at that time the real life context was only occasionally taken into account. For instance, researchers studying the design agency IDEO, realised that designers act as technology brokers by bringing technologies from one industrial domain to another during their design process. They embed these - until then unknown - technologies in the target domain (Hargadon & Sutton, 1996). These observations coming directly from design practice initiated academic research, for instance focusing on design as an activity of technology transformation. Slowly, design researchers started to realise that the reality of the design practice, including its social dimension, forms the

next frontier of research. This also led to the understanding that real life complexity could not be sufficiently studied in laboratory settings, hence studies like those reported in Chapter 7.

Current design research

We have selected four developments in design research, each addressing a different part of the design and innovation process. We have already mentioned the social dimension as being an important focus of current research activities. The second development we address is the upcoming theme of service design and product service systems. The third development is sustainability, which is rapidly gaining momentum. Finally, by studying design in many different contexts, we may have to change our fundamental insights of what design actually is.

Social dimension of design: design as collaborative process

In the previous chapters, we have paid considerable attention to the social dimension of design and innovation in various forms. In the first part of the book, we looked at the user as being one of the critical stakeholders in the design and innovation process. Examples of this are: the participating users in the design process (Chapter 2), the development of use scenarios (Chapter 3), the context as ingredient for the design of user experiences (Chapter 4) and finally, an overview of organising for product usability (Chapter 5).

Involving users in the design and/or innovation process is not something new. Concept testing and focus groups traditionally involved the user in the design process when evaluating the first concepts and thus the overall direction of the further design process (De Bont, 1992). Test marketing is another traditional form of user involvement, be it after the actual development and once the product is finished and about to be launched, either nationwide or even globally. However, marketing has shifted to include front-end activities related to the brand. In Chapter 6, we show that the brand has moved from the logo stamped on the product, to the brand as an inspirational source at the front end of innovation. Uncovering the inside-out and outside-in values of the company's brand is typically not achieved without the involvement of a number of relevant stakeholders. Not only current users of the brand's products and services hold the relevant information about the brand's promises; they might be too biased; collaborating with potential future users adds new scope to the social dimension.

In Chapters 7, 8 and 9, the focus is on the situation 'beyond' the product and user during development, and adds the perspectives of collaboration and value creation involving a larger array of stakeholders. The mirroring of designers together with other developing disciplines (Chapter 7) is one of the new perspectives that sheds light on the social dimension of design practice. Actors and parties in newly established relationships add value to each other, either by addressing societal issues (Chapter 8) or by creating a new ecosystem, whilst also bringing value to the central user (Chapter 9), or both. In addition to the new perspectives described in Chapters 8 & 9, we have seen that the more traditional design and innovation activities also involve many

different stakeholders: in design, engineering, management, production, from suppliers & customers, et cetera.

All these observations and examples show that, without question, design and innovation has become a complex collaborative process with many other disciplines involved throughout the overall product innovation process. Based on our research, we discern four forms of collaboration with:

1   actors from other design and engineering disciplines to arrive at an integrated design,
2   actors at other hierarchical levels and in other non-design functions,
3   actors from downstream processes during development in order to take downstream constraints or opportunities into account,
4   actors from downstream processes aimed at the transfer of the final design to downstream processes (e.g. production ramp-up) (Smulders & Bakker, 2012).

Recently, a fifth form of collaboration has surfaced: collaboration with actors outside the company. This is related to the contemporary industry and academic focus on 'open innovation', a term coined by Chesbrough in 2003. Although many companies were already involved in various forms of open innovation (e.g. co-developing suppliers), it was never set on the corporate and/or strategic agenda as an opportunity to deliberately and strategically become engaged in open innovation to boost innovative output. Since then, many publications, books, conference tracks, consultancies and research groups on open innovation have emerged. At the moment the dust is starting to settle, and some specific research tracks, which we discuss later, are becoming visible.

In fact, the creation of a new business ecosystem might be the result of an innovation that has opened up the traditional relationships among the parties, allowing new parties with complementary knowledge to participate and create new values. A number of current research programmes focus on connecting design theories and methods to these open and networked innovation processes. And, at a larger scale, taking the society-centric perspective, we see yet another group of stakeholders entering the scene; authorities, governmental parties, NGOs et cetera. Perhaps, and this is an important observation, we should consider all stakeholders involved in the innovation activities as a form of user; namely users of the knowledge related to in between stages of new product/ service development! Why shouldn't the sub-processes of development be focused on the developers themselves as users of newly developed knowledge? This raises interesting research questions like, which user-centric design methods are applicable to support these categories of co-creating stakeholders.

Many organisations are aware that they have limited knowledge and that they need additional expertise to create breakthroughs for particular markets. They realize that time and money are not available to develop in-house expertise, so to cope with this, they call in organisations with this specific expertise to move the design and innovation process forwards. In networked innovation processes, many organisations and many disciplines become involved, bringing together a full array of knowledge suppliers. These new forms of collaborating with unknown partners in strategic innovation processes call for research aimed at deeper understanding of the social dimension.

One example of this is in the area of electric mobility. For automotive companies to be successful in this field, it is obvious that they have to collaborate with experts in battery technology, energy providers and with service providers for charging systems. For instance, Renault/ Nissan and Better Place (experts in services) and Dong, the main energy supplier in Denmark joined forces, together with many other organisations. In this case, a strong vision was needed to support scenario building and to arrive at a coherent proposition, taking into account end-users, organisational issues and societal needs. Embarking on with this type of networked innovation journey requires a search and selection process aimed at the identification of the right partners. After that, when sitting at the table, apart from the contractual paperwork, the shared vision needs to result in achievable strategies. Design methods could be instrumental in helping to tackle the complexity and ambiguity of such processes.

A similar situation is bound to arise around autonomous driving. It is not just the design, engineering and manufacture of autonomous cars, but the impact this will have on the present transport system and the automotive ecosystem. Development and introduction will most likely involve public-private partnerships, capable of taking into account the affects this will have on the many stakeholders, regulatory systems and (infra-) structures. For instance, if cars autonomously prevent accidents from happening, what is the value of having crash zones, insurance or even driving licences. How can we collaboratively design the transition from the 'simple' situation of a few autonomous cars, to a mix of automated

and human drivers, and to finally a fully autonomous transport system?

In this type of future design context, new and unknown collaborative problems will arise in relation to the different disciplinary and organisational backgrounds. Current methods in design, even the advanced ones, primarily deal with one discipline and one organisation and, as we have discussed earlier, fall short when addressing multi-disciplinary and multi-organisational issues.

Research is now being conducted to find out to what extent designerly approaches can prove valuable in these networked settings to enhance collaboration. A possible outcome is that current methods work well, but a more likely one is that our existing methods will need to be adjusted and refined.
These examples of ongoing research activities are illustrative for learning opportunities in the field of design research. The application of design methods and tools (design thinking and other designerly approaches) in non-traditional areas might provide us with new insights regarding the phenomena of design and innovation; insights that, to some extent, are hidden in its traditional field of application.

The observations presented here require us to focus on describing, understanding and explaining the social dimension ... later followed by predicting and again later by prescribing how to act and react in collaborative settings.

Service design

Multi-disciplinary design and networked innovation have increased the complexity of product development, making the field of design even harder to investigate. Recent developments in service design and product-service systems, (e.g. CRISP), have expanded the field of design and innovation even more.

For many years, services have been seen as 'simply' being after sales activities, helping maintain products or adding some special activities to the delivery of the products to the customer. We once defined 'services' as being intangible and products as tangible. So, based on this definition, insurance 'products' must be services, or not? Are software programs services? No, these are intangible products that are similar to all clients in terms of the related offerings & conditions. There is a standard contractual relation that forms the intangible product with the insured client. On the other hand, there is also a service element. At the moment the defined event occurs, the insured needs to interact with representatives of the insurance company for claiming the costs. From this perspective insurances can be seen as product-service propositions avant la lettre. A similar case is a bank account that requires you to interact with bank employees every now and then. These interactions can make or break the relationship between company and its customers and must be seen as crucial touch points as described in Chapter 6.

In car sharing, the users do not own a car, but subscribe to an organisation that allows them to use a dedicated car, parked nearby. Is such a proposition a product-service system? Reservations are online, payments are automatic and maintenance is done without the customers' involvement, so where are the service elements? Could the complete system of activities that ensures 24-7 car availability be seen as a service? Or the 24-7 available service desk? Goedkoop et al. (1999) defined product-service systems as "a marketable set of products and services capable of jointly fulfilling a user's need", implicitly indicating a complex set of propositions that is offered to the customers.

Product-service systems are part of a worldwide trend to put product related service elements on the designer's agenda. Therefore the following question becomes opportune: What are the elements that need to be designed and engineered in order to achieve these integrated multi-dimensional propositions? The standardized contract of the insurance policy like the contract of the car sharing company are 'designed' and 'engineered' in such a way that these on one hand fulfil the needs of a large part of the envisioned clientele and on the other hand fulfil the strategic intentions and goals of the company. What about the service elements? Is the behaviour of the insurance employee in interaction with customers explicitly designed by one central group of designers? And if so, does the behaviour development process follow the logic of product design? Do designers possess design methods that are appropriate and applicable for service design? In the hospitality industry, tangible and intangible propositions go hand in hand. What can service designers and design researchers alike learn from this industry?

In other fields of business, there are products like elevators that cannot be purchased without a service contract. This raises questions like, 'What are relationships between the development trajectories of the tangible and intangible parts of the proposition?' Service contracts influence the value and therefore need to be taken into account during the design process. Minor differences in business model can have a considerable impact on the profitability of the product-service system. What are relationships between the design of these elements and the design of the business model? How are these accounted for?

Another issue requiring attention is at what point and for which elements of the development process do customer specific needs have to be tailored. This 'coupling-point' between proposition and customer is related to mass-customization where a large variety is offered to the customer without increased costs for the company. For instance the choice of model, colour and engine for cars. With product service systems this becomes much more complex because there might be more than one coupling point involved. Consider call centers related to product-use where you first go through series of pre-programmed questions before the interaction becomes tailored to you after you have been connected to someone in the company. The design of all these interactions can be part of one and the same integrated proposition and is a continuum from one-size fits all to highly customized proposition elements related to interaction; think about the touch points mentioned in Chapter 6.

Innovation processes in the service industry are characterised by formal and informal participation of actors further downstream. The formal dimension relates to architecture, plans, milestones, targets, gates, etc.. The less formal dimension relates to the creative and iterative activities. Additionally, tangible and intangible elements arise, as well as a time dimension that separates the delivery of one part of the proposition from another part.

A substantial new problem is how the large variety of co-creators, despite their diverse backgrounds, disciplinary logic and languages, tools, methods et cetera, can work towards a common and integrated whole of values for the larger group of stakeholders when designing these complex product-service systems. One of the key factors is to create and maintain consistent and balanced product-service definitions or product-service stories (Chapter 7) that are understood and accepted by engineers, designers, managers and other stakeholders. This we refer to as the overall proposition architecture. It is vital to maintain this architecture consistently throughout the design process by deliberately and frequently interacting with these stakeholders. The various viewpoints and sub-development activities need to be constantly synchronised (Smulders, 2006).

The issues of service design addressed in this section form a brief overview of what is currently under investigation at Dutch universities and their partner institutes. In future publications, we expect to explicitly address service design and the design of product-service systems. This is likely to be in relation to recent developments of applying design methods and tools, also termed 'design thinking', to fields outside our traditional domain of product design. In fact, service design might simply be one of these applications of design beyond the field of traditional product design.

The developments related to service design mentioned here offer us as academics an opportunity to learn more about the phenomena of design and innovation, or more specifically, their active forms: designing and innovating. Investigating the extremes of where design tools and methods are applied will advance our understanding of the growing importance of the social foundations of design and innovation.

Design for sustainability

In the last 20 years, the design community has become increasingly involved with sustainable development, especially the aspect of environmental sustainability. The generally accepted definition of sustainability is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland 1987). It is clear that, with the enormous and massive movements around the world in terms of growth, and the associated dramatic increase in the use of natural resources and increased levels of environmental pollution (e.g. fine dust, scarce and critical materials, CO2, et cetera), there is a challenge for both designers and design researchers.

In the early days of environmental-focused research, tools, methods and strategies were developed by and for designers to minimise the environmental impact of products and product use. Examples from this period are strategies like EcoDesign, Cradle 2 Cradle, and Product/Service systems (e.g. Greenwheels). The main focus with regard to sustainability was on eco-efficiency: if designers would design eco-efficient products, services and/or systems, the threat of climate

change might be averted, thereby resolving social and economic sustainability issues. However, one of the issues with this class of eco-efficient solutions, is that they tend to be more costly to develop and produce. This results in higher consumer prices which affects the competiveness of the companies offering these products. Even though consumers attribute importance to environmental sustainability, they are generally not willing to be the only ones to pay for it ("why should I ...., and not he/she....?").

Therefore, the solutions that have penetrated the market generally have resulted in a fairly insignificant eco-efficiency improvement, e.g. hybrid cars. Although valuable, this low reduction in eco-burden and incremental eco-efficiency improvement has not yet proven sufficient to secure our resources for future generations, whilst maintaining our current quality of life.

More recently, there has been a shift towards a 'service' economy, focusing on business models that are inherently more environmentally sustainable, whilst maintaining market competitiveness. This requires a re-focus; looking for ways and means that make it possible to compare the diverse design solutions and design options, and their impact on sustainability and the competiveness of the product. This has resulted in a new construct that makes it possible to compare different design solutions whilst designing: the eco-cost value ratio (EVR) (Vogtländer et al. 2010). The EVR model aims to bring values for customers and eco-burdens (eco-costs) together in one equation in order to make them comparable during design decision making, thereby enabling the choice of an optimal eco-efficient solution. The EVR is even capable

of comparing designs of unequal functionality, for example different portion packs in the food packaging industry (Wever & Vogtländer 2012). By making it possible to compare unequal products/designs, the EVR-model goes further than existing models like the classical life cycle analysis (LCA) which only makes comparison of designs with the same functionality possible.

It is obvious that eco-efficient value creation goes beyond product design and takes the full ecosystem into account. However, the basics of eco-efficient value creation inherently link design as a value-adding activity to the principles of sustainability, which therefore is expected to lead to more environmentally sustainable solutions that can actually compete with current more traditional 'industrial' products in the market.

These approaches are not specifically aimed at designers only, they have been developed to enable a more holistic approach involving other stakeholders in these innovation processes by incorporating business managers, policy makers and others. This new perspective of eco-efficient value creation that engages all stakeholders in the design-production-consumption-cycle is a very promising route towards developing more environmentally sustainable design processes.
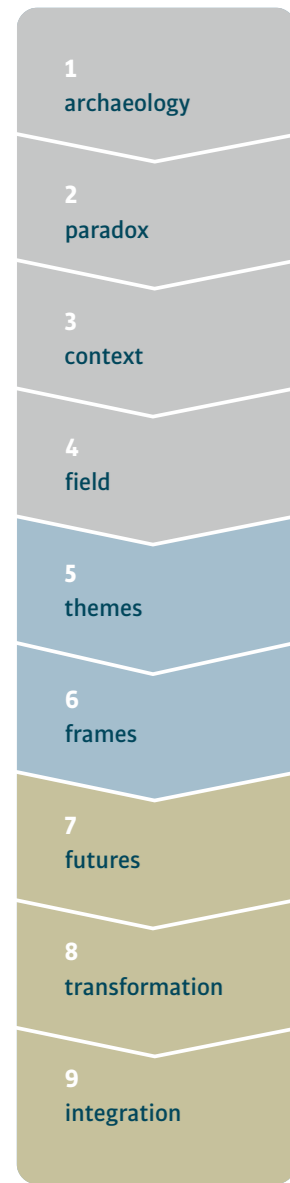
What designers do

Because of our deeper understanding of design and the increased complexity of the design field, we cannot speak

of design as being a straightforward process of rational problem solving, i.e. a process that runs from well-defined problem to unambiguous solution. Design problems are not that clear at the outset of the design process and, because of the increased complexity, issues in need of resolution are not just found at the beginning of the design process, but may show up at any time. Even if the design definition is clear and points to a straightforward rational solution, then designers take a step back and make the problem fuzzy again. For example, they reverse the process by using solutions to create a different perspective on the problem, while at the same time, widening the solution space. This process where designers make use of conceptual solutions to explore the problem space and conceptual problem definitions to explore the solution space and iterate between the two spaces space, has been termed co-evolution (Dorst & Cross, 2001). Solutions are used to improve the understanding of the problem and vice versa. The co-evolution of problem and solution is a central element of 'what designers do'. In this section we elaborate on this aspect, using insights gained from recent research.

Co-evolution of problem-solution in collaborative settings
We know that designers, and often their peers from other disciplines, meander and iterate between the problem space and the solution space (Dorst & Cross, 2001). The above description of design as 'the co-evolution of problem and solution' implies that often there is no fixed design problem that allows designers to 'run' to the solution. Therefore, we prefer to talk about a design

1
archaeology

2
paradox

3
context

4
field

5
themes

6
frames

7
futures

8
transformation

9
integration

Groundwork

Core Frame Creation

Exploring Futures

FIGURE 4 *process of frame creation in nine steps (based on Dorst 2013)*

situation rather than a design problem.

The very fact that design is a complex collaborative process implies that there are as many different perspectives on the design situation as there are (disciplinary) stakeholders. The collaborative perspective (social dimension) implies that interactions are necessary on many occasions during the design and innovation process. What happens during these interactions if we are to take co-evolution seriously? What happens if more than just the design discipline is engaged in a co-evolutionary process? Complex artefacts like photocopiers can easily be divided into sub-systems, however, it is not possible to simply solve the related sub-design problems and then fit all these solutions into one coherent whole. At the specific level of, for example, the geometric interfaces this is perhaps not a problem, but the inevitable influences that solutions of sub-systems have on each other cannot be neglected during the design process. Thus during the process of reviewing and discussing their reciprocal influences we can see that: one man's solution might cause another man's problem, or even worse, block the entire design process because of multidisciplinary intertwinements.

As we have seen in Chapter 7, some problems do not fit neatly into a niche to be solved by either of the disciplines involved, but somehow belong to all of them; they cannot therefore be assigned to or solved by one discipline. These are in-between problems in which designers can support the team in making sense of the situation and showing how it came about. They engage the team in a sense-making process (Chapter 7 Mirroring) that aims to 'de-synthesize' the total design process into each of the separate design activities and their disciplinary assumptions. By explicating all these, at some

point it becomes clear what the underlying cause is of the blocked design situation. During this process, the solution-as-is at that moment is retraced or 'backward-designed' in order to arrive at reformulation of the design problem or design situation. From that point onwards, a set of new design paths of all the disciplines involved leading to new integrated design solutions can be explored. This example clearly illustrates one cycle of co-evolutionary design in a multi-disciplinary setting.

Latest perspective on what designers do: Frame Creation
Another perspective is to apply co-evolutionary design processes at the very start of a multi-disciplinary design situation. Ongoing work points to the ability of designers to create frames in a collaborative setting of different stakeholders (Dorst 2013). Designers apply a varied array of cognitive processes aimed at the identification of a 'door' that opens up a new and challenging solution space. Well understood cognitive activities of designers are threefold: 1) to iterate between the analysis of the design situation and possible early ideas; 2) deliberately changing abstraction levels to consider both the problem space and the solution space; 3) the cognitive ability of designers to move along the design activity line, back and forth between the past and the present.

The process of frame creation described by Dorst (2013) based on empirical and experimental studies, has nine steps that cover these three cognitive activities (*figure* 4). The first four activities can be considered as the groundwork, followed by two core steps that lead to the actual creation of potential frames, and the final three steps that explore

the robustness of the potential frames. The four groundwork steps aim to open up the spaces by considering the 'archaeology', the 'paradox', the 'context' and the 'field' respectively.

The archaeology phase is designed to result in an understanding of the history of the world of the problem owner, and what brought about the design situation in question. This phase does not result in precise descriptions but enables the development of scenarios of the past and the future; the space for change.

The paradox step aims to create an understanding of the 'deadlock': What makes this problem hard to solve? According to Dorst (2013), this is not designed as a confrontation, but as a method to put the issue aside and step away from it. This creates a sense of 'deviousness' and consequently enables the required level of abstraction to consider the situation.

The third step is focused on the lives of the most important stakeholders. This is a sort of contextmapping process to identify present influences on their behaviour, as well as an image of what the future behavioural solution space could be.

By widening the arena, step 4 takes us far beyond this group of stakeholders and opens the potential of new stakeholders coming in who could contribute to a solution. This widening of the arena is similar to the process of creating a new ecosystem as described in Chapter 9, and also includes the actors from 'the rest of the world' as discussed here in the

section on service design.

The core of this frame creation process is formed by steps 5 & 6, where designers look for deeper contextually (organisation) relevant factors that drive the stakeholders and that are common to all involved. These in turn form the themes that connect the stakeholders at deeper levels, thereby opening up a solution space to look for new frames. Referencing this and the other new frames to the broader problem space in a co-evolution process will show the robustness and viability of some of the frames created. In this process, frames might merge, integrate or be disregarded. These two steps end when the group has identified some promising frames. These are not to be seen as final solutions to the design situation, but aim to steer the group in more fruitful directions in the last three steps of the frame creation process.

In step 7, Futures, the first of the three final steps of the Exploring Futures phase, experienced designers build scenarios for solutions identified within the frames that are followed by experimental design concepts that eventually lead to some first ideas for value propositions. Evaluations that consider transformations associated with possible downstream changes and adaptations are part of Step 8. Finally, in Step 9 during the integration of the ideas, a large array of new opportunities emerge when connecting the frame to the existing world.

It is worthwhile realising that Dorst created this new and additional perspective on design by first studying experienced designers in lab setting in the mid-1990s, and by studying the application of design tools and methods outside the traditional field of design in the last decade. He used diverse cases, for example the Australia-based project 'Designing out Crime', dealing with social problems at Kings Cross in Sydney, and applied frame creation in a Dutch project around the Eindhoven Marathon. These cases illustrate what we mean by the learning opportunities for design researchers to be involved in design-thinking applications outside the field of design.

Final chord

We hope that this book and, more specifically, this chapter has made clear that design and innovation research is increasingly a collaborative process between universities and industry partners; academic design researchers cannot conduct industry-relevant research alone.

Design, and its larger brother innovation, are to be seen as verbs exercised by design and innovation actors that operate daily in all kinds of companies and organisations. The development of a single new product is not what makes a company innovative. At lower levels of analysis, designing and innovating take place on a continuous basis in many parts of organisations, even without explicit reference to these words. Designing and innovating as verbs can therefore be considered as natural phenomena. As academics, it is our task to build contextually relevant theories representing these phenomena, and create tools, methods and knowledge which we can transfer to both students and industry.

Towards using new tools: Innovate your innovation process

In this book we have presented new methods, tools and insights into the field of design and innovation. What can you do with this book? First of all, we advise you to carefully look at your organisation in order to find out where there is room and need for improvement, either explicit or implicit. The question to be asked is, 'Do we recognize the design challenges discussed in this book?' If the answer is yes, then review which of the methods, tools and insights might be of help when dealing with these challenges by asking the question, 'So, which tools are relevant for us?'

By embarking on this type of process, you must be aware that this actually is a sort of meta-innovation process, in which you start innovating your innovation process (Smulders & Brehmer, 2012). Like all innovation processes, this cannot be done alone and you will need to identify and include the relevant stakeholders from your organisation. If they are not involved, then how can you ensure that the 'users' inside your organisation will be willing and able to use the new tools within their existing design and innovation practice? This scenario is similar to what is discussed in the section on user centric design. We suggest that you involve future internal users in your innovating innovation process, hence it becomes participatory design and innovation (Buur & Matthews, 2008), but then with internal users and focused on your own innovation process.

Let us assume that you feel there is room for improving your design and innovation process, and that you would like to start a process in your organisation aimed at this. First of all, start the process by getting some of the current actors to participate in a fact-finding workshop. The aim of this first workshop is to share individual observations and to arrive at a 'sense for future directions' related to innovating your design and innovation activities. Each of you will have different intuitions, experiences and observations related to the present status of your innovation processes. All these can be symptomatic of deeper causes that need to be addressed to improve the performance of your innovation. An example of questions to address in this workshop are, 'What makes us think that we need to improve our design and innovation processes?' This will lead to a list of symptomatic items, not all of which are equally important and not all that point in a 'resolving' direction. Based on these symptoms, you try to describe what is presently happening in your organisation and from that, you aim for an understanding of the deeper levels that connect the symptoms into a coherent picture of your organisational needs. In the workshop, it is important to find common denominators that serve as anchor points for the next workshops where you look for possible solutions. Solutions in terms of the required design and innovation tooling and methods could be of value in this situation.

It is likely that you will need more than one workshop to arrive at a robust picture of the 'ist', the 'soll' and the way to bridge the two. In our experience, the process requires three to four consecutive workshops. We also expect that you will discover that many of the symptoms point to the complex social and contextual dimension of innovating, the dimension that currently forms the spearhead of a great deal

of academic research, as we have shown earlier. Something else that you might observe is that, just by understanding what people in your organisation experience during their day-to-day innovating activities, already paves the way to implementing some simple solutions. It is almost like designing; knowing what the problem is leads you to the pathway of resolution.

Once you have discovered what can be changed and how it can be changed, you have to delve deeper into this 'new' area. Any method or tool needs to be adapted to the peculiarities of its future context, including that of its users. You will need to become knowledgeable on these tools in order to do be able to achieve this. So, invite the experts, read recent literature and start dialogues; this will help you to shift the organisational conversations in such a way that the new methods and tools slowly become part of it. This is best done by the future users (you and your colleagues) themselves. So develop a plan, allocate resources, and let the actors in the development process experiment and learn.

One final remark. Do not take this 'innovating your innovation' process lightly. The present situation has proved its value and brought you to where you are now. Adapting your innovation process is a strategic choice, not just something you implement on a whim. An impartial view can help in this process, so make use of knowledge available at the Dutch University based Design Schools and the design consultancies. By collaborating with others, both your organisation and academic researchers benefit; further strengthening the foundations of this field, as well as improving methods and tools. By virtue of doing so, we as universities can deliver better designers, who in turn will be employed in your organisation, strengthening and innovating your own innovation processes, helping you to design for the future!

How to continue?

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Colophon

A timely book for today's times and needs. Design is undergoing rapid change, moving from a focus upon objects and products to incorporate people, organisations, and the needs and requirements of society. This broad, all-inclusive approach promises great advances, but in turn, requires new methods. Where will designers look to find these methods? Right here, in this comprehensive, delightful, and important book.
Don Norman, Author of Design of Everyday Things, revised and expanded edition

Most books on design methods are more or less confined to 'user-centred design.' However, this book opens a new horizon of design methods by including different frameworks that go beyond the user and include organisations and society. This book will be of great value to those involved in advanced design research and education, as it includes in-depth descriptions of a number of important methods supported by case examples, rather than being a 'light' list of methods.
Kun-Pyo LEE, Professor Department of Industrial Design, KAIST and president of IASDR

Advanced Design Methods represents cutting-edge collaboration in Design United, a scientific research program at the technical universities of Delft, Eindhoven and Twente. Design United researchers address significant design problems for value creation in industry, business, and the public sector. This book presents case studies from a wide range of settings together with useful models and a wealth of web-based resources. This is an exemplary starting point for anyone who wants to learn how theory and practice come together for innovative design.
Ken Friedman, University Distinguished Professor, Swinburne University of Technology, Melbourne, Australia

Innovation is the key to our future, for the companies we work for, for us as designers, and for the universities educating new generations of designers. The tools we use are becoming increasingly sophisticated, matching the complex intricacies of the products, services and solutions we are working on. The world we work in is changing and so are we: our field of design is coming of age.

Our message is simple and straightforward: to help organisations adopt advanced design methods, equipping then to deal with the dynamic development environments we encounter as practitioners. This supports Design United's mission: to stimulate and increase interaction between design practitioners and the university design schools. This is vital, as the implementation of advanced design methods requires intensive collaboration when defining and resolving research challenges, and developing new research methods and tools.

This is meant to be a hands-on book. It has been written by researchers working in the field of innovative design questions. They tell us what they have done and how they did it, based on real-life cases. This book provides readers with a clear overview of recently researched and developed design methods that have the potential of making many individuals and organisations more successful in achieving their goals.

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