From outside-in towards inside-out

An excursion to automobile design strategy for the future

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ANJA CAROLIN HOFMANN

FROM OUTSIDE-IN TOWARDS INSIDE-OUT

AN EXCURSION TO AUTOMOBILE DESIGN STRATEGY FOR THE FUTURE

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AN EXCURSION TO AUTOMOBILE DESIGN STRATEGY FOR THE FUTURE

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'[…] There are Designer's things, which are more than simply ways of solving problems; more than a rational, functional or practical problem statement. There is not only a formula. If there was, they would all be making Apple products, Jasper Morrison chairs, or Alvar Aalto stools… Or Eames. These were incredibly rational, too, and ended up being rather more than that.

That is what makes the quality of these products, and I believe that these are the things we really need in this world.'

(Konstantin Gricic)

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PREAMBLE

The statement, ***'Design is not a question of democracy'*** comes from Stübbe, the former Dean of Interior Architecture at the University of Applied Sciences, Coburg. However, it remains unclear whether he is referring to design guidance, decision making, or the visioning phase in the design process. The question thus arises: Is good design matter of hierarchy alone – and is this true in the field of automotive design?

An examination of the hierarchy of automobile original equipment manufacturers (OEMs) reveals a classical pyramid system. But what happens when an average employee – someone working in the interior design department, for instance – has a great idea? And what if he wants use bottom-up communication to convey his innovation? Currently, there is a risk of the idea being quashed by middle management before it reaches any higher-ranked executives. The telecommunication industry, conversely, uses agile processes to communicate innovations in a faster, more stable manner. Indeed, there are rumours that Apple and Google want to start building own automobiles in the near future. So how might they go about this? And what type of process, approach, and hierarchy will they adopt to boost automobile innovation?

One possible solution to enhancing change by using ideas from all parties is offered by von Hippel [2005], who states: *'When I say that innovation is being democratized, I mean that users of products and services – both firms and individual consumers – are increasingly able to innovate for themselves. User-centred innovation processes offer great advantages over the manufacturer-centric innovation development systems that have been the mainstay of commerce for hundreds of years.'* The question then arises as to whether this theory of innovation can be applied to transportation design?

The research topic of this Ph.D., which was inspired by von Hippel's quote, is: **Challenging hierarchical structures in transportation design throughout a more participative and open design process that makes use of user-centric innovations.** While this formulation is currently rather broad, it will be more precisely defined in the coming chapters.

CHAPTER 1 – INTRODUCTION

Automobile original equipment manufacturers (OEMs) are currently in a state of fundamental change, as highlighted by Mary Barra, Chairman and CEO of General Motors, who states: *'I believe the auto industry will change more in the next five to ten years than it has in the last 50.'* [Barra 2016]. First, there are indications that the market is changing due to stricter environmental and political conditions. Second, it is hard to find a unique market for OEMs, as there are many players in the field. Asian automobile producers, for instance, compete on a level playing field in the international market, and exert industry pressure in terms of price and the development of electrical cars (see Point 2 of Table 1) [Mc Kinsey 2014]. Automobile users also see improvements in the infrastructure of other means of transport, making these increasingly attractive [Eriksson 2001]. An exterior pressure aside, the car itself is also changing. The introduction of both electrical power and autonomous driving demands increased digitization: cars need to be equipped with a greater number of assistance systems and autonomous driving features, increasing product complexity (see Point 4 of Table 1). Consequently, the OEM for privately owned cars (see Figure 1) develops towards that of a mobility provider with a flexible product portfolio [Berger 2016]. Against the backdrop of these changes, future automobile interiors will become a 'third place of residence' for users, after their homes and offices, as stated by Gorden Wagener, the Mercedes-Benz Head of Design [Wagener N.N.]. All these factors demand that we rethink the way that automobiles are designed. This Ph.D. intends to contribute to finding better ways of designing cars in the future.

Car design: Time for a rethink?

Most cars are currently designed from the outside-in (i.e. exterior design precedes interior design) [Nissan Motor Corporation N.N.]. The exterior design is developed via a series of manual drawings to define the general style and visual appearance of the automobile. For the interior, however, the assumption is that the focus is more on user-friendliness, ergonomics, the human machine interface (HMI), and the comfort and practicability of passengers. Similar to the exterior approach, this procedure involves techniques such as sketching, working with clay, and digital modelling. The color and trim design then completes the interior, with a selection of colours, fabric designs, wooden grains and leather

adding an experiential and haptic aspect to the car [Mauri N.N.]. Votolato [2007] explains the role of the future automobile interior as follows: *'The modern study of psychology has also contributed to a greater understanding of how we perceive space, recognizing the complexity and variability of human experience. […] If our prior conditioning determines the way we experience travel in a vehicle, our experience is also informed by the design of the vehicle's interior […]'.* Changes in the market and the industry might raise concerns about the outside-in approach to car design. With the increasing importance of the customer perspective (see Point 5 of Table 1) and the rise of autonomous driving and electrical cars (see Point 2 of Table 1), there is increased interest in applying an inside-out approach to car design [Mc Kinsey 2015]. This Ph.D. addresses both approaches. It cannot be seen apart from the changing role of the digitized user (see Figure 2) which might be relevant in the fuzzy front-end of the new product development (NPD) process.

Car design and changes in society

Before presenting the problem statement, research questions and research approach, it is probably wise to discuss some potential influences on car design, as this needs to be taken into account when considering future design developments. These influences could include the 'value for many' phenomenon; the issue of changing lifestyles and status symbols; and game changing developments. The assumed changes are also linked to changes in society, which will be described in the next paragraphs.

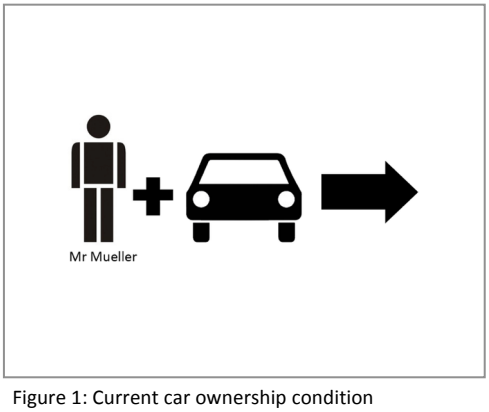


Figure 1: Current car ownership condition

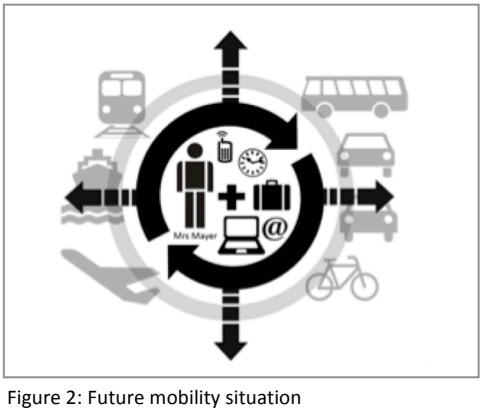


Figure 2: Future mobility situation

'Value for many' phenomenon

The 21st century has seen the digitalization of the masses, mainly via mobile phones and personal computers. Sperling and Gordon [2009] argue that this technology is closely linked to individual's behaviour, enabling people to become more location independent and less dependent on an individual vehicle and its ownership. Figure 2 shows the changing situation for the future of mobility, with the user at the centre of a mobility circle including various transportation options such as trains, buses, taxis, rental cars, bicycles or airplanes. The circular arrows indicate that the traveller is on the move, carrying his personal belongings and digital devices, without owning the transportation media.

Jan Muehlfeit, Chairman of Microsoft Europe, claimed during a European Automobile Manufacturers Association event that even though it may sound strange, the car, for him,

'…will be one of the last spaces to be online.' He predicted diverse, yet crucial future developments in the mobility field based on the increasing size of the human population and its need to be motorized [ACEA 2011]. A second wave of mass mobilization, similar to that of the 1950s, is likely; however, it is probable that most of this growth will take place in countries like China and India [United Nations report 2015], with the number of people expected to multiply. Representatives of the business consultancy Frost & Sullivan [2011] call this kind of mass production with local adaptations for the rising middle class a 'value for many' phenomenon. In response to behavioural changes triggered by digital technology and the growth in world population, Sperling and Gordon have identified a need for new automobile space-saving and energy-efficiency solutions that they call 'Futurama III'. These affordable individual mobility offers, while using less space per person, attach a new comprehensive value to this space. The objective is to provide space with new relevance and quality by emphasising the sense of locality, privacy and flexibility [Sperling and Gordon 2009].

Changing lifestyles and status symbols

Changes in transportation have led to reciprocal changes in the travel business (see Point 5 of Table 1). Companies such as Lufthansa, Deutsche Bahn, and Singapore Airlines offer travel experiences customised to user's behaviour and specific working culture [Amadeus 2014]. These offers can be seen as status symbols, allowing users to feel differentiated, and to display their lifestyle to a certain group, community or audience (see Section 5.0). The term 'status symbol' is defined as *'a possession that is taken to indicate a person's wealth or high social or professional status...'* [Oxford dictionaries N.N.]. It often indicates materialistic, functional, cultural, artistic, or even idealistic values that give elevated status to a society or individual.

Smartphones, computers and tablets are now more the key enablers of external communication, with a profound influence on people's lives both within the sphere of cars and beyond (see Figure 2). The importance of the communication media as referential status symbols is likely to increase, leading to similar changes in the automobile Human Machine Interface (HMI) [Mc Kinsey 2015]. The original human-car relationship, where everything a person needs can be found inside the vehicle (comfort, functionality, safety, etc.), with status conferred by the car's external appearance, is currently changing [Eastlack 2011]. OEMs must hence redefine themselves next to their focus on the classic values of vehicle performance, technology and product ownership.

Game-changing developments

Kramer states that *'although mobility is considered the driving force behind human development, from nomadism in the prehistoric age to the seafaring nations of the explorers to the educational journeys of the classicist period and, finally, to the automobile people of the 20th century, the critique is getting louder, […] of where and when the limits of mobility's usefulness will be reached.'* [Kramer 2005]. This statement raises questions about how and in what form the population will continue to be mobile in the future.

The word 'automobile' has two roots, namely autos, which is Greek for 'self', and mobilis, which is Latin for 'mobile' [Reif 2015]. The term is intended to mean a self-driven carriage

controlled by humans [Da Vinci 1478–1519]. The next automobile revolution, however, could involve driving without a human operator. This autonomous driving is thus already making its presence felt. A shift to autonomous driving vehicles will necessarily involve many new aspects, especially in light of the Mc Kinsey study [2016] that predicted that *'up to 15 percent of new cars sold in 2030 could be fully autonomous'*. This means that car users will be able to drive hands free for a certain period of time, allowing them to perform other activities such as organizing their business schedule, putting on make-up, making a telephone call, etc. At present, however, the interior space of a vehicle is not designed for any activities other than driving. A novel approach to interior car design is thus required to realise the full potential of autonomous driving.

With new players such as Tesla, Uber, Google, and Apple shaking up the domestic car market [Schwartz 2014], it is a favourable time to rethink mental models of a car or transportation system and start with end user requirements. Do users desire a car, a mobility offer, or both? In terms of implementation, the different parties managing digital networks, mapping data, or creating know-how would need to combine their knowledge and expertise and create something new. New players such as IT and telecommunication companies will in all probability enter the mobility field. This means that incumbent players such as single manufacturers and cooperatives will have to find improved ways to serve, satisfy, and meet the 'specific users needs' in the future.

1.1. Problem statement and research questions

The preceding discussion indicates that the automobile industry in general and OEMs in particular are faced with changes in the status quo of automobile design [McKinsey 2014]. Based on the report from McKinsey, statements on potential new challenges were made. In discussion with industry these were further developed and new ones added. A basis for the statements is described in the following text. As this is only anecdotal evidence, this Ph.D. is focussed on checking these points. The 15 potential new challenges are mentioned in Table 1. This Ph.D. explores whether evidence can be found to support these 15 points, and examines some possible solutions. The information is derived from expert and user interviews. These problems, which relate both to market-external and company-internal influential factors, are summarized in Table 1.

Table 1: Insights and assumption of problems

Market-external factors	
1.	Automobile products and portfolios are increasingly comparable with one another. A diversification strategy is required.
2.	Autonomous drive technology, digital HMI, and alternative drive systems (e.g. electrical drive) cause disruptive changes in automobile design.
3.	The up-to-dateness of digital products is difficult to ensure, as the NPD cycle is longer than that of the telecommunication or software industry.[1]
4.	Technical innovations are increasingly applied in an incremental, additive way, and less in a disruptive manner. This may lead to an information overload in terms of the vehicle interior.
5.	User behaviour patterns in communication, mobility, lifestyles and working styles are changing.

[1] Gerybadze has emphasised that the length of the current NPD process entails a crucial problem for the automotive market if it wants to match the much faster consumer electronics market when launching its products. Lecture on innovation management, 31 January 2014, at the University of Hohenheim, Stuttgart, Germany.

	This modified behaviour may be a game changer in the automotive sector.
Company-internal factors	
6.	Increased efficiency means the NPD process is suffering from time and budget cuts (time = money). There are less time gaps in the process and less scope for improvement.
7.	Executing designers do not carry out extensive field and user research. They have no direct access to relevant information in the early design stages.
8.	There is a lack of well-prepared information reaching the executing designers within the corporate NPD process. New insights and user studies do not reach designers in an empathic way.
9.	The communication culture between engineers, designers, and strategic departments needs to improve. Stakeholders from these disciplines do not talk on the same level or engage in dialogue.
10.	Designers do not like to receive ready formulated work tasks from their engineer colleagues. Rather, they want to explore alternative design solutions themselves.
11.	Overall innovation 'production' pressure is omnipresent within the OEMs. This acts as an impediment to innovative trial and error testing.
12.	Most executing designers do not receive written briefs. They hence fail to find new innovations, as the same instructions are repeated over and over, preventing the delivery of verifiable outcomes.
13.	The conventional car design process (outside-in approach) is under re-evaluation. The existing product conception has not enough flexibility and variation in its work focus.
14.	Aside from the advanced exterior design, only a limited form of vision development exists within the fuzzy front-end of NPD. Alternative user mindsets, strategic portfolio insights, and interior design are absent from existing research.
15.	OEMs steep top-down hierarchy does not allow for proactive bottom-up innovations and the transfer of ideas, as the executing designers (as well as other bottom-level employees) have difficulty in correctly positioning their ideas.

Point 1 of Table 1 above indicates that OEM products are losing their uniqueness and becoming increasingly similar to other competitor products [Schwartz 2014]. This is also the case for user behaviour patterns, which are changing fundamentally (Point 5 of Table 1). An example is the above-mentioned description of the progressive movement away from individual vehicle ownership (see Figure 1), with users depending simultaneously on a range of transport media (see Figure 2). Similarly, Johnson and Kirchain mention that the product development process is shortening to reduce conception time and costs [Boston Consulting Group 2014]. There is also the additional pressure to 'produce' innovations to distinguish a brand from that of other producers [Johnson and Kirchain N.N.]. The ongoing invention of yet another assistance system hence seems to be one possible solution, although Hamel argues that the future landscape may be significantly different. He doubts that the addition of more features to a single system is the only possible solution, and suggests that the entire future system should be called into question: *'Change has changed. No longer is it additive. No longer does it move in a straight line. In the twenty-first century, change is discontinuous, abrupt, seditious'* [Hamel 2002] (see Point 4 of Table 1). Hamel's emphasis on disruptive innovation finds support in Wyman's interviews with automotive executives, who consider disruptive innovations *'[…] one of the most important success factors to maintaining a strong competitive position in the auto market' [Wymann 2015] (see Point 11 of* Table 1*). Cankurtaran [2014] further states that 'innovation speed is not an end in itself, but a (possible) means to ultimate product success.'* Despite being recognised as a crucial factor in success, disruptive innovations bring unique challenges. As the product becomes more complex to plan, the productions cycle is extended. The average automotive product conception process can take five to six years from the first design sketch to final production start [Strandhagdesign 2015]. This long de-

sign process (compared to other consumer electronic products) requires a detailed foresight strategy. When a new car is launched, the product development and strategy departments need to have their finger on the pulse of time (see Point 3 of Table 1), which is not always possible with disruptive innovations. Conversely, market and investor demand require these processes to be shorter, more calculable, and more cost-efficient [Whitford 2005] (see Point 6 of Table 1).

The company-internal factors 7, 8, 9, 10, 12 and 13 in Table 1 were not found in the literature, as these are part of the corporate strategy of an OEM, and therefore are not published. Interviews conducted in the field of automotive transportation, vehicle exterior and interior design formed the basis for these statements (see Table 12). They are summarized to gain a holistic overview of all 15 assumptions in Table 1, and used again for the concrete improvement proposals at the end of this research work.

Transformation of problems into research questions

The central research question of this thesis is as follows: **Should the current automobile design process be questioned, reversed (from outside-in towards inside-out), or completed within the new product development (NPD) process?** This question is divided into six sub-questions, which are listed in Table 2. While providing full answers to these questions is an ambitious goal, this thesis will attempt to shine some light on the issues at stake. As can be seen in Table 2, the sub-questions address, the design, its process itself and the organizational aspects of its implementation.

Table 2: Research questions

Main research question	**Should the current automobile design process be questioned, reversed (from outside-in towards inside-out), or completed within the NPD process? Is the inside-out approach in automobile design preferable to the outside-in approach concerning the innovation capacity of user-centred design?**
1.	Can inspiration be acquired from innovation literature?
2.	What are the existing design processes inside OEM's?
3.	What does the future users need and how does their environments change?
4.	What are the functional and emotional goals of alternative acting target groups? And how might these be integrated into a vehicle design?
5.	What are the advantages and disadvantages of the outside-in and inside-out approach?
6.	How to place functions in a vehicle layout?

1.2. Contributions to knowledge

The problem statement, and its transformation into a research question aim to contribute to the knowledge fields listed in Table 3. The table is divided into scientific and practice-based accomplishments. These are interlinked, as neither can exist without the other. Traditionally, academic institutions build the fundamental frameworks for alternative concepts that industry subsequently uses to improve upon existing knowledge. Science enables pioneering research by which to construct frameworks that can be implemented in the industrial field, e.g. by training future academics. Working in a protected research area may offer opportunities to test radical ideas and develop unconventional concepts that are still unthinkable in the everyday automobile design practice. The laboratory sta-

tus enables innovations to be tested and observed by trial and error before being judged by practice-based designers and their defined behaviour cultures.

Table 3: Division of contribution in scientific and practice-based knowledge fields

Field	Contribution to scientific knowledge	Contribution to practice-based knowledge
1	Documentation of OEM-internal design culture to reveal existing black-box conditions as a future challenge.	External perspective on the current design culture to stimulate reflection and change among stakeholders.
2	Exemplary research of unknown user needs to gain strategic design insights into a representative extreme user group.	Exploration of unknown user needs to gain time and create strategic advantages within the PDP.
		Implementing customer requirement lists while taking the most important 'do's' and 'don'ts' into consideration.
3	Exemplary application of extreme user theory on automobile concept design.	Showing alternatives to the existing transportation design process.
	Experimental comparison of the outside-in and the inside-out design approach with further annotation of when each method is suitable.	Offering strategic insights about when it is suitable to apply the outside-in or inside-out approach within the NPD process.
4	Documentation of the automobile design process and its theoretical organization.	The theoretical process improvement model offers the necessary framework of ideas for future real-life implementation and testing.
	Extension of new design process steps to theoretically frame the weak points of the previous process model.	
5	Theoretical model proposition to execute a division of power during the design process flow. This change has to take place in theory before discussion about real-life application can begin.	Practical separation of powers of the head of design from the design brief and strategic research. The aim is to better control political interests, written briefing tasks, and to push innovations forward.
	This step also offers the possibility to execute more in-depth research during the fuzzy front-end phase.	Proposed detachment of the advanced exterior design from the Head of Design
6	Questioning the previous design role and working tasks.	Opportunity to redefine the designer's task and create a mental shift in the strategic design department (concerning the hierarchy structure, work tasks, and profiles, but also by influencing the future product conception).
	Alternative design profile implementation of the design conceptionist profile.	
	Proposal regarding work content redistribution concerning advanced design of exterior and interior parts of the automobile.	
7	Proposing theoretical brief designs and briefing sequence improvements to overcome cross-functional communication hurdles and reach better outcomes.	Providing an elaborated brief and briefing process blueprint to refine the eventual product outcome, in a user-centric manner.
8	Fostering strategic innovation implementation to increase the richness and quality of the design outcome.	The recommendations for change (see Chapter 7 and 8) exist to improve the innovation climate and guarantee sustainable market success.
	This point may consider implementing the design thinking method into the transportation design process.	Suggesting the implementation of early escalation options within the design process to enable the recapitulation of existing design solutions.
9	The automobile concept design is defined as *'a strategic tool within the fuzzy front-end NPD design process'*.	All proposals and measures aim to achieve an alternative vehicle concept design that consists of an innovative approach, new mobility aspects, and more user-centric functions than before.

1.3. Research structure and outline of chapters

This thesis is organised as follows.

Chapters 1 and 2 describe the topic, content, proceedings, and contributions to the field of automobile design innovations in the NPD process. The aim of Chapter 2 is to elaborate the background of innovations in car design and to define the types of product innovation that are the focus of this work. This chapter answers the subquestion 1 from Table 2. A literature study on the definition of an innovation versus incremental inventions is included here, and the standpoint and main research objectives are identified.

Given limited literature sources for the topic in question, the research makes use of data collected via user and expert interviews, which provide both an overview of and insights into the relevant topics. The interviews were carried out with automobile experts (see Chapter 3), experts with knowledge of contextual changes in urban business environments (see Chapter 4), and user interviews of digital business travellers (see Chapter 5).

Chapter 3 documents the status quo of automobile design within OEMs, including descriptions of the automobile process flow, generic behaviour culture, and the application of design methods. Using information from various expert interviews, the chapter also describes the standardized design process. The aim is to provide an overview of the automobile design status quo in the market, which is an answer to question 2 of Table 2.

A project experiment was conducted following the collection of information and insights detailed above. The experiment is divided in three parts, starting with Chapter 4, which includes an exemplary study of the digital business travellers' work context in urban surroundings. The chapter summarizes the main influential factors and criteria that characterise the target group's work and life environment focuses on question 3 of Table 2.

Chapter 5, the second part of the experiment, contains the digital business travellers' qualitative user interviews. The aim was to collect concrete user insights from this target group, summarize them into a common requirement list, and categorize the interviewees into three representative persona types. The aim was to create imaginable user profiles for use in the subsequent student experiment, which contributes to question 4 of Table 2. To supplement the insights gained from desk research and expert interviews, an empirical study was implemented to examine the differences between the outside-in and inside-out design approach (see Chapter 6–7).

Chapter 6 – the third part of the experiment – describes how 92 design students from the Delft University of Technology were asked to adapt a real-life automobile design process, beginning with the product vision phase and extending to the draft design phase. For the purposes of comparison, two different design approaches were applied: the inside-out and outside-in approach. The experiment was set up in an identical manner to test the practice-based automotive design process against the outside-in and the alternative inside-out design approaches. This provided a direct comparison of the two outcomes and allowed to evaluate their individual strengths and weaknesses, which contributes to question 5 of Table 2.

Chapter 7 applies the findings from the previous chapter in text form and, illustrated in a so-called functional 'space mode' format, with space conditions arranged and ranked according to its importance of use. The result is a single 'basic space mode' design – a method that is applied to create strategic automobile designs within the fuzzy front-end phase of the NPD process. This method, which might be new to the automobile design process, allows for content and formgiving issues to be considered separately, which contributes to question 6 of Table 2.

Finally, Chapter 8 contains all reflections and improvement proposals regarding the 15 assumptions in Table 1. This chapter concludes the findings of the research with a catalogue of improvement proposals. Also a check is made if these improvement proposals are relevant by questioning experts. Finally some consequences for future automotive research in the fuzzy front-end is discussed.

Table 4 gives the research structure of the Ph.D. It is divided into an introduction part, a research and status quo remark, the project experiment, and a final conclusion. Detailed chapter descriptions are listed in the middle of the table, as well as in the index at the beginning of the document.

Table 4: Work structure overview

Content	Chapter number	Chapter description
INTRODUCTION	Chapter 1	Chapter 1 provides a research basis for this thesis and describes the problem statement, research questions, main research objectives, contribution to knowledge, research structure and applied methods.
RESEARCH AND STATUS QUO	Chapter 2	Chapter 2 includes a literature study on innovations and describes the main standpoint of this Ph.D.
	Chapter 3	Chapter 3 collects insights and documents the current status quo of automobile design within OEMs.
PROJECT EXPERIMENT	Chapter 4	Chapter 4 includes a study of the digital business travellers' work context in urban surroundings.
	Chapter 5	Chapter 5 collects concrete user insights from digital business travellers. These are summarized, and the interviewees categorised into three persona types.
	Chapter 6	In Chapter 6, 92 design students were divided into two groups to adapt the outside-in and the inside-out approaches to a real-life automobile design process.
	Chapter 7	Chapter 7 illustrates the work results in a functional space mode format. These space conditions are arranged and ranked according to their importance of use.
CONCLUSION	Chapter 8	Chapter 8 summarizes all findings of this work in a catalogue of 11 improvement proposals and evaluates them. The chapter concludes with a final discussion.

1.4. Research methods

This work uses several methods to answer the research questions and achieve the contributions to knowledge listed above. Table 5 lists all the chapters and their respective research methods.

Chapter 3 documents the existing process of automobile design, focussing on the way in which concepts are created. With the help of expert interviews, on-site observations, and narrative inquiries, this information is presented alongside research from the literature.

The qualitative expert interviews were used to build a solid knowledge structure to support the narrative research. These are also used in Chapter 4 for the evaluation of influential user trends and tendencies. The aim was to gain an overview of all influential factors.

Chapter 5 is the first chapter of the research experiment. It includes user interviews, persona profiles, and a range of on-site participant observer data. The persona profiles were created to gain concrete examples of prototypical users for the later experiment. The research in Chapters 4 and 5 was used to generate the design brief information for the subsequent project experiment.

Chapter 6 involves a student experiment in which 92 design students from the Delft University of Technology applied the existing, respectively novel design approach to create an urban car of the future. This chapter involves the early phase of two parallel design processes and the evaluation of these processes. Two student questionnaires were applied.

Chapter 7 analyses the aggregated content, and arranges the most important information in so-called 'space modes'. These functionally described vehicle layouts find their apogee in a final basic space mode design created for to the designers' conception demands.

Chapter 8 checks the recommendations for change via expert interviews. It determines whether practitioners and scientists agree on the proposed recommendations for future car design creation. It also seeks to determine which recommendation has the greatest and least innovation potential, in the opinion of the experts.

Table 5: Research methods application

Chapters	Applied methods
Chapter 3	Qualitative expert interviews
	Ethnographical on-site observation by participant observer (within the Mercedes-Benz design studio in Stuttgart, Germany)
	Narrative inquiry of designers (storytelling)
Chapter 4	Qualitative expert interviews
	Trends and tendencies collection to create an overview map
Chapter 5	Qualitative user interviews
	Common Requirement List (CRL) creation
	Personas creation
	Ethnographical on-site observation as participant observer (at airports, trains, train stations, Metro, car rental etc.)
Chapter 6	Student questionnaires (before and after the student experiment)
	Student experiment with two parallel briefings (Groups A and B)
	Inside-out and outside-in method application
Chapter 7	Space modes creation
	Basic space mode creation
Chapter 8	Qualitative expert interviews

CHAPTER 2 – RESEARCH FOCUS

This thesis proposes to use automobile concept design as a strategic tool in the fuzzy front-end NPD transportation design process. This phase entails the decision of whether to apply an outside-in or an inside-out approach to a specific project, which may in theory lead to different innovations in automobile design. In this chapter arguments for the fuzzy front-end process research are collected, as well as the search for product innovations, and extreme user profiles. The focus areas are the product, the design process and the user fields. Relevant definitions for innovations in car design are given, and the main objectives and research standpoint identified. The definitions are divided in two categories:

- Product and process innovations
- User innovations

General innovation definition

A vast amount of literature exists on the topic of innovation. The term itself has its origins in the Latin terms '*novus*' (new) [Granig 2012] and '*innovare*' (to renew) [Horsch 2003]. It means renewal and amendment, and signifies the development that occurs through change. Drucker [online N.N.] defines it as *'…change that creates a new dimension of performance'.* According to this definition, an innovation challenges the status quo of a market, industry, or corporation to overcome the dominant existing model. **This thesis takes the definition to mean that innovations in the field of automobile design should question the existing status quo.** Furthermore, according to Schumpeter [Biehl 1982], an industry can only be successful and sustainable in the long run if it remains open-minded and absorptive to innovations in thinking, theories, techniques, and developments.

Heindl [2008] states that an idea can only be considered a real innovation when it has been realized and established in the market: *'Invention means making things possible! Innovation means making things happen!'* When a potential user invents something new, he uses existing knowledge or special know-how to create a novel problem-solving method or system. A mental construction alone may hence not be termed an innovation, as new insights must be applied and new ideas and theories tested in a real-life environment. **In**

the present context, applying a real innovation means coming up with an invention (e.g., a new automobile concept), then implementing this idea in the market. Porter also indicates that ***'innovation is the central issue in competitiveness*** *[…]'* [Zairi 1999]. Therefore, design innovations and user insights will be more important—to the extent of becoming essential—as they allow users to differentiate between products made by different manufacturers. Innovation creation is hence a central concern of the research undertaken here.

According to Zairi [1999], product or process innovations can be seen as pure inventions that may become real innovations when market implementation (diffusion) occurs and a considerable degree of success proves the novelty, added value, or quality of the product or service in question. **The present research will focus on the theoretical aspect, gathering various market and user insights to carry out an experiment and transfer this outcome into functional concepts. It will conclude with some proposals for improvement, examined by market experts.**

2.0. Process and product innovations

Furthermore Hauschildt and Salomo [2007] claim that successful innovations are based on the consolidation of 'demand pull' and 'technology push' dynamics. In this work, the definition of 'demand pull' is expanded to include the fact that current user needs are one of the most important indicators of where society will end up in the future. **Only when novel combinations of purpose and meaning are made in the automotive field and an alternative value is defined (such as using the car as a mobile office, for which an autonomous driving technology is needed) can the advancement be termed 'innovative'.** This definition is applied at this research work.

Table 6: Innovation types listed in the OECD report.

Innovation types	Innovation definition
1. Product innovation	*'The introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses.'*
2. Process innovation	*'The implementation of a new or significantly improved production or delivery method. '*
3. Market(ing) innovation	*'The implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. '*
4. Organizational innovation	*'The implementation of a new organisational method in the firm's business practices, workplace organisation or external relations.'*

The OECD report [2007] differentiates between four basic types of innovations, as shown in Table 6 – the product-, process-, market(ing)-, and organizational innovation. They are based on Schumpeter's work [1987] that originally named a fifth type that he calls 'production innovation'. Similar to type 2 (process innovation), this does not focus on the improvement of one production system but on the revolution of an entire industry [Weingarten 2000]. **Of the areas described in Table 6, the present work focuses on product and process innovations in the field of automotive design.** Methods employed include literature research, interviews with automotive experts (see Chapters 3 and 8), innovative users (see Chapter 3) and a student experiment (see Chapter 6).

Table 7: Innovation dimension tool according to Hauschildt

1. What is new?	Content dimension
2. How new is it really?	Intensity dimension
3. For whom is it actually new?	Subjective dimension
4. Where does the novelty start and end?	Procedural dimension
5. Does new mean being successful?	Normative dimension

Hauschildt and Salomo [2007] emphasized the importance of identifying not only the types but also the different dimensions of innovations, according to certain criteria. To achieve this, they developed a tool consisting of five generic questions (see Table 7) to be applied upon an innovation's introduction to the market. The function of this tool is to define the type of new idea in question. Table 7 allows for the classification of ideas by the head of design or the executing designer responsible for an invention. It can also be used to create an exact description of the innovative nature of a proposal, which can be forwarded to decision makers. This method is applied here to find new ways to utilise future automobile space in urban environments (point 1 of Table 7) for the target group of digital business travellers (points 2 and 3 of Table 7). The novelty should begin with the creation process in the fuzzy front-end of the NPD and end with positive everyday experiences for alternative automobile users (point 4 of Table 7). **The implementation of an invention is considered an innovation when…**

- **it differentiates the product from others in the market**
- **a market implementation occurs and a considerable degree of success proves the novelty, added value, or quality of the product or service in question**
  (point 5 of Table 7).

2.1. User innovations

Aside from product and process innovations, this work also considers user innovations that involve the innovating users. This chapter explains the reason for choosing digital business users as a target user group. The innovating user plays a central role in the definition of an innovation given by Drucker [online N.N.]. This thesis seeks to connect these with future vehicle use scenarios. These users are assumed to be creative, abstract thinkers capable of modifying ideas and implementing them in a new context. They have strong problem-solving capacities and are able to communicate new needs, and they trust their intuition and spontaneous creativity. Duncker [iCreate 2013] states that by applying their creative ability to certain problems, users can overcome conventional hurdles[2], reset their regular behaviour patterns, and define new meanings and product functions for vehicles. Intentionally or otherwise, they are able to apply creative strategies, imagination, and skills such as design abilities to create product functions or services, mostly for their own use. The questions thus arise: Why are these users searching for improvements in the first place? What is their motivation for doing so? And are they applicable to the present research project?

[2] Known as 'functional fixedness' – a '*mental block against using an object in a new way that is required to solve a problem'* [iCreate 2013].

Buijs [2012] comments on what Schumpeter [1987] calls 'creative destruction': *'Innovating is considered to be the main engine for societal, cultural, and economic prosperity […] by introducing new ideas and procedures the present ideas or procedures are being challenged.'* So, ***'users may see new options for a better situation and will probably adopt them for their future daily use'.*** He identifies users' personal motivation as the main criterion for the creation of alternative product solutions for situational or long-term improvements. These users may develop or change existing products for their own use (intrinsic motive), or benefit in some other way. Benefits can be either direct or indirect, such as obtaining rewards through a gratification system. Von Hippel [N.N.] also confirms this theory by stating that it is more likely for these users to be driven by personal motives, as their first motivation is to improve their personal situation. These motives can include joy at the prospect of exploration or improvement, prototyping, or an effective feedback system. **This user group is of interest to the present research as they are capable of developing innovative concepts to overcome the obstacles presented by 'functional fixedness'.**

Table 8: The three phases of user innovators according to von Hippel

Type 1	The innovative user	Creates new ideas and develops non-professional prototypes to improve his daily life.
Type 2	The adaptive user	Evaluates solutions and adapts and copies existing prototypes while improving details.
Type 3	The applying user	Identifies market potential, propagates the idea, acts as a partner, produces the product and enters it in the market.

This gives rise to the following questions: What makes an innovative user? Are there any differences in their innovation involvement? Von Hippel describes three types of user profile, with three different levels of innovation involvement (see Table 8) [Mangelsdorf 2011]. Type 1 (the innovative user) is an individual with interesting ideas leading to prototypes. Type 2 (the adaptive user) evaluates existing solutions and improves product details. Type 3 (the applying user) demonstrates professional behaviour in reviewing the market potential and placing the product in the marketplace. **This thesis concentrates on Type 1 and Type 2 users, as they are sufficient for the research task and easier to locate.**

Table 9: Activity stages of innovating users according to von Hippel

Stage 1	User observes his direct environment as a reflective thinker and active critic. He reacts sensitively to the influences and ideas of other users, products, functionalities, and so on. He thinks seriously about improvement possibilities.
Stage 2	User offers verbal criticism and gives feedback when asked. He discusses ideas and searches for an exchange of opinions in informal user communities (face-to-face, online forums etc.)
Stage 3	User becomes intellectually active and develops his own creative thoughts and ideas. He makes direct improvement suggestions (mostly for his personal advantage) to the original producer of the product or service.
Stage 4	User becomes physically active and wants to change or improve the current situation, products, or conditions to better match the actual demand (in his immediate periphery). He tries to change or individualize something by producing a customized one-of-a-kind prototype. Sometimes other users adopt his ideas.
Stage 5	User develops ideas for products or services that are physically and intellectually new and develops generic strategies to put them into practice. He wants to solve a concrete but generalized problem with a semi-professional prototype development. He may search for partners or choose to team up with producers, leading to a transfer of his idea or system towards the mass market.

Von Hippel describes the innovative user in more detail – the five stages in Table 9 list the different stages of involvement, depending on the innovation level of users (as shown in Table 8). At Stage 1 of Table 9 the process takes place exclusively inside the user's head. He observes distinctive environmental states with no external manifestation. An example of a Stage 4 user is an individual who discovered a knotting method to convert a customary cardboard box and a rope into a comfortable but elegant carrier bag with handles. His original need was to find a straightforward, cheap, and practical solution to transport goods, and plastic bags were neither available nor suited to the circumstance. The carrier box was created not spontaneously but through a detailed observation of the problem. Ongoing modifications were made until the perfect solution was found. **For this thesis, the innovation question depends on whether the users' solution is different to that of others; whether it creates additional value; and whether it adapts to specific needs or situations, even when the same technique is used repeatedly.**

Lead user approach

It is often difficult to confirm the originator or intellectual owner of the idea behind a product or service. When an innovating user identifies his personal 'best practice' solution to improve an established product or situation, it is vulnerable to being copied and adopted by other users. Von Hippel [1988] mentions that when many people adopt a system repeatedly, a user trend is born. Sometimes, an existing model is further developed and adapted, turning the original idea into a real market innovation. There are hence many occasions when the question of intellectual property cannot be fully resolved. In general terms, innovating users are driven more by a frontier mentality that seeks to be the first to do something rather than the need to assume sole ownership of an innovative idea. They enjoy sharing, discussing, and evaluating ideas with other experts. According to von Hippel [2005] they *'[…] can develop exactly what they want, instead of relying on manufacturers to act as their (often very imperfect) agents'*. Members of this group are described as product innovators, sources of innovation, smart designers, critical thinkers, and researchers – often all of the above. Von Hippel terms them 'lead users'.

Table 10: Three criteria to identify lead users according to Urban and von Hippel

Criteria 1	The velocity of adaptation of other innovations
Criteria 2	The degree of dissatisfaction with existing product solutions
Criteria 3	Investments by users into needed innovative products and services to find already existing improvements

This group represents a creative minority that develops advanced ideas, life scripts, and non-professional prototypes to improve their personal situation. Often experts in their field of knowledge (due to their private or professional interests), they are generally expected to be ahead of their time in their thought processes, and more future oriented than the rest of society. Von Hippel describes these lead users as an elite group of innovators whose potential is a source or facilitator of innovations in industry and science [Von Hippel 1986]. From the sliding scale in Table 9, the typical lead user belongs exclusively to Stage 5. However, the entire innovating user group is much bigger than the lead user

group alone. Urban and von Hippel [1988] list three criteria to identify real lead users by their characteristics and behaviour patterns in Table 10.

Herstatt et al. [2006] describe lead users as users with long-lasting technical knowledge who are unhappy with current solutions and strongly interested in finding better ones. Mangelsdorf [2001] states that they are: *'[…] sophisticated users who are the most likely to innovate to satisfy their own needs'.* What makes a real lead user grow into an innovating pioneer? Is it their mindset, philosophy, or specific behaviour? In 1986, von Hippel [Urban and von Hippel 1988] defined the term lead user as follows: First*, **'lead users face needs that will be general in a marketplace – but* they *face them months or years before the bulk of that marketplace encounters them, and lead users are positioned to benefit significantly by obtaining a solution to those needs.'*** A major challenge faced by every global industry is thus to identify from among its prospective target groups those high-end innovating users who are ahead of the entire 'adoption curve' [von Hippel 2008]. **By recognizing such new or different user needs, it is possible to gain an additional R&D time margin. This may even lead to first-mover innovation success in the market.**

At present, there are different opinions on the defining characteristics of a lead user. A single person cannot act as a lead user in several areas simultaneously, as possessing expert knowledge across many different fields at the same time seems implausible. It is hence necessary to identify specific characteristics, skills, and profiles according to the sector, industry, and field of research in question. The lead user methodology tries to combine the interrelated dependencies of technological and market-driven developments by designing the innovation process in close cooperation with users and eventually producers [von Hippel and Urban 1988]. Von Hippel describes a four-step method to combine a lead user hypothesis with actual market research. He makes the following recommendations: *'(1) specify lead user indicators; (2) identify the lead user group; (3) generate a concept and/or product with lead users; and then (4) test the final lead user concept or product'* [von Hippel and Urban 1988].

This choice of user group and innovation method has both advantages and disadvantages. One advantage is that involved lead users make it possible not only to generate 'out of the box' information about a company's products but also to obtain a whole-sector overview, including information about direct competitors in the market. According to Herstatt and Lüthje [2004], the lead user method also provides new or alternative insights beyond general OEM internal information gathering. Classical automotive market research asks questions about specific functions and product improvements, as well as current user needs. The lead user method on the other hand is less specific, while difficult to control in a closed development system. It offers a broader possibility to seek out disruptive solutions in various fields. **Automotive design research cannot not rely on the lead user method alone; rather, on a well-defined user-centric product development process where detailed functions can be inquired. Another method is hence required to examine the fuzzy front-end of the NDP.** This research follows the definition by Herstatt and Kohlbacher [2011]: *'The goal of user-centred design is to transfer user needs into product specifications, and thus ensure the satisfaction of the future customers […].*

The role of the user is to be purely an information source for the designer, who then hopefully is able to innovate.' The lead user method is hence excluded from the present research based on this interpretation of the innovating user's role within the NPD cycle.

Finally, as lead users represent a minority social group, they can be difficult to locate, which is further reason for their exclusions here. During a lecture from Leifer at the Hasso-Plattner-Institute in Potsdam [2011], Stanford's professor of design thinking pointed out that the major disadvantage of utilizing lead users is the small number of people that are available for research projects. They are difficult to find, identify, and integrate, and **it remains questionable whether their insights represent those of a broader audience.** The focus is hence on a broader range of innovating user ranging from stage 1-5 of Table 9.

Similarly, the specialist nature of the field means that it is difficult to identify and collaborate with automotive experts as lead users. Automobiles are a specialist field in which only a few individuals have the expertise to compete at a high technology level within the OEMs. For instance, this would demand knowledge of battery technology, HMI principles, safety issues, design trends, CO_2 regulations, and more. These different competencies limit the possibilities to design or conceptualize a vehicle that can be certified for worldwide use. A lead user approach cannot, therefore, be applied as easily in the automobile industry as for producers of more simple goods, such as household equipment or shampoo [Herstatt et al. 2014].

Open innovation approach

The open innovation approach proposes a method whereby 'internal' employees of a company and 'external' users (sometimes clients) collaborate in a joint product development project. Both sides may add innovative thoughts, ideas and practical input to the future product. One example is a new American car producer called Local Motors [Buhse et al. N.N.], headed by Jay Rogers that is trying to integrate innovative user insights into its product development. An online community of car enthusiasts are encouraged to participate in the design, manufacturing, and engineering processes of building customized automobiles [Rogers 2012]. These community members can participate either passively or actively in the company's workshops. They can even take part in the prototyping and manufacturing processes. **This approach demonstrates a new openness in the automobile industry, where complete secrecy is often a top priority.** Wentzel [Buhse et al. N.N.] states that this approach offers new possibilities to develop components in a quick and cost-efficient manner. Tomczak [Buhse et al. N.N.] believes that users no longer wish to remain passive; rather, they would like to actively participate in the design process. Rogers regularly asks his community what the next 'big thing' is that the company should produce. He collects user statements, creative suggestions, and designs, nominating one concrete project for which he collects prior online orders to be executed within a certain timeframe.

While the open innovation approach works for Local Motors (a start-up company), it is questionable whether this business model is suitable for the OEM mass market. Krzywinski notes that the current trend is for automotive brands to keep their plans secret until the moment that a brand-new product is launched. Traditionally, OEM's internal R&D departments (including vehicle design) operate under conditions of extreme confidentiality

[Krzywinski 2012]. The question thus arises: How to deal with public or client failures when applying an open innovation approach? It seems possible that this approach may also disturb an automotive company's established brand. **It is hence necessary to come up with alternative concepts and effective strategies (apart from the open innovation approach) to bridge this conflict of information and knowledge transfer between vehicle designers and users.**

Clarification is also required regarding how an invention becomes a real innovation in time-sensitive and complex development processes, where innovative ideas are communicated widely at the beginning of the development phase. Experience indicates that communities share their expertise with anyone who is interested, and ideas are immediately discussed and spread online. This leads to some serious challenges to secrecy and security in the OEM mass market, which can impede market advantages. Based on the reasoning above, these issues represent the sensitive points for OEM's to integrate the open innovation method in their product development system. **For these reasons, this type of research method (as well as the co-creation issue) is excluded to be a standard role model in OEM's internal NPD processes.**

2.2. Research standpoint

In summary, this study seeks to gain insights into future car interiors by considering the everyday design practice of automobile OEMs; the scientific research of innovation experts such as von Hippel [1986]; and user-centric design generation for automobile interiors by Vink [2005 and 2012], and Vink and Brauer [2011]. The Delft innovation model process flow described by Buijs [2012] provides an understanding of the circular product development process, aligning it with future innovation creation in the automotive field.

A new approach is needed to anticipate the changing nature of future vehicle use. In the field of technical design research, the work of Krzywinski [2009 and 2012], Kranke et al. [2009 and 2010], and Seeger [2005, 2007 and 2014] is useful for studying the conceptual design side of the overall vehicle design process. Krzywinski [2009 and 2012] documented certain design processes and automobile design briefs that have otherwise received limited scientific attention. Seeger [2014], meanwhile, gives a general overview of technical design developments and industry process flows. He insists that human beings are the benchmark for all vehicles, and not vice versa.

The thesis also examines the classic transportation design tasks described by Wachs and Weinlich [2011] to see if there is scope for the introduction of a more holistic process. These tasks are *'Design = Drawing - researching - simulating - analysing - intervening - interviewing - constructing - on-site testing - correcting - calculating - communicating…'*[3] Interviews have revealed that expanding the existing automobile design tasks requires a talent for multidisciplinary communication, as well as analytical and interpretation skills to address user that live future automobile needs already today. These tasks are considered necessary for designer to translate and apply the latest aspects of user behaviour into the automobile environment.

[3] Translated from the German: *'Design = zeichnend – recherchierend – simulierend – analysierend – intervenierend – interviewend – konstruierend – im Feld erprobend – korrigierend – kalkulierend – kommunizierend…'*

Extreme user approach

This research does not explicitly discuss either the lead user approach, the co-creation method or the open innovation method. **Extreme users, however, are suitable here as they cover a broader percentage of society compared to any lead users. Over time, extreme user innovations represent an even larger demographic, as these users are considered 'early birds' in terms of societal behaviour developments.** Their extreme lifestyles and behaviour patterns may also indicate the potential to be avant-garde role models for future mobility. This work hence studies extreme user reports (rather than their actual actions) dedicated to Stages 1–4 of Table 9, taking notice of always-faster product follow-ups and innovation pressure in automobile NPD.

The approach used in this work is a promising method of implementing innovations within OEMs [Gassmann and Sutter 2008]. While the value of extreme user input is recognised by scholars and practitioners alike, the systematic integration of a strategic extreme user approach has not been applied in automobile practice so far [Springer et al. 2006]. One promising example is Adrian Hooydonk, BMW's head of design, whose work approach reflects his broad education in industrial design. He recognized the importance of the changing user mobility in the future, and hence was the first to develop a purpose-designed electrical car (the BMW i-series). With future urban target groups in mind, this research explores alternatives for modifying interior spaces to resemble a multidisciplinary work environment. This user-centric design approach, and its application to extreme users, provide the basis for subsequent research and seek to identify the right time to implement sustainable user innovations into the design process.

Research objectives and assumptions

The literature indicates that the exemplary application of a representative extreme user group allows us to gather new insights and develop novel innovation approaches in the fuzzy front-end of automobile transportation design. The changing lifestyles of these progressive target groups may lead to new societal behaviour patterns and groundbreaking technical advancements. This Ph.D. focuses on the design field within the product development process of an OEM, with the aim of exploring opportunities for innovative improvements. The automobile interior – a 'third place' in which extreme users may either work or carry out their private affairs – has been identified as a focus area for the application of innovations. The 'third place' is defined by Oldenburg [2002] as one that *'host[s] the regular, voluntary, informal, and happily anticipated gatherings of individuals beyond the realms of home and work'*. He goes on to state that, *'[…] Where the means and facilities for relaxation and leisure are not publicly shared, they become the objects of private ownership and consumption'*. This offers both an entirely novel perspective and a new role for the automobile interior as both a fully-fledged working environment to share, as well as a private space. Consequently, the automobile interior will play a more important role in both the emotional and functional interactions of urban business travellers. This thesis will address those extreme users that have the power to invert the mobility paradigm and its value allocation system. The design process and its innovation infiltration will therefore be subject of research. As **this research intends to challenge previous practices in transportation design by implementing a more open and participative design process, with the help of user innovations.**

More broadly, this work seeks to challenge the existing status quo of the NPD design process model, with the aim of implementing more user-centric automobile innovations. The subculture of automotive transportation design will be closely examined to identify existing obstacles to innovation. Methods will include a step-by-step experiment for identifying possible tools and methods that challenge previous strategies, work practices, and intellectual approaches. As such, this research seeks to leverage the strategic imbalance of exterior and interior advanced automobile design in the fuzzy front-end phase. **The aim of this work is to understand the reasons behind the existing situation, and to come up with concrete proposals to transform the information transfer between the head of design and the executing designer into a vivid dialogue.**

CHAPTER 3 – AUTOMOBILE NEW PRODUCT DEVELOPMENT

This Ph.D. addresses the relationship of interior and exterior design, the strategic involvement of the fuzzy front-end phase, and the general interaction between the design and the engineering department inside OEM's. There are many studies on design aesthetics e.g. Aicher [1984] or Amadao Lorenzo [2011] with much documentation about exterior design e.g. illustration books and portfolio websites. However, extant literature does not adequately address the relationship between the interior and exterior designers and their current participation in the design process. Therefore experts were interviewed. Systematic knowledge on the comprehensive design process in OEM's is also lacking and how innovations were implemented in the early phases of the process. This is not surprising as it is competitive-sensitive information and therefore questions on these topics were asked in interviews as well. To gain insight into these issues, semi-structured interviews were carried out with 12 automobile design experts. The aim of this chapter is to gain an overview on how the design process works and how the respective collaboration in-between the different disciplines are organized at that time. Special attention was given on how the culture of automobile design finds its expression, and what this means for a vehicle's interior, respectively exterior designer. The remainder of this chapter presents the results of these expert interviews.

3.0. Method

Qualitative interviews were carried out with six experts to obtain first-hand insights on the context of automobile design culture, the automobile interior versus exterior design discipline, the hierarchical structure within design departments, design innovation, the automobile design process, the design brief and briefing phase, and an expert vision on future mobility. The outcomes will later be used for a deeper research (see Chapter 7). For the interviews a guideline was applied, following an approach described by Weyers [2007], which includes a semi-structured questionnaire. Questions like *'How do you define (design) innovations?'* and *'Are there significant differences in-between the automobile exterior and interior design?'* were asked. Three additional pre-interviews were conducted

to gain first insights into the automobile design world. These pre-interviews not only provided the researcher with crucial background information, but also helped to refine the questions that would ultimately be asked to the six experts. It was important that the interviewee had no ostensible, personal interests of self-manifestation or any personal advantage in providing information to the interviewer. Questions were asked regarding every specific interviewees field of expertise. By following Weyers' [2007] approach, the interview process has been divided into four main phases:

1. Preparation: writing an interview guideline
2. Data collection: planning and executing the interview
3. Data documentation: documenting the interview
4. Data analysis: analysing the collected material to relate it to literature

Interview guide

The basic questions asked to these experts are shown at the Appendix in Table 50 of this document. The interviews were semi-structured, which means that there was room for elaborating topics when the expert wanted to explain more. The interview guide can be found in Appendix of Table 50 in a master version in German and English languages.

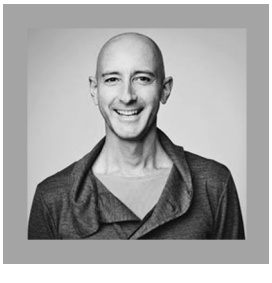
Participant selection

According to Honer [1994], there are two important characteristics that every expert needs to possess: a long-lasting experience of at least 10 years, and, in this case, a field-specific 'niche' knowledge of automobile design and innovation, which was a selection criterion. Another aspect was added because this chapter aims for a broad exploration. Therefore experts should come from different backgrounds such as the practice-based industry towards the scientific university research. They should come from different educational and brand-related backgrounds – from exterior to interior specialists – to represent the most inhomogeneous, objective variety of opinions. All participants coming from university institutions were covering the span of the educational field in German automobile design. Their students work all over Europe and around the world for diverse OEM's and automotive suppliers. The selection of experts was made to consider the transportation design scenery from different point of views (culture, hierarchy, professional background, interior and exterior design). Thus, insights of specialists into the transportation design subculture were explored rather than the number of responses. Six additional people preferred to stay anonymous. Therefore they cannot be described in the same way as the previous six ones. These six persons were interior designers (3), advanced designers (2) and a strategic designer (1), being a specialist on the design process. Based on the before mentioned criteria, the following six expert profiles were selected:

Expert 1: **Prof. Lutz Fügener**
Professional background: Professorship at the University of Pforzheim. Pforzheim, Germany
Field of expertise: Transportation design

Expert 2: **Prof. Andrea Lipp**
Professional background: Professorship at the University of Reutlingen. Reutlingen, Germany
Field of expertise: Transportation interior design and materials

Expert 3: **Prof. Dr. Othmar Wickenheiser**
Professional background: Professorship at the University of Applied Sciences, Munich, Germany
Field of expertise: Transportation design, Industrial Design



Expert 4: **Prof. Paolo Tumminelli**
Professional background: Professorship at the Köln International School of Design (KISD), Köln, Germany / Field of expertise: Transportation Design, History of automobile transportation

Expert 5: **Daniel Starke**
Professional background: Head of interior design at BMW Group, Munich, Germany
Field of expertise: Automobile transportation interior design, Electric-powered vehicles, multidisciplinary working approach

Expert 6: **Frank Köber**
Professional background: Marketing innovations manager at Daimler AG, Stuttgart
Field of expertise: Innovation evaluation, automobile innovation portfolio management

Analytic procedure

All expert interviews were documented, transcribed, and analysed. Insights of these specialists into the field of design were explored from a qualitative side. The interview text was scanned on filter terms and subjects of Table 11 and Table 12. Next, the main insights gathered from the analysis were summarized in single propositions and grouped into 'identified subject areas' to gain a better theme overview on all joint expert statements (see Table 12). This was done by first condensing the content and then by defining the propositions. All topics that were not related to the research question were excluded of the analysis phase.

Table 11: List of filter terms of expert interviews

Filter terms	Design culture, design behaviour, communication
	Automobile interior/exterior design, differences of design disciplines
	Hierarchy, communication hurdles, innovation
	Innovation, black box, creation of new ideas
	Automobile design process, design phases, improvement possibilities
	Design brief, design briefing, design material and qualities
	Future transportation/mobility, visions, scenarios, electric/autonomous driving

3.1. Expert interview results

The six interviews took between 1.5 to 3 hours and its results are described in this section. It was interesting to see that all experts were willing to collaborate and took their time. The 'identified subject areas' and statements are listed in Table 12. The seven subject areas were: Automobile design culture, automobile interior versus exterior design discipline, hierarchical structure within design departments, design innovation, automobile design process, design brief and briefing phase, and expert vision on future mobility.

Table 12: Joint expert statements

Identified subject area: **Automobile design culture**	
Filter terms: Design culture, design behaviour, communication	
1.	The head of design's behaviour and communication culture influences each corporate design culture sustainably. (Lipp)
2.	It is a challenge to communicate between different automobile specialist fields, as their mutual understanding is often misleading. (Fügener)

3.	A comprehensive understanding and mutual appreciation between the design and the engineering departments is missing. (Anonymous 1)
4.	The design studio itself is set up with an international mix of people and thus communication difficulties inside the department are part of the day-to-day business. (Fügener)

Identified subject area: **Automobile interior versus exterior design discipline**	
Filter terms: Automobile interior/exterior design, differences of design disciplines	
5.	Exterior design refers to styling surfaces and graphical lines, but handles less functional topics. (Lipp)
6.	A comprehensive understanding and mutual appreciation between the design and the engineering departments is missing. (Anonymous 1)
7.	Interior design is less sculpturally shaped than the exterior, and works are more functionally oriented, and thus a more detailed briefing makes sense. (Fügener)
8.	Transportation interior design work is more complex than the exterior one, as more disciplines are involved and more individual volumes need to be designed. (Wickenheiser)
9.	Interior design is the result of team and co-operating work. (Lipp)
10.	Interior design applies a more holistic work approach and supports the pure aesthetical formgiving by answering ergonomical, technical, or material knowledge questions. (Lipp)
11.	Interior design integrates complex context information into limited space concepts so that the designer has to think in three-dimensions. (Lipp)
12.	According to future car construction principles, the interior and exterior design disciplines will merge, representing one and the same structural element of a car to be designed at once. (Lipp)
13.	Surprisingly the interior design is still developed separately from a vehicle's exterior design. (Fügener)
14.	The interior design of a vehicle will become more important in the future and therefore needs to be anticipated in the design process. (Anonymous 2)
15.	At this moment, the transportation interior design offers more disruptive innovative development options than the exterior design. (Lipp)

Identified subject area: **Hierarchical structure within design departments**	
Filter terms: Hierarchy, communication hurdles, innovation	
16.	Today's automotive communication structures are not enough open-minded and receptive to permit initiators from all different specialist areas. (Fügener)
17.	The interior designer is educated as an open-minded integrative worker that doesn't match so well with the current automotive hierarchy system. (Lipp)
18.	The reduction of hierarchical steps within the design process might influence the process flow sustainably and enable further product innovations. But its combination is by no means mandatory. (Fügener)

Identified subject area: **Design innovation**	
Filter terms: Innovation, black box, creation of new ideas	
19.	We are experiencing a lack of reforms and renewal in the transportation design branch, as there exist many more technical possibilities than the taken options. (Fügener)
20.	The automobile design is re-producing its routine knowledge over and over again, as restrictions in the field of aerodynamic resistance, company-intern PDP processes, and the hierarchy system are blocking new disruptive developments. (Wickenheiser)
21.	The vehicle purchaser is less open-minded concerning automotive innovations than he is in other industries. (Fügener)

22.	The electric vehicle represents a new chance for disruptive space development. (Wickenheiser)
23.	The designer's manual know-how of drawing is often requested, but there is also a need to apply their other abilities such as creativity and cross-disciplinary working. (Lipp)
24.	Immaterial knowledge creation and design research are hard to verify, but they prepare the ground for interventions into the fuzzy front-end design process concerning design leadership aspirations. (Fügener)
25.	There is a need for non-hierarchical, informal frameworks where designers can meet, discuss, and exchange their visionary ideas. (Lipp)
26.	Innovations need to be seen as 'optional deals' that require an open-minded sense for abstraction, imagination, and a strong will for change. (Köber)
27.	Outer design restrictions, such as material shortages and new technological or social developments, might stimulate disruptive vehicle innovations. (Lipp)
28.	The application of extreme user situations could be one option (out of many possible ones) to generate disruptive innovations. (Lipp)

Identified subject area: **Automobile design process**	
Filter terms: Automobile design process, design phases, improvement possibilities	
29.	Many design departments do not possess a documented process structure that might give the chance to discuss organizational changes and implement process improvements. (Anonymous 2)
30.	The design process will be more and more standardized, streamlined, and improved. (Anonymous 2)
31.	The interior designers should be involved at earlier stages in the design process to have the chance to generate even more meaningful innovations. (Anonymous 1)

Identified subject area: **Design brief and briefing phase**	
Filter terms: Design brief, design briefing, design material and qualities	
32.	There exist many different ways and qualities of designs briefings in the market. (Anonymous 1/Lipp)
33.	The briefing type and its detailed content design already influence the later-day design outcomes notably. (Fügener)
34.	The additional burst of creativity represents an exceptional extra of each designer's performance. (Fügener)
35.	The design brief should not be too detailed in such a manner that the designer could still apply his own creativity. (Anonymous 1)
36.	Paradoxically, the briefing takes place quite often in a verbal form so that the designer can relate to previous design knowledge. (Fügener)
37.	Each responsible project manager has to act empathetically and sensitively to translate the original work task into a design brief. (Anonymous 1)
38.	The first brief(ing) marks a classical bottleneck in between the board of management and the head of design. (Fügener)
39.	Every time a brief is passed on, the forwarding individual modifies it verbally. (Fügener)
40.	Anything that happens to be invisible, intangible, or might not be experienced in any form does not exist for the designer. (Anonymous 2)
41.	Efficient streamlining of processes leads towards pre-definition of products, which prevents innovative acting in a disruptive form. (Fügener)

42.	The new 'speed' in product development results in a mass production of many, but similar, vehicle designs and concepts.[4] (Wickenheiser)
43.	Designers are transformed into design producers, as there is always less time for them to undertake field research or to reflect on their prior work results. (Wickenheiser)
44.	The earlier a designer is involved in the briefing phase, the more requested are their creative-abstract competences and the more diverse are the corresponding design outputs. (Lipp)

Identified subject area: **Expert vision on future mobility**[5]	
Filter terms: Future transportation/mobility, visions, scenarios, electric/autonomous driving	
45.	Within the autonomous driving vehicle, the human being represents the most stable constant, even though its space usage will change completely. (Fügener)
46.	The interior space of a car will be rather defined throughout simplification and user-friendliness in the future, instead of a constant addition of complexities. (Fügener)
47.	When the autonomous driving vehicle would represents the people's 'third place' in urban areas, its concept complexity will further increase. (Fügener)
48.	Sharing of vehicles is a powerful instrument that offers use of an exclusive space by individuals during the time of its utilization. (Wickenheiser)
49.	Changing interior scenarios do play a major role in sharable space concepts that can be customized throughout digital support. (Wickenheiser)
50.	Instead of more functional or emotional aspects, design is looking for better-developed communication share points. (Tumminelli)
51.	A car could be rather designed from inside-out in the future, whereas the seat would feature the main referential point of the concept. (Anonymous 2)

3.1.1. Identified subject areas

In this chapter the following seven subject areas that were identified out of the expert interviews of Table 12 are further described.

Identified subject area: **Automobile design culture**
The identified subject area of automobile design culture showed that the persons interviewed mentioned cultural influences. Cultural differences, which bias the end result, were found between different specialist fields, between the design and engineering and between different nationalities.

Identified subject area: **Automobile interior versus exterior design discipline**
The interviews revealed that the exterior is more focused on styling issues and less on functional topics. Comments regarding the interior design were that it is more complex, more functional oriented, consists of more teamwork and applies a more holistic approach. It also predicted that there is a merge of disciplines and will get more attention in the future. And it offers more disruptive innovation development options.

Identified subject area: **Hierarchical structure within design departments**
The experts indicated that the current hierarchy structure is not enough open-minded to

[4] Wickenheiser: *'In former times Audi produced 80 vehicles in around 40 years. In contrast to this in the last seven years they have already designed around 60 cars with the same number of employees than before…'*
[5] The following insights do not play a major role within this chapter's content and hence the interpretation of points 44 to 50 is postponed to Chapter 4 to 7.

permit initiators from all different specialist areas. It was assumed that a reduction of the hierarchical steps might influence the process flow and enable further product innovations. This is a chance to better integrate the interior designer that doesn't match so well with the current hierarchy system.

Identified subject area: **Design innovation**
According to the experts interviewed, nowadays designers are re-producing their routine knowledge in form of drawings, and do less apply their other abilities such as cross-disciplinary working. This prevents the creation of disruptive innovations that are defined as 'optional deals' driven by material shortages, social or technical developments. To create these, immaterial knowledge and design research must be generated e.g. through the application of extreme users situations or by creating informal frameworks to discuss visionary ideas.

Identified subject area: **Automobile design process**
The experts believed that the design process would be more standardized in the future but a documented process structure is insufficient. And that the interior designer should be involved at earlier stages in the process. The hierarchy within the transportation design department influences the interior–exterior communication because not every one is enough open-minded, and open-mindedness does not correspond to the current hierarchy system.

Identified subject area: **Design brief and briefing phase**
It has been found out that the increasing speed in design development produces many but similar design outputs as there is less time for field research and reflection. They also indicated that the designer's briefing takes place in a verbal form, which means that it gets modified slightly every time it is passed on to the next party. This makes it different to reproof original work tasks and rate the designers performance. Therefore the design brief should be written down, but not too detailed so that the designer can still apply his own creativity at an early moment in the design project. It is also important that the brief can be experienced in multisensory ways, so that the designer includes important information in his designs.

Identified subject area: **Expert vision on future mobility**
With respect to their vision on future mobility, the experts suggested that in first instance the user wants more simplification and user-friendliness than an increased complexity within the vehicle. But as usage will change towards sharing models and the vehicle might be even utilized as 'third place' for alternative scenarios, its concept complexity will further increase. This requires rethinking hitherto design strategies and moves the automotive interior to the centre of attention.

Interpretation of expert statements

All interviewees approved that the company culture and behaviour pattern of each individual head of design influenced the overall design atmosphere and had substantial impact on the outcome. The understanding on how to interact with one another and the sharing of experiences are considered crucial for any sustainable product success.

Statements 1 and 2 make clear that the communication culture in between the design and its surrounding engineering departments should improve. One of the interviewees made clear that there is a need for changing the manner in which information should be exchanged with mutual respect, and interpreted for the involved executing designers.

The interviewees assigned the role of exterior design[6] to be mainly responsible for formgiving and styling topics, while interior design deals with content, surfaces, and participating stakeholders that result in a demanding work task. For the latter, a comprehensive communication is requested to bridge future vehicle development complexities and to face challenges at the earliest moment possible.

In statements 12 and 13 of Table 12 make Lipp and Fügener clear that the general vehicle development has to work more collaboratively concerning both, the exterior and interior design. They even assume a synchronous cooperation of the interior and exterior design to support future innovations. This indicates a need for restructuring the design process flow's organisation, especially by considering the fuzzy front-end of design.

In accordance with digital and other technical developments, Lipp, Wickenheiser, and Starke expect the automotive interior to represent a drastically changing field with huge innovation potential for the present and the future (see Points 14 and 15 in Table 12). Also, according to Fügener [2011_b] *'...In future the classical three-box-model – with front engine, rear trunk, and the driver's cabin in-between, is massively questioned. A definite exterior look does not exist anymore. I could […] construct a cube as well as an egg. Everything depends on what I aim to do inside...'*[7] Testimony 39 of Table 12 proposes to document the design process (see Section 3.2.5) to support further process advancements and involve the interior design earlier in the design process. Hence Points 16 and 17 confirm that the executing designer has a better chance to elevate his innovative ideas in detail.

At the same time, it is common sense that regular product innovations represent a part of any successful automobile OEM, although disruptive ones are not very common in the moment (see Points 17, 18 and 31 of Table 12). It must be admitted that these can neither be produced serially nor controlled, but stimulated consciously. They represent 'optional deals' that require an open-minded sense for abstraction, imagination, and a will for change, as argued by Köber in Section 3.2.4. The central question of this work is how to create, develop, and implement more of these innovations during the early design phase, such as an extreme user application.

[6] It needs to be mentioned here that also the exterior designer deals with certain content during the design process. Wickenheiser describes his task as the following: *'Creating the perfect balance of a silhouette, proportion and form in such a way that the client identifies emotionally with the vehicles outward appearance immediately and over a long period of time, demands a highly skilled expert. To come up with a convincing design result he has to simultaneously use his head, hand and heard in order to deliver the appropriate aesthetic content for a premium dynamic product. So intelligence, artistic knowledge and craftsmanship as well as the empathy for the correlation between visual and emotional impact of shapes on the human subliminal perceptions are crucial factors for the exterior designers.'*

[7] Translated from the German: *'...Das klassische Dreibox-Auto – vorne Motor, mittig Fahrerkabine, hinten Kofferraum – ist jedenfalls massiv infrage gestellt. Es gibt keine zwingende Außenansicht mehr. Ich kann ebenso gut einen Würfel bauen wie ein Ei. Alles hängt davon ab, was ich im Innenraum machen will...'*

In addition, Statement 18 makes it clear that a more direct communication and flat hierarchy system can foster the creation of innovation within the early design stages. According to Fügener, the early creation of non-tangible knowledge plays an important role in developing content-driven design innovations.

Most interviewees agreed that there are different types of design briefs and ways of communicating information. The designers preferred a generally formulated, verbal brief for having the utmost freedom to find creative solutions by themselves. The written brief is imperative to evaluate each individual design performance and to assess the complete work status within the NPD process (see Point 19 in Table 12). The experts affirmed in Point 20 of Table 12 that the involved designer often receives solely verbal statements as design brief. The communication passes various responsible persons with the risk that the original project aim could change (see Point 21 in Table 12). This type of corporate process and the increasing speed in development might lead to a constant re-production of routine knowledge. So there is a risk to leave previous placed unique ideas and thus the application of potential innovations out.

A complexity in these processes is that designers are better in processing information via visual, multi-sensual ways and less adept in throughout reading in contrast to traditional left-brainers (see Point 24 in Table 12). Fügener mentions that this insight should be respected in future brief designs, as it influences the final output quality of the later design.

3.2. Literature research

A literature review was conducted for each subject area identified in the expert interviews. The remainder of this chapter presents the insights collected from the literature review of this work.

3.2.1. Automobile design culture

Several studies such as from Krzywinski [2012] and Lewin and Borroff [2010] confirm the expert's opinion that the exterior design of automobiles is more focused on styling. Krzywinski [2012] argues that the majority of people imagine this discipline acts mainly in the formgiving field. Lewin and Borroff [2010] emphasize that *'…historically, the typical moniker for automotive design was styling'.* Nevertheless, this term is considered problematic today, as it implies that they focus exclusively on finding the perfect curve with a proportional harmonious outer appearance [Fügener 2011_a] at the expense of implementing experiential, functional, or atmospheric aspects of design. The classical automotive designer is able to apply many different design styles at an automobile design project. At the centre of any formgiving design is aesthetics, which find its expression throughout a metaphorical approach. Besides that, Seeger [2014] defines that the *'design of an automobile object underlies the multisensory perception of the human being, that results in multidimensional design qualities'*[8]*.* Accordingly, this work uses a different concept in following a much more open, user-centred, and function-oriented design approach from the Anglo-Saxon definition. The expanded design term '*includes the design concept, the planning, the construction and the proper reflection on its output in general*' [Oswald 2008].

[8] Translated from the German:: *'Dem Fahrzeugdesign liegt deshalb normalerweise eine multisensorische Wahrnehmung zugrunde, die eine multidimensionale Designqualität ergibt.'*

Historical roots of the car styling discipline

Von Mende explains that back in the 1920s, mainly functional and affordable mass-produced automobiles like Henry Ford's Model T (Fordism), or high-end cars such as a Bugatti, Maybach, Mercedes-Benz, or Duesenberg were dominating the market [Braess and Seiffert 2007]. The latter were built by carmakers and finished by professional coachbuilders. These outfitter companies created custom-made, rolling salons for the most luxurious taste. Good examples are the early Mercedes-Benz vehicles equipped with latest mechanical driving technology while looking like an ancient carriage from its outer appearance [Legate 2009].

Figure 3: Mercedes-Benz 8/38 PS, type Stuttgart 200, built from 1926–1928.
Copyright: Daimler AG Archive. Stuttgart, Germany

As time went by, more people could afford buying a car. So avant-gardist automobile customers began looking for more advanced, individual, and styled models promising visionary prospects to its owners. The photograph of the Mercedes-Benz Stuttgart with a woman in front of the Le Corbusier house in the Weissenhof residential area displays the progressive mental change of that time (see Figure 3). One can observe the far more futuristic design language of Corbusier's architecture, which is considered as contemporary form language even today, in contrast to the seemingly old-style automobile right up front.

In 1927, the American car manufacturer General Motors (GM) searched for a new way to produce more individual and fashionable cars to differentiate from the pure mass of affordable and functional, yet similar-looking, automobiles. They hired Harley Earl, who owned an extraordinary sense for formgiving and style. He was able to apply his artistic talent and found the new discipline automobile styling, right next to the long-time settled engineering field: *'Earl made the company a world leader in car design and styling, while defining the car design process and its use of the* two-dimensional *(2D) sketch, modelling clay, the full-size clay model, and the concept car.'* [Lewin and Borroff 2010]. It is noteworthy that this specialist field was not developed as part of the company's internal research and development plan but due to market-driven impulses of that time.

3.2.2. Automobile interior versus exterior design discipline

According to Parry and Graves [2008] as part of the diversification of the product portfolio, target group specific customer classifications also took place. Various agencies developed methods to find out what the next possible automobile need or desire could be while trying to avoid failures at the same time [Brandes et al. 2009]. Not surprisingly, the differentiation strategy became more important in this saturated market. Edelmann [2011] listed the main vehicle parameters for modification: car motorization (engineering), form language (transportation exterior design), and equipment and components (transportation interior design and technical conceptions).

Portfolio diversification through automotive styling

In the last few years, the OEM's have widened their product portfolios extensively to meet every possible individually, technically, climatically, culturally, and socially inspired customer needs around the globe. This strategy is accompanied by high board- and investor expectations to increase production volumes with an on-going growth of profit margins per automobile entity. Hence, the OEM represents a business enterprise that tries to find solutions to bundle the huge scale of technical functions. Instead of focussing on specific automobile models, the OEM's have developed comprehensive strategies to separate the car's basic technical features from its outer body by introducing platform strategies. So, designers are now able to form several bodyworks, such as a limousine or coupé style, with one and the same motorization and interior furnishing. Wickenheiser described in his expert interview to see a huge potential in designing autarkic bodyworks in form of mass-customized products. He believes that customers and designers might develop custom-made car body shells and individual interiors only via online conversation to be placed into standardized packages in the future [Wickenheiser and Kuhfuss-Wickenheiser 2007].

The portfolio diversification might lead to increasing sales figures, thereby creating a huge benefit for the corporations itself.

Criticising design make-up

Wagner [Wagner 2011] criticizes that automobile design has become the servant of technology and marketing, both of which are encouraging extroverted car designs. This view is shared by a number of other scholars such as Haug [2009] who already remarked this phenomenon in the 1970s.[9] In her interview, Lipp even characterizes the exterior design of a car as a pure styling discipline in which the task is to find the perfect outer proportions that are strongly affected by fashion or architectural influences and less by functionality. This is a valid concern, as there are more and more well-informed customers being able to diversify between pure stylistic images and the provided content, space, and usage qualities inside the vehicle. Finally, Aicher [1984] highlights the one-sided reporting about cars in the media – whether they are described as a pure, cool, and technical object created by pioneering engineers, or as an emotionally sculptured and dynamic creature from a formgiving point of view. He emphasises the limits of this representation of cars and cautions against leaving the practical aspects completely out. Aicher [1984] claims: *'The designers are in demand. Not the stylists who care about formal problems of the actual 'Zeitgeist', but the architects of automobiles, the concept framer who interpret the car as human object in its way of use, sizes, interior furnishings and therefore in its form language of course too. Hence those forms derive from its original cause now.'*[10]

Demystifying automobile design

The architect and furniture designer Piero Lissoni termed cars in his interview as over-engineered objects that are derived from an inequality in the product conception process between the design and the engineering department. By today, transportation designers represent a small minority within the technology-driven automotive company and are an integrative part of the R&D department mainly lead by engineers. The Daimler AG, for instance, employed around 275,000 people in 2012 [Statista N.N.]. About 21,000 of them worked in R&D, another 500 can be roughly identified as automotive designers. Thus, the latter represent around 0.18% of all employees and only 2.38% of the total R&D staff. It is assumed that their numbers in other automotive companies, such as Audi or BMW, are of similar proportions. These figures indicate that only a small minority of people are influencing the final automobile product concept and the way it is designed.

When they were asked about improvements concerning the NPD process, many automotive designers of diverse German premium brands were longing for more professional acceptance and respect from the cooperating engineering departments. Besides, they

[9] He observed the social relevance of designed products by creating artificial illusory appearances and promised to the customer certain practical product values at the moment of its purchase (also when these values became insignificant later on). The promise tries to fulfil the aim of being maximally sensual appealing in order to achieve its expected exchange value.

[10] Translated from the German: *'Trotzdem steht Technik heute nicht im Vordergrund. Sie wird sich erst wieder frei entfalten können, wenn Zielsetzungen und Konzepte abgeklärt sind. Die Designer sind gefragt. Nicht die Stylisten, die sich nur mit formalen Problemen des Zeitgeistes beschäftigen, sondern die Architekten des Autos, die Entwerfer, die das Auto als Humangegenstand verstehen, in seinem Gebrauch, in seinen Größen, in seiner Ausstattung und damit auch natürlich in seiner Form, aber einer aus der Sache abgeleiteten…'*

wished to be involved at an earlier moment within the conceptual NPD process. In practice, OEM-internal meetings consist of one to two designers and a much larger group of engineers. Given their sheer number, engineers determine the topic, content, and progress of a meeting, causing designers to feel a clear lack of influence and insignificance. It might be one indication as to why some designers adopted a closed, introverted, and eccentric behaviour that can be interpreted as a survival strategy. Engineers, on the other hand, offer a very different account of the situation. To them, designers appear to be an unassimilated group of individualists behaving extravagantly within the NPD process. They are concerned that if the design is integrated at an early stage, they will be confronted with many counter-arguments, questions, and stepping-stones that will waste a lot of time. Thus, integrating design at a later point in the process is the more sensible and efficient approach to them.

By looking at both positions, a serious failure in appreciating the other party and communicating with each other becomes apparent. Fügener interprets this as a lack of mutual understanding: '*The language is different. They occasionally use the same words, but do mean other things. The proper applicability is ambiguous as it concerns the concrete feasibility and affordability that appears to be quite abstract to designers. The huge task is that all the information must be deeply rooted at both sides. And in most cases the internal structures are not really open… They just aren't.*'[11] Also, Badstübner, Audi's head of exterior design, confirmed this point of view by saying: '*We tend to make the mistake that we have an exterior department, an interior department and a technology department, and they all know what they're doing but the connection is not so good. I think it's important to basically lock them in one room…'* [Etherington 2012]. Consequently, the situation leads to the previously described state by Aicher and Lissoni, where products embody either the cool over-engineered direction or the pure emotional-designed one. Lipp even thinks that one can perceive from the final product whether or not the departments communicated and cooperated in a cross-functional way. Both Fügener and Lipp mention in their interviews that it is difficult to measure whether this situation occurs in all OEM's in exactly the same way and with the same intensity. Lipp suspects that the location, communication culture, number of facilities, and organizational structure are influential factors of this two-sided relationship. This lack of mutual understanding causes differences in behaviour and attitudes of the members of each discipline and makes it difficult to cooperate in one automobile NPD project.

3.2.3. Hierarchical structure within design departments

Lipp furthermore mentions that the designer's tendency for isolation can also be explained by the fact that formgiving design ideas can be easily stolen by sight. This is not the case within engineering departments where one would need to study technical details, calculations, or construction plans for quite a time. Fügener notes that the novelty issue of the outer vehicle design nowadays does have a major strategic importance con-

[11] Translated from the German: *'Die Sprache ist eine Andere. Sie verwenden mitunter die gleichen Worte, verstehen aber unterschiedliche Dinge. Die Anwendbarkeit von Wissen ist unklar, weil sie ja immer die Machbarkeit und die Bezahlbarkeit betrifft. Das ist für den Designer relativ schwer zu fassen… Das bedeutet, dass sich die Information bei jedem verwurzeln muss. Und dann sind meistens die Strukturen nicht offen, um Initiatoren aus allen Bereichen zuzulassen. Das sind sie einfach nicht.'* From: Expert interview Prof. Lutz Fügener.

cerning the vehicle USP and later sales campaign, which is why this area is rigorously protected within the companies' R&D division. Lipp confirms that strict confidential obligations were introduced within the design studios that led to black box-like working conditions for the executing designers confirms. Only few design-external (but company-internal) collaborators are allowed to enter the defined areas, and no information, such as scribbles of ideas or models, can leave the place without special authorization. Thus, designers are essentially separated from the other R&D employees, making it difficult to directly share and informally discuss their actual work with their technical colleagues. On the other hand, some of the designers did appreciate this well-protected situation. They mentioned in the pre-interviews that it offers them the possibility to work more freely in an unoffended manner, and allows them to unfold their creativity on a focused area. This exclusive approach makes it easier to keep relevant information and ideas secret until they present it to the board. While it is clear that different organizational members have varying opinions and experiences regarding the hierarchical structure within the design department, the principal question remains unanswered: To what extent does the current situation support a better-adapted and more user-centred final product outcome?

The ability to execute state-of-the art automobile design demands not just creativity and sketching talent, but also access to sufficient and diverse sources of information that might be implemented into the design outcome. Point 26 and 27 of Table 12 affirm that the designers have to 'produce' automotive designs continuously. All pre-interviewees indicated that only few books, magazines, written reports, or briefs are studied within the design studio during their field research. The designers all agreed that exploring the web, watching futuristic science-fiction films, playing video games, or doing urban on-site excursions from time to time would animate them sufficiently for doing their work. Afterwards, they would regularly exchange their impressions and ideas with other designers sitting next to them. They mentioned to follow the same procedure during the design development until it is handed over to the head of design to be officially discussed with the board. By observing this situation from an objective point of view, one does not only miss the integration of diverse sources of information, concrete user insights, trend and tendency reports, and a constant market comparison, but also, in the first place, a generic discussion culture on-site. Point 1 and 2 of Table 12 indicate that the hierarchical structure currently employed by OEM's leads to not only the development of pure monocultures in the technology and design fields, but also to a detachment from real-life user necessities. Depending on the point of view, this state can be described as the willingly controlled clashing of different professions and cultures in a hermetically sealed black box, or a well-defined playground.

The interviews showed that the hierarchical structure within the design department is strong organized and could block collaborations and innovations. Williams et al. [1994] argue that because of its high complexity and the necessity of expert know-how, automotive companies are organized in hierarchical, non-democratic structures. Lipp mentions, that unlike other design disciplines, the OEM-internal automobile design department is organized analogous to this system. Normally, freelancing product designers are accustomed to working in loose alliances of laid-back design agencies with flat hierarchies managing many different projects in parallel. Their working hours vary greatly and are often above the average of 35–40 employee-working hours per week. Many of them cover dif-

ferent fields of proficiency, working in or for various branches at a time with changing contact persons. From a freelancer's point of view, the automobile designer's work conditions seem quite cramped and restricted, thereby representing an atypical top-down hierarchical structure. In his interview Fügener explains that such a structure is necessary due the high degree of complexity within the automotive development, which causes an extraordinary high division of work content and demands extensive organisation.

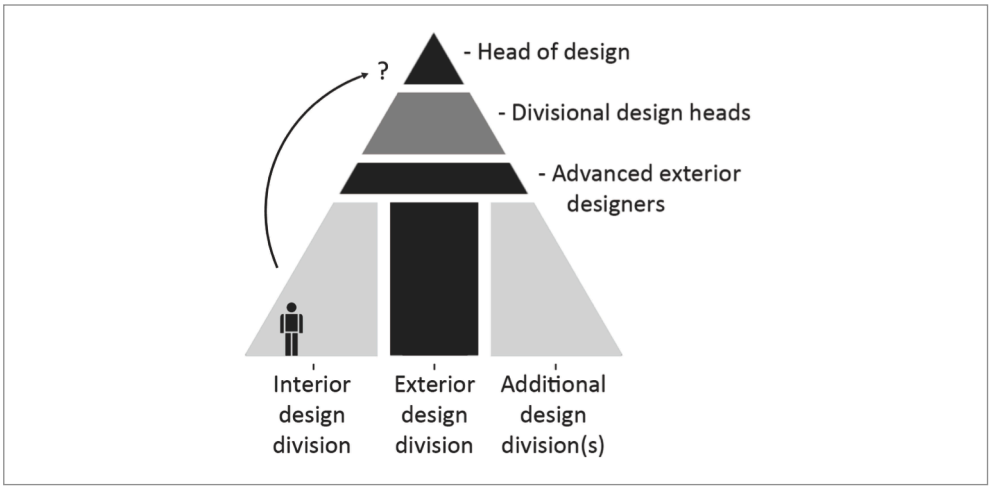


Figure 4: Generalized hierarchical pyramid based on expert interviews (own illustration)

Figure 4 shows the basic structure of an automobile design department, comprising the head of design, certain divisional heads, the exterior advanced design, the division of interior and other associated design departments. The predominant pyramid system of that branch becomes apparent: exterior design and interior design topics are clearly separated (see Figure 4). The clearly visible power arrow starts from the head of design, and continues towards the divisional heads, the advanced exterior design, and ends in the exterior design. The four stakeholders are closely connected, developing the automobile future altogether. Mainly because of their shared understanding [Kleinsmann 2006] and philosophy in formgiving research, it is quite usual that the next head of design will come from the current advanced design field. The BMW Head of design Adrian van Hooydonk illustrates a notable exception, being an educated industrial designer from the TU Delft, with a further training at the Art Center College of Design in Vevey, Switzerland.

Transportation interior designer's position of dilemma

According to the interviewed experts the interior design is unable to exert a significant influence on strategic product design decisions within the fuzzy front-end phase, as such decisions are mainly not part of the advanced design process. Looking at Figure 4, one may ask what happens to a great idea that is developed by an interior designer on the left side at the bottom of the pyramid. Might their ideas have a chance to succeed at the top and be listened to by the corresponding head of design? Most of the experts interviewed admitted the minor strategic involvement of interior design within the fuzzy front-end phase today. But they predicted an increasing importance and stronger involvement in

the future. As a matter of fact, exterior design creates the first overall outer impression of a car that should radiate the spirit of time. According to Tumminelli, the exterior awards the product with an aesthetically appealing look through aggregating different forms and lines to become a characteristic three-dimensional personality, representing a unique product DNA.

The interior design is mainly not involved in the early advanced design development, nor does it participate in board meetings when first exterior design form studies are presented. This specialist field is responsible for solving complex situations and it requires the collaboration of different niche specialists and disciplines—ranging from design to technology. The transportation interior designer has to think and act as a team player by nature to meet a variety of functional as well as design-related touch points defined in the brief. Because of this tight but complex sphere of action, Wickenheiser and Fügener emphasize in their interviews that proper interior design constitutes the most difficult design task of all. Fügener indicates that, in the product development process, the main problems are the different work interfaces and the proper ways in which these specialists communicate to each other. Before they tend to verify possible solutions to its smallest details, they often lose the all-over project vision. He additionally mentions the well-known phenomenon of designers running out of ideas, when having worked yearlong at one and the same OEM scene with strong restrictions and limited innovation options of any change or variety. The question is if the interior designer who practises his facilitator position, has to stay enclosed in this specialist trap or has a chance to act and develop projects in a more strategic way at an earlier phase? Also anonymous 1 thinks it is desirable that the interior designer should remain involved at an even earlier moment within the NPD process. He considers this active participation as a kind of fundamental requirement so that the interior designer is able to develop own visions and ideas, and creates more innovations in number and bandwidth [Wagener 2012].[12] The closing question of the interior designer's position of dilemma concerns whether disruptive ideas of the advanced interior design might be taken seriously in the fuzzy front-end of NPD.

3.2.4. Design innovation

Köber, one of the interviewed experts, is convinced that the successful application of innovations became unique differentiators within the automotive market. This differentiation is crucial for OEM's long-term survival and key competitive advantage. This research (see 2.0) distinguishes between product-, process-, market(ing)-, and organisational innovations, as these constitute for different ranges of novelties prosecuting their own intentions. As mentioned before, production innovation, proposed by Schumpeter [1987], has been added to this definition. This work focuses on organisational design processes and user innovations, with the intention to cause a design-driven re-innovation of the final automobile design itself. Therefore, the main focus is set traditionally on technical innovations and developments to standout from other competitors. Aicher [1984] remarks that one should not constrain automobile history exclusively to the technological front, but follow a more multidisciplinary approach. He refers to Ferdinand Porsche, an obsessed technician who used diverse solutions at a time to fulfil a specific aim, and, consequently, un-

[12] Representing an exception, Mercedes-Benz owns an advanced interior design studio in Como/Italy and thereby represents the solely known facility of that kind, according to a Mercedes report.

derstood this pool of solutions as an instrument to choose from whatever is needed to solve the superior assignment of tasks [Aicher 1984]. In practice, however, most of the innovations that OEM's develop during the course of a year do not have any specific conceptual intention for one certain improvement, such as assistance features and comfort functions (e.g. hot stone massage, rear view cameras, intelligent lighting, autonomous driving features). They are rather associated with the different automobile models later on. It seems that technology has lost its original track in acting for one's own sake, instead of serving the human being. Aicher also mentions that car manufacturers are stuck in a technology trap. He emphasizes seeing a car as 'conceptual formulation with a program and aim' to search for solutions within the proper reservoir of technological and design skills. User studies show that customers do not appreciate all features per se; rather, they are interested in how features can improve their personal lives through intuitive experiences (see Section 0). The interviewees also made clear that the former automobile driver profile of being a technology enthusiast and reading through instruction manuals before driving a car has become quite outdated. Instead, today's drivers want a simple but intuitive programme navigation with sophisticated aesthetic appeal. The expert Lissoni complains that today's technology-filled cars are over-engineered; inherit many functions, even though most drivers do not need them. He warns against the possibility to let engineers rule solely in constructing something that humans have to use later on. As an example, Fügener thinks that the start-stop automation button marks an exemplary case that caused a more complex usage proceeding than ever before. To him, this development did not mean more simplicity, but a typical feasibility-driven novelty without producing an additional value for the end user. Fügener assumes that technical feasibility does not lead to user innovations by all means, although many are applied novelty features in the car.

Novelty pressure within the automotive lifecycle

The interviewees mentioned the need for innovations within an automobile OEM. Wickenheiser, Fügener, Tumminelli, and Heiliger [Auto Motor Sport 2009] share the opinion that German OEM's do act in more evolutionary ways than acting revolutionary and that there is a general lack of design innovations. Wickenheiser thinks that manufacturers repeatedly reproduce similar designs, as the market demands steadily new looking products to keep sales numbers and brand expectations high. Regular vehicle facelifts are a good example of selling only slightly reworked designs in-between two product launches. Only minor changes, such as lighting design or parts of the bodywork, have to be made that cause less costs, but achieve the desired novelty effect. The product bandwidth rises, but the designer does not have more time for doing research or even reflect on their final work output. According to shorter product lifecycles and net development time, transportation designers are transformed into design producers. Wickenheiser cites the example of Audi that has produced around 80 vehicles in the last 40 years. But in the last seven years the company has launched around 60 vehicles with nearly the same number of designers. This example provides an overall view on today's transportation design situation— moving between the fulfilment of daily tasks and the attempt to act innovative.

Gerybadze [2014 N.N.] remarks that *'success in innovation is dependent on the ability to define and influence standards, the dominant design and architecture of business models'.* In the context of the automobile industry, this statement wants to say that the best and

most user-friendly design and intuitive user solutions must be found for implementing innovations successfully into the market. Similarly, Wickenheiser addresses the problem of innovation acceptance and names the BMW iDrive logic that has not been evaluated by the user in a positive way, even though it meant a smart cluster of functions. A novel sense-making cross-combination of technology and user-centred design are in demand, as pure technology features have lost their status as unique selling propositions. Frank Köber, marketing innovations manager at the Daimler AG, is an expert in evaluating emerging innovations and grouping them into strategic portfolios by looking at the market, user, and comparative product ranges. He argues that innovations are like 'optional deals' that we either make out or not. Successful cars can be built with, but also without, them. People who participate at this selection and evaluation process need to be open-minded with an elevated sense for abstraction, imagination, and a strong will for changing the present into a future idea. He states: *'Our imagination of innovation within the marketing context is that these should be profoundly experienced by the customer... As we are marketing deputies, customer experience and client communication are at forefront. Therefore the topics of target customer, target group, and milieu, mark a quite relevant facet of the proper derivation process of innovations.'*[13] Köber also states that an innovation has to be a kind of novelty with enough differentiation potential to contribute to the attractiveness of the end product. For him, a car consists of many novel product features and functions that produce a variety of different forms and facets of sensible experiences. These applications, functions, and features with their specific novel characteristics are defined and clustered into the so-called innovation search fields to be eventually accumulated in one final product context. The marketing-related innovation definition of Köber does not fully correlate with this work's standpoint on innovation conditions and circumstances. It differs in terms of its holistic approach and has to fulfil a behavioural or additional social user aspect. Accordingly, a sole implementation of extra functions or features does not identify a real user innovation. Furthermore, the composition of certain novel fragments makes it difficult to speak of a radical but even more of an incremental approach [Köstner and Wagner 2009].

Radical vs. evolutionary innovation

Rajkovic [2001] formulates the difference between incremental (or evolutionary) and radical innovations as follows: *'Relative to radical innovations, incremental innovations are more market-driven and based on market analysis; therefore, they are more likely to be successfully commercialized and less likely to suffer from insufficient demand, an advantage not shared by radical innovation… Even though incremental innovations as competitive differentiation advantages of a firm are at risk of being neutralized by competitors…'* This type of marketing innovation can be introduced faster into the market, but has short time winning margins within the global competition. Verganti [2009] marks the major differences with comprehensively developed vehicle concepts that form a holistic 'new meaning' to the customer, market, or branch itself. For him and Lipp, radical innovations are mainly pushed by breakthrough technology developments that have the power to

[13] Translated from the German: *'Unsere Vorstellung von Innovation aus der Marketingperspektive, ist dass sie hochgradig Kundenerlebbar sein soll. …Wir sind Marketingvertreter und deshalb steht für uns Kundenerlebbarkeit und Kundenkommunizierbarkeit im Vordergrund. Von daher sind die Themen Zielkunde, Zielgruppe, Milieus eine sehr relevante Facette dieses Herleitungsprozesses.'* From: Expert interviews Frank Köber.

cause an industry turnaround and therefor represent a *'major source of long-term competitive advantage*' for corporations [Verganti 2009]. This research work defines a radical innovation as a 'new dimension of performance' [Drucker online N.N.], such as an additional use of conventional automobile space or a new function that changes the whole quality of the system so that a radical intellectual approach of superior class is achieved (see Chapter 2). Verganti [2009] notices that radical changes and ideas are often disposed or even blocked by its immediate environment or users: '*A design-driven innovation, by definition, differs substantially from the dominant meaning in the industry.'* It changes its former original function into a novel meaning for the same or a novel user. Moreover, it is not sure if these radical innovations would be welcome within the experienced and complex NPD processes of today, as they might disturb controlled proceedings and question previous behaviour structures fundamentally.

Open vs. closed design innovation models

By looking at the example of the automobile industry, it is common sense that most R&D sites are the best protected and outwardly isolated parts of the whole company, as the product's future is developed there. And this future determines a company's success and survival within the market. Hence, it seems unbelievable that many R&D departments still form unique sources of inspiration and advancement for industrial products in competitive environments, especially at a time when novel concepts, such as co-creation and open innovation approaches, are conquering the market. Although the possibility to shift traditionally closed innovation models from the automobile NPD towards a more open process that absorbs and integrates outer influences and user approaches is often talked about, urgent thinking shifts need to occur before they models can be realised. Chesbrough [2003] wrote: *'Companies are increasingly rethinking the fundamental ways in which they generate ideas and bring them to market - harnessing external ideas while leveraging their in-house R&D outside their current operations.'* OEM's have to meet the challenge of defining cooperative frames and strategies—where and how to handle these alternative research and development methods—to generate sustainable future automobile design innovations and keep them secret at the same time. Thus, there is a pressing need for an alternative design approach for industry practitioners to exceed the limits of pure formgiving design and to find joint solutions—not for applying design or technology for its own sake, but for achieving a final user-enriching outcome. This work searches for a conceptual framework that is part of the automobile's design process to place proposals for change. Thus, a primary look at the common automobile design process is necessary.

3.2.5. Automobile design process

According to Holston [2001], *'The design process offers an inclusive approach for arriving at innovative design ideas that can differentiate the client from their competition...*' Furthermore it *'helps the designer to stay focused, …to manage complexity of projects by providing a system for organizing information and people, …and provides a framework for collaboration*'. Lewin and Borroff [2010] even describe the holistic design process as an *'aesthetic cultivation of every element of an automobile that is visible to a customer…'.* **This research work follows these definitions, but takes the view that the design process is a functional and aesthetic cultivation of every element of an automobile that can be experienced in multi-sensory ways by a customer.**

The common automobile design process, unlike other design processes, can be compared to a competition where different teams want to win a prize by expressing creative ideas in the best possible way. This specialized niche discipline has developed its own rules and basic principles—away from common products and industrial design beliefs—towards an elitist field represented by the few. In particular, the automobile exterior designer possesses a trained acumen to sketch complex ideas through scribbles or thumbnails of the highest quality that are easy to understand. This illustration logic fundamentally characterizes the entire specialist area and signals the designer's individual development, among other things. The better these right-brainers draw, the easier they can be understood, and the more probable it is that they can communicate new design ideas in the process and have a career inside the design department. Lipp underlines that the classical design process originally intends to use a greater amount of time for doing basic research to draw a bigger picture. Thus, the designer analyses the already existing, possible ways to move—where it should take place and how long the product may last. Afterwards, ideas are collected and roughly illustrated—the more the better. Next, single sketches will be discussed; they will be compared with each other and then sorted out so that only the best of the best are finally left. Then, variations of these best two to three ideas will be further developed and sketched again so as to explore diverse possible choices. This process takes place over and over again until a final design direction is found, with the right combination of design volumes, proportions, and form language.

Automobile design process organisation

Even though all interviewed experts presume that standard automobile design processes work in a similar way everywhere in the industry, none of them can make a definitive statement. Hence this section describes and subsequently discusses the standard automobile design process organisation as a prototype, based on literature and interview insights. Figure 5 represents the basic process overview that has been divided into its fundamental design phases. Then, taking this basic division as the starting point, the further design stages were inserted. The mutual communication with other specialist fields, such as diverse engineering departments, takes place of course, but the process description of Figure 5 has been left out on purpose to concentrate on the inner design course. Kleinsmann describes the product design process (PDeP) as the shift of an originally 'unorganized' towards a 'systematic managed activity' that is practised in multidisciplinary teams to be called integrated product design [Valkenburg 2000]. She states that *'well-performed integrated product design processes may result in higher speed to the market'* [Kleinsmann 2006], which is common sense within the automobile PDP today. Due to economic issues and external market pressure, the project time frame is squeezed over and over again [Lewin and Borroff 2010]. This, in turn, often comes at the expense of research and reflection time for the executing design teams.

The automobile design process itself represents an integral part of the corporate product development process (PDP/PEP), conducting diverse New Product Development (NPD) projects. Even Fügener, a long-time observer of the automotive field, cannot confirm with absolute certainty if all European OEM's do apply a similar design process within the automobile NPD. He suspects it to be the case, but cannot provide any concrete evidence for it. This makes it rather clear how well protected these processes and field of work are,

where, so to speak, the corporate core value creation of the company takes place. There do not exist any official overview illustrations or descriptions by any OEM as they are a considered highly confidential. To render the standard automobile design process, mainly expert opinions, press statements, and free literature sources have been approached (see Figure 5 and Figure 6). Buijs [2012] describes that, right from the start, the design process needs to be understood as an iterative and non-linear process, where diverging refinement and iteration loops are part of the daily business. The proper process flow and its results remain in constant movement. Many OEM's, such as BMW or Mercedes-Benz, use the stage gateway model in their PDP, as it offers defined lines of action and steps where certain tasks need to be completed. These quality gates are used as measurement tools to see which point of the development phase has been reached within the remaining time scheme. According to Wildemann [2004], this must be observed to ensure there is enough time left until the final design freeze.

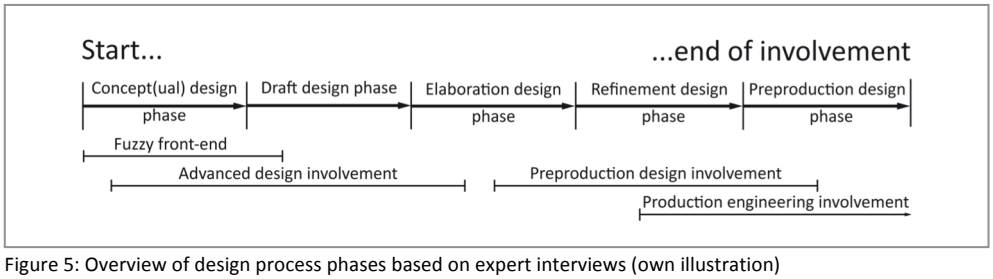


Figure 5: Overview of design process phases based on expert interviews (own illustration)

Once a promising design direction has been identified, it needs to be approved by the corresponding heads and board members. This means that the actual design status with its distinctive characteristics and attributes will be maintained and taken along to the next step for further development. From this moment, the design direction can no longer be changed. Also, as Eger et al. [2005] remark in their research: *'At least in theory the specifications are frozen before conceptual design begins, which in turn is frozen before detailed design starts. And before manufacturing can start, the entire design needs to be frozen.'* The design process draws through various levels of the hierarchy pyramid, and varies in its intensity and form of execution, according to the brief within the different design departments. The following section is divided into five phases (see Figure 5) and documents the universal master process to render one big picture:

1. Concept(ual) design phase
2. Draft design phase
3. Elaboration design phase
4. Refinement design phase
5. Preproduction design phase

Design process phases and work stages

These five phases describe the whole design process in rough sequences. Each of the phases is subdivided into smaller work packages—the so-called stages— where the detailed work content and aims are documented (see Figure 6). Phases 1–2 are called the fuzzy front-end or early design phase (see Figure 5); they play a major role in the following

research work. Therefore, the term 'fuzzy' can be understood as a rather vague episode, of the later precisely structured design process. Mareis et al. [2010] analysed that as a matter of time and situation at this moment, the process decisions are made onto a still insufficient information base.

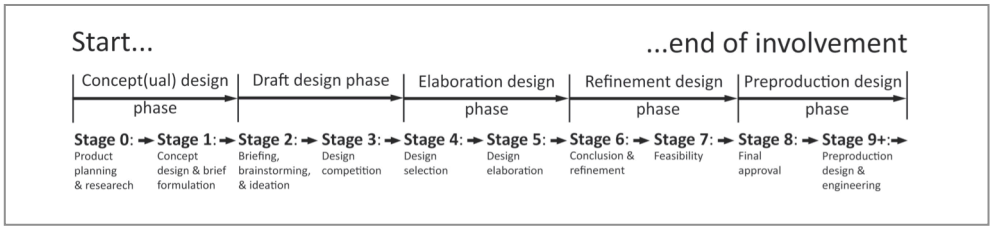


Figure 6: Design process phases with detailed stages based on expert interviews (own illustration)

Stage 0	Product planning and research
Participants	Board of management, alternative strategic and technical departments, with the head of design.

A common myth, that the design process starts with just some scribbles is hereby not affirmed. However, this could not be further from the truth. Pfitzer and Rudolph [2007] argue: *'It starts* with *the* determination *of the goals which have to be achieved.'* Once the formal 'go' of the board is achieved, the official design process starts with the conceptual design phase in Stage 0. Already, at the very beginning, strategically oriented departments undertake diverse market and customer group research within the company. These departments are in search for new formats within the existing portfolio, innovative product concepts that are diverging from already existing models and additional functions and feature or services that could be applied later on. At this stage, the rough product parameters and central essence of the later vehicle characteristics are defined. To discuss these matters, a series of multidisciplinary team meetings of technical, design, and marketing departments take place.

Stage 1	Concept design and brief formulation
Participants	Alternative strategic and technical departments, head of design, and advanced exterior design.

This phase starts right after the board and top management set their fundamental aim by conducting a joint meeting or workshop with the design, strategy, and marketing department. Once the rough idea of a so-called concept exists, technical and social sciences become involved more closely. Due to the relevant impact of cultural differences, local circumstances, age groups, user milieus, market trends and user insights, there should be a careful consideration of the type of product placement and production volume. The brief is often accompanied by a specified technical product package from the engineering department and specification sheets from marketing or product strategy. The technical product regulations, goal setting critical attributes and rough specification of market, user, context, cost and time effectiveness, parameters with future product qualities are set step-by-step. All these activities culminate in a first aim definition and detailed brief formulation.

Stage 2	Briefing, brainstorming, and ideation
Participants	Head of design, advanced exterior, and executing exterior design

After the head of design and their divisional heads start to brief the advanced exterior design department (see Figure 4) about the novel undertaking, the actual draft design phase starts at once. By doing brainstorming sessions with only rough package settings in mind, first concept sketches, which include diverse product characteristics, are collected. The designers search for first ideas to resolve formgiving questions: what brand-typical form language or style should be applied to lead to a distinctive outer appeal, a recognizable automobile 'face' from the front side view? Should the vehicle look like a defending, yet aggressive, tiger? Should it have muscular shoulders of a jumping lion, or radiate the gentle elegance of a resting panther (metaphorical approach)? These questions are directly linked to the proper formgiving design, dealing with product proportions, it's sizing for an empathic first-glance effect, referencing to well-known analogies or themes, supported by additional collages, material, and mood boards.

Stage 3	Design competition
Participants	Head of design, and executing exterior design.

Lewin and Borroff [2010] note: '*Though this period is highly competitive, designers typically encourage and enhance one another's designs for the greater good.'* At the end of Stage 3, a brief list is prepared to compare all existing designs, validate them, and find the most promising styles to follow [Macey and Wardle 2008]. Again and again, ideation loops are made to reach the set product parameters and the corresponding qualities at their best expressions. Up to the moment a final design direction through one or more concrete sketches is chosen among all participants, the actual team building starts. Then again, a more detailed sketching of a whole bandwidth of variations of these sketches continues.

Stage 4	Design selection
Participants	Board of management, head of design, executing exterior design.

At this part of the process, the board and top management typically spends some time doing strategic approvals and overhauling the proper work progress. The design proportions of the vehicle body, its corresponding greenhouse, the character line, and the silhouette are further developed and aligned with the package setting. After having selected five to ten most interesting designs out of the final shortlist, small clay mock-ups in the scale 1:4 or 1:5 and first digital three-dimensional CAD-models are produced. These models should support the final design choice. Therefore, *'[f]or one, potentially very young designer, this special moment means his or her design has won the contest and will be turned into reality'* mentions Van Hooydonk [2012_b].

Stage 5	Design elaboration and technical matching
Participants	Head of design with executing exterior and interior design.

At Stage 5, the preproduction designers of exterior and interior design begin to elevate and concretise the future automobile product. There starts a parallel development process of the corresponding specialist fields of the exterior and interior design that are defined in its work steps to the smallest detail [Braess and Seiffert 2007]. Out of the final de-

sign choice, tape renderings and prototypes are built in the scale of 1:4 or 1:1 to identify the perfect vehicle silhouette. These designs already include all package and concept parameters. The task of these prototypes is to create mental models that are visible and tangible to all project participants. Working within multidisciplinary teams from colour and trim, to material, HMI specialists and production engineers, prototypes play a very important role in supporting a joint understanding of the all-over project aim. All these parties need to cooperate to manage the project challenges that are arising out of different subjects such as the user experience or technical field.

Stage 6	Conclusion and refinement
Participants	Head of design, executing exterior and interior design.

The craftsmanship of producing real-life 1:1 scale clay models (next to CAD) is still relevant as '*they are often rolled outside into the daylight to better understand surfaces, lines and creases in natural light…*' and the designer is *'able to physically walk around them… to appreciate different viewpoints and perspectives'* [Lewin and Borroff 2010]. After further refinements of exterior design surfaces and light gradients, final correction loops are carried out and the physical model is scanned with a 3D scanner to generate first Strak[14] data drafts. Thus, the idea is to raise 3D data of all visual surfaces of the vehicle's interior and exterior by merging technical as well as aesthetical formgiving issues. Additionally, the interior division builds up seating boxes and operates within a 3D projection room, the virtual cave, to test ergonomical issues, HMI, and the colour and trim designs (next to a technical mock-up).

Stage 7	Feasibility
Participants	Head of design, executing exterior and interior design.

After two to three years of design work, a novel designed product has been jointly developed in a 1:1 scale work prototype so far. In Stage 7, this prototype needs to be proven through customer feedbacks (car clinics etc.), cost calculations, and so on to determine whether the product is feasible for mass-production before being introduced in the global markets. In addition, a substantial check of all defined product marketing, target group, and context parameters from the original product briefing need to be executed. The final product verification gives direct feedback about the actual project state and production maturity, and thereby might lead to further product modifications.

Stage 8	Final approval
Participants	Board of management, alternative departments, head of design, and executing exterior and interior design.

These after-design stages are characterised by a high involvement of production engineers, who prepare the production phase by handling all technically feasible issues. In the first instance, the final board approval overhaul must take place so that all digital data and additional information can be handed over to the responsible persons for preproduction. After the official affirmation, the design department carries out the last design freeze.

[14] It originates from the English word 'strake'. This data bridges the automobile design work with the engineering department. The digital data of the product is collected in form of a point cloud and will be used for further technical proceedings.

Stage 9+	Preproduction design and engineering
Participants	Alternative departments, head of design with executing exterior and interior design.

In the preproduction design and engineering stage, the product is further improved, so that additional roadworthy vehicle prototypes can be built for long-term road assessments. At the end of this stage, various efforts are made to further refine processes, and to prepare tools and data for factory modifications to finally accelerate the vehicle production [Wildemann 2004].

Time range of NPD processes

Hooydonk [2012_a] indicates that it lasts for around one year to start from an empty sheet (Stages 2–6) until arriving at a 1:1 scale clay model, the final design prototype. Then, it takes another two years until the vehicle can be produced (up to Stage 7). Gerybadze [2014] notes that the time factor within a NPD cycle is a crucial problem from a technological point of view. He refers to the much faster consumer electronics market that tends to lap the automobile development multiple times. This in turn might require revising the product in a late state if its applied technology features are still market relevant. On the other hand, the former Volkswagen Group's head of design, de Silva, tried to speed up the design process itself. He claims that the last Golf 7 (launched in 2008) was designed (from the draft design phase to market launch) in only 20 months. De Silva [2012] reasons this velocity with a prior-placed positioning paper concerning the future Golf design by following the motto *'When you know where to look at, it can speed up the process enormously'.* This time profit-making might involve greater market and sales strategic advantages, but requires also a timely and fully developed concept setting, which represents the central aim of this research.

3.2.6. Automobile design process innovation

The sheer velocity of the process flow mentioned by de Silva is considered an important factor for product success. Another insight is that also the application of sustainable product innovations requires profound process innovations as well [Hauschildt and Salomo 2007]. Accordingly, this work postulates that without designing a process, that is organisational culture change, radical product innovations only have limited chances to bloom [Köstner and Wagner 2009]. Moreover, Fügener believes in a direct link in-between the process design and the product innovation generation without being obligatory. He clarifies that by saying: '*…One issue might enable the other, without acting conditional. It is impossible to plan a production innovation. But I can try to reduce resistances and create free space for action.'*[15] According to Machiavelli [1950], *'…there is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things.'* That is why, among other issues, the general focus of this research is set on improving the automobile process innovation flow.

The American National Science Foundation [2010] describes the process of innovation as an *'introduction of new or significantly improved products (goods or services), processes,*

[15] Translated from the German: *,...Das Eine ermöglicht das Andere, aber bedingt es nicht. Das geht ja gar nicht, ich kann ja keine automatisierte Produktinnovation irgendwo einbauen… Aber, ich kann versuchen Widerstände abzubauen und Freiräume zu schaffen.'*

organizational methods, and marketing methods in internal business practices or the marketplace'. Fichter and Hintemann [2015] interpret the definition of a process innovation in broad as well as narrower terms. The broad interpretation includes the invention (discovery of a new idea) and implementation of a novelty, as well as the diffusion and imitation of a novelty, whereas the narrow definition excludes the diffusion and invention phases itself. The typical process innovation contains three steps: first, the invention itself, where the above-mentioned ideas are discovered; second, the innovation testing, where the ideas are developed, user feedback collected, and technologically tested; and third, the diffusion, where the ideas are implemented within a broader socio-economical field.

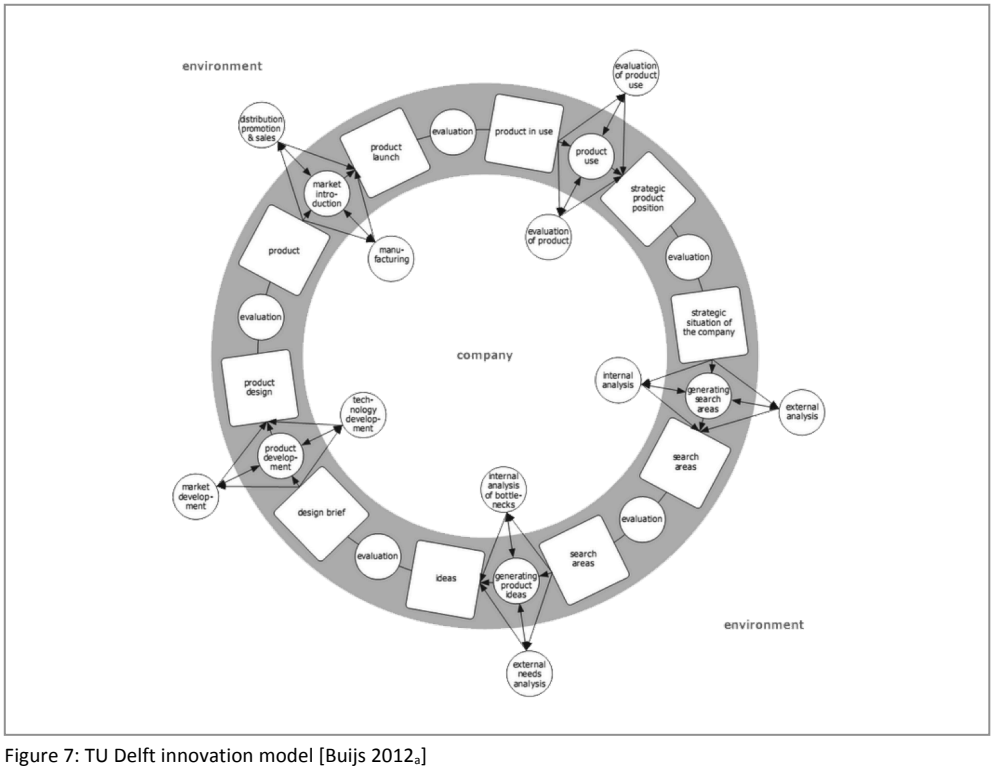


Figure 7: TU Delft innovation model [Buijs 2012$_a$]

Contemporary innovation research concentrates on the holistic innovation process itself as well as on idea generation, prototype creation, internal enforcement, and the final idea implementation. The trial and error method still forms the basis for any successful innovation development, also in the transportation design field. For example, the Hasso-Plattner-Institute's school of design thinking implemented iterative cycles by applying their design thinking method over and over again to prevent failure all along the line [Hasso Plattner Institute of Design 2017]. In situations where the proper innovation would not occur immediately, the designer has to repeat that model over and over again until a better idea is found. This method has been deduced from the designer's original nature, generating innovations throughout their general joy and curiosity in experimentation [Bart

2009]. Buijs [2012$_a$] remarks that it is most important for the 'innovation learning cycle'[16] to collect a proper market and user feedback, *'the interim result of the previous stage',* to add the gained insights into the next NPD cycle and learn from it (see Figure 7).

Every time the process model makes a round leap or moves on to the other side, all participants, such as the company department or employees, might learn something new. The cycle is divided into five process stages called product use, strategy formulation, design brief formulation, development, and market introduction. A feedback loop is included in each stage. Every circle in Figure 7 represents an interim result, every square a subprocess. The primary starting point is Stage 1, with a regular change of circles and squares. This research work concentrates mainly on Stages 1–3, starting with the second triple circle module of internal analysis, generating search areas, and the external analysis reaching until the design brief square (see Figure 7). The Delft innovation model shows that a successful process innovation urgently requires an effective and all-embracing process structure, followed by a disciplined implementation within a certain time. The challenge presented by Buijs's [N.N.] innovation model is that he presumes the product innovation process to be *'similar to an (experiential) learning process*'. Also, the transportation design process requires these regular reflections and lessons that might be implemented even during its design phases.

Fuzzy front-end design process innovation

Buijs [2012$_a$] referred to diverse studies of Cooper who emphasizes the importance of decisions made in the fuzzy front-end as key to new successful products. It is commonly known that at this point of the NPD process, the highest rung of the company's internal hierarchies is involved. Just like the design process documentation, there exist only few and not-recorded details or public insights into how and in what form this strategic thinking and conception process takes place. For improving innovation conditions and circumstances sustainably, it is important to understand the early design phases. Therefore, the next sections concentrate mainly on the fuzzy front-end of the design process within NPD. The corresponding fuzzy front-end cut-out of Figure 8 is sub-divided into three stages: product planning and research (Stage 0); concept design and brief formulation (Stage 1); and briefing, brainstorming, and ideation (Stage 2). Before Stage 0 kicks off, the head of design has to understand the origin of the product idea and interpret it by means of his experience and personal goal-setting for a further concept design formulation. Anonymous 1 confirms that at this complex intellectual and creative process step, a distinct sensitiveness and interpretation talent is in great demand. As right up to that moment the head of design has developed a vision of the future product concept, the designers add a collateral emotional feeling or image to it. Then, the product is characterized by distinct human and, respectively animal-like attributes such as an aggressive or friendly look. Seeger [2014] terms this method a metaphorical design approach. At this moment, parts of the design brief come into existence in such a manner that the succeeding advanced exterior design can perform the task of shaping the vehicle's outer bodywork.

[16] The circular TU Delft innovation model is considered similar to the Hasso Platter Institute's school of design thinking philosophy [Hasso-Plattner-Institute of Design 2017].

Hyundai describes this moment as a time when *'…creative ideas that break the mould, the thrill of challenging the norm, cutting-edge technology and the ability to understand people's desires enable the Design Center to gauge future megatrends'* [Hyundai Motor Company N. N.]. There are various influential factors that might boost innovative thoughts, designs, and action of the fuzzy front-end advanced designers. Keinonen and Takala [2006] point out that the concept design process *'needs to be done without applying excessive control that would jeopardize the exploratory nature of the process. Traditional process models of product development and design often focus on controlling design for managerial purposes, which with their predefined milestones do not seem to easily apply to the objectives of concepting'*. Several experts demand more liberal thinking right from the start of the design process, where novel themes and visions can be developed and therefore should not follow strict process steps with fixed time frames yet. They consider splitting the strategic power into divisional heads and responsibilities for product-related concept issues (see Section 0). As a matter of fact, the automobile concept design process should be applied as a strategic tool within the field of NPD for a controlled clashing of different mindsets, professions, and cultures representing a well-defined playing field for innovations. As it is hard to influence the head of design's first ideas and interpretations of a new product task (see Section 0), Stage 0 will stay untouched in the field of innovation generation. The type of innovative thinker and visionary personality, who is appointed head of design, is part of a strategic board decision of every OEM.

Innovation approach in process stage 1: Concept design & brief formulation of NPD.

The concept design and brief formulation stage depicted in Figure 8 aims to collect the most important goal-setting attributes for the formal design brief. Nowadays it is often the head of design and the exterior advanced designers who define the nucleus of the project goal as this represents a main strategic decision on the success or failure of future products. Defining the project goal offers these individuals the opportunity to demonstrate outstanding leading qualities as well as visionary abilities to know what would make a certain future automobile product successful. Bernhard Mattes, vice president of the Ford Customer Service Division, supports this opinion, saying: *'It is impossible to democratize certain processes, such as in design. When asking 4 million customers for their individual opinion, you will receive 4 million diverse answers.'*[17] This quote clearly demonstrates the sheer impossibility of gaining 'everybody's' approval. The question arises as to whether an OEM should undertake efforts to escalate retracted structures and offer potential advancement opportunities for the bottom level. This research identifies this condition as an important missing link within the current automobile concept design practice.

Takala and Keinonen emphasize that successful concept creation consists of 'three activities with two main phases': first, the acquisition of knowledge; second, the successful development of product concepts (concept generation); and third, the proper concept evaluation. The first design activity is already illustrated in Stage 0 of Figure 8, the second is

[17] Statement from Bernhard Mattes, CEO of the Ford-Werke GmbH Köln in the context of his Hohenheimer Rotary lecture with the title: Automobilindustrie: Globale Herausforderungen! Globale Strategien! Regionaler Erfolg. [27.11.2013].

planned formally in Stage 1, while the third should be applied at the end of the design phase. Nevertheless, there are many interpretations of how to understand the respective development of product concepts from a designer's point of view. Krzywinski [2009] thinks that the process is characterized by cognitive and linguistic conditions. He identifies two general methods of generating proper design concepts, namely the 'compiling' way and the 'extracting' way. He identifies the latter as typical to the transportation design field, where designers sketch many versions over and over again to finally pick up one of the many available solutions. This latter proceeding represents the current practice with the fuzzy front-end of automobile design, but, at the same time, lacks a deeper strategic approach. Uhlmann, however, focuses on the core task of the concept design by saying*: 'The key content of the design concept is the subjective definition of the essential design objective…The design concept is goal setting; as a "nucleus" it holds all nature-determining characteristics of the design, focusing on the users experiencing*' [Krzywinski 2009]. This research clearly follows Uhlmann's definition by interpreting the design concept as a concrete aim setting of the most important design goals. This can be realized in a written, and also visual, form without applying concrete vehicle formgiving or styling issues.

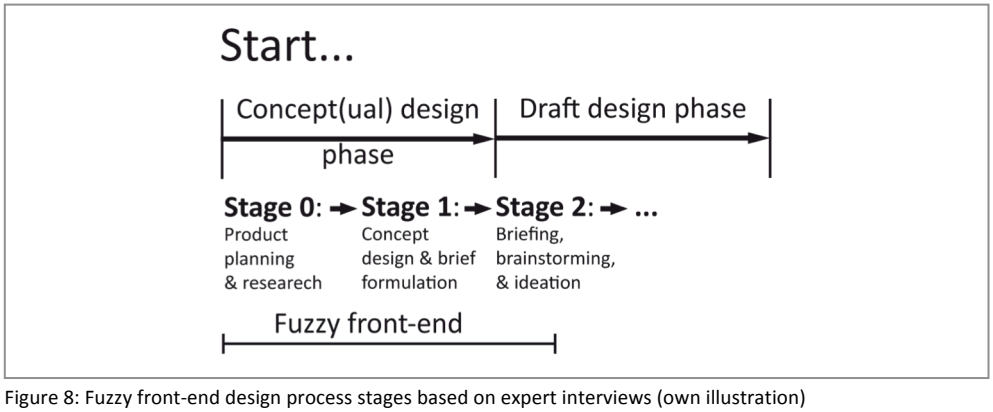


Figure 8: Fuzzy front-end design process stages based on expert interviews (own illustration)

Thus, at the end of the concept design phase in Figure 8, a final design brief needs to be formulated and handed over to the executing design departments. The brief represents the first written record, a statement of intent, filled with relevant content formulated by the head of design. Toyota design [N.N.] defines the design brief as a task of setting the project goal, target group profile, and other aspects of the vehicle development plan. By handing over the task to the advanced design department, the head of design commissions the first official assignment of an existent future project which can be verified subsequently. Anonymous 1 indicates that the concept is still vague and thus the divisional heads receiving the brief need to be enormously sensitive to absorb every indication given by the head of design. The divisional heads act with an empathic talent to interpret the creative ideas and visions to convey them to their design teams. Fügener describes the transfer of information from the board towards the head of design, and then again from the head towards the divisional heads, as a really thin bottleneck within the process. This is because each of the participants can change, paraphrase, and annotate significant details to this brief. Hence, this transfer of information marks a distinctive influential factor in the design process concerning the later outcome. In general, Fügener evaluates an indi-

vidual's design performance with reference to the actual design task the person has to fulfil in terms of the design brief and their personal contribution. According to him, this important question has not been explored sufficiently, as the proper brief might already contain the lion's share of innovative content of the later design concept. Fügener encourages exploring new ways of reformulating, which already exist in design tasks, without specifying any vehicle formgiving or styling issues. Therefore, the aim is to offer the executing designers the maximum of creative liberty (see Section 0). This approach would make it possible to place a distinct user innovation in the project, independent of the way of solving the design task. It can also offer the possibility of applying a real design performance in Process Stage 1 in accordance with Fügener's definition.

Innovation approach in process stage 2: Briefing, brainstorming, and ideation of NPD

In the design briefing, brainstorming, and ideation stage the corresponding brief has to be commissioned and communicated to the operating designers and responsible departments. This stage is the second important strategic point of the entire NPD process. Thus, the aim is to create alternative product visions, offering possible variations and alternative scenarios to information-receiving designers. When performing a briefing, divisional heads and their team leader regularly refer to former projects by saying to their designers: *'Do it like project x, but slightly different in area a and b'.* The problem is that thereby innovations are left out quite often, as observed by an OEM employee who was involved in the design process change management. Several other experts confirm that it is quite usual to work by verbal acclamation. Fügener cites the example of designing a further BMW model 3, where he assumes that the brief contains not more than some detailed packaging information and the well-known brand-specific design DNA. So when designing follow-ups of previous models, this appears to be quite comprehensible, but less so in the case of developing new stand-alone products. However, the majority of NPD projects where product concepts tend to be 'quite' similarly structured. After the design briefing takes place, the designers starts to interpret certain details of the former brand-specific DNA, symbols, and other identifying features such as an Audi single frame. They brainstorm and then design diverse versions of that central element, even though only one out of these many might get ahead.

In contrast to the more implicit and vague knowledge processing of the sculptural exterior design, Fügener sees the need for a more concrete and explicit cooperative flow of information for interior design, as these are far more functionally oriented. Cross [2008] furthermore identifies these circumstances as 'ill-defined' or 'ill-structured' problems by saying: *'There is no definitive formulation of the problem. When the problem is initially set, the goals are usually vague and many constraints and criteria are unknown.'* Furthermore, he states: *'…the problem is unlikely to be internally consistent.* This statement emphasizes to think about how and where this constant problem formulation can be placed within the regular automobile design process (see Chapter 6). Also Howe underlined: *'I believe in intuition. I think that's the difference between a designer and an engineer…'* [Cross 2008]. According to this mindset, facts are important, but emotional impressions to activate creativity mark 'the central ingredient' for innovating within the fuzzy front-end of the automobile briefing process [Gaier 2011]. Von Oetinger and von Pierer suggest that creativity

is not dependent on cognitive abilities alone, but also involves the usage of knowledge, motivation, and curiosity to experiment by trying to handle contrariness of many different kinds [Jacobs 2007]. They particularly accentuate that there does not exist an absolutely assured scientific theory of creative acting, and point out the importance of individual 'conditional constellations' for creating innovations [Von Pierer and von Oetinger 1997].

When asking diverse vehicle designers where they would source their inspiration from, most of them answered they would visit art and design exhibitions, make some trend spotting at urban areas, surf the web, and watch science-fiction movies. According to diverse statements of automobile designers (interior to exterior as well as advanced to preproduction design), it turns out that 'most' (if not all) of them do not read briefings or research studies properly before they start sketching. Some executing designers do not even receive a written brief at all. When asked the reason, they replied that those tonnes of reports and studies simply appear boring and superfluous to them. It is not the information itself that they view as redundant, but the way in which the information has been processed and illustrated visually, which do not catch their attention at all. They claim that those reports and studies would show a high degree of awareness about problems, but they also reveal pure limitations and prohibitions concerning the vehicle conception to them. Cross [2008] found out that these limitations do not correspond to the designer's creative nature that wants to find new solutions in proactive and positive ways instead. The information produced by scientists restricts their imagination immensely and thus they mainly exclude or ban these topics from their design brief. A couple of designers even confessed that they have picked out some buzzwords of the provided briefing afterwards to justify their already produced designs for selling it back to their 'internal clients'. Designers do not like to receive readily developed technical concepts from the engineering department to be further wrapped in design either. Instead, they want to be intellectually challenged in finding and creating own design solutions independently or jointly on equal footing with the engineers. According to Lewin and Borroff [2010], an '*effective communication remains key throughout the design process in order to successfully steer the evolution of a vehicle product through a process that has to account for a range of influences, all impacting on the final design'.* The above-mentioned design challenge within Process Step 2 depicts the second identified point within the design process to insert innovative content and will be examined in Section 8.0.

3.3. Discussion

This chapter summarized the relevant literature and expert insights onto one common knowledge base. A joint fundament in the field of design culture, the design hierarchy system, the design process and process innovation as baseline for further discussions was created. Key findings include the imbalance in-between the exterior and the interior design discipline that needs to be improved. As the interior design offers a huge thematic area for research, it needs to be involved more extensively in the strategic design development. It was found out that there is no detailed design process documentation. Nor is there a design brief or briefing process record also inside design departments. In the majority of cases, the design brief is not even written down or handed over to the executing designer. Consequently, automobile design has to reproduce its routine knowledge over and over again, which ultimately blocks new disruptive developments. It was also ob-

served that user insights are not actively studied or implemented, as its research content appears too boring to read to the designers. This fact might cause an innovation absence in the automobile vehicle design, which marks a problem for this development field. When considering how and where the innovative input might be inserted within automobile NPD one must find alternative solutions. From the literature and interviews described above, the following central questions and challenges emerged (see Table 13).

Table 13: Central questions and challenges

1.	How to implement disruptive user innovations within the design process when user insights are not specified, written down, or discussed so far?
2.	How does state-of-the-art research information enter the designer's world to be considered within future vehicle designs? It seems doubtful that these may create outstanding user-centred innovations by examining similarly structured information over and over again.
3.	How could an alternative, but appealing, design brief look like?
4.	How to brief executing designers in a more goal-oriented manner according to their creative nature and proactive mentality so that they include essential information in their designs?
5.	How to re-proof the implementation of these insights and re-evaluate design outcome when briefing parameters have not been written down before?

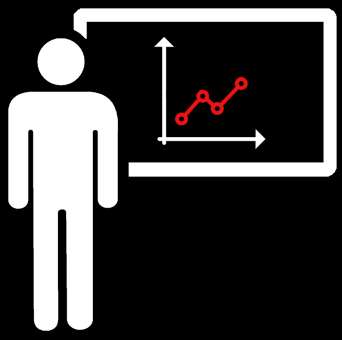
The following chapters of user trends and tendencies (see Chapter 4), user exploration (see Chapter 5), the student experiment (see Chapter 6), and concept design creation (see Chapter 7) are part of the following research experiment. The aim is to find answers to the above-mentioned questions, to gather further research insights, and to elaborate concrete proposals for the later recommendations for change (see Chapter 8).

Table 14: Tasks to master in this work

Task 1	General macro trends and tendencies that act as concrete briefing components for the further experiment need to be identified.
Task 2	Extreme user insights of the fuzzy front-end automobile NPD design process need to be implemented in order to gather crucial time margins and market advantages.
Task 3	Designers need to be emotionally addressed in such a manner that they deeply incorporate users, brief insights, and solutions strategies into their designs for improving product quality and usage scenarios sustainably.
Task 4	A hierarchy-independent communication and conception medium within the automobile design environment needs to be established. The purpose is to directly translate and transfer unfiltered objective information since the official board mandate (1), marketing, strategy, engineering and design workshops (2), and head of design's vision reporting (3) into the final design elaboration and until the refinement design phase.
Task 5	There need to be found alternative ways to involve the interior design earlier within the conceptual design phase. The aim is that user-centric interior innovations shape outstanding product concepts, deriving from the inside [Macey et al. 2008].

Next steps to go

As these formulated questions appear in a non-specific manner, concrete tasks for further research have been developed. Thus, the aim is to discover alternative ways to transfer information in a more empathic and brief formulation, in order to find alternative briefing forms and process designs (see Table 14).



CHAPTER 4 – USER TRENDS AND TENDENCIES

As today's employees combine everyday work and private life in a flexible manner, they look for a good work-life balance and an attractive office environment that is rich in variety and enhances their creativity [Groenesteijn 2014]. Hence, working part-time, via home office, having a company-integrated kindergarten, chemical cleaning, or a gym, are some of the facilities today's employees look for [Chandrasekar 2011]. It is assumed that this type of flexible business work is projected to increase even more in the future [PricewaterhouseCoopers 2014]. An extreme example are the regular business travellers whereof The Economist [2015] reported that companies spent *'a record of $1.25 trillion'* in 2015 *'on sending employees on work trips'*. This Ph.D. addresses the topic of changing work conditions and environments in the context of these business travellers that depend on further improvements in this field.

For this reason four experts were interviewed to explore what the consequences of flexible business work are in four different work fields. This chapter reports the results of these interviews and provides an overview of the current and possible future factors affecting future knowledge worker that move in a more and more digitized environment. By following the philosophy of the Delft University of Technology triangle of *'Doing design in an interdisciplinary area combining insights about people, technology, and business to create new solutions'* [Industrial Design Engineering 2014] (see Figure 9) this work is divided into five search fields from A–E that are derived from this areas (see Table 17). The topic of changing business culture, developing work conditions, flexible work profiles, changing work environments, and future work skills and user behaviour were studied. The aim is to find out how current work conditions develop further (technology Point of Figure 9), how peoples work skills and user behaviour as well as work profiles are changing in the future (people Point of Figure 9). And it is to determine how the future business culture and its work environment will develop (business Point of Figure 9). The aim is to better understand these users and their influential factors in the urban environment by a first contextual research.

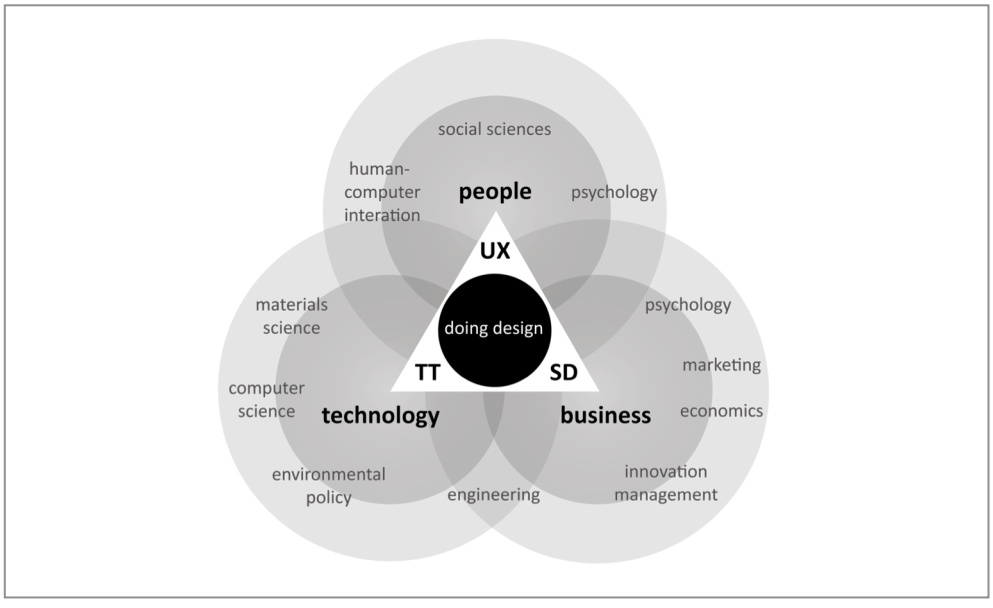


Figure 9: Delft University of Technology triangle of study programmes and disciplinary areas

4.0. Method

Interviews were carried out with four experts to obtain first-hand insights on the context of changing business culture and nomadic lifestyles, developing work conditions, future work skills and professional user behaviour, flexible work profiles, business travelling avant-garde necessities, changing work environments and mobile space layouts. The outcomes will later be used for a deeper research (see Chapter 6). For the interviews a guideline was used following an approach described by Weyers [2007], which includes a semi-structured questionnaire. Questions like *'Can you explain what makes these business travellers standing out'* and *'Do you think that they increasingly combine private and business maters during their hotel stay'* were asked. It was important that the interviewee had no ostensible, personal interests of self-manifestation or any personal advantage in providing information to the questioner. Questions were asked regarding every specific interviewees field of expertise. By following Weyers' [2007] approach, the interview process has been divided into four main phases:

1. Preparation: writing an interview guideline
2. Data collection: planning and executing the interview
3. Data documentation: documenting the interview
4. Data analysis: analysing the collected material to relate it to literature

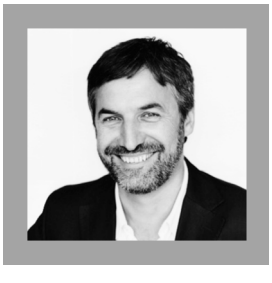
Interview guide

The basic questions asked to these experts are shown at the Appendix of this document. The interviews were semi-structured, which means that there was room for elaborating topics when the expert wanted to explain more. The interview guide can be found in the Appendix of Table 51 in German and English languages.

Participant selection

According to Honer [1994], there are two important characteristics that every expert needs to possess: a long-lasting experience of at least 10 years, and, in this case, a field-specific 'niche' knowledge of design, hotel and brand management and architectural researcher, which was a selection criterion. Another aspect was added because this chapter aims for a broad exploration. Therefore experts should come from different backgrounds such as the practice-based industry towards the scientific university research. In this research different educational and brand-related backgrounds – from the hotel to the design furniture branch were applied to represent an inhomogeneous, objective variety of opinions. This allowed the representation of different point of views on the future travellers work environment, work culture, lifestyles, work skills and conditions. Based on the before mentioned criteria, the following four experts were selected:

Expert 7: **Laura von Wangenheim**
Professional background: Author,
art director at mediaworx in Berlin, Germany
Field of expertise: Nomadism, experimental photography, and product to graphic design



Expert 8: **Bernd Neff**
Professional background: Vice president of Brand, Marketing and Communications Design Hotels AG in Berlin, Germany / Field of expertise: Hotel design and conception, creative user groups, international urban avant-garde, business traveller, international thinker, good sense for the next big thing (Zeitgeist), mainly acts from the customer's point of view

Expert 9: **Piero Lissoni**
Professional background: Head of his
design and architectural studio in Milan, Italy
Field of expertise: Product design and architecture, knows and works for the international high-end design market, addresses the digital business traveller

Expert 10: **Dr. Alexander Rieck**
Professional background: Architect, joint head of LAVA architects, and employee of Fraunhofer IAO in Stuttgart, Germany / Field of expertise: Changes in work behaviour, work culture, office layouts, and space concepts, architect and urbanist, specialised in creating urban centres and sustainable environments (Masdar City concept of Abu Dhabi, UAE)

Analytic procedure

All expert interviews were documented, transcribed, and analysed. Insights of these specialists into the field of work were explored from a qualitative side. The interview text was scanned on filter terms and subjects of Table 15 and Table 16. Next, the main insights gathered from the analysis were summarized in single propositions and grouped into 'identified subject areas' to gain a better theme overview on all joint expert statements (see Table 16). This was done by first condensing the content and then by defining the propositions. All topics that were not related to the research question were excluded of the analysis phase.

Table 15: List of filter terms of expert interviews

Filter terms:	Business culture, nomads, mobility
	Work changes, conditions, communication, office facilities
	Work skills, society and user behaviour, future work
	Differences in work, work profiles, personal travel needs, exclusivity, services
	Work environments, future changes, atmospheres, environmental factors

4.1. Expert interview results

On average the interviews took between 1.5 to 3 hours. It was interesting to see that all experts were willing to collaborate and took their time. The identified subject areas with its corresponding statements are listed in Table 16. The seven subject areas that could be identified were: Changing business culture and nomadic lifestyle, developing work conditions, future work skills and professional user behaviour, flexible work profiles, business travelling avant-garde necessities, changing work environment and mobile space layouts.

Table 16: Joint expert statements

Identified subject area: Changing business culture and nomadic lifestyle	
Filter terms: Business culture, nomads, mobility	
1.	There were always nomads, and there will be nomads in the future. (Lissoni)
2.	The nomadic lifestyle is more an attitude than a method of work. (Von Wangenheim)
3.	The nomadic life can be divided into the fields of eating, sleeping, personal hygiene, searching for an intimate retreat, strolling around, communicating, and working. (Von Wangenheim)
4.	The most common factor of mobile people still owning their human dignity is to care for their personal body hygiene and treatment. (Von Wangenheim)

5.	Feelings of comfort, or a sense of home, might be achieved through diverse factors such as music, speech, or smell. (Von Wangenheim)

Identified subject area: **Developing work conditions**	
Filter terms: Work changes, conditions, communication, office facilities	
6.	We are approaching the end of the industrial time stepping into a post-industrial age and thus the concept of work needs to be redefined. (Rieck)
7.	The work sequences and concept of presence from the industrial age do not fit our contemporary work reality anymore; they are disconnected from place and time. (Rieck)
8.	The need for communication and cooperation within each work environment is constantly rising. (Rieck)
9.	The concept of personal mobility and business travelling will still be relevant in the future, as human contact seems to be irreplaceable. (Rieck)

Identified subject area: **Future work skills and professional user behaviour**	
Filter terms: Work skills, society and user behaviour, future work	
10.	The mixture of spare and work time represents an actual challenge of our society. (Rieck)
11.	Personal motivation and creativity are key aspects of our future work. (Rieck)
12.	The most challenging task is to find at any urban environment a silent place for work. (Von Wangenheim)
13.	Every form of heavy luggage the traveller has to carry around is not desirable. So it is better to organize items and information locally or in a digital form. (Von Wangenheim)
14.	The idea of sharing mobility suits the digital business traveller's life, but needs to offer even more flexible and spontaneous mobility options. (Lissoni)

Identified subject area: **Flexible work profiles, business travelling avant-garde necessities**	
Filter terms: Differences in work, work profiles, personal travel needs, exclusivity, services	
15.	The human being consciously perceives its social rank and intuitively tries to improve its current position through luxury items and services. (Rieck)
16.	The ever-valid concept of luxury works mainly throughout the system of comparison. (Rieck)
17.	The modern business traveller brings their work equipment along and is not in search of any classical business facility. Instead, they look for inspiring experiences. (Neff)
18.	As many as 18% of the design hotel customers are willing to pay some 50% on top of the common hotel price, when an extraordinary design experience is involved in their stay. (Neff)
19.	Therefore, people are searching for alternative, more extravagant, but comfortable and private meeting formats. (Neff)
20.	These travellers want to feel specially treated. Exclusivity is a central topic for them. (Neff)
21.	The ultimate idea is to unite like-minded people in one space or environment. (Neff)

Identified subject area: **Changing work environment and mobile space layouts**	
Filter terms: Work environments, future changes, atmospheres, environmental factors	
22.	Future product development is not about pure technology application, but more about meeting real customer needs. (Lissoni)

23.	The spatial adaptation for varying atmospheric as well as functional work situations is missing. (Rieck)
24.	With the help of acoustics, light, scent, climate, and temperature, the human being can be shifted into different moods. (Rieck)
25.	The aim is to gradually match the user's mood with each space comfort factor (or vice versa). (Rieck)
26.	The automobile interior's surface might take over the screen's original task. (Rieck)
27.	Autonomous driving represents a basic requirement for every transmission of business functions towards the automobile interior. This might be the start of a completely new era of smart space use in the future. (Rieck)
28.	Automobiles and architecture will be extremely important influential factors that are in mutual reliance to our future cities. (Rieck)

4.1.1. Identified subject areas

The five subject areas that were identified out of the expert interviews of Table 16 are described in the following paragraphs.

Identified subject area: **Changing business culture and nomadic lifestyle**
Statements 1 and 2 of Table 16 make clear that nomadic lifestyles are a phenomenon, which will continue in future. People living a this lifestyle have basic needs such as the demand for cloth, food, personal hygiene, and they are searching for intimate retreats, strolling around, communicating, and working (see Statements 3 and 4 of Table 16).

Identified subject area: **Developing work conditions**
Points 6 to 9 of Table 16 express the paradigm changes implicated by the new post-industrial era. Work conditions are changing – the office times are not in-between 9-to-5 anymore, for instance. Locations of work will vary, and work will be managed from home, from hotels and while travelling. Consequently, the way people communicate and cooperate with each other changes too (e.g., meetings in virtual conference rooms as opposed to physical ones). People's degree of mobility increases too, as they travel more.

Identified subject area: **Future work skills and professional user behaviour**
Number 10 of Table 16 makes clear that the content of work is changing. Non-tangible aspects, such as creativity, silence, or the access to information, marked in Points 11 to 14 are possible success factors of this future work culture. In a mobile business world these aspects are more difficult to achieve than in former spatially fixed work environments.

Identified subject area: **Flexible work profiles, business travelling avant-garde necessities**
All interviewees agreed that the concept of luxury would remain valid, but the understanding of what 'luxury' is will change (see Points 15 and 16 of Table 16). As work will be more flexible regarding locations and the content. The business travellers have interest to present themselves in an original way to differ from other fellow travellers. They are part of the experience economy and want to incorporate the way they live and perceive the world in a rather unique way. Therefore the luxury concept has to adapt to this new human needs to experience luxury also on the go (see Points 17 to 21 of Table 16).

Identified subject area: **Changing work environment and mobile space layouts**
For automobile products a more user-centred concept with various atmospheric moods is in demand (see Statements 22 to 26 of Table 16). As a matter of fact, the changing work

environment will influence architectural concepts as well as automobile design—the latter mainly through the implementation of autonomous driving technologies mentioned in Points 27 to 28 of Table 16.

4.2. Literature research

A literature review was conducted for each subject area identified in the expert interviews. Each of these subject areas in turn incorporated thematic foci to further explore the subject. The remainder of this chapter presents the insights collected from the literature review. The outcome of the expert interviews was compared to literature to check if the expert comments could be found in the literature as well. This research was applied in categories named accordingly.

4.2.1. Changing business culture

Within the identified subject area of changing business culture the thematic focus areas are constant work re-organisation and shifting values and work conditions.

Thematic focus: **Constant work re-organisation**

Rieck announced in his interview the end of the industrial age that is shifting to the post-industrial time. As a consequence, he says, that the concept of work needs to be redefined, as our work reality of today is disconnected from place and time (Point 6 and 7 in Table 16). Rieck emphasizes the importance of personal communication in today's and future work environments that won't loose its role (see Point 8 of Table 16). Because of this aspect he also thinks that personal mobility will stay an ever-relevant issue for business people in Point 9 of Table 16. Also Fügener (see Section 0) mentioned the possibility to create a 'third place' for work within the autonomous driving car in Point 47 of Table 12. He thinks that this combination would have the potential to solve two tasks in one. Literature provides support of these two statements. For instance Oldenburg [2002] defined the term of the 'third place' of work, which refers to alternative work environments that partly replace the conventional office (see Section 0). Different automobile concepts such as the Mercedes-Benz F015 Luxury in motion vehicle or IDEO's workspace pod called 'WorkOnWheels' experiment with the interiors of autonomous driving cars, illustrating that the changing concept of work is recognised by practitioners too. These novel concepts offer newly gained space and time while driving on its own.

Thematic focus: **Shifting values and work conditions**

This shift of value and work conditions also means that the automobile is regarded more as a mobility medium rather than personal property. Von Wangenheim terms the nomadic, non-territorial lifestyle more an attitude than a method of work (see Point 2 of Table 16). She mentioned that the feeling of comfort, or a sense of home, might be achieved anywhere through factors such as music, speech, or smell within any closed space (see Point 5 of Table 16). Also for Lissoni, the future automobile development is no more about pure technology application, but more about meeting real customer needs in form of flexible services anywhere anytime (see Point 22 of Table 16). The sociologist Daniel Bell, who states that the economy is on its way from a producing towards a service-based one, also noted this change [Haas 2011]. When work content and the idea of what is valuable changes, then the way we deal, manage, and handle information will change profoundly,

too [Malik 2013/2016]. A group of researching scientists from the New Zealand Council for Educational Research, described that era the following: *'The Knowledge Age is a new, advanced form of capitalism in which knowledge and ideas are the main source of economic growth (more important than land, labour, money, or other tangible resources). New patterns of work and new business practices have developed, and as a result, new kinds of workers, with new and different skills, are required'* [Amos 2014].

4.2.2. Developing work conditions

Within the identified subject area of developing work conditions the thematic focus area is shifting work content.

Thematic focus: **Shifting work content**

Riek considers personal motivation and creativity are key aspects of future work (see Point 11 of Table 16). Neff even presumes it as the ultimate idea to unite like-minded people in one space or environment on equal terms (see Point 21 of Table 16). The report 'Future Work Skills 2020' identifies main drivers that fundamentally change the content of work. One of these drivers is named the 'rise of smart machines and systems' and it requires that *'…We will have to rethink the content of our work and our work processes in response'* [Institute for the Future 2011]. IAB researcher Promberger verifies that technical knowledge and complex knowledge-based work will be more important in future. These views find support from literature. Hutt, Walker and Frankwick [1995] mention that steeply rising hierarchical structures within corporations are gradually being dismantled; as such structures pose a hurdle to contemporary barrier-free communication. The result is that people can communicate, cooperate, and debate in a more democratic manner, and on the same level. An example for this work behaviour is the Vitra Workbay office system, designed by the Bouroullec brothers and launched at the Milanese furniture fair. The installation showed many different combination possibilities for office user to create alternative but professional work environments that differ from the traditional model [Vitra 2012]. Web corporations like Facebook with Mark Zuckerberg have been living and developing that culture of open communication for many years [Kohli 2015], e.g. by placing their principals in the midst of their staff within open space offices, instead of isolating them within the usual single prestige cubicles.

4.2.3. Flexible work profiles

Within the identified subject area of flexible work profiles the thematic focus areas are outsourcing corporations, increase of mobile work(ers), freelance workers growth', fusion of private and professional life, flexible working hours, mobile computing growth, mobile data access and information protection, and open source mentality.

Thematic focus: **Outsourcing corporations**

Rieck makes clear that the concept of personal mobility and travel for business will still be relevant in future, as human contact seems to be irreplaceable (see Point 9 of Table 16). As companies constantly try to act more flexibly and to lower their fixed costs, they are moving in leaner, self-regulating systems that also tend to be less location dependent. This might cause a long-term change of work profiles, as fewer people will obtain long-term contracts as regular company-internal employees, but be employed as freelancers

for more short-term project-related assignments. DePillis [2015] calls this model an 'on-demand economy', a model that changes the classical interpretation of constant work profiles towards a world of many flexible, eventually parallel, and mainly temporary employee engagements.

Thematic focus: **Increase of mobile work(ers)**
Lissoni thinks that the idea of shared mobility suits the digital business traveller's life, but needs to offer even more flexible and spontaneous mobility options than today (see Point 14 of Table 16). This happens because companies tend to invest less in new human capital and ask for more demand-oriented and temporary support from external sources. Hauschildt and Salomo [2007] report about a management strategy that advises to switch towards 'make, team or buy', respectively 'make, team and buy' business models. Such a switch pushes the company to rethink their core business and then to decide what they can achieve by themselves, team-up with other organisations, and buy externally in order to reach their project goal.

It is important to note that the mobility needs of people *'can vary greatly across geography, industry, business size, and mobile worker type'.* Skilled workers will move in the future wherever their work is in demand. It seems likely that mobile work will accelerate in general terms such as *'[...] Western Europe's mobile worker population will grow from 10% to 11%.'* And *'Western Europe is second to the United States in terms of mobile technology adoption […]'* mentions Boggs et al. [2010]. The majority of these mobile workers represent temporary worker, project-specific employees, and freelancers.

Thematic focus: **Fusion of private and professional life**
Rieck mentioned that the fusion of private and professional life represents a challenge for the business nomad and our society. In the absence of a clear boundary between their private and professional lives people need to define new personal rules for time-outs and recovery breaks, as this would increase the stress factor. Rieck also thinks it is necessary to find new space qualities and convertible space atmospheres to compensate the extreme requirements of the business traveller (see Point 10 of Table 16). Neff mentioned that these travellers long for inspiring environments as 18% of the design hotel customers are willing to pay some 50% on top of the common hotel price, when a design experience is involved in their stay (see Point 17 and 18 of Table 16). He indicates that they are searching for more extravagant, but comfortable and private meeting formats and wish to adjust each space according to their personal needs (see Point 10, 23 and 25 of Table 16). With the help of acoustics, light, scent, climate, and temperature, the human being could be shifted into different moods within space to solve this issue thinks Rieck (see Point 24 of Table 16).

Thematic focus: **Flexible working hours**
Rieck mentioned that the work sequences and concept of being constantly present in the office do not fit in our contemporary work reality anymore; as these are disconnected from place and time (see Point 7 of Table 16). He thinks that the mixture of spare and work time represents an actual challenge that society needs to cope with (see Point 10 of Table 16). Companies are increasingly recognising this; an example is the R&D department of the Volkswagen Group that introduced flexitime working and removed all time record-

ers that controlled the former coming and going of the employees. Also Dieter Zetsche, chairman of the Daimler AG, wants to implement flexitime working in parts of the company [Schneider 2016], as it was observed that people people who work flexible hours are more productive for the company, while costs are shrinking as administration staff and bureaucracy expenses are diminishing [Stengel 2012]. Flexible working hours will also have implications for performance assessment. Angelica Gifford, top manager at Microsoft Germany, highlights that people will rather be measured for their individual performance than for their pure time attendance in future. She says [Haas 2011]: *'When or* where *somebody does his work is mainly his personal business. We do not have a time detector mentality or an attendance list.'*[18]

Thematic focus: **Mobile computing growth**

Working flexible means '*more than just working from home'* mentions Boucher [2013]. *'It is about working from wherever you need to be, whether that's from a café with a client, a customer's HQ or during your commute.'* Wangenheim (expert 7) remarks that the most challenging task when working flexible is to find a silent place for work within the urban environment (see Point 12 of Table 16). She also points out that carrying around heavy luggage during this time is not desirable. She thinks it is better to organize items and information locally or in a digital form (see Point 13 of Table 16). Rieck emphasized the constantly rising need for communication and cooperation within each temporary work environment (see Point 8 of Table 16). Literature also agrees with this statements: Boucher recommends making the *'best use of technology such as audio and video-conferencing, instant messenger and mobile internet …while strengthening collaboration …between colleagues – even if employees aren't physically in the same place.'*

Another example is Intel that published a paper describing how the corporation changed its business value of mobility in their enterprise. By offering their employees' mobile computing options and variable workspace designs instead of fixed working stations, Intel has seen a significant increase in overall productivity and satisfaction. In 2008 around 80% of the Intel employees already used already a pc as their primary 'business tool' [Intel 2008]. Mobile computing has become a strategic asset for Intel. Wireless-enabled notebooks increased the productivity per average employee by more than five percent and help to create a more efficient work environment.

Thematic focus: **Open source mentality**

Not being constrained to fixed work locations means that people spend more time working online. For the user, cloud computing has become a central tool of location-independent data access and processing. This 'remote network of servers' offers people access to data from all over the place mentions [Rankin and Shumack 2016]. Neff emphasized that the modern business traveller brings his personal work equipment along and is not in search of any classical business facility such as a fully equipped office space. Instead, they look for inspiring experiences and are open to share their insights (see Point 17 of Table 16). In line with Neff's expert statement, Neef et al. [2009] describe the business traveller's open source mentality: *'…the digital world is kind of a participatory cul-*

[18] Translated from the German: *,Wann jemand seine Arbeit macht und wo, ist zu einem Großteil ihm selbst überlassen. Bei uns gibt es da keine Stechuhr-Mentalität und auch keine Anwesenheitslisten.'*

ture. Certain offers and cooperation possibilities can be created throughout many creative tools. …Quite often it is less about the individual profit, but the enrichment of the digital community itself. The web makes digital natives to digital producers, whose self-generated content and open source mentality substitutes increasingly the use of billable services.'[19]
Based on the expert interviews and extant literature it can be concluded that within this digital communities arose a liberal sharing idea, where everybody might participate or contribute something to the collective one day.

4.2.4. Changing work environment

Within the subject area of changing work environment the thematic focus areas are genius loci, urban relevance, public working and open information exchange, urban subcultures producing creative energy, urban utopias as role-models, a city is not a city is not a city is not a city, workspace design as attractor, office layout development, personal workstation design, decentralised work zones, work-life fusion, and continuous work environment adjustment.

Thematic focus: **Genius loci**
The section above demonstrated that within the digital revolution, everybody and everything will be connected and thus people are able to move and choose their proper work locations more independently. Rieck thinks that the concept of personal mobility and business travelling will still be relevant in the future, as he regards human contact as irreplaceable (see Point 9 of Table 16). Morace [N.N.], the Italian sociologist and Future Concept Lab founder, terms this 'genius loci', *'the talent and energy'* of a certain location diverging from any other. He believes that no place, location, or ambience is exactly the same, as each space provides a distinct potential to stimulate its proper visitors. Von Wangenheim agrees with this standpoint and thinks certain work places should be chosen according to each user's specific needs and work intentions, as the feelings of comfort, or a sense of home, might be achieved by diverse factors (see Point 5 of Table 16). This leads to a situation where travellers might choose their workplaces out of a portfolio of office hubs, home, cafés, hotels, clubs, or even cars depending on what their needs are at a particular point in time.

Thematic focus: **Urban relevance**
The future foresight expert Frank Ruff emphasizes that living and working urban does not strictly mean that people need to reside in a city. Instead, people mostly move and live in urban agglomerations that are located within commuting distance to the inner city centre [Abele 2013]. These urban places may play a major role concerning the above-described genius loci as they include these many different locations with individual talents to enrich people. Neff thinks that urban environments are most likely 'the place to be' because of its circulating creativity, and knowledge accumulation through people. To him it represents the place to find and identify new talent and economic power (see Point 21 of Table

[19] Translated from the German: *'Interaktion ist geteiltes und geschätztes Gut der Netzgeneration: Durch zahlreiche Kreativtools kreieren sie Angebote und Kooperationsmöglichkeiten. […] Oft steht dabei gar nicht der Profit, sondern die Bereicherung des digitalen Gemeinwesens im Vordergrund. Das Web lässt die Digital Natives zu digitalen Produzenten werden, deren selbst generierte Inhalte und Open-Source-Mentalität zunehmend die kostenpflichtigen Angebote ersetzt.'*

16). Literature approves this point with Florida [2012_a] saying that the '*quality of place can be summed up as an interrelated set of experiences within the public'.* He identified three key factors: '*the combination of the built environment, diverse people of all ethnicities, nationalities, religions, and sexual orientations'* that interact with each other and the *'vibrancy of the street life, café culture, arts, and music'.* According to Florida, the urban environment represents an energetic creativity reservoir, attractive work environment, and target location for the future travelling work force (see also Point 28 of Table 16).

Figure 10: Snapshot 1 – Berlin in 2030 created by Die Krieger des Lichts and xoio
Copyright: Daimler AG, Society and Technology Research Group, Berlin/Stuttgart.

Thematic focus: **Public working and open information exchange**
Neff thinks that the modern business traveller brings his work equipment along and is not in search of any classical business facility. Instead, they would look for inspiring experiences (see Point 17 of Table 16). Thus, the formerly closed office space transforms into an open workspace where people have the opportunity to stay at diverse public locations. He argued that people are searching for alternative, more extravagant, but comfortable and private meeting formats (see Point 19 of Table 16). An example is the urban business traveller visiting his groups design hotels worldwide. As many as 18% of the design hotel customers are willing to pay some 50% on top of the common hotel price, when an extraordinary design experience is involved in their stay (see Point 18 of Table 16). Neff thinks that the absorption of different environments boosts people to think out of the box. Events, meet ups, and work units that take place at cafes, airport lounges, or coworking spaces showed this. These spaces transform into a new type of resource that does not only serve the digital bohemian anymore. An example is the 'Digital City Shang-

hai' project that provides a public service platform for people moving in this local 'information highway' [Van den Besselaar and Koizumi 2003] i.a. to find a proper place to work.

Thematic focus: **Urban subcultures producing creative energy**

According to Ramasubramanian [2010] cities are rather *'…places of contradiction - extreme affluence exists alongside severe poverty' that 'offer the best and the worst to their citizens'.* The energy of these clashing positions would create many creative outputs to its observers. A striking example is the creation of the UNESCO Creative Cities Network [2004] that unites 116 cities *'that have identified creativity as a strategic factor for sustainable urban development.'* Also Neff thinks that people are searching i.a. for more individual, but comfortable and private meeting formats to act creative (see Point 19 Table 16). The city is recognized as a place that offers the best technical infrastructure, mobility options, and electricity supply, wifi, gastronomy, and a certain potential client-density in such a manner that it gains the highest attractiveness to the business travellers.

Figure 11: Snapshot 2 – Los Angeles in 2030 created by Die Krieger des Lichts and xoio.
Copyright: Daimler AG, Society and Technology Research Group, Berlin/Stuttgart.

Thematic focus: **A city is not a city is not a city is not a city**

Rieck stresses that one city format differs fundamentally from the other one. Ramasubramanian [2010] explained that '*…Terrorism, suburban population shifts, the restructuring of urban economic bases, social fragmentation, new immigrant populations, and the complex forces of globalisation. Each change had a lasting impact upon the urban experience'*, highlighting how urban environments develop in different ways in response to demographic, economic, political and social changes. Therefore, it is not possible to talk of 'the one and only city concept' anymore. A group of researchers from the Daimler Society

and Technology Research Group Berlin identified a typecast of possible city formats, which exist all around the globe [Maxeiner 2010]. The exemplary illustrations of Berlin (Figure 10), Los Angeles (Figure 11), and Shanghai (Figure 12) for the year 2030 provide an insight where and how future mobile workers might move inside cities. They show a variety of landscapes and surrounding conditions of these places. The form language, context, or infrastructure of a city are categorized inter alia these different types of urbanity [Abele 2013]. This can be seen in Figure 12 – an Asian city for example, where life and work takes place in multilevel city structures. Mass transport media and individual transportation that drives partly autonomous connects the inhabitants trespassing between the different levels. The Berlin snapshot also shows how the transportation rules in urban environments are changing, where bicycle driver and alternative-driven vehicles have clear priority before automobile road users. The red carpet in Figure 10 expresses this preference.

Figure 12: Snapshot 3 – Shanghai in 2030 created by Die Krieger des Lichts and xoio
Copyright: Daimler AG, Society and Technology Research Group, Berlin/Stuttgart.

Thematic focus: **Workspace design as attractor**

According to Rieck, personal motivation and creativity are key aspects of our future work (see Point 11 of Table 16). Similarly, Neff noted that contemporary business travellers do not look for classic business facilities but seek inspiring experiences at locations they equip with their business equipment (see Point 10 of Table 16). A number of successful companies have already acknowledged this. Samsung, for example, has changed its work environment fundamentally in an effort to give their employees a reason to spend more time at the office. They applied an appealing but also comfortable work environment with surrounding lifestyle that is 'easy to tailor and manage' [Waber et al. 2014]. The air conditioning system for example can be individually adjusted and is as quiet working as possible

for not disturbing people during work. But also the chosen furniture in the public office spaces represents a vivid and more informal lifestyle outfitted with design objects and colourful lighting. The open offices transmit a friendly, bright and positive space atmosphere that is embedded in extroverted architecture with an industrial touch [Vincent 2015]. Another example is Vitra, where *'80% of all truly innovative ideas are developed through personal communication'.* They claimed in their showroom (2013) that '*the office becomes a marketplace of knowledge and a venue for social interaction – it is no longer 'just' for working'*. Vitra's idea is that everybody can work wherever he wants, collect inspirations, and discuss or develop innovative ideas together with colleagues. They seek to achieve this through specific designs, materials, and space solutions that reflect the corporate philosophy and give their employees freedom to think, discuss, and work.

Thematic focus: **Office layout development**
The joint office space represents the most familiar work environments today. Rieck pointed out that the need for communication and cooperation at work is constantly rising (see Point 8 of Table 16), and that the aim of this space is to bring like-minded people together (see Point 21 of Table 16). He also noted that the spatial adaptation for varying atmospheric as well as functional work situations is missing (see Point 23 of Table 16). However, this is not a simple task. One of the first examples of open space office experiments took place at the Daimler Society and Technology Research Group's office in the 1990's. They tried to practice non-territorial office concepts, where none of the employees had a fixed seat or table. Soon it became clear that the majority of people preferred a constant workstation, where they could leave personal and professional things and had to adjust their environment only once, according to their preferences.[20]

Another example is the google [Howarth 2014] or Skype office design [Etherington 2011] that reinterprets their corporate culture according to the contemporary lifestyle. Even though it is only about facilitating architecture, the playful and relaxing work environment of these companies is well known for offering a casual, freely configurable, and personalized work environment to their office staff, which is a main point of attraction. Summing up, the perfect work environment should be partially open, transparent, bright and should offer cross-connections as well as recreation areas, meeting and telephone zones, say NL Architects who designed a contemporary office project from NS STATION in Utrecht [Seidel 2013].

Thematic focus: **Personal workstation design**
Riek [2011] carried out an extensive research on the most important influential factors and the composition of typical workspace atmospheres. Among the factors studied were lighting, noise, temperature, humidity, and environmental weather effects – all part of the perfect settled office space. Figure 13's left part illustrates the old work environment of organized hierarchies with isolated private single spaces cubes. The right part of Figure 13 shows an exemplary future office design layout with an open work ambience. It is separated into different zones – a 'palette of places' [Mullany 2003] where diverse types of work can be executed. The space is divided into smaller working zones, and each of which have several workstations. Any of these zones could be transformed into a major control

[20] Narrative from the Daimler Society and Technology Research Group. Berlin, Germany.

centre or a creative production place [Heiner N.N.]. Bene [N.N.], an office furniture manufacturer developed diverse examples of these workstation designs for example. Vitra [N.N.$_a$] also demonstrated that an office space needs to be neither boring nor homogeneously designed. They conducted several research studies and experiments how future work might take place and finally grounded their philosophy in a project called 'citizen office' [Vitra N.N.$_b$]. The idea behind is that the citizen (the employee) of a certain place (office) can populate various areas and move all over the office place. Hence, the 'citizen office' concept can be compared to an eco-system that offers various retreats and shelters formed by little islands in the open office space.

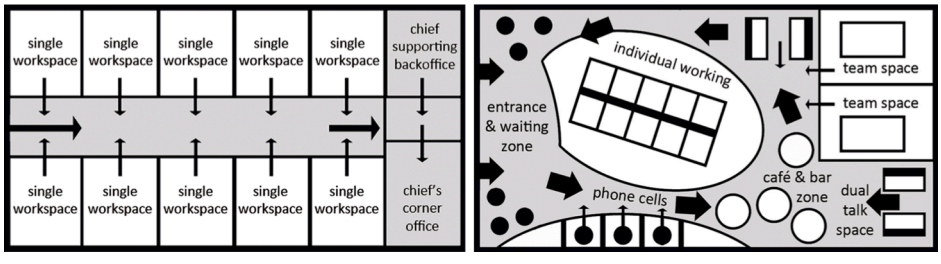


Figure 13: Layout 1 on the left side shows an example of the classical office concept in contrast to Layout 2 on the right side that illustrates a contemporary open space office design

Thematic focus: **Work-life fusion**

Rieck mentioned in the interview that the concept of work needs to be redefined as society is approaching the end of the industrial time, stepping into a post-industrial age (see Point 6 of Table 16). He also mentioned that the merge of spare and work time especially of digital business travellers represents a challenge of our society that needs to be overcome (see Point 10 of Table 16). Also through the parallel use of space for private and professional matters, the user requirements have substantially changed. Lissoni emphasized that future product and space development is not anymore about pure technology application, but more about meeting real customer needs (see Point 22 of Table 16). An example of this mixed environment is the Soho House in Berlin [N.N.], where one can observe the new generation of digital workers with a modern mindset working in a different setting. This space mixes gastronomic elements like a bar and a restaurant with a professional work environment such as a lounge-like open workspace. Most of their users work in the media, web start-ups, or creative industries, but also own professional office spaces.

Thematic focus: **Continuous work environment adjustment**

In his interview Gricic stated: *'My personal wish was always to unite life and* work *[…].* The *office is changing generally towards that direction […]. Furniture is reacting to that. It is mainly affiliated to how we use things. But also by asking what work really means? What is a proper working day? And where might I execute that work precisely? At the kitchen at home, the coffee shop, or the company office?'* [Weißmüller 2012].[21] With this statement

[21] Translated from the German: *'Für mich war immer mein persönlicher Wunsch, dass Leben und Arbeit eins ist. […] Allgemein verändert sich das Büro ja in diese Richtung […]. Möbel reagieren darauf. Das hat viel damit zu tun,*

Gricic makes clear that the different work types, the content of work, and people's social behaviour need to be defined first before any designed objects, such as furniture or vehicles are introduced as work environment. Rieck understands this readjustment as a spatial adaptation of varying atmospheric as well as functional work situations (see Point 23 of Table 16) to match the user's mood with different space comfort factors (see point 25 of Table 16). Gricic also thinks that there is no single environment that might meet all expectations; instead, ranges of flexible, temporary adjustable space situations are needed. Rieck thinks that the human being could be shifted into different moods with the help of acoustics, light, scent, climate, and temperature (see Point 24 of Table 16). These statements make clear that the proper understanding of future work is not tightly interwoven with one build environment anymore. Location-independent work refers to the local atmosphere, social interactions, the way of being inspired, and communicating these insights to fellow colleagues [Lopez 2013].

4.2.5. Future work skills and user behaviour

The thematic focus areas within the identified subject area of future work skills and user behaviour are new media literacy, physical work mobility, permanent mobile status, work flexibility standby, multitasking abilities, interdisciplinary work approach, open minded action, sensual experiences for creativity mining, social-emotional intelligence, virtual collaboration, and cross-cultural competency.

Thematic focus: **New media literacy**

Besides the change of office locations and work layouts, the skills and user behaviour will change as well. Rieck emphasized that the need for communication and cooperation within each work environment is constantly rising (see Point 8 of Table 16). The industry requires work skills and user characteristics that are completely new according to Stillmann [2011]. For example computational skills and knowledge how to handle communication technology to attend virtual university lectures, a medical consultation, or business conferences in the future. Von Wangenheim recommends storing information for work locally or in a digital form so that one does not have to carry it around (see Point 13 of Table 16). These activities will be common in the next years as the *'[t]he explosion in user-generated media including the videos, blogs and podcasts that now dominate our social lives, will be fully felt in workplaces in the next decade […]'* writes the Institute for the Future [2011].

Thematic focus: **Work flexibility standby**

In 2012, the Deutsche Telekom [2012] commissioned a study asking 15.000 people from 18–30 years from 26 countries how their perfect workday would look like. 72% of all the interviewees said they would prefer work schemes with flexible weekly hours. Instead, the model of trust-based working hours reached only 49% acceptance from them. As many as 20% of the German respondents said they wish to structure their working hours on their own. Besides, *'[m]any participants could even imagine to work an average of around 8 hours on the weekend'* analysed the Deutsche Telekom [2012]. The survey showed the flexibility of this age group being ready to take over responsibility as 76.8% would even leave the country and go abroad for receiving a rewarding job. Fairclough

wie wir Dinge benützen. Aber auch mit der Frage, was ist überhaupt Arbeit? Was ist ein Arbeitstag? Und was ist der Ort an dem ich arbeite? Ist das meine Küche zu Hause, ein Café, oder ist es das Büro in der Firma?'

[1999] claims that 'working people' should be explained that this type of work flexibility standby represents an economic necessity of our time so that they might act even more flexible concerning fluid job market situations and changing work profiles. This confirms their flexibility attitude and willingness to go wherever their personal skills are required.

Thematic focus: **Multitasking abilities**
In its study on future work skills the Institute for the future [2011] finds that travellers would like to handle information simultaneously at every moment, prioritizing them in a hierarchical order. Their aim is to work synchronously in a well-organized manner, with high efficiency and productivity in a limited time claims the report. *With more people teleworking from home, the office will be an extension of our homes, and vice versa, with no clear demarcation between the two'* mentions Sibley [2011]. So it is quite probable that people deal with various private and professional matters at a time. One can presume that more and more multitasking abilities are needed to merge different single modes and actions into joint ones.

Thematic focus: **Interdisciplinary work approach**
Lindberg et al.[22] note that future skilled worker have to act as broad generalists as well as experts in specific areas of expertise at the same time: *'…throughout the 20th century, ever-greater specialisation was encouraged,* the *next century will see transdisciplinarity approaches take center stage'.* According to the institute for the future [2011] *'We are already seeing this in the emergence of new areas of study, such as nanotechnology, which blends molecular biology, biochemistry, protein chemistry, and other specialities*.' Rieck also indicated that the need for communication and cooperation within each work environment is constantly rising as there are people collaborating with increasingly different backgrounds (see Point 8 of Table 16). Thus, this thematic focus wants to make clear that the market requires newly merged profiles that need to develop yet.

Thematic focus: **Open-minded action**
Rieck noted that personal motivation and creativity are key aspects of our future work (see Point 11 of Table 16). Likewise Beitzner argues that skills such as the ability to think differently and independently are crucial for being able to generate innovations, and thus are highly prioritised by companies' human resources departments. Nevertheless it is widely known that time spent working and the velocity in finding and developing disruptive innovations are not necessarily congruent. *'Creativity doesn't know office times,'*[23] also confirms a young rising start-up agency founder based in Berlin [Beitzer 2011]. In fact, innovations are time-independent, qualitative, and not comparable to an assembly band production with a certain predictable output. Smulders[24] identifies this behaviour as the main misunderstanding of huge multinationals towards their R&D departments today. Companies would have the expectation to create innovations and willingly set pressure on their developers to literally 'produce' new ideas in an infinite loop. He thinks that these prospects come from an insufficient clarification in the market that failure and disorder, being part of open-minded action, are an elementary requirement to develop innovations.

[22] According to Hasso Plattners' school of design thinking philosophy, the aim is to obtain knowledge in the width and depth, as symbolized in their T-shaped graphic mention Lindberg et al. [2011].
[23] Translated from the German: *'Kreativität hält sich nicht an Bürozeiten.'*
[24] Content from discussion with Dr. Frido Smulders at the Delft University, The Netherlands.

Thematic focus: **Sensory experiences for creativity mining**

Mohn, chairman of the Bertelsmann AG, mentions: *'The huge potential of creative and unexploited human capital will define the destiny of our economy'* [von Pierer and von Oetinger 1997].[25] Instead of contracting always-new masterminds, many corporations tend to train their staff on the job in applying creative, iterative methods and techniques such as the design thinking method [Plattner et al. 2011]. Rieck thinks that with the help of acoustics, light, scent, climate, and temperature, the human being can be shifted into different moods (see Point 24 of Table 16) whether to feel more relaxed, work more concentrated or to develop a great idea for example. Neff also mentions that the modern business traveller would rather look for *'inspiring experiences'* instead of classical business facilities today (see Point 17 of Table 16). Literature confirms this point. '*Perception is the process of selecting, organizing, and interpreting information*' mentions Schmitz [2012]. Vom Orde [2014] suggests that the perceptual field of the senses, such as haptic experiences, are closely connected to each other and may present the gateway towards creativity and inspiration. Ernst and Bülthoff [2005] think that experiences such as feeling, seeing, or hearing novel sensations, stimulate certain cerebral areas in the human brain, and link old information with latest experiences to foster new thoughts and ideas. The Hasso-Plattner-Institute's school for design thinking implemented these insights into their design thinking method.[26] Haptic self-made prototypes, short life-theatre plays, and other creative outputs are highly appreciated and required by them during the on-going design process [Hasso Plattner Institute of Design 2017].

Thematic focus: **Social-emotional intelligence, virtual collaboration, and cross-cultural competency**

Lissoni thinks that future product development is not about pure technology application, but more about meeting real customer needs (see Point 22 of Table 16). This thinking involves social-emotional intelligence, a cross-cultural competency and communication ability to, for example, understand various target groups. Social intelligence also marks the need for a novel interaction quality that is not new itself, but new in its context and level of complex product development. According to the institute for the future [2011], *'Socially intelligent employees are able to quickly assess the emotions of those around them and adapt their words, tone and gestures accordingly. This has always been a key skill for workers who need to collaborate and build relationships of trust, but it is even more important as we are called to collaborate with larger groups of people in different settings'.* Sibley [2011] also adopts this view, as evident from the quote *'[…] in an age when people can work from anywhere, the office will become valued more for its social and cultural role, rather than a place simply to work*.' This statement from literature supports Rieck's argument that we reached the end of the industrial time stepping into a post-industrial age and thus the concept of work needs to be redefined (see Point 6 of Table 16).

[25] Translated from the German: *‚Das große unerschlossene Potential kreativer und unternehmerischer Menschen wird das Schicksal unserer Wirtschaft bestimmen.'*

[26] Buijs clarifies that creative people are the intuitive originators of the design thinking idea. They are able to stimulate their creativity for synthesizing facts—one of their much-vaunted characteristics.

4.3. Research results

In this section the main points of the identified subject areas are summarized. Per identified subject area the thematic focus areas are shown. An attempt is made to put these into short wordings that can be later used as a part of the design brief. These wordings are called 'user trends and tendencies' and are assembled to a common overview map in Figure 14. This trends and tendencies are meant to identify main contexts of usage as well as precise user needs of possible future work environments. The collected focus areas point towards a new diversified mobile worker profile that needs to be explored and further defined in the next chapter.

Trends and tendencies overview map

Table 17: Summary of influential user trends and tendencies

Search fields of identified subject areas	Thematic focus area	User trends and tendencies	
A – Changing business culture	▪ Constant work reorganisation ▪ Shifting values and work conditions	A1 –	Public work tank
		A2 –	Virtual data dealer
		A3 –	Knowledge economy
B – Developing work conditions	▪ Shifting work content	B1 –	Collaborative office playground
		B2 –	Outsourced know-how worker
C – Flexible work profiles	▪ Outsourcing corporations ▪ Increase of mobile work(ers) ▪ Fusion of private and professional life ▪ Flexible working hours ▪ Mobile computing growth ▪ Open source mentality	C1 –	Creativity
		C2 –	Mobile location adopters
		C3 –	Digital nomads
		C4 –	Private pro
		C5 –	Private pro working times
		C6 –	Virtual collaboration society
		C7 –	Participative sharing community
D – Changing work environment	▪ Genius loci ▪ Urban relevance ▪ Public working and open information exchange ▪ Urban subcultures producing creative energy ▪ A city is not a city is not a city is not a city ▪ Workspace design as attractor ▪ Office layout development ▪ Personal workstation design ▪ Work-life fusion ▪ Continuous work environment adjustment	D1 –	Genius loci
		D2 –	Global urbanites
		D3 –	Public co-working
		D4 –	Hot-spot society
		D5 –	Corporate employer branding
		D6 –	Flexible work layouts
		D7 –	Reactive environment and corresponding objects
		D8 –	Quality co-working atmosphere
E – Future work skills and user behaviour	▪ New media literacy ▪ Permanent mobile status ▪ Work flexibility standby	E1 –	New media literacy
		E2 –	Interdependent intercultural working

	▪ Multitasking abilities ▪ Interdisciplinary work approach ▪ Open-minded action ▪ Sensory experiences for creativity mining ▪ Social-emotional intelligence, virtual collaboration, cross-cultural competency	E3 –	Permanent mobile state
		E4 –	Multi-tasking ability
		E5 –	Interdisciplinary work approach
		E6 –	Novel adaptive mindset
		E7 –	Design thinking and creativity application
		E8 –	Social-emotional intelligence

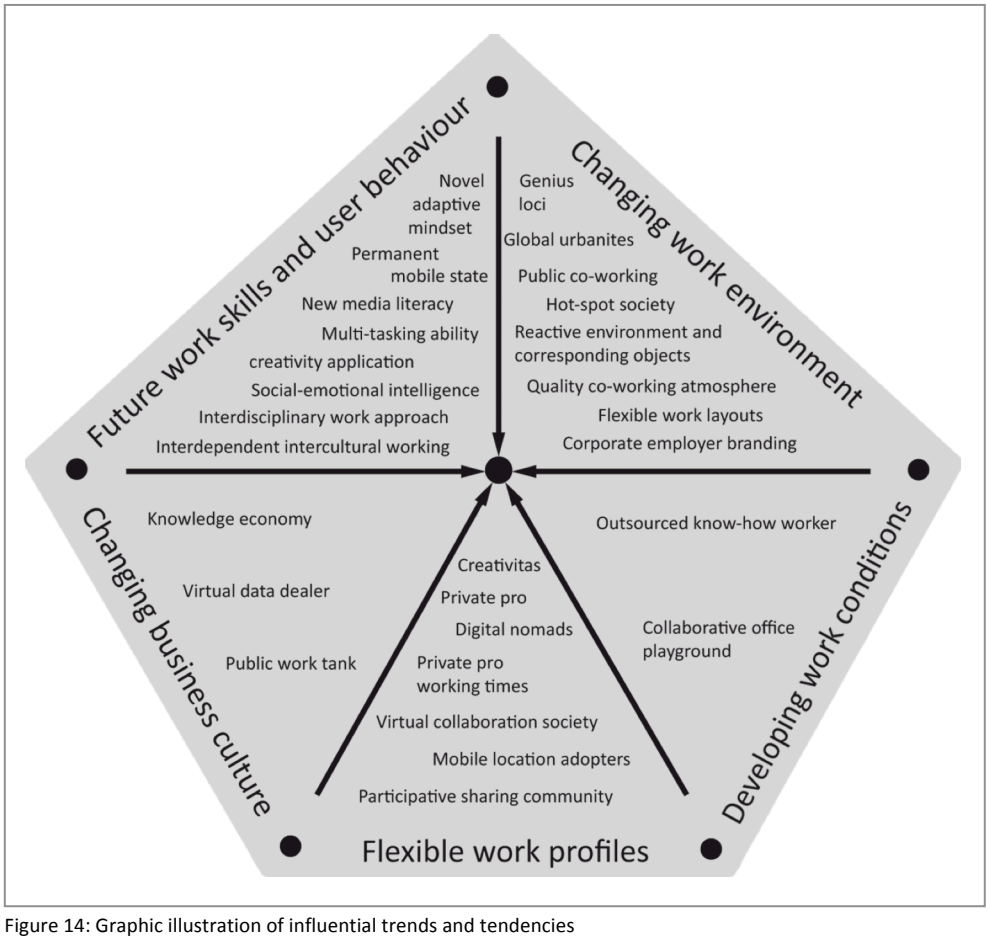
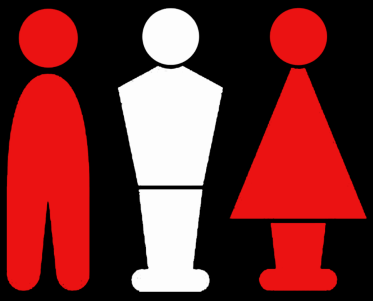


Figure 14: Graphic illustration of influential trends and tendencies



CHAPTER 5 – USER PROFILE EXPLORATION

The expert interviews and literature review presented in the preceding chapters provided valuable insights into future business traveller's life. In this chapter this topic is further explored by studying people that work already today in a way that is expected to be seen more often in the future. The new way of working while travelling is in fact not so new. In 1955, Corbusier lived the life of a frequent business traveller, accompanied by his personal belongings such as coat, pen, sketchbooks, and working papers. He described himself with the following words: *'Corbu visits the whole world, his grubby rain jacket in his arms, his folder full with business papers, a shaver and toothbrush, brillantine*[266] *for hair, and his suit from Paris, which dresses him in Tokyo or Ahmedabad (without vest).'*[267] Some 50 years ago Corbusier portrayed the business travelling avant-garde that were using the airplane at this time. His descriptions and observations of people and their individual behaviour come close to today's qualitative milieu studies executed by the Sinus-Institut [2015]. Similar to Corbusier's [1985] statement that '*…within fifty years we (people) transformed into new creatures on our* planet' this chapter wants to find out how the target group of business traveller's will differ from today's travellers? It is to explore how the target group of business travellers will transform in future by looking into their current lifestyle and workstyle, personal travel preferences and mobility behaviour. Therefore literature research and interviews with so-called extreme users were conducted that are now working according to the way of work, foreseen to increase in the future.

5.0. Method

Semi-structured interviews were carried out with 16 participants who frequently travel for business to obtain first-hand insights on the context of creative innovators, private pro(fessionals), business nomads, multi-tasked workforces, spatial location adapter, digital media literates, alternative status seeker, sharing model user, multimodal traveller, and glocal urbanites. In these interviews their individual characteristics were studied and grouped into persona profiles and an allover requirement list to define a common way of working and travelling. The outcomes will later be used for a deeper research (see Chapter 6). For the interviews a guideline was used following an approach described by Weyers [2007], which includes a semi-structured questionnaire. Questions like *'Do you work while*

travelling to a destination?' and *'Do you live a digital life from a private and professional point of view?'* were asked. The aim was to identify each user's individual characteristics, typify and group them into persona profiles accompanied by a common requirement list. It was important that the interviewee had no ostensible, personal interests of self-manifestation or any personal advantage in providing information to the questioner. Questions were asked regarding every interviewee's daily travel, work experience and their personal improvement ideas and wishes. By following Weyers' [2007] approach, the interview process has been divided into four main phases:

1. Preparation: writing an interview guideline
2. Data collection: planning and executing the interview
3. Data documentation: documenting the interview
4. Data analysis: analysing the collected material to relate it to literature

Interview guide

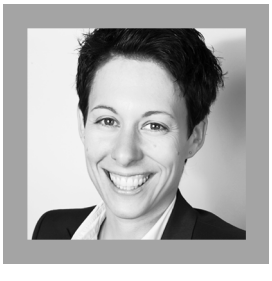
The basic questions asked to these users are shown at the Appendix of this document. The interviews were semi-structured, which means that there was room for elaborating topics when the user wanted to explain more. They contain the following elements: the interviewee introduced himself and reports about his professional background. He then described his daily business routine and its specific rhythm relating to different types of environments. After this, relevant issues—such as the business travellers work culture, work tools, and circumstances they do worry about—were questioned. In correspondence to the user innovators range described in Table 8 and Table 9, the interviewees were motivated to explain how they already improved certain work situations and found solutions to upgrade surrounding products. Finally, they expressed their ideas, thoughts, and critique of the automobile interior, gave concrete inputs, and described what could be their ideal interior setting for 2020–30. The complete interview guide can be found in the Appendix of Table 57 in German and English languages.

Participant selection

The 16 users for the qualitative interviews were chosen according to the following criteria: The aim was to find the most diverse profiles of business travellers to represent an inhomogeneous, objective variety of opinions and ideas to catch a broad target group perspective. This allowed the representation of different point of views on the future travellers work environment, work culture, lifestyles, work skills and conditions. Therefore users should come from different backgrounds such as the design, fashion, sports, IT, or automotive sector. They also worked for all kind of different company sizes such as small, medium but also large enterprises. And there was a wide choice of age differences, ranging between 25 to 55 years to create a wide scope in people's diversity in working-age. Al interviewees are listed subsequently in alphabetical order. Their associated job title, profession, branch, travel behaviour, and the current city of residence are described as well. Based on the before mentioned criteria, the following 16 experts were selected:

User 1: **Dr. Klaus Batz**
Job title and profession: Con.pro GmbH, CEO of Local Council Consulting and CEO of European Waterpark Association e.V. Branch: Consulting, lobbying for small and medium-sized companies in recreation sector, public bath-houses, swimming pools etc. / Travel behaviour: Regular traveller within Germany/Europe / Mobile devices: A smartphone, a pc, a tablet, and a usb stick (also a printer and a beamer) / City of residence: Nürnberg, Germany

User 2: **Dr. Michael C. Blum**
Job title and profession: Toll Collect GmbH,
Head of Strategy and Corporate Development
Branch: Infrastructure, pricing, policies, and politics
Travel behaviour: Irregular traveller, mostly on a daily basis
Mobile devices: Two smartphones, two pc's
City of residence: Berlin, Germany



User 3: **Dr. Julia Borggräfe**
Job title and profession: Daimler AG, Head of Human Re-sources for Sales and Financial Services (Western Europe); Human Resources Compliance Manager Europe, Lawyer
Branch: Automotive / Travel behaviour: Regular traveller (every week several days all over Europe)
Mobile devices: Two smartphones, a pc, an iPod
City of residence: Stuttgart/Berlin, Germany

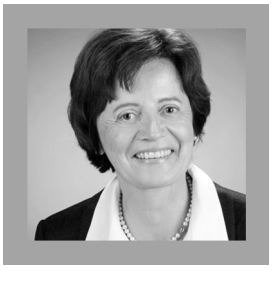
User 4: **Nadin Brendel**
Job title and profession: Founder and Head of Moutique, Tour Manager and Band Agent / Branch: Music and lifestyle / Travel behaviour: Regular, long-term travelling (two to three weeks) / Mobile devices: A smartphone, a pc, a portable printer, a calculator, and a navigation device City of residence: Berlin/Munich, Germany

User 5: **Dr. Silke Claus**
Job title and profession: Bayern design GmbH, Executive Director of the Design Promotion Institute of the Federal State of Bavaria, Germany / Branch: Design with all its sub-categories / Travel behaviour: Regular private and business traveller / Mobile devices: A smartphone, a pc, a tablet
City of residence: Nürnberg/Hannover/Braunschweig, Germany

User 6: **Thomas Felgenhauer**
Job title and profession: Daimler AG, Real Estate
Branch: Automotive, real estate management
Travel behaviour: Regular travelling (every week)
Mobile devices: A smartphone, a pc
City of residence: Berlin, Germany

User 7: **Wibke Hetfeld**
Job title and profession: Adidas Group, Global Sports Marketing, / Project Leader Training, Event and Marketing Organizer Branch: Sportswear / Travel behaviour: Regular traveller (three days per week) / Mobile devices: A smartphone, a pc / City of residence: Amsterdam, The Netherlands

User 8: **Dr. Peter J. Henssen**
Job title and profession: Cofounder and CEO of the start-up lifestyle, news and email magazine Sugarhigh GmbH / Branch: Design, art, culture, music, entertainment, lifestyle, web/IT Travel behaviour: Irregular but constantly flexible and moving / Mobile devices: An iPhone, a pc
City of residence: Berlin, Germany



User 9: **Heike Kohler**
Job title and profession: Alcatel-Lucent GmbH Deutschland AG, former Vice-president (Financial Controlling) within the Corporate Division of Communication Systems, Stuttgart; Business Economist / Branch: IT, finance
Travel behaviour: Regular traveller (from several days to weeks) / Mobile devices: A smartphone, a pc
City of residence: Stuttgart, Germany

User 10: **Henning Rieseler**
Job title and profession: Porsche Design, Senior Designer (Head of Berlin Design Studio), Product Designer
Branch: Product design, fashion / Travel behaviour: Regular travelling (Europe) and irregular international traveller (mainly within Asia) / Mobile devices: A smartphone, a pc, a tablet / City of residence: Berlin, Germany

User 11: **Tanja Roos**
Job title and profession: Entrepreneur, Co-founder of a personalizable travel guide called Nectar & Pulse - your local soulmates, Design and Product Manager / Branch: Product, graphic and web design, art, fashion, lifestyle
Travel behaviour: Irregular, long trips (sometimes several weeks) / Mobile devices: A smartphone, a pc
City of residence: Munich, Germany

User 12: **Walter Schaff**
Job title and profession: Daimler AG, Director of Human Resources of Marketing, Sales & Financial Services Europe
Branch: Automotive / Mobile devices: A smartphone, a pc
Travel behaviour: Regular national and international travelling / City of residence: Berlin/Stuttgart, Germany

User 13: **Carina Rabeian**
Job title and profession: Entrepreneur, Co-founder of a personalizable travel guide called Nectar & Pulse - your local soulmates, Design and Product Manager / Branch: Product, graphic and web design, art, fashion, lifestyle / Travel behaviour: Irregular, long trips (sometimes several weeks) / Mobile devices: A smartphone, a pc
City of residence: Munich, Germany

User 14: **Dr. Johann-Georg Schumm**
Job title and profession: A.T. Kearney, Senior Associate, Business Economist / Branch: Consulting / Travel behaviour: Regular national and international traveller / Mobile devices: A smartphone, a pc
City of residence: Zurich, Switzerland

User 15: **Remy Tjitra**
Job title and profession: Microsoft Deutschland GmbH
Branch: IT, sales and distribution / Travel behaviour: Regular national, irregular international traveller
Mobile devices: A smartphone, a pc
City of residence: Munich, Germany

User 16: **Nicole Voigt**
Job title and profession: Microsoft Deutschland GmbH
Branch: IT, sales and distribution
Travel behaviour: Regular national, irregular international traveller / Mobile devices: A smartphone, a pc / City of residence: Cologne/Munich, Germany

Analytic procedure

All user interviews were documented, transcribed into sections, and analysed. Insights of these extreme users into the field of work were explored from a qualitative side. The interview text was scanned on the following filter terms and subjects of Table 18 and Table 19. Next, the main insights gathered from the analysis were summarized in single propositions and grouped into 'user attributes' to gain an overview on all joint user statements (see Table 19). Insights of the traveller's life into the professional business nomad's environment were explored rather than the number of its responses. It happened that this concrete input can be used for the later student briefing. The aim was to consider the business travel scenery from different point of views (culture, hierarchy and professional background). All topics that were not related to the research question were excluded of the analysis phase.

Table 18: List of filter terms of user interviews

Filter terms	Personal creation, creativity and innovation
	Private and professional life, personal challenges
	Aspects of personal mobility and nomadism
	Multi-tasked work, work definitions and organisation
	Users search for varying work spaces, spatial conditions and users preferences
	Digital behaviour and degree of digitalization in daily work as well as list of work equipment
	Personal lifestyles and status symbols in the private and professional sense
	Sharing, ownership perceptions and opinions
	Means of transport in usage and way of usage
	Meaning of urbanity and professional business

5.1. User interview results

On average the interviews took between 1,5 to 3 hours. It was interesting to see that all users were willing to collaborate and took their time. The 'identified user attributes' are listed in Table 19. The ten user attributes that could be identified were: Creative innovator, private pro(fessional), business nomad, multi-tasked workforce, spatial location adapter, digital media literate, alternative status seeker, sharing model user, multimodal traveller, glocal urbanite.

Table 19: Joint user statements

Identified user attribute 1: **Creative innovator**	
Filter terms: Personal creation, creativity and innovation	
1.	In constant search for creative ideas with a unique selling proposition (USP). (Batz/Henssen/Roos/Rabeian/Voigt/Tjitra)
2.	The best and most innovative ideas occur during vacation, travel time, or in a café. (Brendel/Borggräfe/Claus/Rieseler)
3.	Defines herself throughout her own creative-innovative acting as an all-embracing profession. (Brendel/Henssen/Rieseler/Roos/ Rabeian)
4.	Creativity represents the best possibility to find new ideas and resolve old problems. (Blum/Felgenhauer/Schaff))
5.	Needs to act creatively in his business environment in unconventional ways. (Blum/Borggräfe/Henssen/Hetfeld/Kohler/Voigt/Tjitra)
Identified user attribute 2: **Private pro(fessional)**	
Filter terms: Private and professional life, personal challenges	
6.	Mixes private and professional life mostly in an imbalanced way. (Batz/Brendel/Schaff/Schumm/Voigt/Henssen/Hetfeld)
7.	Believes in a combination of mastering professional work challenges and taking recreational breaks to achieve a tolerable work-life balance. (Claus/Schaff)
8.	The work tool usage should offer boundary-exceeding lifestyle and working style creation. (Brendel/Borggräfe/Rieseler/Voigt/Tjitra)
9.	When she stays overnight, she carries her running shoes, a magazine/book, and sports clothes with her, next to her standard business equipment. (Voigt/Hetfeld)
Identified user attribute 3: **Business nomad**	
Filter terms: Aspects of personal mobility and nomadism	
10.	The average travel time for a business traveller is three to five days a week. (Batz/Borggräfe/Felgenhauer/Hetfeld/Kohler/Rieseler/Schumm/Voigt/Tjitra)
11.	The main problem of a business traveller is the weight of his luggage he carries around. (Batz/Blum/Borggräfe/Felgenhauer/Rieseler)
12.	Travels with maximum two pieces of luggage containing private and professional items. (Batz/Blum/Borggräfe/Claus/Kohler/Rieseler/Schumm/Voigt/Henssen)
13.	The luggage stays ready equipped all the time. (Blum/Schumm/Roos/Rabeian)
14.	Next to a good technological infrastructure, a sufficient storage place and direct light for work is needed while travelling. (Batz/Borggräfe/Voigt)
15.	Needs, first of all, an easily adjustable table or surface and storage for her handbag. (Claus)

16.	Lifetime-stealing processes, complicated systems, and services mark the worst nightmare for efficient business travellers. (Batz/Blum/Borggräfe/Brendel/Claus/Felgenhauer/Henssen/ Hetfeld/Kohler/ Rieseler/Schaff/Schumm/Voigt)
17.	Functional, pragmatic aspects are the most important ones in any product or service. (Batz/Borggräfe/Brendel/Claus/Felgenhauer/Kohler/Rieseler/Schaff/Voigt)

Identified user attribute 4: **Multi-tasked workforce**	
Filter terms: Multi-tasked work, work definitions and organisation	
18.	During her travel time she answers emails, writes texts, reads, or talks via phone. (Claus/Batz/Blum/Borggräfe/Brendel/Claus/Henssen/Hetfeld/Schumm/Roos/Schaff/Rabeian /Voigt/Tjitra)
19.	Works generally during travel and completes the leftover tasks of the day according to the outer environment. (Batz/Blum/Borggräfe/Claus/Hetfeld/Schumm/Voigt/Tjitra)
20.	Work is also considered as networking. (Brendel/Henssen/Roos/Rabeian)

Identified user attribute 5: **Spatial location adapter**	
Filter terms: Users search for varying work spaces, spatial conditions and users preferences	
21.	Constantly searches for suitable work environments to acquire specific work content. (Blum/Brendel/Hetfeld/Schaff)
22.	Can only produce text/content in absolutely silent spaces where he can concentrate. (Batz/Borggräfe/Brendel/Felgenhauer/Rieseler/Voigt)
23.	Needs music and an inspiring atmosphere to act creatively. (Borggräfe/Brendel/Claus/Rieseler/Roos/Rabeian)
24.	A comfortable seat, work surface with drink and food deposit, and storage for clothes and luggage are needed to prepare well for work while travelling. (Claus/Hetfeld)
25.	It is important to have access to an extended infrastructure of electricity, the internet, food, and hygiene facilities during travel time. (Batz/Henssen/Hetfeld/Rieseler/Roos/Rabeian /Voigt)
26.	Access to good-quality food is fundamental. (Batz/Voigt)
27.	A good lighting quality and no reflections are crucial for any effective work environment. (Blum/Brendel/Borggräfe/Claus/Henssen/Hetfeld/Rieseler/Roos/Rabeian/Voigt)
28.	Needs a private space for phone calls and short meetings when working in public. (Blum/Brendel/Claus/Hetfeld/Voigt/Schaff/Tjitra)
29.	Contemporary office spaces offer non-territorial space with flexibility, including silent and private areas as well as communicative zones. (Voigt/Hetfeld)
30.	The classical office space is not very important anymore. (Brendel/Kohler/Roos/Rabeian/Voigt/Tjitra)

Identified user attribute 6: **Digital media literate**	
Filter terms: Digital behaviour and degree of digitalization in daily work as well as list of work equipment	
31.	Digitalization and networking will be more and more important in future. (Batz/Brendel/Hetfeld/Kohler/Voigt/Rieseler/Roos/Schaff/Rabeian/Tjitra)
32.	Thinks life is already tightly interwoven with the web. (Borggräfe/Brendel/Hetfeld/Kohler/Roos/Rabeian/Voigt)
33.	Around 90% of professional research work takes place via the web nowadays. (Batz/Brendel/Kohler/Rieseler/Roos/Rabeian)

34.	Uses at least one smartphone, tablet, and pc for work. (Batz/Blum/Brendel/Borggräfe/Claus/Felgenhauer/Henssen/Hetfeld/Kohler/Rieseler/Roos/Schaff/Rabeian/Tjitra/Voigt)
35.	Wants to load terminal equipment while travelling. (Batz/Blum/Henssen/Hetfeld/Schumm/Voigt)

Identified user attribute 7: **Alternative status seeker**	
Filter terms: Personal lifestyles and status symbols in the private and professional sense	
36.	The new working style is termed as more effective, flexible, faster, and agile. (Brendel/Henssen/Kohler/Tjitra/Voigt)
37.	Are paid according to their individual performance, instead of their presence. (Batz/Blum/Borggräfe/Brendel/Kohler/Rieseler/Roos/Schaff/Rabeian/Schumm/Tjitra/Voigt)
38.	The automobile itself represents less a status symbol, but can be part of a comprehensive mobility statement. (Batz/Blum/Borggräfe/Brendel/Felgenhauer/Henssen/Roos/Rabeian)

Identified user attribute 8: **Sharing model user**	
Filter terms: Sharing, ownership perceptions and opinions	
39.	Sharing space or media at the same time, or in parallel, with other fellow travellers is no problem. (Batz/Borggräfe/Brendel/Claus/Henssen/Hetfeld/Kohler/Roos/Rabeian/ Voigt/Tjitra)
40.	Sharing is of no consequence when personal information safety concerning any personal screen visibility is guaranteed. (Batz/Borggräfe/Brendel/Claus/Felgenhauer/Henssen/Kohler/ Rieseler/Schumm/Voigt)

Identified user attribute 9: **Multimodal traveller**	
Filter terms: Means of transport in usage and way of usage	
41.	Uses different media of transport, which are the most suitable for each individual situation. (Batz/Blum/Borggräfe/Claus/Hetfeld/Kohler/Roos/Schaff/Rabeian/Schumm/Voigt/Tjitra)
42.	Tends to use the train more than the car, as he can work during travelling. (Batz/Claus/Rieseler)
43.	A vehicle is considered less a work tool, but a personal fun factor or emotional object. (Batz/Henssen/Rieseler/Schaff/Voigt)

Identified user attribute 10: **Glocal urbanite**	
Filter terms: Meaning of urbanity and professional business	
44.	Travels mainly to urban centres and uses diverse media of transport to reach each destination. (Claus/Henssen/Hetfeld/Rieseler/Roos/Rabeian)
45.	The most used medium of transport after the airplane is the taxi or car rental services. (Blum/Borggräfe/Brendel/Felgenhauer/Hetfeld/Rieseler/Schaff/Schumm)
46.	Needs better-adapted and user-friendlier storage possibilities within the vehicle interior, especially during urban use. (Batz/Blum/Borggräfe/Brendel/Roos/Rabeian/Voigt)
47.	Bigger cities naturally imply a major attraction for people. (Borggräfe/Brendel/Henssen/Rieseler/Roos/Rabeian/Voigt)
48.	Location-based services are more than welcome. (Batz/Borggräfe/Brendel/Henssen/Rieseler/Roos/Rabeian/Voigt)

5.1.1. Identified user attributes

After the interviewee's joint user statements with identified user attributes were identified (see Table 19), the next step was to elaborate on their common characteristics. Therefore information was used from the following sources: collected interview insights from Section 5.0 with joint user statements (see Table 19), and common requirement list and literature research (see Table 61). The user attributes are described in the following ten passages into its detail. These characterizations were necessary to form coherent overall user profiles.

Identified user attribute 1: **Creative innovator**

Six of the 16 interviewees mentioned that they are in constant search for new ideas that have the quality of a unique selling proposition (USP). 5 users even define themselves by their own creativity (see Point 3 of Table 19) and 7 mentioned that creativity is an integral part of their daily business environment (see Point 5 of Table 19). Since the business travelling user group operates under time pressure with constantly changing residences; they are driven by their diversified work, wherever it is located. It was found that the interviewees own various forms of creative potential, which enables them to transform their immediate work environment into a suitable space for all kinds of temporary needs. Besides that, they are able to convert hitherto established product usage intentions into new ones and may overcome Drucker's functional fixedness boarder (see Sections 4.2.1 and 2.0). It was found out that they are acting in a recreational manner throughout applying a novel adaptive mindset.

Identified user attribute 2: **Private pro(fessional)**

During travel time the business travellers manage aspects of their private lives as well as their professional lives – they keep contact with friends, family, and colleagues, take part in sporting activities and other hobbies, and organize medical visits. However, this is not easy for the users, as there are always new organizational and bureaucratic matters that need to be addressed, preferably while traveling (see Sections 4.2.1 and 4.2.2). Seven interviewees out of 16 mentioned the imbalance between their professional and private lives when they are on the road (see Point 6 of Table 19). But nevertheless organizational and bureaucratic matters need to be sorted out, preferably while traveling, to mange professional and private life simultaneously (see Sections 4.2.1 and 4.2.2). Five of the interviewees termed their working style as more effective, flexible, faster, and agile than some years before (see Point 36 of Table 19). Interestingly there were only 2 interviewees that pay attention to combine their professional work challenges with recreational breaks to achieve a tolerable work-life balance (see Point 7 of Table 19).

Identified user attribute 3: **Business nomad**

Nine users said on average they would travel at least three to five days a week (see Point 10 of Table 19). The same number reported that they travel with a maximum of two pieces of luggage per person (see Point 12 of Table 19), as their main problem is the total weight they have to carry around (see Point 11 of Table 19). This aspect means an important physical health as well as mental (organizational) issue for them. 13 business travellers for instance reported that time-stealing processes, complicated systems, and ser-

vices mark the worst nightmare for efficient business travellers (see Point 16 of Table 19). This contemporary form of nomadism[27] refers to humans who are in continuous motion within urban conglomerations. They seem to be detached from the idea of a persistent settlement for the rest of their life. Even if this group represents a small percentage within society at this moment,[28] they are still pioneers in their field by living a vari-mobile future mention Feldhaus and Schlegel [2013]. 12 of the 16 interviewees mentioned that they would be rather paid according to their personal performance, than their constant presence at a certain place (see Point 37 of Table 19). Correspondent to former nomadic behaviour, the interviewees claimed to change their current location as soon as their accessible resources such as work cease to exist or other life-saving aspects are guaranteed elsewhere. A fast adaptability is considered a must-have, as they move within unknown locations where they adjust their environment according to their needs. The interviewees stated that they are travelling at least three days a week. This means wherever fundamental vital needs move, they would follow them (see Section 4.2.1–4.2.5).

Identified user attribute 4: **Multi-tasked workforce**
14 participants mentioned that they engage in extensive multitasking when travelling – they answer emails, write texts, read, or talk via phone so they don't loose time (see Point 18 of Table 19). Eight participants even reported working during their travel time and complete the leftover tasks of the day (see Point 19 Table 19). In literature the mobile business traveller is described as a specialist in dealing with the shortcomings of his surrounding environment as well as in dealing with other resources [Wouter 2014]. They became a 'survival experts' and learnt to act pragmatically and flexibly, and also developed diverse multitasking talents to face any problem in daily work-life routine. The Time magazine called this species 'Yumpies' (Young upwardly mobile professionals), similar to Margreiter's [2009] 'Flexpatriates', who are 24/7 available for their clients and customers (see Section 4.2.1 till Section 4.2.5).

Identified user attribute 5: **Spatial location adapter**
Business travellers' spatial mobility behaviour is mainly dependent on the location and type of client they are working with, and their need for various work environments in a specific period of time (for doing different types of work). Four participants mentioned that they are in constant search for the most suitable work location from where they can access the web and have a communicative team space or a creative brainstorming area (see Point 21 of Table 19). They remarked, that they sometimes search for appropriate environments to acquire only a specific type of work – such as to develop creative ideas there. One example is the need of six users that were searching for a silent space where they can concentrate well and produce text or other work content with substance (see Point 22 of Table 19), while seven other participants required a private space where they can make phone calls and have short meetings when working in public (see Point 28 of Table 19). Several times a day, they would adjust a temporary work space in form of lighting, comfort etc. to the best fitting solution for a certain type of work (see Section 4.2.1 till

[27] The described business traveller has at least one steady place of residence, but changes his work environment constantly (=vari-mobile behaviour).
[28] Counter argument of Larry J. Leifer, director of the HPI-Stanford Design Thinking research programme and professor in mechanical engineering, during his D-Flect session on Thursday 17th of November 2011 at the HPI School of Design Thinking in Potsdam.

Section 4.2.5). The interviewees Claus and Hetfeld remarked that a comfortable seat, work surface with drink and food deposit, and storage for clothes and luggage are needed to prepare well for work while they are travelling (see Point 24 of Table 19). Ten users also named the lighting quality they would love to adapt to be a crucial aspect for an effective work environment (see Point 27 of Table 19) as well as the access to electricity, the internet, food, and hygiene facilities during their travel time (see Point 25 of Table 19). They remarked that the quality of their everyday mobility allows them to achieve their aims as well as to gain recreation and satisfaction during each trip.

Identified user attribute 6: **Digital media literate**
Ten of 16 participants indicated that digitization and networking would be increasingly important in future (see Point 31 of Table 19). Another seven users think that their current life is already tightly interwoven with the web (see Point 32 of Table 19) as around 90% of their professional research work takes place online today (see Point 33 Table 19). They are advanced users of the state of the art technology: they own only a few items (at least one smartphone, tablet, and pc), which also happen to be of emotional value, that are necessary for their mobile life mentioned 15 business travellers (see Point 34 of Table 19). The interviews showed that they are generally curious and adapt fast to new systems, as they love to apply, download, and test apps, software features, and other tools. While following potential employers or temporary work assignments, seven business travellers said that they are in constant search for wifi hotspots and a loading infrastructure while they are on the move (see Point 35 of Table 19). This point should make clear how dependent they are on their digital media tools.

Identified user attribute 7: **Alternative status-seeker**
The interviewees confirmed that smartphones and tablets are influencing their lives more and more profoundly, as they have become personal key enablers of communication and organization and also a status symbol towards the outer world. These symbols are in existence ever since people want to distinguish themselves from others, feel individual, or show their habitus to a certain group of reference, community, or even to a broader audience. Eight participants reported that the original human-car affiliation (of having comfort, functionality, and safety inside, and everything representative outside the car) will not work in the same way anymore, as the car would transform from a classical status symbol into a mobility tool (see Point 30 of Table 19, and Chapter 5).

Identified user attribute 8: **Sharing model user**
As mentioned before all interviewees confirmed that individual experiences gain importance over sole product ownership (see Chapter 5.0). In addition, the user wanted to report, exchange, and reuse or share more of his ideas and experiences digitally with friends and family. In particular, the urban residents (10 out of 16 interviewees were urban residents) that did not have an assigned parking slot or a garage at their disposal, but a good access to public transportation, questioned the importance of having proper possession owning a car for example. They identified a constant development from personal car ownership towards a temporary automobile use. Almost all interviewees were prepared to change (or already did change) their automobility-centred business travelling into multimodal mobility behaviour by integrating sharing models. On the other hand mentioned various participants that car sharing requires many disciplined users, as it is more

difficult to keep quality promises and a spontaneous flexibility at a high level (see Section 4.2.1–4.2.5). Ten out of 16 users are happy to share space or media at the same time, or in parallel, with other fellow travellers (see Point 39 of Table 19). However, they are concerned about the visibility of their pc or tablet screens to others and the safety of their personal information (see Point 40 of Table 19).

Identified user attribute 9: **Multimodal traveller**
The group of business travellers mentioned that they generally use various transport systems such as airplanes, trains, taxis, car rental, the metro, bike etc. to reach their next destination (see Section 1.2). 12 interviewees out of 16 confirmed this in saying that they will preferably take the closest, most comfortable, and fastest transportation medium possible for each individual situation (see Point 41 of Table 19). In case the public transportation system is located close by, a further counter argument is found against sole car usage and for using a mobility-mix. Batz, Claus and Rieseler even favour the train over the car as they can work there during the travel time (see Point 42 of Table 19). However, when the interviewees decide to use a car during their travels: it has to offer them some additional benefits such as an extraordinary experience or a personal status upgrade, for example than just the convenience of not having to carrying their baggage, arriving faster at the next destination, or having a central parking spot reserved. They were of the opinion that for business reasons a car is considered a standard feature to reach their destination in a certain time. On the other hand five participants also considered it a personal fun factor or an emotional object, when they have time and the leisure to enjoy it (see Point 43 of Table 19).

Identified user attribute 10: **Glocal urbanite**
Since 2008, more than half of the global population live in cities reported the United Nations Population Fund [2007]. To seven of the 16 travellers bigger cities do naturally imply a major attraction potential as they process their business there (see Point 47 of Table 19). For them, urban areas offer a wide range of flexible and varying work environments with infrastructural options to them (see Section 4.2.1–4.2.5). Six interviewees reported that they move mainly within urban areas, in central parts of the megacities[29] (see Point 44 of Table 19). Eight participants said that the most used medium of transport there (after the airplane) is the taxi or car rental services (see Point 45 of Table 19). The same number of interviewees mentioned that location-based services are more than welcome (see Point 48 of Table 19).

Interpretation of expert statements

The identified ten user attributes will be used as main points of reference in this Ph.D. thesis. They describe the most common behaviours and preferences of the digital business traveller group. Based on these characteristics deriving from the interviewees, a central user profile has been defined. Table 20 lists the ten identified user attributes, each accompanied by a user profile description that offers a better insight of every characteristic.

[29] A city with up to five million inhabitants can be called a megacity. In China, for example, these are again classified into a so-called tier city system, starting with Tier one megacities from 10+x million inhabitants. http://osio-china.com/2012/11/16/chinas-city-tier-system [04.07.2014].

Table 20: User profile definition

Identified user attributes		User profile description
1	Creative innovator	They share all kinds of personal insights, local tips, and strategic information with their community, to be able to create something new.
2	Private pro(fessional)	They work 24/7 with no limit of working hours so they combine their private and professional life.
3	Business nomad	They frequently travel at least three days a week and work within several environments during their daily routine.
4	Multi-tasked workforce	A distinct type of social-emotional intelligence and cross-cultural competency marks them.
5	Spatial location adapter	They constantly improve non-perfect working situations according to their personal needs.
6	Digital media literate	They are digital natives by heart and carry at least three mobile communication devices.
7	Alternative status-seeker	Instead of owning a car they are striving for alternative status symbols.
8	Sharing model user	They have a driver's licence and regularly drive an own, as well as rented or shared car.
9	Multimodal traveller	They use different mediums of transportation such as airplanes, rental/own cars, trains, taxis, the subway, or simply walking by foot.
10	Glocal urbanite	They travel to various, mainly urban and unknown, destinations and are not regular commuters.

The following user statements summarize for what type of lifestyle and working style this group of business travellers stands for. Voigt (user 16) says: *'My payment is result-oriented and not presence dependent. With my smartphone, I can be reached everywhere and it is already a small computer…'* This is what Table 20 mentions in Point 4, 5, 6, 7, and 10. Batz (user 1) on the other hand tells: *'My private life is fully integrated in my professional life on the move…'* Table 20 reflects this statement in Point 2 and 3. Also Brendel (user 4) mentioned: *'From time to time I need a shelter in order to work, to relax, or to organize some private stuff…'* Her testimony fits to Point 1, 2 and 4 of Table 20. Eight users also reported that the original human-car affiliation and everything representative outside the car would not work in the same way anymore, as the car would transform from a classical status symbol into a shared mobility tool. This statement relates to Points 8 and 9 of Table 20. Out of these ten points three main characteristics can be extracted such as digital affinity, the target group's business concern and their nomadic behaviour. These were applied to define the digital business nomad's (DBN) profile (see Table 21).

Table 21: Definition of the digital business nomad's nomenclature

Digital	Business	Nomad
Digital-affine and creative user	Business traveller, moving mainly in between urban environments	Nomadic travel behaviour with no regular work place in a specific period of time

5.2. Persona creation

While Chapter 4 reveals information about contextual surrounding factors of the DBN, Chapter 5 analyses the users' work and private behaviour patterns. The interviewees made clear that today's automobiles represent a complex and compartmentalized (i.e.

consisting of small isolated pieces working independently from one another) product where even basic user-evident requirements are not in focus anymore.

According to the transportation design experts Lipp and Fügener, a systematic integration of joint persona insights into design briefings has not been realized within the automobile design departments yet (see expert interviews in Section 0. The automobile expert interviews showed that extensive target group studies of corporate psychologists, sociologists, or strategists, seem either boring or bewildering to the car designers in charge. They prefer reprocessed information in a more descriptive form, such as exemplary illustrations, to boost their creative mind (see Point 35, 37 and 40 of Table 12). Easily comprehensive and vividly formulated persona portraits can enrich the original design brief given to designers, as they allow designers to imagine their future customer more easily.

Therefore, a closer look at real-life users is necessary to clarify background motives for and against certain mobility and travel concepts as well as lifestyles (see Section 5.0). The use of personas offers a practical interaction design tool for developing more suitable user-friendly high-tech products for everyday consumers by that allowing the identification of user groups that differ with respect to their *'goals, tasks and skill levels'* [Cooper 2008]. The aim is to facilitate a deeper understanding of a certain target group's specific behaviour patterns and set the stage for transforming them into tangible representatives, which can later be tested.

Creation procedure

The 16 interviewees were clustered into main groups according to their matching attributes and most common indicators (see Figure 15). This process resulted in three concrete persona types, which were given names (*smart competitive pragmatic*, *digital efficiency pro*, and *creative networking enthusiast*) that describe their most significant characteristic in a nutshell (see persona types in Table 22). The interviewees matching with each persona were listed at the user profiles column of Table 22.

Table 22: Persona types – user profile correlation

Persona types	User profiles
Persona 1: Smart competitive pragmatic (see Section 5.2.2)	User 1: Dr. Klaus Batz User 2: Dr. Michael C. Blum User 5: Dr. Silke Claus User 6: Thomas Felgenhauer User 12: Walter Schaff
Persona 2: Digital efficiency pro (see Section 0)	User 3: Dr. Julia Borggräfe User 7: Wibke Hetfeld User 9: Heike Kohler User 14: Dr. Johann G. Schumm User 15: Remy Tjitra User 16: Nicole Voigt
Persona 3: Creative networking enthusiast (see Section 5.2.3)	User 4: Nadin Brendel User 8: Dr. Peter J. Henssen User 10: Henning Rieseler User 11: Tanja Roos User 13: Carina Rabeian

Indicator description

In order to better describe each persona group the following netgraphic indicators were created out of the user attributes of Table 20. The aim was to describe and compare the different persona types. Each type distinguishes by his creativity, design and technology affinity, personal mobility mix (means of transport used during one journey), degree of digitalization and personalization, sharing mentality, work- and travel style, mix of private-, and professional life, sense of pragmatism and functionality, and its conscious choice of status symbols (see Table 23).

Table 23: Netgraphic indicators

Identified user attributes	Transformation into netgraphic indicators
Creative innovator	▪ Affiliation with the creative class
	▪ Design affinity
Private pro(fessional)	▪ Mixture of private and professional life
Business nomad	▪ Synchronous work- and travelling
Multi-tasked workforce	▪ Pragmatic and functional lifestyle
Spatial location adapter	▪ Importance of a fixed local office
Glocal urbanite	
Digital media literate	▪ Level of digital work environment and communication tools
	▪ Technology affinity
Alternative status-seeker	▪ Car as a main status symbol
	▪ Importance of personalization
Sharing model user	▪ General sharing mentality
Multimodal traveller	▪ Degree of multimodal mobility-mix

The netgraphic master of Figure 15 is used as a supporting tool to visualize these significant differences among the personas. Each netgraphic indicator of Figure 15 has been divided into a scale of five subdivisions, where Step 1 equals the lowest and Step 5 the highest possible achievement in each category (see App. Table 63). In order to facilitate a comparability of the different persona types, they were characterized in the same repeating format and categorical cluster. The descriptive information of persona 1–3 were gathered out of the user interview material of Section 5.0. Then, each personas main insights were summarized in an individual requirement list (IRL) in App. Table 58 for persona 1, App. Table 59 for persona 2 and App. Table 60 for persona 3. For the subsequent persona description a cluster was introduced to divide the persona portrayal into a first character overview (character description with netgraphic), then explain their distinctive working style and lifestyle and their mobile work behaviour and mobility pattern. Since this research aims to uncover the users' personal preferences in the automobile field, the cluster also applies their automobile preferences and includes concrete user voices concerning their perfect automobile interior setting.

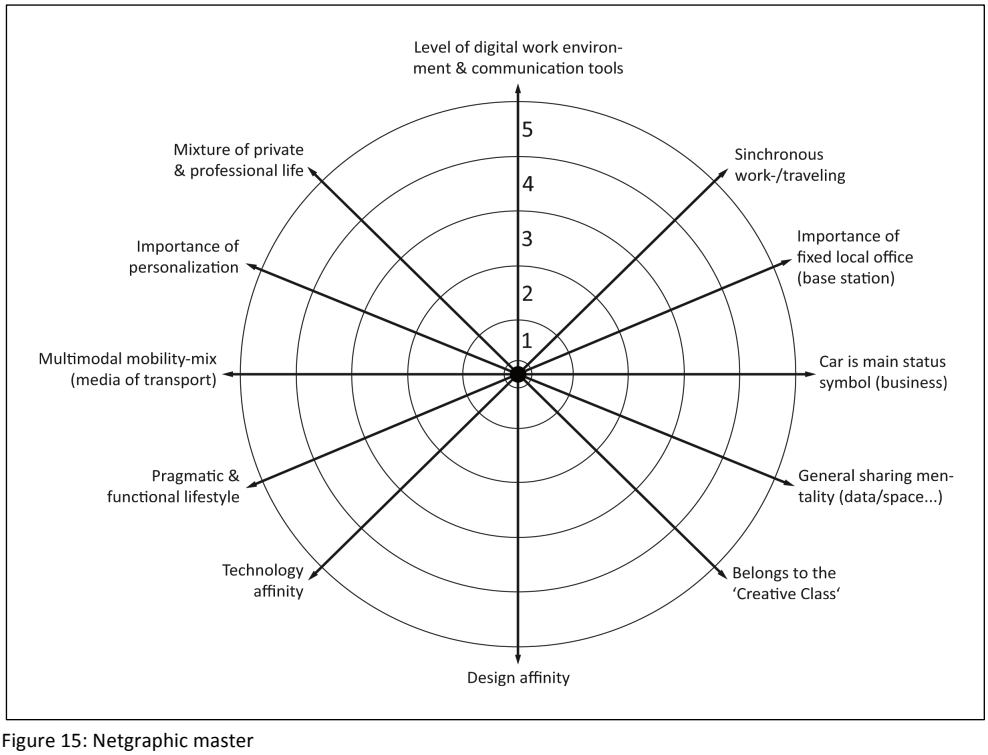


Figure 15: Netgraphic master

5.2.2. Persona 1: Smart competitive pragmatic

Figure 16: Persona 1 - Smart competitive pragmatic

Character description

The smart competitive pragmatic[30] is a responsible, freelancing, and safety-aware person that tries to keep everything under control. He is ambitious, motivated, and works efficiently. Persona 1 is in a restless mood, always on the fly, and is surrounded by activities. The smart competitive pragmatic is also thoughtful, intelligent, and is always on the lookout for challenging intellectual tasks to compete with machines, other fellows, or his surrounding environment. He knows even the most minor details within his area of expertise and generally thinks in an efficient way. Persona 1 has a remarkable sense of brand and quality awareness, especially concerning handcrafted products and services, e.g. handmade shoes, quality food and beverages, consumer electronic products, and premium cars. He refuses to buy products he doesn't know enough about to judge their quality, or when the price is far overrated. He is a connoisseur of luxury items, with a good sense of quality (see Figure 16).

Personal working style and lifestyle

The smart competitive pragmatic owns all essential work tools such as pcs, tablets, or smartphones for his personal use. These items only make sense to him when he benefits from them personally or professionally, as pure possession appears rather useless to him. Thus, being a passionate tech-lover and digital end user, he prefers a playful, and pragmatic handling of products. This means that he loves to test items that propose new qualities, but wants to experience the self-explanatory concept of it. The smart competitive pragmatic is an extensive apple user (iPhone, mac, iPad, iWatch etc.) but does not like the hype around the brand so much. He is not an innovator but rather an excited user to experience everyday benefits from these products. A typical example is the 47-year-old self-employed businessman Klaus B., who went into business with his own consulting firm. He travels at least two or three days a week within Germany or other European countries, and carries his work tools and personal items constantly with him. Figure 17 illustrates that Persona 1 is mainly a pragmatic personality with a functional lifestyle, who still uses his fixed local office as a main base station.

Mobile work behaviour and mobility pattern

'Everything will be more digitalized in future. My employees and I work fully interconnected. It is important to me that there are no secrets, and that there is transparency. So everybody needs access to all data',[31] states Batz while referring to his collection of work and communication tools for staying in contact with his staff and clients. Persona 1 generally owns a premium car—mostly a premium station wagon or limousine with comfort features such as ergonomic seating, individual-configured leather interior, and all possible safety options-which offers user-friendliness and practicability in their daily life. For them, the personal car needs to have a functional format and should offer sporty driving possibilities as well. The smart competitive pragmatic only uses the car when he needs it for a formal client appointment (as representative item) or when carrying heavy material and

[30] Within the following text the corresponding female or male form is used, according to each persona's gender showed at the illustration.

[31] Translated from German: *'Meiner Meinung nach wird alles in Zukunft noch viel mehr digitalisiert sein. Meine Mitarbeiter und ich arbeiten komplett vernetzt. Jeder muss Zugriff auf alle Daten haben. Es ist mir sehr wichtig, dass es keine Geheimnisse gibt und Transparenz da ist.'*

other work equipment. Persona 1 travels more and more by fast trains, airplanes, taxis, and rental cars. He tends to purchase flat rate mobility cards for travelling all over the country without taking the trouble of individual ticketing. The benefits of using public transport are not limited to time efficiency and convenience alone, but extend to physical health too. For example, one of the interviewees deliberately reduced his automobile journeys as they exacerbated the symptoms of the chronic backpain he experienced due to sitting in front of his pc for extended periods of time. Work occupies a huge part of persona 1's private life that can be termed an imbalanced situation. That is why using public transportation is more efficient to them, as it allows business travellers to work or to take a power nap while travelling to their next destination.

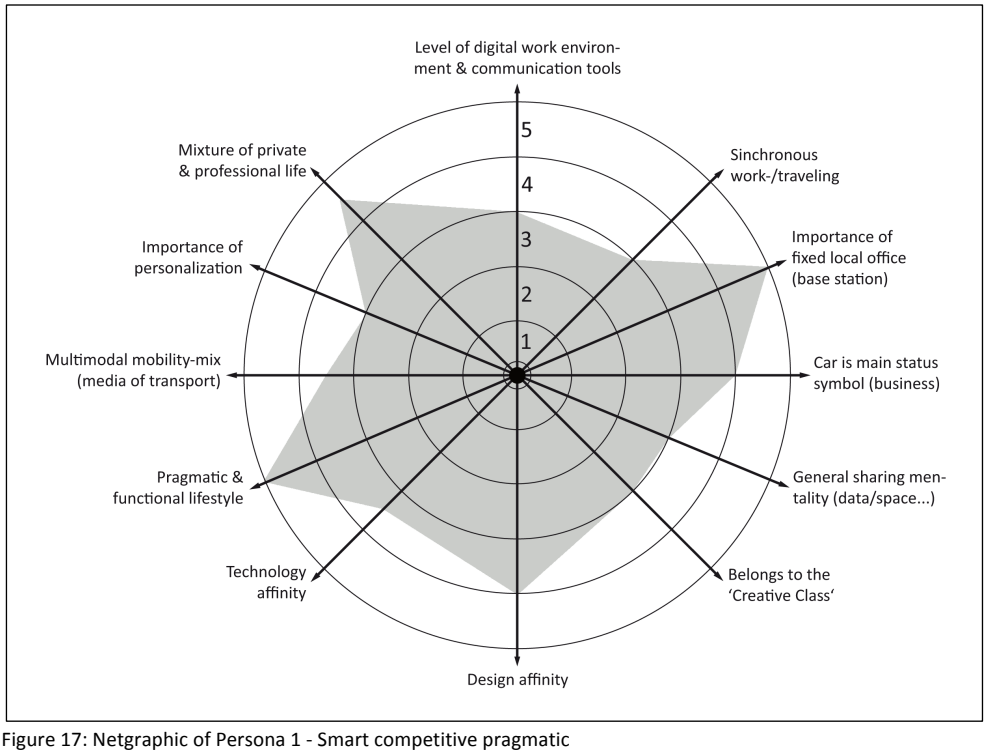


Figure 17: Netgraphic of Persona 1 - Smart competitive pragmatic

Automobile preferences

Figure 17 reveals the importance of the automobile as a status symbol that is part of the smart competitive pragmatics life, even though driving a car means inefficiency and an absolute waste of time for them. The only thing they can do while driving the car is to keep talking on the phone and listening to music or an audio book. That is why most of them prefer to take the train instead, where they can work simultaneously while travelling to the next destination. Persona 1 is already full of expectations about what type of advantages the partly-to-fully autonomous driving car might offer them, as Dr. Silke Claus (user 5) states: *'I love to drive cars, even though it does not match my everyday professional life at this moment. But I do make holidays with automobiles. Again, I really love*

driving, but in terms of work it simply means wasted time for me.'[32] Walter Schaff (user 12) mentions: *'The type of car I would use depends on the proper city size… I would always choose as much comfort and vehicle size as possible. And, I really appreciate an implemented, reasonable, practical, and comprehensible navigation system.'*[33]

The perfect automobile interior setting

Concerning the automobile interior, Dr. Batz mentioned:
'The perfect automobile interior has proportions like a Jaguar from the 60s,
...is extremely comfortable and offers a good all-round view,
...is easy to handle and adapts to the physical needs of each passenger,
...and has an automatic park assistant, which would be just perfect.
…And when the time will come to drive completely autonomously, then the vehicle will turn into a mobile living and working space. The car might be shaped according to further needs and individual requirements that are located at the proper interior. A maximum multifunctional space for work and small in-car depots is needed… with a keyboard in front or even more advanced solutions (such as gesture control). Also, small trays for beverage would be great, as there does not exist a well-designed solution yet.'[34]

Also, Mr Schaff says: *'The interior should be a pleasant mixture of an aesthetic and functional design. I mean fine, hand-worked and open-pored wood. Not just aluminium or plastic. On the other hand, I would prefer to have a maximum of free space inside the vehicle. I would love to have all the possibilities of a multiple space use. That would be just ideal.'*[35]

All interviewees of Persona 1 agreed in favour of high-quality vehicles with premium appeal, a well-worked material, a self-explaining HMI, a general pragmatic concept and an avant-garde but serene vehicle design language. Therefore, all distinguishing issues of this persona are listed in a nutshell within this individual requirement list under seven categories in Table 58.

[32] Translated from German: *'Ich fahre wirklich gerne Auto, auch wenn es im Moment für meinen Alltag einfach nicht praktisch ist, aber Urlaube mache ich schon mit dem Auto. Ich fahre persönlich gerne, nur im Arbeitsalltag ist das einfach zu anstrengend… verschwendete Zeit.'*
[33] Translated from German*: 'Mein Fahrzeug der Wahl ist abhängig von der Stadtgröße... Ich würde immer so viel Bequemlichkeit und (Auto)größe wie möglich nehmen. Gut wäre es, wenn es eine komplett sinnvolle, nachvollziehbare, praktische Verkehrswegeführung hätte...'*
[34] Translated from German: *'Mein perfektes Interieur hat Formen wie ein Jaguar aus den 60er Jahren. Es ist extrem bequem. Es bietet eine gute Rundumsicht und es soll einfach zu bedienen sein. Es soll sich so weit wie möglich den körperlichen Bedürfnissen der Insassen anpassen. Wenn es dann noch eine automatische Einparkhilfe hat, dann passt das perfekt. ...Und wenn es tatsächlich einmal soweit kommt, dann wird natürlich das Fahrzeug zum mobilen Wohn- und/oder Arbeitszimmer. Je nachdem, es gibt dann noch ganz andere Kriterien, die an den Innenraum gestellt werden. Und zwar diese, dass man einen möglichst multifunktionalen Raum braucht, wie Arbeits- und Ablagemöglichkeiten. Man könnte eine Tastatur vor sich haben, oder evtl. gibt es da auch schon andere Lösungsmöglichkeiten (wie Gestensteuerung?). Dann wären kleine, smarte Ablagen für Getränke nicht schlecht, da diese Dinge bisher nicht so gut gelöst sind.'*
[35] Translated from German: *'Von der Innenausstattung her sollte es eine angenehme Mischung aus einem ästhetisch-emotionalen Design sein. Ästhetisch im Sinne von meinem Faible für schönes, offenporiges und feingearbeitetes Holz auf der einen Seite (nicht nur Aluminium oder Plastik). Auf der anderen Seite sollte es relativ viel Raum und Luft haben und relativ wenig Enge. Und wie besprochen multifunktionale Nutzbarkeit für verschiedenen Zwecke. Dann wäre es ideal.'*

Persona 2: Digital efficiency pro

Figure 18: Persona 2 - Digital efficiency pro

Character description

The digital efficiency pro represents an experience-driven performance and goal-oriented business type. She is a smart rationalist with a liberal and open-minded personality, constantly looking for efficient and straightforward solutions. To meet her ultimate goals and to achieve a smooth workflow, she is willing to accept all kinds of helpful work tools. Being an extensive business traveller, the digital efficiency pro is hard working, highly flexible, dynamic, socially integrated and smart. She travels across the world and thus is extremely self-confident about what she has gained and wants to gain in future. Furthermore, she is ready to take over responsibility in professional terms and pays the price of temporary loneliness due to long exhausting working hours. The digital efficiency pro is interested in cars and curious about latest technological features within the telecommunication industry. As progressive technology integration is the core topic of her work, she feels like a proactive soulmate of the Anglo-American Silicon Valley culture. Persona 2 likes easy-to-handle, efficient, and functional technology that is fun as well (see Figure 19).

Personal working style and lifestyle

This rational thinker is always on the move and intentionally resigns from consistent daily routines and regular working hours. She knows about the importance of a good physical and mental balance, and therefore practices sports such as running, cycling, or swimming excessively, as she can continue to carry out such activities nearly everywhere. The digital efficiency pro is ambitious, acts efficient, and is highly success-oriented on the professional side. Concerning her personal working style, she is well organized with regard to content and time. Similar to the smart competitive pragmatic, she does not like wasting time—e.g., queuing for an absurdly long time such as 25 minutes. Persona 2 prefers working for contemporary companies, such as Google or Microsoft, whose products and lifestyle represent part of today’s digital elite. She works all over Germany and around the

world, and communicates mainly via video-conferences, live chats, phone calls, and emails. Her life is extremely networked and digitalized (see Figure 18).

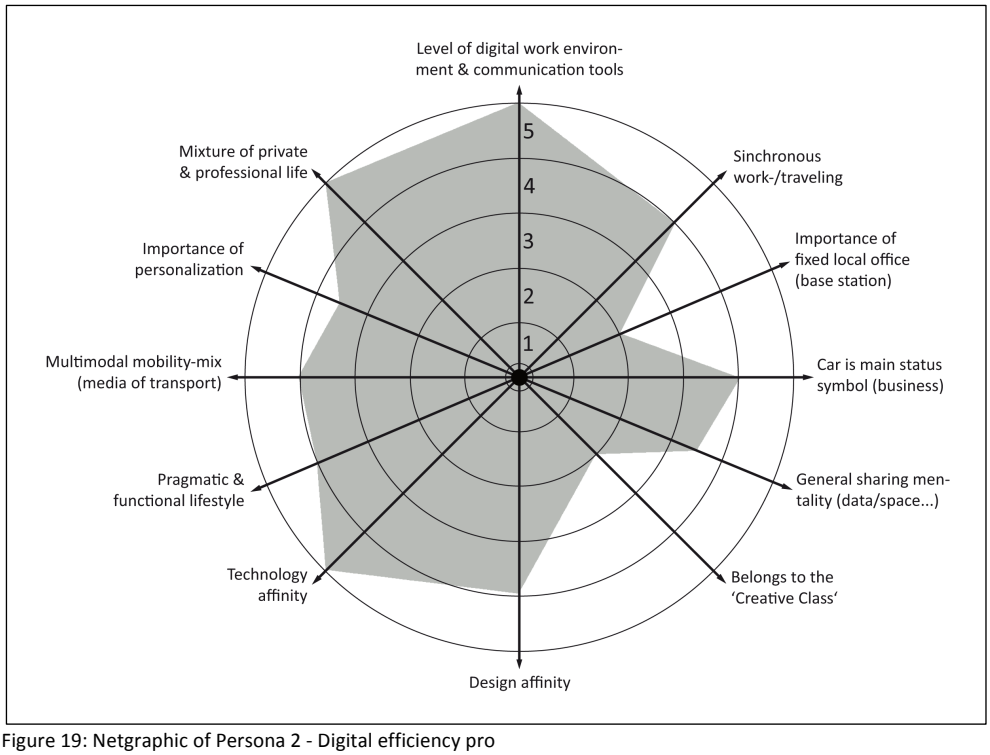


Figure 19: Netgraphic of Persona 2 - Digital efficiency pro

Mobile working behaviour and mobility pattern

Travelling constantly for work is a defining characteristic of the digital efficiency pro. Through the use of mobile working tools such as mobile phones and pc's or tablet's she operates relatively location-independent and tries to exploit any leftover time gap between appointments and travel time. If possible, she prefers to work in a quiet hotel room, a rented office space, or a local subsidiary of her company, instead of those places of destination where many clients are located within hectic streets, crowded places of city centres, or urban agglomerations with industrial buildings next to sandwich bars. When Nicole Voigt arrives at an airport or a train station, the next stopover spot must be time-saving, user-friendly, and especially, trustworthy. The ambitious IT sales representative from Munich says: *'I drive directly to the client. And afterwards, I often drive to the next one. One tries to be as efficient as possible.'*[36] As she visits two to three customers a day, she returns quite late at the hotel or even returns home the same day. As time is money for her, she wants to lose as little time as possible with any sort of organizational matter. So, sometimes her only chance to work quietly is inside a car. The digital efficiency pro draws on preferably flexible and pragmatic mobile solutions such as taxis, car rentals, or

[36] Translated from German: *'…dann fahre ich direkt weiter zum Kunden. Danach oftmals auch gleich zum Nächsten. Man versucht das ja so effizient wie möglich zu machen.'*

public transportation (see Figure 2) to reach her destination in time. The slogan 'usage instead of ownership' is applicable to her everyday mobility practice

Automobile preferences

The digital efficiency pro drives a well-motorized premium car such as an Audi A6 with a collection of extras, such as sport or comfort features. She would never buy a car that is not fun, cool, or sporty as it still plays an important role in her life (see Figure 19). To quote Julia Borggräfe (user 3): *'I think the body size is an important factor, just like the topic of functionality in terms of usability issues... It should be stylish but far away from this status thing… I guess, in future, it will always be less relevant. To me, it is more important how I personally feel inside the car, that it is comfortable and offers all functionalities that I need. I do not mean frills but I am referring to a general goal-orientation.'*[37] According to the user statements, the proper automobile interior design and functional concept is likely to be important for this key user group in the future.

The perfect automobile interior setting

The digital efficiency pro wants to install a whole location-independent, autarkic, and flexible office within the automobile interior. Her ideal automobile has at least one flat tableboard with electricity supply and a free wifi connection. Johann-Georg Schumm (user 14) thinks: *'A – it should be arranged clearly. B – it should be constructed logically. And, not too detailed in its proper functions. It should not distract from driving and be configurable in order to adjust one's own personal needs and desires.'*[38] Nicole Voigt (user 16), on the other hand, has more functional requirements such as: *'A navigation system that works. A good sound system is also important. It should be of low maintenance. It should not have a glossy finish, which you have to really look after. Furthermore, a storage for drinks and food would be great, as well as accessing my music via a usb port.'*[39] All distinguishing issues of this persona are listed in a nutshell within an individual requirement list of seven categories in Table 59.

[37] Translated from German: *'...die Körpergröße halte ich für einen ganz wichtigen Faktor, sowie das Thema der Funktionalität (einfache Bedienbarkeit)... Einen Stil sollte es schon haben, aber weg vom puren Status platziert sein. ...ich vermute, dass er in Zukunft auch weniger wichtig sein wird. Es muss eher darum gehen, ob das angenehm ist, ich mich wohlfühle, mir das Auto die Funktionalitäten bietet die ich möchte. Dies meine ich nicht im Sinne von Schnickschnack, sondern von zielführend.'*

[38] Translated from German: *'A – es sollte übersichtlich sein. B – es sollte logisch von der Struktur her aufgebaut sein. Es sollte nicht überdetailliert sein, also sprich in den Funktionen. Es soll wirklich einfach, bzw. relativ einfach sein. Es sollte nicht vom eigentlichen Fahren ablenken. Und es sollte soweit konfigurierbar sein, dass es auf die eigenen Wünsche und Vorstellungen angepasst werden kann.'*

[39] Translated from German: *'Ein Navigationssystem das funktioniert. Ein gutes Soundsystem finde ich auch wichtig. Nicht irgend so ein ‚Hochglanzdingens', was man dauernd pflegen muss. Eine Getränkeablage und ein USB-Anschluss für Musik ist auch wichtig.'*

5.2.3. Persona 3: Creative networking enthusiast

Figure 20: Persona 3 - Creative networking enthusiast

Character description

The creative networking enthusiast is a business traveller who is friendly, fanciful, and creative, but also hard working. She is perfectly connected with her subcultural niche like fashion, music, product design, web, or service design fields. Persona 3 has a widespread international network of friends, digital fans, and community members, including private and professional contacts that merge with each other. She is a keen design enthusiast with a great sense of extravagant lifestyle and thus dresses up in an individual mix of vintage pieces, small fashion labels, and international luxury brands. Whatever she buys, it must tell a story and should meet her personal aesthetic taste. The nectar&pulse founder (user 11 and 13) mention: '*It is quite important for me to find some spots in between to eat something... We are very picky and would never enter a café if it is not cool. If not, we prefer to pass by and wait for half a day to find something better.*'[40] She loves to try out new things and is quite curious to discover the world by acting creatively, such as by dis-

[40] Translated from German: *'Es ist auch wichtig dazwischen noch schnell Spots zu finden, um z. B. etwas zu essen. Wir sind da mittlerweile sehr penibel geworden. Wir würden nicht in irgendein Café gehen, wenn es nicht cool ist, dann verzichten wir lieben darauf und warten eher noch einen halben Tag.'*

covering a *'vibrant art gallery, a hidden café, a delicious restaurant, or a buzzing underground club*' [Rabeian and Roos N.N.] in any city. Her creative and explorative flair gives her the ability to discover new ideas, develop future innovations, or to solve problems straightaway. She loves old records, music, art, and photography, and also tries the latest communication technology, such as Google glasses or the iWatch, being a digital native by heart. Persona 3 can be characterized as a glocal[41] resident, as she feels quite connected with the globe as well as the surrounding local community (see Figure 21).

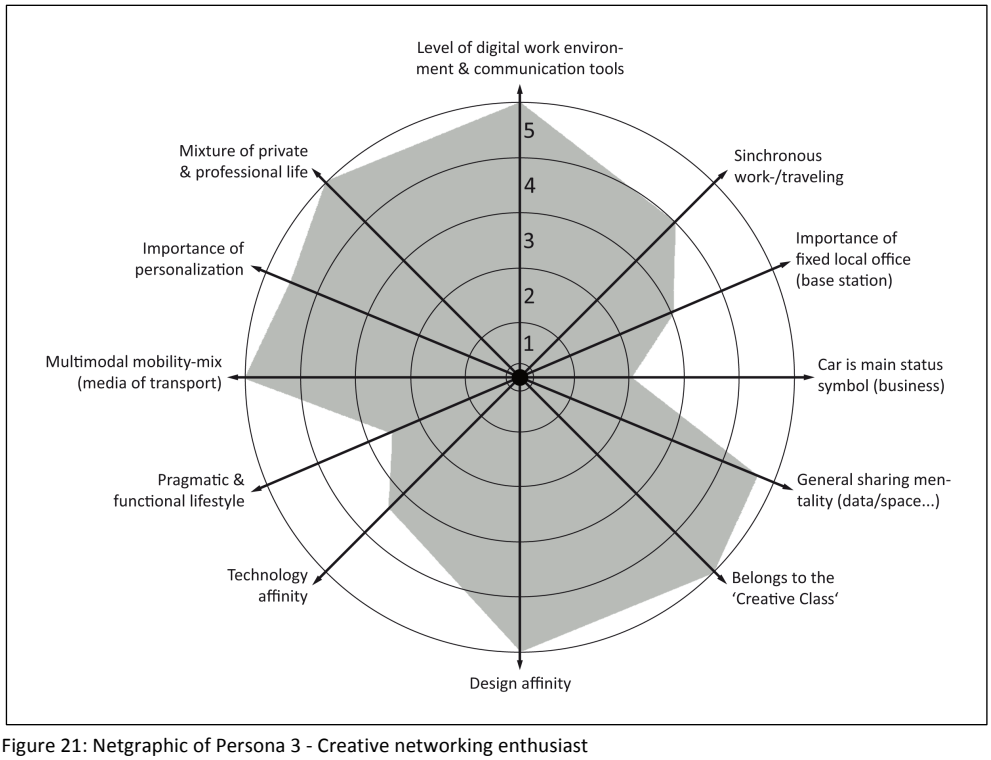


Figure 21: Netgraphic of Persona 3 - Creative networking enthusiast

Personal working style and lifestyle

The creative networking enthusiast's are hard-working individuals such as freelancing booking manager, studio designer, or start-up founder of individualized travel guides like the Berlin-based company sugarhigh. Persona 3 loves to spread personal information via social media platforms such as facebook, twitter, flickr, or pinterest to share good hints for holiday trips, restaurants, and photos of musical events with her friends. Therefore, the internet is her primary source of information and mode of communication with her peer group. She uses it to exchange opinions there, tell stories, and illustrate her life in photos in order to manifest her personal image and online status (see Figure 20). That is why Nadin Brendel (user 4) describes real work as: *'…rather networking. Yes, a lot of net-*

[41] Glocal: Globally and locally focussed at the same time.

working and meeting people. I need to transfer a lot of information via facebook and other social media websites during the day so that people could recognize my online presence.'[42]

Mobile working behaviour and mobility pattern

The creative networking enthusiast undertakes trips for around two to three days, and more rarely some longer international ones. And during that travel time she has various appointments that are directly scheduled one after another. *'So, quite often, one person stays within the car and the other handles the meetings'*, tells Carina Rabeian (user 3) a creative networking enthusiast. During these travels the iPhone and iPad are their permanent reliable source of information and permanent travel companions (see Figure 21). As she is always on the move, Persona 3 carries her personal mobile office along. She represents the typical multimodal traveller who chooses the best medium of transport available in that moment. Thus the type of available transport is of minor importance and only general velocity does mostly matter.

Automobile preferences

The creative networking enthusiast drives automobiles on several occasions, but most often she uses temporarily rented ones. She would love to personalize her atmosphere each time by changing light and space situations, and access her private music collection through cloud computing. If these basic conditions improve, the creative networking enthusiast could think of using the car as a temporary urban base station for her business issues. Nadin Brendel (user 4) confirms this by saying: *'If there was the possibility of driving a car and simultaneously... assembling all the things of your daily life which are important for work, that would be just great for me. The three most important things are, of course, the functionality of the car, the time saving, and its comfort features. You have to feel well… I would love very much if there were a printer inside the car that could be smartly integrated into the interior and directly attached to a big screen. Everything would be connected and directly onsite… I wonder why we do not have such facilities till now!'*

The perfect automobile interior setting

As persona 3 represents the local design avant-garde, they prefer a stylish product but no old-time luxury or anything conservative similar to a gentlemen's club. They have little interest in using the automobile as a status symbol itself; instead, they have the desire to search for the most outstanding experiences (what is a status symbol for them again). Tanja Roos (user 11) summarizes it in the following way: *'Dear Designer, my favourite car would be a living room, bedroom, and office in one. You could really work there, put your seats in different arrangements, and have a coffee together. And then, you could spend a night there or change your clothes (having all your clothes there). It would have a lot of storage and different atmospheres; it would be affected by lights and also have materials to adapt everything according to your needs and specific situations. It would be nice to invite people there and arrange a meeting inside the car, and thus the atmosphere should be like that of an office. But, the next moment, it should be possible to have a bedroom at-*

[42] Translated from German: *'Arbeit bedeutet für mich eher Networking. Ja, ganz viel Networking und Leute treffen. Ich muss viele auch über Facebook und die ganzen Social Media Webseiten darstellen, was man eigentlich tagsüber so macht. Das mache ich, damit die Leute merken, dass ich präsent bin.'*

mosphere, too. I would like to have a car, which is like a friend or someone who knows your preferences. So, as soon as you enter the car, it will know your needs, what you like or dislike, and really adapts to the person.' And her business partner, Carina Rabeian (user 13), adds: *'I would like to have a car which would fit my own personal needs, where I could work, sleep, and meet some friends in-between. So basically, it should be a car where you would feel at home wherever you are.'* The distinguishing characteristics of the creative networking enthusiast are listed within an individual requirement list of seven categories in Table 60 of the Appendix.

5.3. Research results

This chapter suggests enriching the original design brief of the project experiment with easily comprehensive and vividly formulated portraits. The personas should help the designers to imagine their future better. In a next step it is to summarize, select, and list the overlapping netgraphic insights of App. Table 58, Table 59 and Table 60 into a common requirement list (CRL) to gain an overview on the users key messages (see Figure 22).

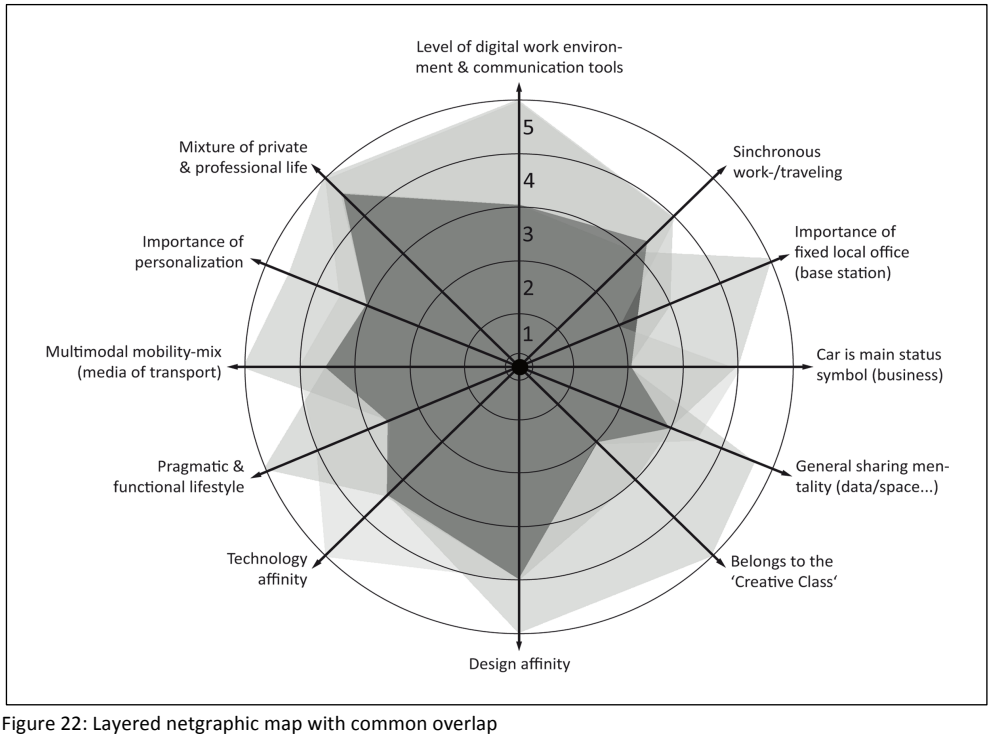


Figure 22: Layered netgraphic map with common overlap

Reprocessing joint user insights into a CRL

Accordingly, all joint user insights of the layered netgraphic map in Figure 22 were listed and summarized in a common requirement list in App. Table 61. The darkest zone in Figure 22 shows the common overlap of all persona insights [Cooper 2008] with its highest rating scores in circle 5 (see master in Figure 15 and scores in App. Table 63. By consider-

ing its highest degree of rating scores and congruence, the requested differentiation categories (see below) of each persona are ranked in sequence:

- Mixture of private and professional life (1st place)
- Design affinity (2nd place)
- Degree of multimodal mobility-mix (3rd place)
- Synchronous work- and travelling (4th place)
- Technology affinity (4th place)
- General sharing mentality of data, insights, or space (5th place)
- Level of digital work environment and communication tools (5th place)
- Importance of personalization (5th place)
- Pragmatic and functional lifestyle (6th place)
- Car as a main status symbol (7th place)
- Affiliation with the creative class (8th place)
- Importance of a fixed local office (8th place)

User recommendations for vehicle improvements

Owing to this prioritization, this research work focuses onto the first five out of the eight place classifications, as they are the most-relevant ones. These recommendations have been divided into two priority boxes according to the netgraphic ranking. The priority box 1 of Table 24 showcases the main user insights; whereby Table 25 evidences the second-order preferences. At this point of the experiment the aim was not to find concrete design solutions but to list precise problem descriptions from a functional user point of view.

Table 24: Priority box 1 of digital business nomad's CRL of cars (1st–5th place)

1.	Want an intelligent and sophisticated storage system for their luggage inside the car
2.	Prefer a designated customizable place for their handbag, trolley, pc, and suitcase in the car
3.	Car should be connected to the internet via an integrated cloud system
4.	A more private space mode is needed within the automobile
5.	Want smart location-based service offers to find excellent restaurants, hotels, etc.
6.	Want location-based offers also for private life, such as where to meet a friend, where to go swimming, eat an ice cream etc.
7.	Want a safe place to store and charge several digital devices simultaneously within the car
8.	Prefer minimalistic avant-garde design with significance
9.	The apple design is their overall benchmark
10.	Need a new type of timeless emotional design offer
11.	Superb design quality signifies a luxury issue to them
12.	Want just-in-time pre-conditioning of car interior
13.	Prefer a just-in-time alert system of time delays of every means of transport that they want to use
14.	The automobile must offer alternative efficient time-saving proposals for the user
15.	Need better-designed flexible space modes within automobile interiors
16.	Need in-car working options (office mode)
17.	Need a relaxing in-car refugee
18.	Install a smooth, trustworthy, and fast travel organization system with supreme service and traveller assistance
19.	Appreciate invisible and safe in-car-storage options

20.	Need a feature or tool to protect from sun insolation especially while working and a non-transparency status for changing cloth, sleeping etc.
21.	Need an absolutely reliable, up-to-date, and smart navigation system
22.	Want up-to-date technology systems inside the car, being easily adaptable to their devices
23.	Prefer less but reasonable technology features and buttons that offer them an extra value
24.	Want more user-friendly and intuitive operating systems within the car
25.	Premium carsharing services should be especially offered for professionals
26.	They appreciate a staged sharing principle

Table 25: Priority box 2 of digital business nomad's CRL of cars (6^{th}–8^{th} place)

1.	Want a bigger screen next to combi-instrument for multiple applications with web access
2.	Prefer more freedom to face challenges within the automobile interior
3.	Want a user-friendly and elegant way of luggage storage without baggage lifting or built-in barriers
4.	Install a small frozen food compartment to cool food and beverages
5.	Want their luggage to be treated with caution, as they are their closest travel companions
6.	VIP treatment services and areas are needed with member issue for car rental etc.

In order to form universally valid, qualitative evident tasks out of many individual points of view, all information was collected, listed, and ranked accordingly. The final common requirement was processed and prepared for the subsequent student briefing of the student experiment (see Figure 57 and Figure 58).

User assumptions on automobiles

Throughout the interview procedure and persona creation it became evident that mobile workers need attentive user-centred concepts related to pragmatism and suitability, rather than more high-tech features and software systems. The users emphasized a well-thought-out, stable, adjustable environment that lends itself to flexible use. The research made also clear that these personas are still temporary automobile users rather than actual car owners. To them the automobile acts mainly as a functional enabler within the classical business context, as Nadin Brendel (user 4) says: *'I do have a few emotional connections with a car. What I do not like is when the vehicle is too big and unpractical to park. Everything just has to work well and should be easy to drive… To me, it is important that I can connect my iPhone or iPad there to play music…'*[43] This statement makes clear that an alternative type of value creation should take place to solve the contemporary issues surrounding automobile use (e.g., searching for suitable parking slots throughout smart service systems), and to offer temporary recreation retreats for tired travellers. Additional improvement issues are high-quality product solutions, an intuitive HMI and communication system, and a constant flexibility in the type and frequency of vehicle usage. The users would like to be able to charge several working tools (e.g. for their pc, smartphone, and tablet) simultaneously because access to fully charged battery capacities gives them a feeling of safety. Later on it needs to be differentiated whether these improvement issues represent solely satisfying features for the user, attach an extra portion of fun, lifestyle, or an added experiential value to the vehicle. Hence a shortlist with the

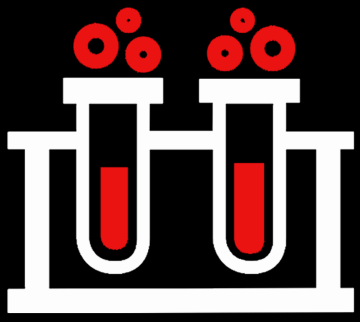
[43] Translated from the German: '*Emotionale Bindungen zum Auto habe ich eher wenig. Nicht so gut ist es, wenn es zu groß ist und ich das Gefühl habe, dass ich es nirgends parken kann. Das muss gut funktionieren und sich gut fahren lassen. Es müssen einfach die Basics gegeben sein... eine Verbindung zu meinem iPhone bzw. iPad herzustellen sein, damit ich Musik abspielen kann. Das ist wichtig...'*

main presumptions of user statements for future vehicle concepts, derived from the above-mentioned priority boxes (see Table 26), is illustrated below.

Table 26: Shortlist of presumptions for future vehicle concepts

1.	The changing behaviour pattern and mind-set of these extreme users provokes a new thinking of individual mobility concepts and vehicle usage, especially in urban environments.
2.	An urban short-distance vehicle might be an own product class of individual transportation.
3.	This vehicle type demands its own, respectively, specialized design system, as its requirements are completely different from those of the present models.
4.	There might exist a variety of automobile property and usage situations like shared ownerships, commercial fleets, and temporary rental and car sharing concepts simultaneously.
5.	This vehicle should consume only minimal space, as in future megacities there will be a space shortage in the private and commercial fields. So, car parks or towers within the inner urban circles will be rare and restricted, and represent an expensive luxury only available for a minority of people.
6.	That is why the car needs to offer a optimized and flexible space usability.
7.	The urban vehicle could have an optimized energy consumption concept; it captures a second role in balancing energy overflows or shortages throughout a smart storage area network (smart grid).
8.	The vehicle should be only electrically powered, as mainly short-distances trips will be undertaken within the city—urban agglomeration (no range problems). For this environment sporty driving is highly requested. And at the same time, electrical energy is required to be used as a flexible, moving battery storage for gaining a solid urban energy supply.[44]
9.	According to diverse expert statements, it is also quite probable that the vehicle will drive entirely or rather partially autonomous within the next 15-20 years (technical presumption).
10.	It is also quite probable that each individual user will be able to socialize with his appropriate automobile interior space. The more often he uses the customized objects, the more he might be affiliated in an emotional digital relation.

[44] According to developments like the Siemens VDO wheel hub electrical engine called eCorner, more and more energy efficient and CO2-free cars can be produced to move around the city centres. http://www.greencarcongress.com/2006/09/siemens_vdo_mak.html [15.01.2014].



CHAPTER 6 – STUDENT EXPERIMENT

In the previous chapters indicators were found that digital business travellers use automobiles in different ways than former users did. Three central elements that differ to former vehicle users are:

- The digital business traveller usually does not own a car, but leases or rents it repeatedly. This means that he has to become familiar in a short time with the respective HMI system of each car brand.
- He also uses automobile space for other purposes; such as for conferencing, changing cloths, as storage space and also wants to store his pc safely when he leaves the car.
- When the digital business traveller moves in urban environments he is in constant search for a quiet, personal space for work and retreat.

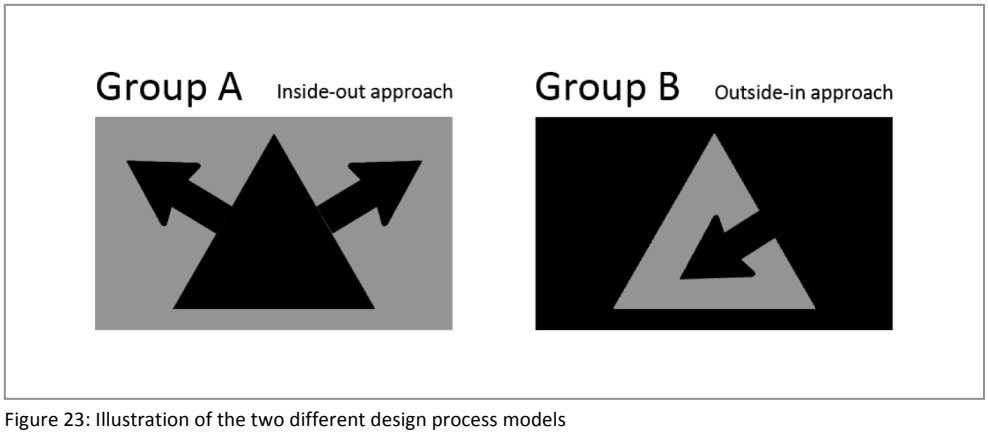


Figure 23: Illustration of the two different design process models

The current automobile design approach is the outside-in approach as described in Chapter 3. This approach falls short of addressing the novel needs of the digital business traveller. It is assumed that he is more concerned about the extent to which his car is able to facilitate his activities rather than its outer styling. Chapters 4 and 5 indicated that an alter-

native NPD design process and design approach are needed to address the digital business traveller's needs. The aim of this experiment is to find out whether a design that starts with the functional requirements of the user needs is better suited for the target group than a design which starts with the styling of the outside of the vehicle. Figure 23 shows a schema illustrating the two approaches with a rectangle form representing the exterior and a triangle form that outlines the interior automobile design. Group A designs accordingly to the illustrated arrows from the inside of the triangle towards the outside rectangle form. Group B designs from the outside of the rectangle towards the inside of the rectangle. The question is how these two approaches could lead to differences in design regarding the final product. The aim was to understand the coherence of outstanding target group insights and their influences on the transportation design conception to insert innovations into the NPD process.

There are indications in literature that focusing on the car user could lead to a car, which fits better to the target group. Hiemstra-van Mastrigt [2015] describes in her PhD that it is expected that the use of small handheld devices, such as PDAs, smartphones, e-readers and tablet PCs, will continue to increase. It is quite probable that the users will also apply these devices while they stay in the car so new vehicle interior solutions need to be found. She also states that the XchangE concept by Rinspeed, presented at the Geneva Motor Show in 2014, shows how the interior of an autonomous vehicle could be designed more focused on the user. Wagner et al. [2014] describe another solution to better fit the car to the individual user by making parts easy adjustable and add elements within the interior.

Also the expert interviews indicate that this new inside-out approach could be useful (see Table 12 in Section 3.1). All experts indicated that a closer cooperation between the exterior and interior design is necessary to bridge future vehicle development complexities. Lipp and Fügener assume a synchronous cooperation for interior and exterior design in the future to apply more innovations (see Point 13, 23 and 25 of Table 12). In accordance with digital and other technical developments, Lipp, Wickenheiser and Starke expect the automotive interior to represent a drastically changing field with huge innovation potential (see Point 14, 15, 49 of Table 12). Also, according to Fügener [2011$_b$], *'...In future the classical three-box-model …is massively questioned…'*[45].

Thus, both the literature and the expert interviews highlight a need for restructuring today's design process organisation, and imply a move from the outside-in towards an inside-out approach. Before setting a direction for this restructuring, it is first necessary to understand 'how' these two approaches differ with respect to the design of the final product. This chapter reports an experiment, which sought to assess how the two approaches do lead to differences in the final product regarding inner space quality, user-centeredness, outer space appearance and contextual embedment into the urban environment. The mentioned criteria were chosen for comparison as they outline the most important vehicle qualities that can be experienced by the future user.

[45] Translated from the German:: *'…Das klassische Dreiboxmodell ...ist jedenfalls massiv infrage gestellt…'*

6.0. Method

The experiment was conducted with 92 master students at the Faculty of Industrial Design Engineering of the Delft University of Technology. The students were given the assignment to design a future automobile for the year 2030. The student project started in October 2012 and lasted until the end of January 2013 (see Figure 24). All students were divided into 20 groups with 4-5 students each. Care was taken to ensure that the groups were balanced in terms of gender, professional and cultural backgrounds. Half of the groups were given the assignment to apply the outside-in approach. The other half received the task to make use of the reverse method (see Figure 23).

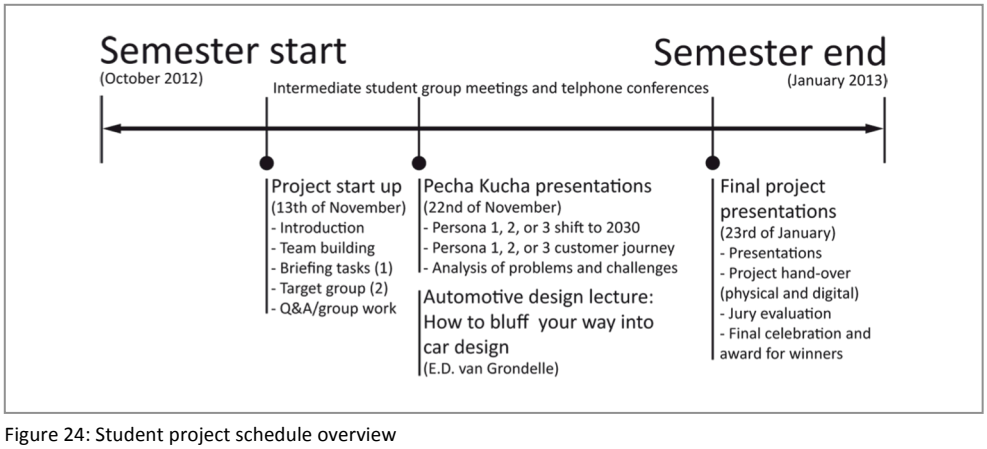


Figure 24: Student project schedule overview

Before and after the experiment students completed a questionnaire, which assessed their level of knowledge in the automobile field (from being novices to semi-experts). The questionnaire also included items to evaluate if and how their personal perception of the automobile field changed during the experiment. It was to find out if the participating students developed a kind of outstanding empathy for this specific target group. This procedure took place in the same way for all questions of the first and second questionnaire.

The students were not informed about the background research, hypothesis, or aim of the research project to prevent any effect that this knowledge may have on the outcomes. At the end of the experiment all group reports and presentations were analysed and scanned if they met the brief criteria using a 5-level scheme. Table 27 shows five different rating criteria classifications from the lowest valuation with 20% goal achievement (no-hardly achieved), 40% (aspects achieved), 60% (achieved), 80% (more than achieved) until to the highest one with 100% goal achievement (fully achieved).

Table 27: Rating criteria classification of student outcome

Aim	No–hardly achieved	Aspects achieved	Achieved	More than achieved	Fully achieved
% of achievement	20%	40%	60%	80%	100%

6.1. Brief and briefing design

The design brief was entitled 'urban (auto)mobility 2030', and it asked the student groups to design an automobile space for tomorrow's digital business nomads based on the criteria shown in Table 28. They were requested to find solutions that combined future business practices and private issues to develop an automobile concept vehicle that would represent a comprehensive mobility system.

Table 28: Vehicle requirements as brief criteria for group A and B.

- Maximize inner space quality, and qualitative and quantitative level of detailed elaboration
- Urban vehicle concept for short-distance movement only
- 2+x seats for various space settings
- Merging micro and premium car characteristics for small high-end vehicles
- High-end car sharing system for temporary car usage
- Electric motorization [Green car congress 2006] that offers new space conditions
- Partly autonomous driving features for more freedom to act
- Maximize the user-friendliness
- Maximize the target group orientation and persona fit
- Maximize the inner automobile space quality
- Maximize the inner space flexibility and multiple situational space use
- Minimize the overall space consumption ('reduce to the max.')
- Attach additional value to the conventional automobile concept
- Add additional communication media (phone, internet etc.)
- Fixed installation of a driver's seat (as permanent autonomous driving vehicles are not assumed as standard situation in the year 2030.)

To create the design brief as realistic as possible, the draft brief was presented to experts from Daimler and their comments were used to produce the final brief. All student groups received the same brief (see Table 29).

Table 29: Inside-out and outside-in approach briefing task

Group A: Inside-out approach with automobile interior focus	**Group B:** Outside-in approach with automobile exterior focus
Please design a car from the interior towards the exterior. Start with the inner part.	Please design a car from the exterior towards the interior. Start with the outer part.

In addition to the criteria of Table 28, the brief included the common requirement list of Table 30 and App. Figure 57–58 (original student hand-out) and three persona portraits to be found in Figure 25 and App. Figure 59–61 (original student hand-out). The common requirement list (CRL) presents the summary of all user statements gathered in the interviews. These statements were collected and condensed to a minimum measure to be applied as fundamental briefing information, independent from the different target group's opinions. This list states the DBN's point of view concerning travel, work environments, work behaviour, and their preferred car interior of the future.

Table 30: Common Requirement List (see original student CRL in App. Figure 57 and 58.)

Categories	**Issues**
Travel and organization	▪ DBN is travelling 2-5 days a week ▪ People do not like to waste time, wait or queue anywhere (car rental stand, train station, airport…)

	▪ A functional and consistent travel organisation has supreme priority ▪ They use time gaps in-between meetings to work, charge batteries, relax or sleep as it gives them a good feeling because of the double occupation
Travel luggage	▪ Credo: 'Reduce to the max.' and transport the least possible (do not travel with max. three pieces of luggage) ▪ Everybody has a detailed system to pack one's bags ▪ Own suitable travel luggage of good quality ▪ Luggage must be lightweight ▪ Women do not like to lift luggage (search for an elegant way of storage)
Space and travel system	▪ Sharing in the sense of multiple use is widely accepted (hotel, train etc.) ▪ People are in search of privacy while they work on travel ▪ Consider driving a car as a waste of time, a luxury issue ▪ Claim their business car is a more functional object than their private one ▪ Do not like any sun reflections on their screen while working
Mobile worker, work and work tools (hardware and software)	▪ Emphasize a functional, up-to-date and user-friendly technology ▪ Smartphone is a little computer but has a too small screen to work ▪ Manage an immense workload and long unlimited working hours ▪ Tendency of an unbalanced private and professional life ▪ There is always less time for travel and local acclimatization (stress factor) ▪ There are two extremes of mobile workers: One that is doing the main work in a traditional office and only uses the phone and email while travelling. And another one that it managing the full work load while travelling and whose work content is situation and environment dependent ▪ For content-related work they need a quiet hotel room, lounge or office ▪ Do not like to phone at public places because of privacy issues ▪ Extensive traveller has extreme requirements = strong personality ▪ Have their own system of status symbols and services such as priority check-in's, Lounge access, frequent flyer cards, seats with wifi and socket) ▪ Basis environmental conditions for mobile worker: A flat table area, electrical charging possibilities and wifi
Automobile details	▪ Car sharing is accepted, but needs to be clean, functional and premium ▪ Want a better holder/cooling system for food and beverages in the car ▪ Want an universal holder for mobile phones with charging possibilities ▪ Want an intelligent and sophisticated storage system for their luggage ▪ Claim that the automobile interior derives technology-wise from stone age concerning communication, charging system, and smartphone adaptation ▪ Car should have an additional/bigger screen with possibilities to check emails, find restaurants (not necessarily a pc) ▪ Car should offer wifi/cloud system to access the personal music collection ▪ Car should have an integrated and well operating navigation system with just-in-time updates on traffic jams etc. ▪ Working inside an automobile is too tight and narrow today ▪ Extreme cold/warm temperatures inside the car are not convenient ▪ Prefer simple touch screens and intuitive HMI systems inside the car
Design priorities	▪ Credo: Less is more ▪ There is a huge demand for superior designed lifestyle that is perceived a contemporary luxury issue ▪ The apple design is their general benchmark ▪ Appreciate a well-reasoned and elevated design quality (connoisseur)

The persona portraits in Figure 25 contain a short description of individual persona characteristics, their specific mobile work behaviour, personal lifestyle and working style, and exemplary interviewee statements of automobile preferences (see App. Figure 59–61). A descriptive netgraphic and additional photos per persona were also presented to the stu-

dents to stimulate their imagination about each persona's private and professional lifestyle. The groups were free to choose one of the three personas.

Figure 25: Persona 1, 2 and 3 shown in an overview (self-generated persona information)

Table 31 lists all group information and chosen persona-approach constellations. It can be seen that six groups chose persona 1, nine groups persona 2, five groups persona 3, and that 12 groups applied the inside-out approach, while eight groups used the outside-in approach in the student experiment.

Table 31: List of group names, chosen persona's, and approaches

Group profiles (in alphabetical order)	**Persona 1**	**Persona 2**	**Persona 3**	**Inside-out approach**	**Outside-in approach**
1st group: All for one			X	X	
2nd group: Cayak		X			X
3rd group: Cilly5		X			X
4th group: Craft Design	X			X	
5th group: Die Dromedar	X			X	
6th group: Hip'po			X		X
7th group: KITT	X			X	
8th group: MforN		X			X
9th group: NACK	X				X
10th group: Nico's Angels		X		X	
11th group: Pinpoint		X		X	
12th group: SHIFT			X	X	
13th group: Shifting			X	X	
14th group: Snabb	X			X	
15th group: Strategic Cookie		X		X	
16th group: Studio030		X			X
17th group: Sugar Power	X				X
18th group: The Workshop		X			X
19th group: Utopi		X		X	

20th group: Xtrovert			X	X	
Total number of choices	**6**	**9**	**5**	**12**	**8**

6.2. Procedure

The project's kick-off event started with a welcome and introduction session, followed by an additional briefing (topic, task, and aim setting, target group explanation, and personas presentation). As the first step, the groups needed to redefine the briefing. Then, they created first concept ideas and elaborated them in discussions, scribbles, illustrations, and physical prototypes. Finally, the student groups fine-tuned their best concept ideas and prepared the concluding presentation. All groups were asked to document their work throughout the whole design and conceptualization process in a weekly group report.[46] Figure 26 shows a representative excerpt of group 16. The groups had to hand over their produced prototype ideas, videos, and scribbles, in a summarized work documentation. All final group presentations were filmed.

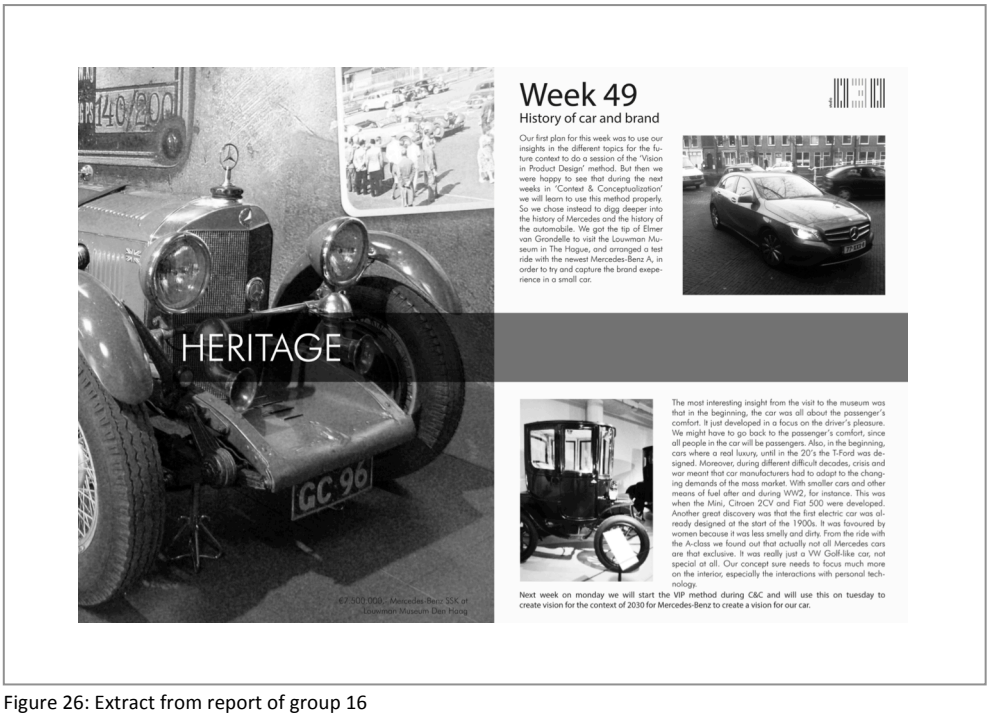


Figure 26: Extract from report of group 16

The report should contain a summary of each group's gathered information on technological developments, their chosen persona needs, and consequences for the car design. Part of the assignment was to interview additional user representatives of the digital business nomad. They were instructed to ask them about their social life, travel behaviour, mobile working habits, and daily work routine (see Figure 27). After that, they had to transfer the gathered insights into the year 2030. One week later, an intermediate presentation to all

[46] The project was valuated with six ECTS points. One point corresponds to 30 hours of work effort.

students and the coaching team in the student room took place. There, each group presented a future customer journey of their persona—a workday or week of their chosen persona—by using the Pecha Kucha format. They had to demonstrate different paradoxes in a DBN's life by identifying critical points and challenges related to their daily professional and private lives. After having defined these needs the functional design was developed in form of scribbles, haptic prototypes but also 3D models. Finally each group had to develop project-specific services together with a comprehensive automobile interior and exterior concept design.

6.3. Guidance

All 20-student teams received guidance by two coaches (a professor specialized in product innovation and a Ph.D. candidate specialized in innovative vehicle interiors). The students had the possibility to visit a car museum and a dealership. Throughout a university-internal database, the students were able to access published studies on future automobile transportation and urban developments. They did research via internet or the university library. During the design process, a transportation design specialist gave a lecture and supported the grou23ps in elevating their individual vehicle design (see App. Table 64).

6.4. Evaluation method

The students had to describe their design process and content in form of reports during the project. The outcome was evaluated regarding the criteria of Table 32 and its subordinated questions. Each rating criteria is supplemented with two questions that helped to evaluate the group's goal achievement. Table 64 and 65 in the appendix list the judging panel of eight persons from the university and its cooperation partner that participated at the experiment (of the 8 judges, only Bujis and Hofmann were involved in the guidance of the groups). The panel selected a top three of the best designs. The individual jury quotes were taken to relate them to the inside-out and outside-in results (see App. Figure 62–64).

Table 32: Common inside-out and outside-in approaches rating criteria

1.	**Inner space quality, and qualitative and quantitative level of detailed elaboration** Did the students apply the brief criteria and develop alternative space concepts? Did they include all automobile preferences of Table 30?
2.	**User-centeredness, persona fit, and customization possibilities** Did they satisfy their persona needs of Figure 59–61 sufficiently? Did the students meet the comprehensive CRL of Table 30?
3.	**Outer space appearance, status symbol effect, and general visual quality** Did they visually or physically realize a real prototype concept of the vehicle exterior? Did they design a status symbol with a high-end visual quality?
4.	**Contextual embedment and impact on outer environment** Did they visually or physically realize a real prototype concept of the vehicle exterior? Is the whole concept embedded into the urban environment?

6.5. Outcome evaluation

After the assignment the outcome was checked if the brief criteria and main goals were achieved. All presentations have been evaluated by the appointed judging panel with the help of the evaluation list (see App. Figure 62–64) to achieve the first ratings of the stu-

dent outcomes. The panel rated primarily the students' presentation quality, and the product and service idea of each group, and less their written reports.

Parallel an evaluation process was followed that analysed the written documents as well as illustrated outcomes according to the rating criteria classification of Table 27. All reports and presentations were analysed according to the student brief and its rating criteria, described in Table 32. The group reports and presentations were listed according to its activities and technology features placed inside or around the vehicle. In sum 25 different activities and 42 technology features were recorded from all group outcomes. Table 33 lists them comprehensively. These were applied to develop and place new assistance features and general functions within future automobiles. Table 66 and 67 in the appendix show them divided into inside-out and outside-in approach outcomes.

Table 33: Created activities and technology features overview

Chosen activities – types of interaction (in alphabetical order)	
1.	Activity modules (sports, music…)
2.	Agenda setting and business planner
3.	Automated driving & pick-up
4.	Automated shoe cleaner
5.	Car as service unit (dry cleaning of cloth…)
6.	Designing the cars outer look & style
7.	Digital communication & social networking
8.	Disposal space (bin…)
9.	E-learning & mental challenges
10.	Flat working surface (table)
11.	Individual user welcome (entry)
12.	Local advisory (restaurants, parking…)
13.	Medical video consultation
14.	Mood adaptation & flexible personalization
15.	Navigation system (just-in-time)
16.	Physical movements & sports
17.	Privacy situation (darkening window…)
18.	Rotating, flexible comfort seat, couch, bed
19.	Safe storage
20.	Seamless car charging, parking & maintenance
21.	Seamless device charging (pc, iphone…)
22.	Storage
23.	Temporary vehicle locking system (code…)
24.	Vehicle neutralization (physical and digital)
25.	Wardrobe & cloth hanger
Chosen technology features (in alphabetical order)	
1.	App application
2.	Augmented reality features
3.	Automated coffee cup stabilization
4.	Automated mind control
5.	Accident-free driving & pick-up technology

6.	Autonomous driving
7.	Biomimicry vehicle design
8.	Car drives with electricity/bio fuels
9.	Car-to-X communication
10.	Cloud-based communication
11.	Digital booking platform
12.	Smart energy management (recuperation)
13.	Emergency button
14.	Engine placed inside of wheels
15.	Entertainments system
16.	Ergonomical driving system
17.	GPS tracking system
18.	Heart-rate tracking system
19.	Interactive gesture & voice control
20.	Interactive data screen (IDS)
21.	Interactive data table – touchpad (IDT)
22.	Key = iris scan by nearfield technology
23.	Local advisory (restaurants, parking…)
24.	Luminous smart textiles
25.	Machine intelligence & digital assistant
26.	Nanotechnology & lightweight materials
27.	Noise isolation system
28.	OLED technology application
29.	Permanent web access
30.	Privacy situation (darkening window…)
31.	RFID technology application
32.	Seamless car charging, parking & maintenance
33.	Seamless communication system
34.	Seamless device charging (pc, iphone…)
35.	Shape-shifting, responsive & interactive environment
36.	Sharing technology
37.	Smart glass technology
38.	Spherical wheels
39.	Solar-system technology (on rooftop)
40.	User personalization system (climate control…)
41.	Video conferencing technology
42.	Visualization of energy management

Examples of outcome

The following work examples from five groups illustrate the type and quality of outcomes of the student works. Group 16 found a clear but simple way of communicating messages in just one image. The illustration of Figure 27 highlights their persona's daily work routine, sequence of travel, and the medium of transport they use while being digitally connected and receiving suitable services at a time. Group 20 transformed all client needs into a 'personal issue'. This group developed a caring system shown in Figure 28 that acts as a personalizable travel companion resolving all sorts of daily problems. As a member, you can benefit 24 hours from this service: James the butler remembers your name, personal

preferences, and provides you with an umbrella when it might rain—similar to an exclusive hotel guest.

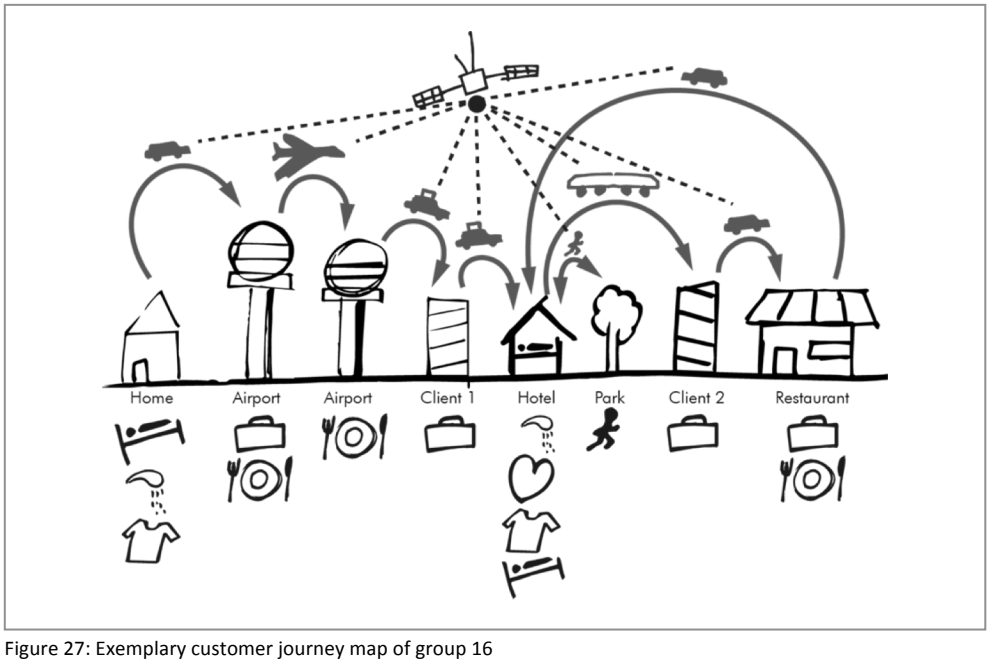


Figure 27: Exemplary customer journey map of group 16

Figure 28: Student group 20 with their imaginary helper James

Figure 29: Service concept with own device from group 11

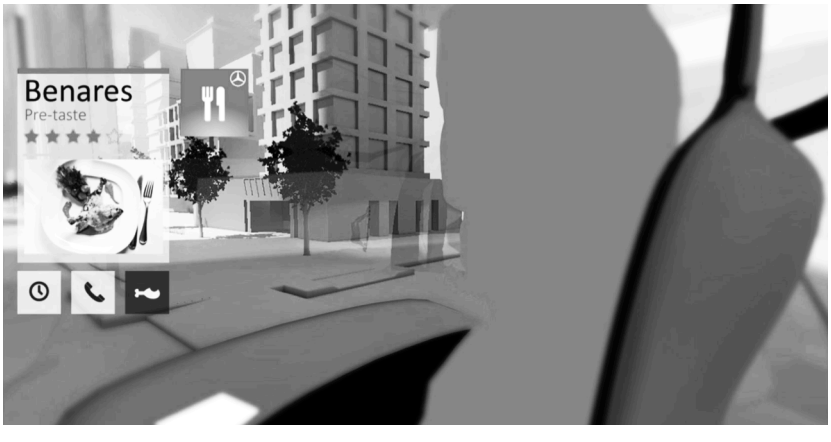


Figure 30: Service design of group 11

Group 11 developed a comprehensive service system that operates inside and outside of the car. Additionally, a piece of jewellery–a personal artefact is provided to the customer that offers entrance to an exclusive service lounge and accompanies him everywhere (see Figure 29 and 30). The group also widened the automobile idea and developed a contextual concept that offers different services within the urban environment (see Figure 33).

Also group 2 developed a car rental system that can be equipped with activity modules. These modules can be booked in advance and personalized according to each user's individual wants (see Figure 31). That includes sports and music equipment as well as professional work tools, entertaining items and software features.

Group 5 in Figure 32 elaborated an unconventional vehicle design by maximizing its inner space use. Inside the vehicle diverse media tools were placed that transformed the interior into a flexible meeting or individual working zone.

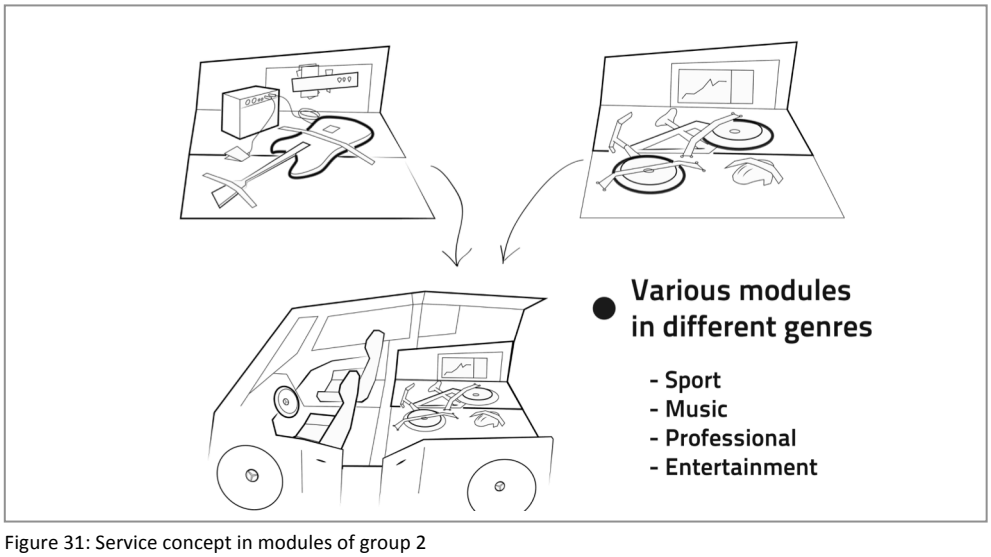


Figure 31: Service concept in modules of group 2

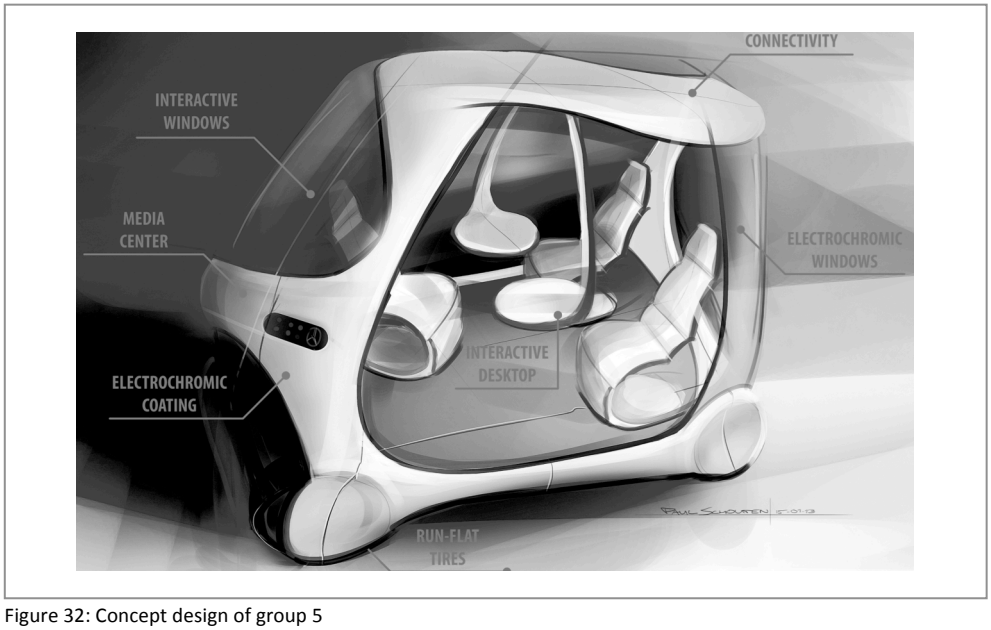


Figure 32: Concept design of group 5

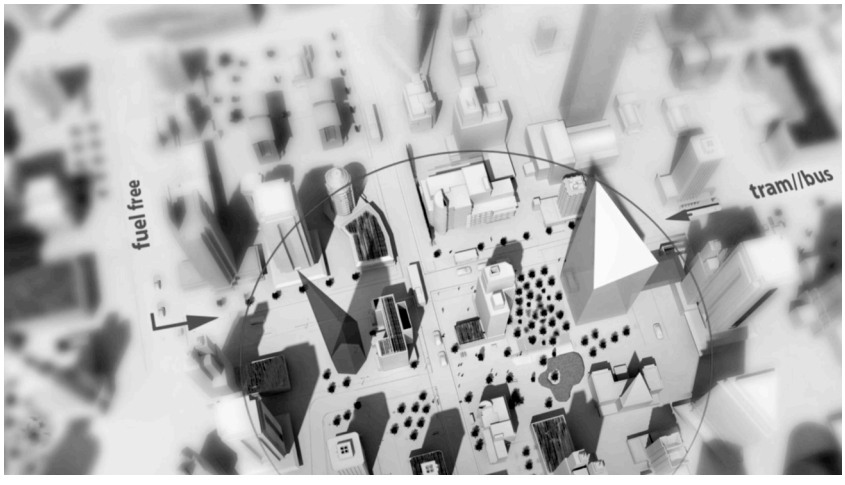


Figure 33: Contextual concept integration of group 11

6.6. Experiment results

The student groups developed many new ideas, but only a few culminated them into visible or physical designs. One reason mentioned by the students was the huge difficulty for them to work with concrete three-dimensional design layouts and blueprints – they did not know where to start or end in sketching the design. Drawing an automobile sketch by hand requires elevated skills in three-dimensional thinking, which may have been challenging for the inexperienced students. Furthermore, the automobile represents one of the most complicated objects in design, which encloses many functions and features in a limited space. Although the sketches were not fully elaborated the concepts could still be evaluated because they were supplemented with written reports.

App. Table 66–67 present a first overview of all individual student group results, their activities, types of interaction, and applied technology features invented by them. It can be observed in Table 34, that many groups tried to meet the brief and CRL requirements in their designs, but did not meet the full requirements of the briefing. From a qualitative side, most of the student findings were already available in the market, previously discussed, too expensive to build, or still far away from mass production. But some groups created novel ideas and an outstanding interior and exterior quality in the project. This can be seen in the right column of the total group scores of Table 34. Three of the groups succeeded to reach 140% (two groups applying the inside-out and one group applying the outside-in approach).

Differences between inside-out and outside-in approach

The evaluation shows differences between the inside-out and outside-in groups. The average target achievement of the groups applying the inside-out approach was 60% in the field of interior and 38.3% in the field of exterior development. The groups that utilised the outside-in approach, on the other hand, reached 50% in the field of interior and 57.5% in the field of exterior design elaboration of the full target achievement. **Thus this out-**

come showed that, although the inside-out approach led to a better interior design outcome, the outside-in approach scored higher in its allover result (encompassing both interior and exterior outcomes).

Table 34: Evaluation chart of approach assessment

Group name		Inside-out approach		Outside-in approach		Total group scores
		Interior achievement	Exterior achievement	Interior achievement	Exterior achievement	
1st group:	All4one	60%	40%			100%
4th group:	Craft Design	60%	40%			100%
5th group:	Die Dromedar	80%	60%			**140%**
7th group:	KITT	80%	60%			**140%**
10th group:	Nico's Angels	60%	40%			100%
11th group:	Pinpoint	80%	20%			100%
12th group:	SHIFT	40%	20%			60%
13th group:	Shifting	40%	20%			60%
14th group:	Snabb	60%	40%			100%
15th group:	Strategic Cookie	40%	60%			100%
19th group:	Utopi	40%	20%			60%
20th group:	Xtrovert	80%	40%			120%
2nd group:	Cayak			60%	60%	120%
3rd group:	Cilly5			60%	40%	100%
6th group:	Hip'po			60%	60%	120%
8th group:	MforN			80%	60%	**140%**
9th group:	NACK			20%	60%	80%
16th group:	Studio030			60%	60%	120%
17th group:	Sugar Power			20%	40%	60%
18th group:	The Workshop			40%	80%	120%
Total scores		720%	460%	400%	460%	
Average target achievement		**60%**	**38.30%**	**50%**	**57.50%**	

Another interesting finding was that every student group (independent from the approach they applied) developed diverse, but *adaptable* interior designs, which could be changed in such a way to accommodate all different moods of the future space user. The results of the inside-out and outside-in groups did not display marked differences in the total numbers of activities and technology features that they incorporate d in their designs (see Table 35). Despite that it needs to be mentioned that all students had a high focus on users in their university courses, which makes it difficult for this group to perform a real outside-in approach. Summing up the groups applying the inside-out approach found 18 activities and 31 technology features, while the groups applying the outside-in approach identified 22 activities and 26 technology features in total. On average both groups created some 7.63–7.75 activities and 7.66–8 technology features (see Table 35). This could be an indication that the same level of inventiveness, creativity and user-centredness were found in both approaches.

Table 35: Comparable chart with numbers of activities and technology features

Approach	Number of activities – types of interaction	Number of technology features	Average activities – types of interaction per group	Average technology features per group
12 groups applying the inside-out approach	18	31	7.75	7.66
8 groups applying the outside-in approach	22	26	7.63	8

Table 36 lists the three most chosen activities and technology features created by each group. Again, both groups show similar outcomes. **It can be seen that the inside-out and outside-in approach that is applying persona information lead to comparable findings in this field.**

Table 36: Most chosen activities and technology features

Approach	Most chosen activities – types of interaction	Most chosen technology features
Groups applying the inside-out approach	1. In-car storage (9)	1. Autonomous driving (15)
	2. Seamless car charging, parking & maintenance (8)	2. Alternative driving vehicle (9)
	3. Time schedule & business planning (7)	3. Cars as intelligent machine with digital servant (7)
Groups applying the outside-in approach	1. Autonomous driving (7)	1. Autonomous driving (8)
	2. Seamless car charging, parking & maintenance (6)	2. Alternative driving vehicle (7)
	3. Local advisory (5) Mood adaptation & personalization (5) Mobile, flexible and comfortable seating (5)	3. Smart glass (5) Cloud-based system (5)

6.7. Questionnaire results

In this paragraph the results from the questionnaires are described, that the participants had to complete in the beginning and the end of the experiment.

Introducing the student questionnaire

Analysis of question 1: **Student profiles and facts**

Table 37: First analysis of student profiles and facts

Student countries of origin	22 countries (The Netherlands, Germany, the UK, Italy, France, Spain, Portugal, Romania, Bosnia, Slovenia, Turkey, Sweden, Denmark, Canada, Australia, Colombia, Brazil, China, Taiwan, Surinam, India, and Curacao)
Student age range	21–29 years (majority was between 21–23 years old)
Student gender mix	44 female students (48%) 48 male students (52%)
Students obtaining a driver's licence	75 of 92 students (17 students did not correspond to that question)

Students owning a car	10 of 92 students
Students preferring public transportation to driving cars	12 of 92 students

Descriptive information of question 2: **Opinions on today's automobility**
Regarding question 2 (*'What does the automobile of today mean to you?'*) the following answers were given by the students: Today's automobiles mean a place of social exchange, a stressful parking hassle, velocity and fast driving, a good alternative for bad weather, a luxury item, good driving experience and joy, efficiency, dense traffic jams, high costs, privacy and personal space, safety, a medium of transport during holidays and longer distance trips, a lifestyle issue and status symbol, freedom and independence, comfort, and finally, a functional medium of transport to drive from place A -> to B (see Figure 34–35). After having collected all answers they were enumerated and classified. This procedure took place in the same way for question 3 and the subsequent questionnaire. Question 2 revealed that for 18 out of 92 student the car was termed a functional medium of transport (20%), and a convenient object of comfort (11%). Moreover, they pointed out that in their current life situation of being a student—having less money at their disposal and getting a free monthly ticket for public transportation (does only struck the Dutch students)—the car does not play a central role in their life yet:

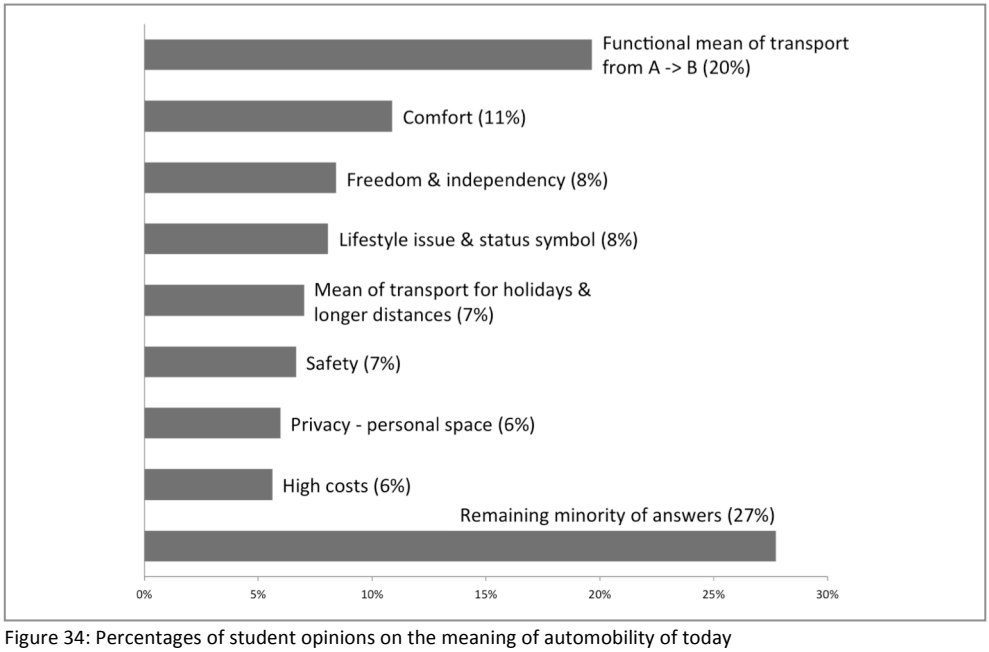


Figure 34: Percentages of student opinions on the meaning of automobility of today

The most rated answers also showed that the car neither fascinated them excessively nor signified something extremely emotional to them. Figure 34 illustrates the eight most-rated answers the students chose: From 20% (equivalent to 18 persons) until 6% (equivalent to 6 persons).

Descriptive information of question 3: **Opinions on future automobility**
Regarding question 3 (*'What role should the automobile play in future urban contexts in the year 2030?'*) 28% equivalent to 26 out 92 students mentioned that in future the car is a functional medium of transport to them (see Figure 35). Second, 24% equivalent to 22 out of 92 students that want the future car to embody sustainability and environmental friendliness. One of the students, Karthik V., 23 years old from India wrote for instance: *'The car of tomorrow in an urban context should be a powerhouse of information with low carbon footprint and energy consumption.'* Besides this (in the remaining minority of answers of Figure 35), they mentioned that the future automobile should adapt to the outer urban environment, respect ethical issues, be connected and interactive, have some added values, be an automobile office, be personalizable, be a sharing vehicle, and offer personal space.

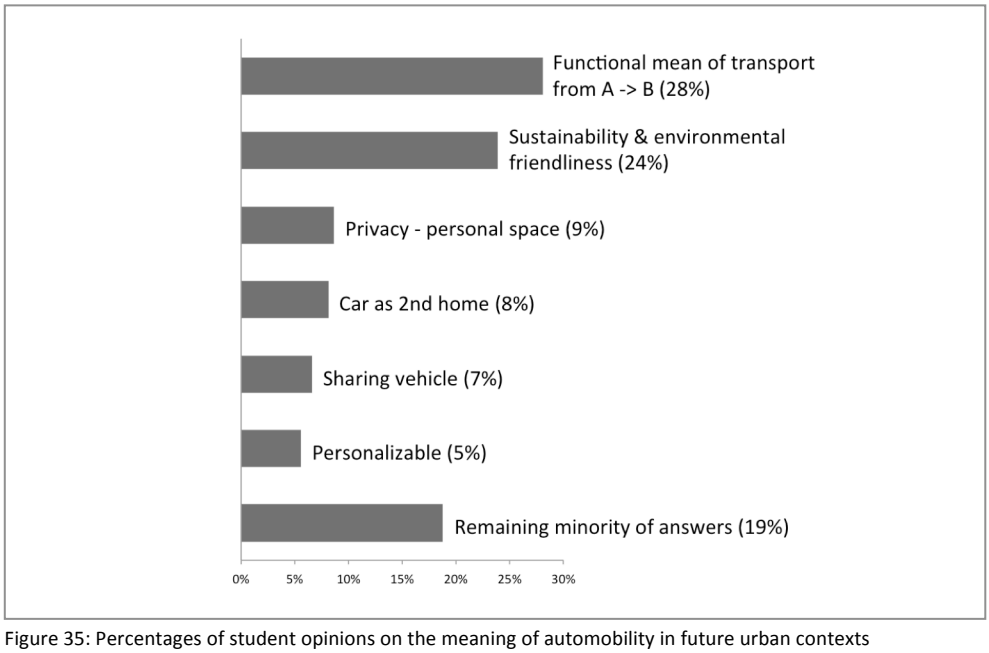


Figure 35: Percentages of student opinions on the meaning of automobility in future urban contexts

The answers made clear that a car is not representing a symbol of freedom to them anymore, as it is also mentioned by Florida [2012_b]. Their ultimate goal was to comfortably reach a certain place in time. This outcome showed a difference compared to former generations, who still consider the car as a major status symbol instead of a daily convenience (Froitzheim 2015). 8% of the students would love to use a vehicle to feel at home, but they had no ambition to own this object or care for it. For instance, Amy, 23 years form the Netherlands thinks that *'The future car should provide more than driving you from Point A to Point B. It should feel like a second home and be interactive (It should feel like being one with nature).'* Also 6 out of 92 students (7%) mentioned that a vehicle should be a pure sharing product. Sophie T., 22 years old from France believed that *'The car should be a part of the architecture of a city. A shareable save place that consumes less parking lots.'* Brian B., 22 years from Italy said: *'I personally think they will have the role of person-*

al taxis. And outside cities, they will be replaced by more massive but still 'on-demand' transportation systems...'

Closing student questionnaire

After having executed the student project, the previously applied questionnaire was distributed for a second time.

Descriptive information of question 1: **Student profiles and facts**

Table 38: Second analysis of student profiles and facts

Students countries of origin	22 countries (The Netherlands, Germany, the UK, Italy, France, Spain, Portugal, Romania, Bosnia, Slovenia, Turkey, Sweden, Denmark, Canada, Australia, Colombia, Brazil, China, Taiwan, Surinam, India, and Curacao)
Students age range	21–29 years (majority was in-between 21–23 years old)
Students gender mix	44 female students (49%) 45 male students (51%)

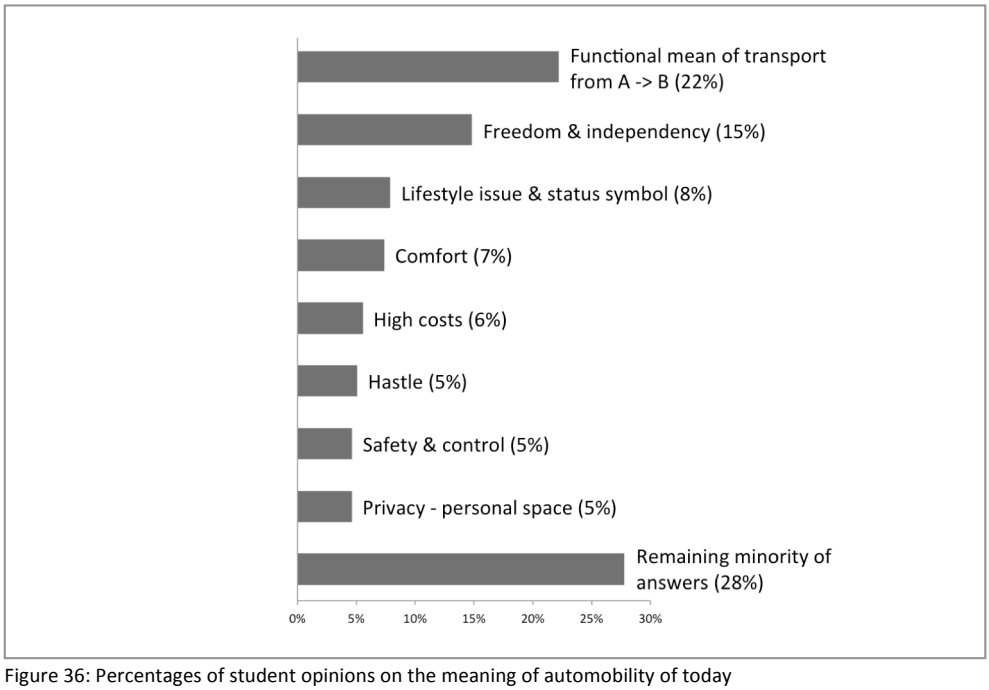


Figure 36: Percentages of student opinions on the meaning of automobility of today

Descriptive information of question 2: **Opinions on automobility of today**

Regarding question 2 (*'What does the automobile of today mean to you?'*) the main issue that the car is a functional medium of transport to drive from Place A -> to Place B was comparable to the results of the questionnaire before the test was done (see Figure 36). The only remarkable point was that the issue of freedom and independence the vehicle offers to its driver climbed up to the second place (15%, instead of the former 8%). Besides that, the comfort issue lost some approval rates (from 11% to only 7%) and went

from the second to the fourth position. It was found that the students loved the positive aspects of a car, such as reaching new places in a fast and comfortable manner. But all the negative points did not make it worthwhile for them to have the privilege of an exclusive use. In fact, this age group represents a new generation of carsharing users who want flexible mobility options, instead of a singular car ownership.

Descriptive information of question 3: **Opinions on future automobility**
Regarding question 3 (*'What role should the automobile play in future urban contexts in the year 2030?'*) it became evident that the students considered themselves as informed semi-experts willing to share their knowledge with others. In contrast to the first questionnaire, the second one shows a rather disaggregated field of opinions co-existing next to each other. Thus, the student statements became more diverse in their variety and less distinct in the role the automobile might play within urban environments (see Figure 37).

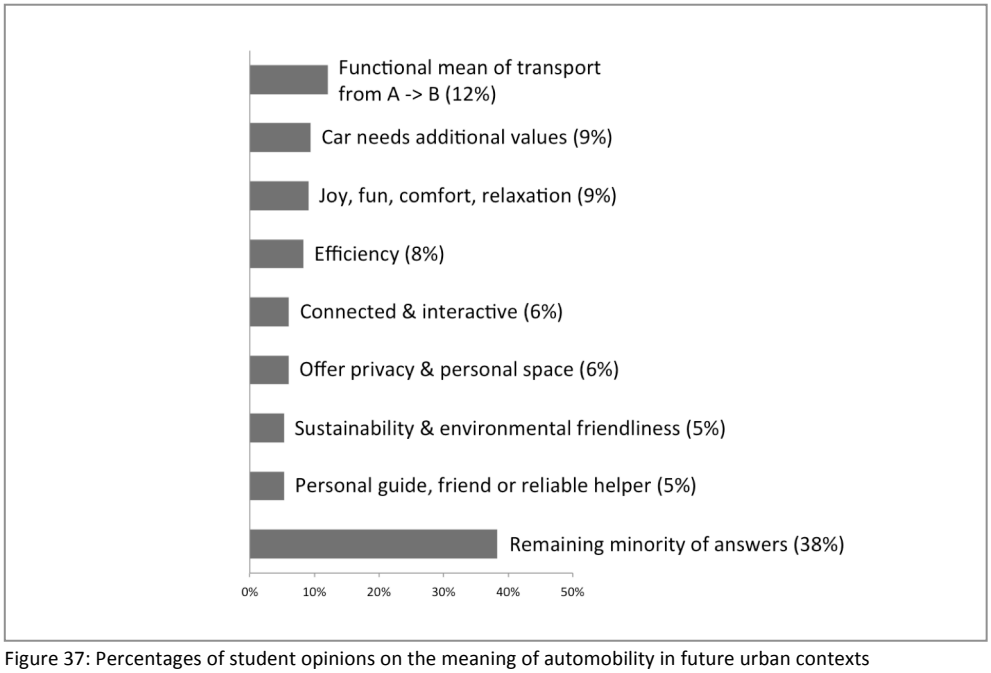


Figure 37: Percentages of student opinions on the meaning of automobility in future urban contexts

The classical first place (the car being a functional mean of transport) remained but continued to lose support (11%, instead of former 28%). A remarkable point is that the students answered the second question from their personal points of view, while they did not do so for the third question. It reveals that the students were aware of their own position while emphasizing the position of the DBN. 5%, equivalent to 5 persons out of 89, mentioned that to them the car is a personal guide, friend or reliable helper. For instance, Tong L., 22 years from China confirmed this fact in writing: *'The urban automobile of the future will be a proactive servant.'* Sophie T., 22 years from France even described that *'a vehicle should be as discrete as it can be.'* In comparison to the first questionnaire, the students turned into a more thought-provoking status in the second one, by thinking about the detailed conditions within the vehicle interior. 6%, equivalent to 5 students

wrote that the future vehicle should offer personal space and a higher level of privacy to the user. Catalina, 32 years from Colombia mentioned that they *'…should offer personal space for storage while stopping-over at multiple places and doing things on the go.'* Also for 9%, equivalent to 8 student opinions, future automobility has to follow different and more subordinated guiding values. Jeske N., 22 years old from the Netherlands sums it all up in saying that the automobile *'…should be a friend, a home, and a house. It should welcome you, help you and guide you through unknown areas.'*

Summary

By comparing the two questionnaire results it shows that the students transformed from someone who had no clue about cars at all into semi-experts able to understand the current market situation. They were able to diversify between their personal opinion on cars (see second questionnaire, question 2) and their objective view on future developments (see second questionnaire, question 3). This development was considered rather impressive because of the car's high degree of complexity.

6.8. Discussion

The experiment analysed two different design approaches and its effects regarding the final automobile product.

User innovativeness of inside-out groups

The aim was to find out whether the inside-out or outside in approach inserts more user-centred innovations into the NPD process. Therefore four different criteria had to be considered (see Table 32). The 12 groups using the inside-out approach reached an average of 60% in meeting criteria 1 and 2, and 38.3% fulfilled the criteria 3 and 4 (see Table 34). It can be seen that the students met the interior-focused topics with an increased percentage (see criteria 1–2) but bore the exterior or content-related topics much less in mind (see criteria 3–4).

Inside-out groups focussed more on individual user needs

Most of the student groups using the inside-out approach applied a nearly transparent, glassy exterior that approximated the interior closer to the outer context, but erased the exterior existence almost completely. An example for this is the work of group 5 (see Figure 32). **Thus, it appears that the inside-out approach results focussed more on the awareness for real user needs and increased the chance of product integration within the automobile interior than the outside-in approach.**

User innovativeness of outside-in groups

On the other hand, from the eight groups applying the outside-in approach, 57.5% achieved the task of fulfilling questions 3 and 4 (exterior criteria), while 50% fulfilled questions 1 and 2 (interior criteria) (see Table 27–Table 34). When applying the outside-in approach, the interior and exterior tasks were achieved in a similar accomplished manner. **Summing up, there is an indication that the inside-out approach is more suitable for reaching a superior level of the automobile interior conception. Meanwhile the outside-in approach achieved a balanced result in both disciplines.**

General inventiveness of student groups is comparable

Both groups reached a comparable level of inventiveness concerning the number of created activities and technology features (see Table 35). On average both groups invented some 7.63–7.75 activities and 7.66–8 technology features. **This could be an indication that the same level of inventiveness, creativity and user-centredness was found in both approaches.** Also Table 35 lists the same or analogous type of the most chosen activities and technology features. The two groups do not differ clearly from each other.

The persona application led to a general user focus

Both approaches applying persona information lead to comparable findings in the automotive field. The students accomplished to meet the full persona-specific needs in their concept designs, independent from their applied approach. Based on the former research a larger difference could be expected by applying the two different approaches. This might be caused by the fact that all students had a likewise education and level of development. Both groups were equally mixed according to their gender and cultural background and they received the same design brief and briefing. Despite these similarities between both groups a difference was found. **The quality of each approach's execution differs from one to the other** (see Table 34).

Up to the moment the student designers were in touch with some target group insights, they intuitively involved also some human aspects when applying the outside-in approach. It is supposed that the exemplary illustration of personas stimulated the designer to apply user-centric content in their designs. When this is the specific aim of the product development, it might be expedient to even strengthen this point of exploring target group-specific problems and life circumstances before the designer starts to take up formgiving designs. One proposal is, to give the designer additional time and budget in the future NPD process, independent of any approach or strategy they apply.

Well performing groups were successful no matter what approach they applied

On the other hand at Table 34 it can be seen that the scores of the 5th, 7th, and 8th group were persistently high with a total score of 140%. These well-performing groups met the brief criteria, no matter what type of approach they followed (here: the inside-out and outside-in approach). **Therefore it is considered that the first aim of any OEM should be to form the 'best designing teams' for reaching the best quality outcomes possible.** The topic of how to identify or create these 'best teams' is excluded from this research. Here it is defined as the best performing team that met the criteria of the design brief.

To proceed with these insights and the discussion of Section 3.3 towards concrete NPD process improvements, an exemplary concept design system needs to be developed. The aim is to create a functional work tool, a systematic approach that helps to map atmospheric interior states in form of concrete space activities and technology features.

CHAPTER 7 – CONCEPT DESIGN CREATION

The student concepts showed that interior flexibility is important to facilitate the wide range of user activities. The 20 groups detected that the automobile interior needs to transform into a 'second, third and even fourth place' – a multiple use location within the future urban environment (see Section 0). As part of the experiment a need was identified to design future cars for DBN's that offer various space states – so-called modes. A space mode describes an all-over spatial situation or atmosphere within the automobile interior that contains different space activities and technology features. It consists of functional aspects as well as atmospheric components.

The groups identified up to 22 vehicle activities such as in-car storage, or a time schedule & business planner and up to 31 technology features like autonomous driving, or a digital servant technology to satisfy the users spatial needs (see Table 35). In order to implement these, modifications in the design process are necessary. This means in turn that the design process organization will be more complicated and should be brought forward in the process stage. Derived from the student experiments outcome, the aim is to create a conceptual interior design that is applicable at the fuzzy front-end of NPD.

Fügener thinks that the interior design department has not yet participated at stage 1-2 of the fuzzy front-end design process of NPD (see Figure 5 and Figure 6). Therefore a new mode of organizing interior content needs to be found (see Point 13 of Table 12). This content will be important to create a strategic design brief for the formgiving designers at the draft design phase in Figure 6 where the interior and the exterior design meet for the first time in the design process (see Point 13 of Table 12). Fügener and Anonymous 1 mention that even today the communicational aspect challenges the interior specialist field (see Point 2 and 3 of Table 12). One can estimate that this new constellation will require an exchange of opinions, by which future communication needs to increase. The sum of these changed conditions marks a new starting point for both specialist fields – the exterior and the interior design within the transportation design department. To proceed with these insights concerning the NPD process and design brief improvements, a methodical concept design tool needs to be developed. This tool stimulates discussions in the early design phase regarding how the ultimate concept design can be achieved.

7.0. Method

As an exemplary space concept the proportion of a compact size car (e.g. Mercedes-Benz A-class) is used as a standard layout. The outer measurements of the vehicle are 3575mm (length) x 1719mm (width) x 1575mm (height). There are limits as to how much the seats can be moved within the automobile interior, as an active driving situation with a front seat and steering wheel had to be guaranteed. Consequently, the seating position represents a central point of reference in the allover design layout.

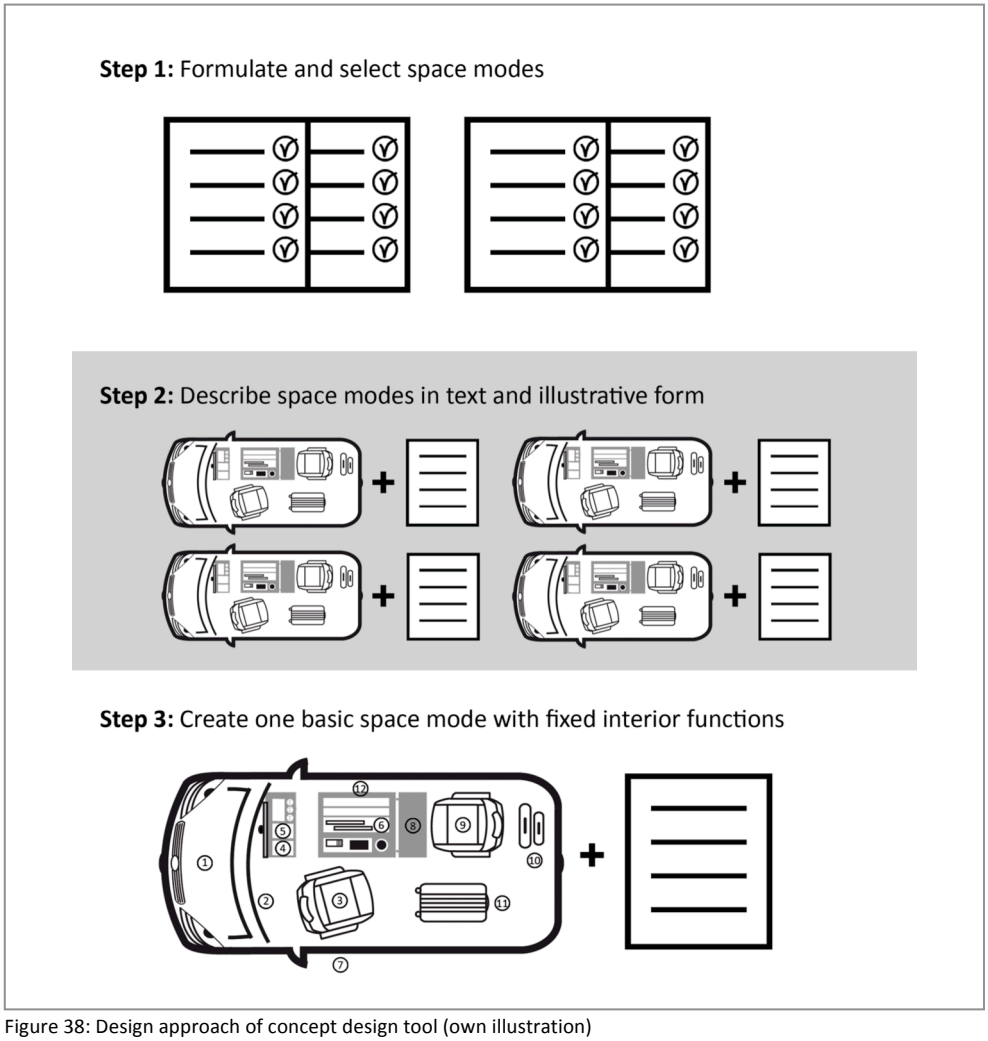


Figure 38: Design approach of concept design tool (own illustration)

This research looks for a way to elaborate different atmospheric states that were created out of the identified space activities and technology features. A three-step design approach is described in Figure 38. First, all space modes were named, listed and ranked according to its number of nominations within the student works. The most nominated eight modes and detailed settings were chosen, further elaborated and described. Each mode

was illustrated in a functional layout as well as described in text form. Finally, one basic space mode was created that incorporates the most important characteristics of the eight previous parameter specifications in one central space concept. This mode marks the conceptual ground for future automobile content to be developed, prior to any styling and formgiving activity within the fuzzy front-end phase.

7.1. Procedure

According to Figure 38 the modes and their corresponding activities and technology features are elaborated as follows:

Step 1: Formulate and select space modes
The space modes were counted in all 20 student group outcomes (see App. Table 68), and each mode consists of the sum of space activities and technology features. If a mode was mentioned more than five times, it was selected for this study (see Table 39). According to the group nominations a range of the eight most applied modes with at least five nominations were chosen. These eight modes are described and grouped into affiliated themes. Then all experiment activities and technology features of App. Table 66–67 are listed in Table 40 to give each space condition its individual characteristics and specifications.

Step 2: Describe space modes in text and illustrative form
Each individual mode is described in text and pictorial form by explaining first the mode activities and technology features. Then follows an explanation of its specific space mode characteristics and atmospheric conditions. Finally each space mode is illustrated within a standardized vehicle layout.

Step 3: Create one basic space mode
Every vehicle function that found an iterated placement inside the vehicle interior is listed in Table 41. They are based on an analysis of the 20 student designs. Its most applied interior functions are placed inside the basic space layout and marked by a number. All of these numbers are described in Figure 47 and Table 43 according to its functions and atmospheric characteristics. This layout concept represents the central base of communication – the design brief for the later formgiving design in NPD.

7.2. Space modes creation

The student group outcomes were scanned according to all types of possible space modes that were proposed from them. The identified modes were listed in App. Table 68 and universally named. 14 joint modes could be identified. To better handle the subsequent mode processing, only modes with at least five nominations were selected. Table 39 highlights the resulting 8 modes that will be further elaborated and described.

Table 39: Identified space modes

Name of space modes		Number of nominations
Mode 1	Individual working mode	15
Mode 2	Business meeting mode	14
Mode 3	Relaxation & stress release mode	11
Mode 4	Power napping & sleeping mode	8

Mode 5	Manual driving mode	7
Mode 6	Refreshing & dress-up mode	7
Mode 7	'Feeling like home' mode	5
Mode 8	Practising sports & healthy lifestyle mode	5
Mode 9	Emergency mode	4
Mode 10	Dining room mode	3
Mode 11	Privacy mode	2
Mode 12	Space neutralization mode	2
Mode 13	Automated pick-up service & parking mode	2
Mode 14	Mobile toilet mode	1

Table 40 shows each mode's individual characteristics out of the corresponding experiment's activities and technology features. These give each mode an individual expression and form their profile.

Table 40: Space modes formation out of activities and technology features

	Activities	Mode							
		1	2	3	4	5	6	7	8
1.	Activity modules (sports, music etc.)			X			X	X	X
2.	Automated driving/pick-up service		X	X	X		X	X	X
3.	Digital communication & social networking		X	X	X	X	X	X	
4.	Disposal space (bin etc.)	X	X	X	X	X	X	X	X
5.	E-learning & mental challenges	X				X			X
6.	Local advisory			X		X	X	X	X
7.	Mood adaptation, personalization, persona fit			X	X	X	X	X	X
8.	Outer look & style modification		X	X	X	X		X	X
9.	Physical movements & sports			X					X
10.	Privacy situation/issue (darkening window)	X	X	X	X		X	X	X
11.	Rotating, mobile & flexible comfort seating	X	X	X	X		X	X	X
12.	Safe storage	X	X	X	X	X	X	X	X
13.	Seamless pc and iphone charging	X	X	X	X	X	X	X	X
14.	Storage	X	X	X	X	X	X	X	X
15.	Temporary vehicle lock/un-lock	X	X	X	X	X	X	X	X
16.	Time schedule & agenda planning	X	X	X	X	X	X		X

	Technology features	Space mode characteristics							
1.	Autonomous, accident-free driving & pick-up service	X	X	X	X		X	X	X
2.	Automated coffee cup stabilization	X	X	X		X	X	X	X
3.	Augmented reality	X	X	X				X	X
4.	Cars drives electric/bio fuels etc.					X			X
5.	Car-to-x & car-to-car communication	X	X	X	X	X	X		
6.	Cloud-based communication system	X	X	X			X	X	
7.	Efficient energy use					X			X
8.	Energy recuperation system					X			X

9.	Engine placed inside of wheels					X			
10.	Ergonomical driving balance	X	X	X	X	X			X
11.	GPS-tracking system	X	X			X			X
12.	Interactive data table (IDT)	X	X						X
13.	Interactive data screen (IDS)	X	X						X
14.	Interactive gesture & voice control	X	X	X	X	X	X		X
15.	Key through iris/finger scan	X	X	X	X	X	X	X	X
16.	Light weight materials & nanotechnology					X			X
17.	Machine intelligence with digital assistant	X	X	X	X	X	X	X	X
18.	OLED-technology	X	X	X		X	X		X
19.	Privacy/darkening window	X	X	X	X		X	X	X
20.	RFID-technology	X	X	X	X	X	X	X	X
21.	Seamless battery charging & car parking	X	X	X	X	X	X	X	X
22.	Seamless communication system	X	X	X		X	X	X	X
23.	Seamless pc, ipad & iphone charging	X	X	X	X	X	X	X	X
24.	Shape shifting, sensitive & interactive interior	X	X	X	X	X	X	X	X
25.	Sharing system	X	X			X			
26.	Smart glass	X	X					X	X
27.	Solar rooftop					X			X

Space modes description with detailed characterization

Each of the eight space modes includes specific space situations, functions, and atmospheres that define a particular automobile interior situation. Each mode is divided into the categories of mode activities and technology features, space mode concept characteristics, and atmospheres.

Mode 1 – Individual working mode

The individual working mode describes a solitary automobile work situation for one to maximum two persons in a private atmosphere. These persons are withdrawn from the outer world into an encapsulated, quiet space that offers data access, work tools, and conversation confidentiality. This space offers a higher level of intimacy than any public space. The term 'working' means that users can carry out their work on the pc or by hand, use a flat surface as the writing area, charge wireless electronic devices, and have trustworthy wifi access everywhere.

Mode activities and technology features: The advantage of this status is that travellers can handle confidential work on their pc such as concluding client presentations, actualizing their agendas, or making telephone calls while being fully protected from the outer public environment. The DBN wants to charge all his working tools and personal gadgets simultaneously while he works there. The interviewees stated that the users want standardized plugs at their personal disposal to charge all their tool batteries. But the environment can also be used for social networking to keep in touch, informing the community about something, posting their status, or checking the agenda for their spare time plans.

Space mode concept characteristics, and atmosphere: The user needs to be able to step in and out of the vehicle, and move without hindrance inside the space to have direct access to storage units and work surfaces. Additionally, this interior state contains one to two comfortable fold-out, rotatable seats, with a functional and generously spacious open placement surface (a full table is not necessary), an integrated professional working light, a huge screen, various charging options, free wifi with cloud access, an integrated paper bin, and an additional printing option completes the actual user's wish list. Absolute privacy can be accomplished by pushing a button to make the glass surface a non-visible zone. An automated space pre-conditioning and air quality control are also basic space requirements of this mode. The integrated cooling box, containing water and little snacks, and the integrated cup and bottle holder are highly appreciated by the target group. Finally, a temporary safe storage box, such as an invisible safe (invisible from the outside view), has been integrated so that the user can temporarily leave the car without carrying luggage (see Figure 39).[47]

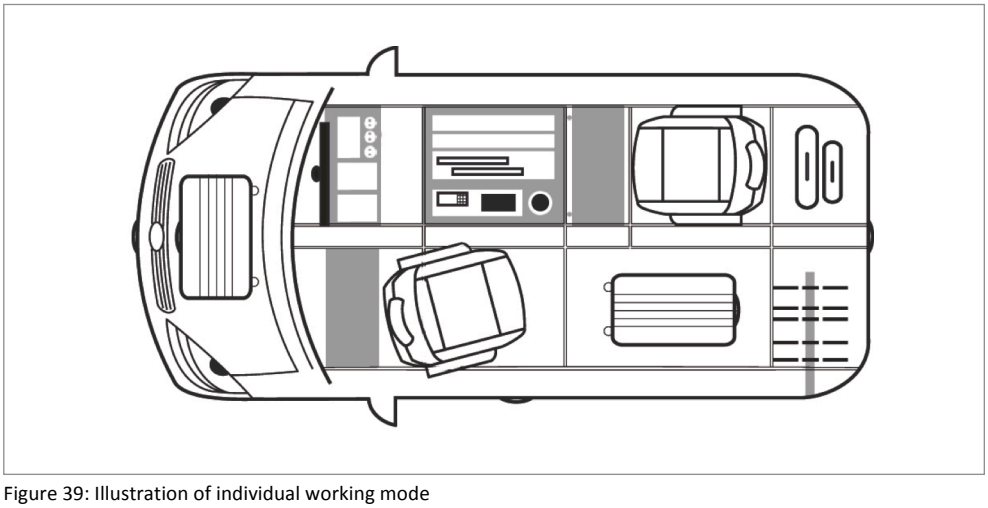


Figure 39: Illustration of individual working mode

Mode 2 – Business meeting mode

In case, two colleagues or business partners want to meet, a small and spontaneous conference or informal meeting of a maximum of three persons can be arranged within the automobile space.

Mode activities and technology features: In this mode, users can meet to join a telephone or video conference, or prepare for a future client meeting together. Therefore, wifi access and the possibility to seamlessly charge several devices at a time while being comfortably seated are obligatory features. The majority of interviewees stated that they are still dealing with physical paper work, such as business contracts or concert tickets, and therefore need a flat surface for doing paperwork, as well as placing a pc and other

[47] A conventional car design layout with the engine compartment at the front side was used. It was assumed that the electrical engine would be placed there to offer the maximum of space capacity at the rear side. These illustrations do not want to style the proper automobile look but rather define the functional areas of usage.

items. Integrated water and coffee cup holder, a cooling box for water and little snacks, a paper bin and a printing option are also considered necessary features. Finally, the adequate pre-conditioning of space temperature and air quality inside the automobile interior represents a basic requirement of the business meeting mode too.

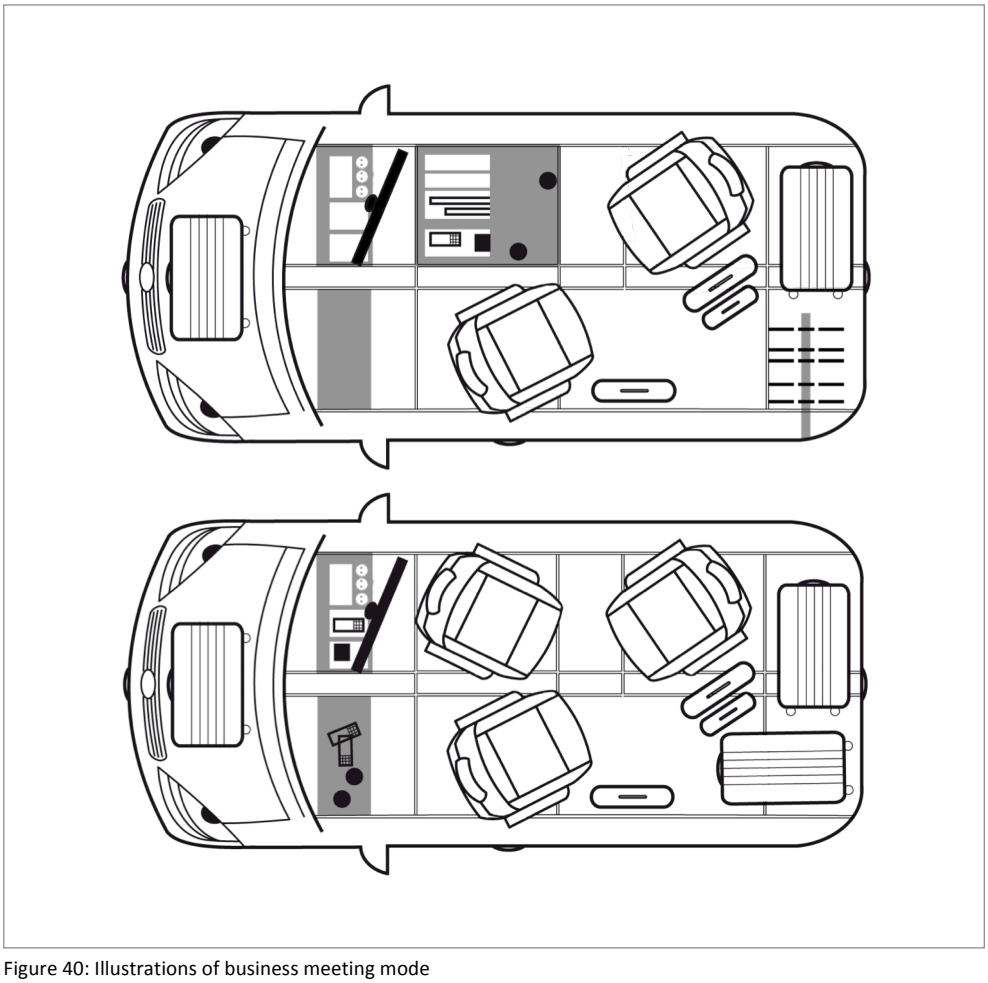


Figure 40: Illustrations of business meeting mode

Space mode concept characteristics, and atmosphere: For doing so, user need the possibility to easily step in and out of the car altogether and store their trolley and other luggage behind. They need to have sufficient colour-neutral working light as well as the possibility to adjust diverse atmospheric light scenarios to transform the space into different types of meeting atmospheres. The business meeting mode offers comfortable fold-out and rotatable seats where all conversational partners will face each other in a circular constellation without any priority or status position. With the introduction of autonomous driving, the traditional space concept will be suspended, and makes it possible to create non-hierarchic alternatives of seat constellations. This means that all seats are ranked equal in their functional design. For supporting contemporary communication, high-

quality space acoustics with a smart speaker system and an integrated screen or a projector are required (see Figure 40).

Mode 3 – Relaxation and stress release mode

This mode offers recovery possibilities for physical and mental health to a single person within the automobile interior. During the use of this space mode, the DBN can relieve himself of travel, business, or private stress through an effectively isolated space that is completely protected from the outer environment.

Mode activities and technology features: As the users relax preferably in a horizontal position, an adequate situation in form of a daybed with reclining backrest has been created to reach the ultimate relaxation effect. They can listen to recreational music, enjoy a hot stone or cooling massage with fitting light, and scent scenarios that will activate their five senses. In addition, users can reduce their stress levels by meditating or performing yoga on the automobiles own mat on the vehicle floor. They may also exchange their business outfits with private or sporty clothes within the visually protected interior and hang it on the corresponding coat hangers.

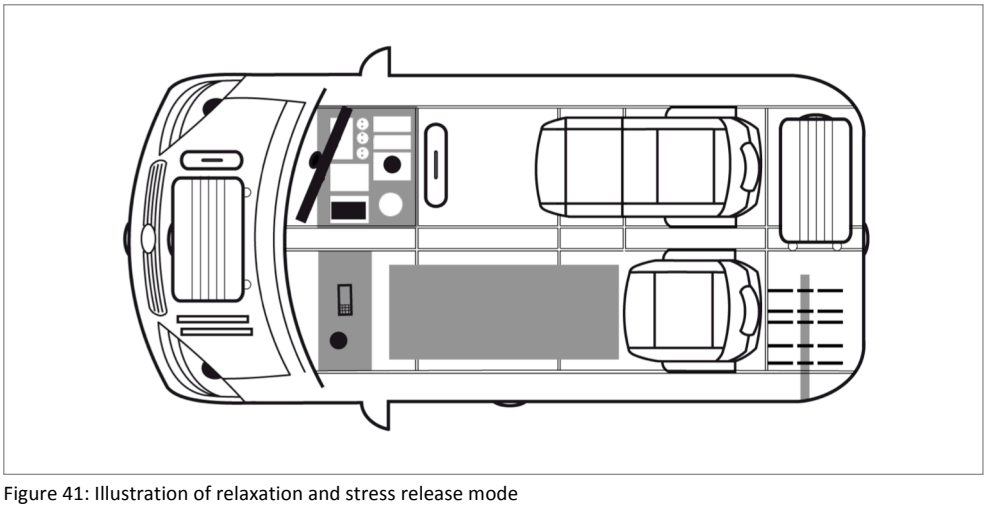


Figure 41: Illustration of relaxation and stress release mode

Space mode concept characteristics, and atmosphere: The automobile interior offers sufficient free space to transform an average seat into a professional massage lounger. The user can relax in a horizontal position with integrated footrest, enjoying a personalized scent, his music collection, atmospheric light, sun protection, and good air quality. Upon request, books, magazines, or newspapers can be delivered to the user's automobile, regardless of where it is, via an exclusive concierge service. While the user is resting, all personal tools can be charged and luggage stored. Completely blocked wifi or telephone devices guarantee an undisturbed relaxation within his urban oasis (see Figure 41).

Mode 4 – Power napping and sleeping mode

This mode offers the possibility to enjoy a 10 to 40 minute power nap or even longer recovery sleep in absolute darkness and silence. As many business travellers need to span some time in between and gather new energy for the next demanding business meeting, this mode can help them to overcome time gaps and bridge different time zones.

Mode activities and technology features: The power napping and sleeping mode and the relaxation and stress release mode can be used while the automobile is parked or moving autonomously. Thus, absolute noise isolation and eliminating any disturbances, digital as well as environmental, is obligatory. With the vehicle interior not visible from the outside, users can change clothes or carry out daily grooming activities such as applying make-up.

Space mode concept characteristics, and atmosphere: To enable users enjoying a more comfortable sleep, an additional pillow, neck pillow, and blanket are offered directly next to the lounger. The user can apply a facial mask with cooling gel, activate lulling music or an audio book, and adjust their preferred sleeping temperature for falling asleep in an easy manner. Besides the simultaneous charging possibilities of devices**,** in this mode, every wifi or telephone connection is blocked (see Figure 42).

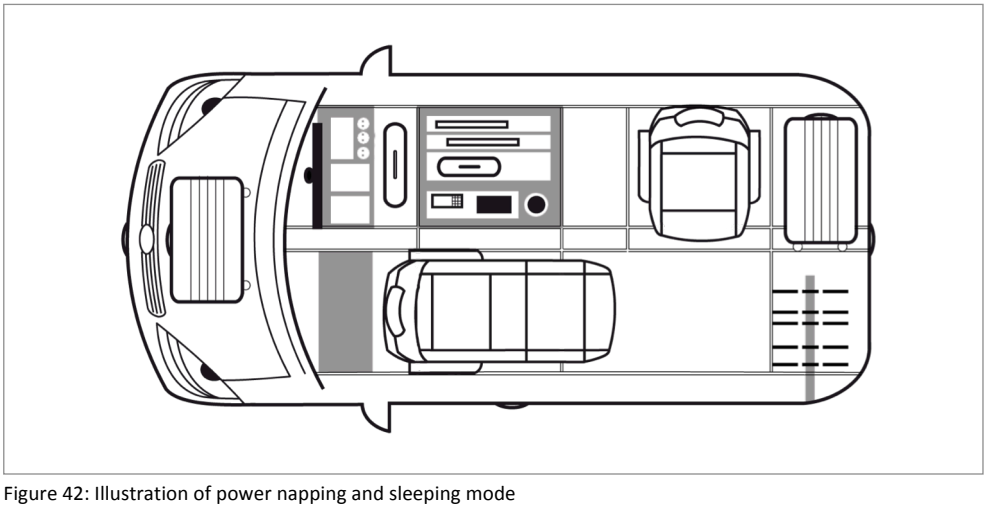


Figure 42: Illustration of power napping and sleeping mode

Mode 5 – Manual driving mode

This space condition addresses the usual situation of a user who still drives manually the automobile. In the future, the user is likely to have more assistance systems at his disposal compared to the present. However, driving will not yet be an autonomous act, as the user is most likely responsible for all actions. This mode describes the moment of finding the car, entering the space, loading, organizing luggage, and adapting the driving facility to the user's size, comfort, and personal needs.

Mode activities and technology features: While the urban car of the future is expected to run on electrical power, manual driving is considered a sporty activity, which means fun

and joy for the driver. As there will be many different road users such as walker, fellow cars, bicycle- and scooter driver on equal terms, the manual vehicle driver needs support in obtaining a free circumferential 360° visibility. In case the driver needs a break he may change from the active driving mode into the autonomous one.

Space mode concept characteristics, and atmosphere: Because of energy savings, the automobile should be lightweight and offer a good engine performance to make it fun to drive within the urban areas. Moreover, the navigation system should be able to plan smartly and reliably, figure out up-to-date routes with least traffic jams as well as the most exciting sightseeing or restaurant spots in town. A circular view and an active-passive driving hand-over management are required as standard features in each vehicle (see Figure 43).

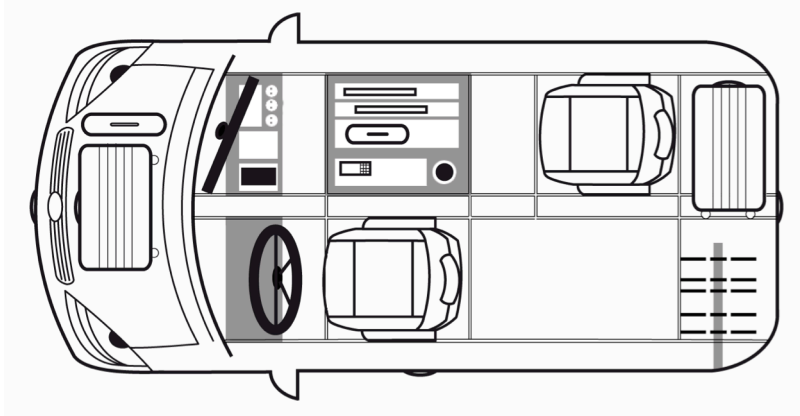


Figure 43: Illustration of the manual driving mode

Mode 6 – Refreshing and dress-up mode

The refreshing & dress-up mode offers the possibility to change clothes and shoes, and to put on business make-up. It is suitable for having a stopover between two business meetings and to change clothes (from business to private style or vice versa).

Mode activities and technology features: One basic requirement is to easily access all luggage pieces from the inside of the car to be able to open them and put some clothing on available hangers. Users need an additional storage area too, to put their shoes and clothes that they have changed out of. For emergencies, such as when a business blouse gets stained, white replacement shirts are stored inside the former automobile glove compartment together with a laundry bag. In addition, a large foldout mirror (at least the size of a laptop) with sufficient lighting, and the rack for organizing a business or evening make-up and some hair styling should be placed inside the vehicle interior.

Space mode concept characteristics, and atmosphere: At least one fold-out rotatable seat at the front row is needed. Additionally, direct access to trolleys and other luggage is necessary to open them on a free surface. Another key requirement is an adjustable sight

camouflage through electrically modifiable vehicle windows to guarantee a maximum of inner space privacy (see Figure 44).

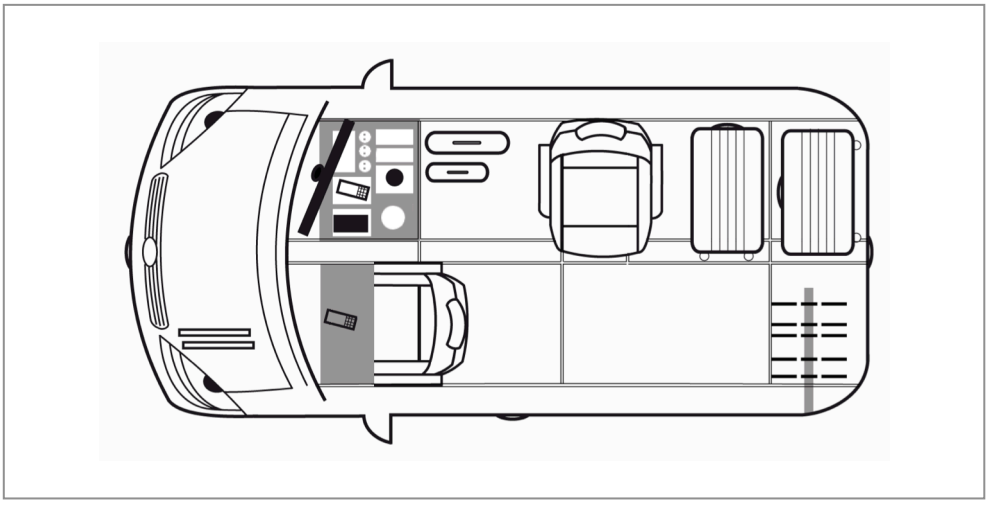


Figure 44: Illustration of refreshing and dress-up mode

Mode 7 – 'Feeling like home' mode

This mode describes the act of feeling individually welcome when arriving at the automobile object and entering the vehicle interior. The importance of this mode should not be underestimated, as it generates positive impressions that can linger in the personal memory for quite a long time.

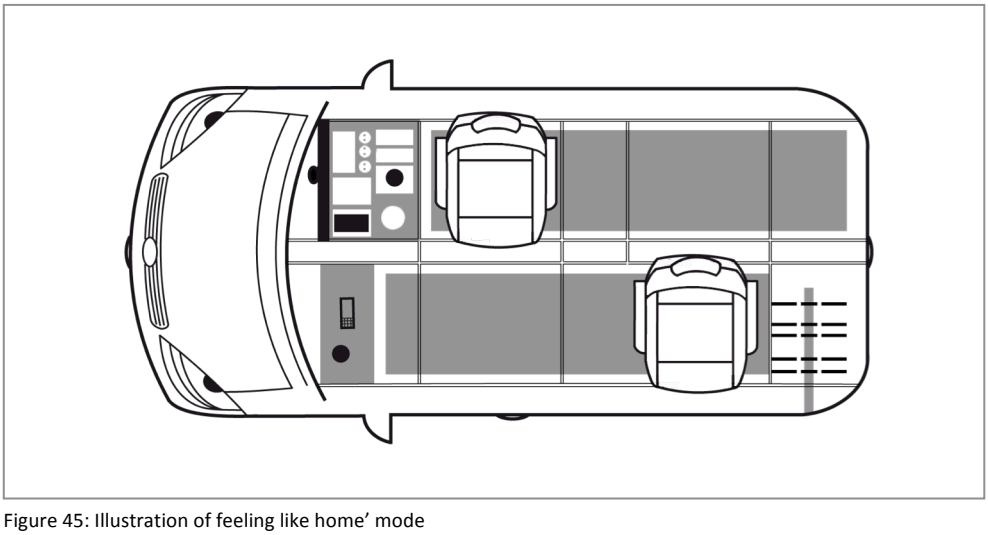


Figure 45: Illustration of feeling like home' mode

Mode activities and technology features: A staff member introduces the vehicle and activates a personal ID for using the mobility service that will be improved by the smart vehi-

cle system later on. He also asks the user about music and room temperature preferences, favoured atmospheric light installations, scent, and seating positions. All preferred adjustments are memorized and activated the next time the user enters the space for gaining a positive first experience.

Space mode concept characteristics, and atmosphere: Throughout the automobile wifi connection every personal user ID and preference can be saved subsequently within the cloud. This enables the user to access his personal music collection, apply an intelligent pre-conditioning temperature, and configure personal lighting and scent scenarios, among others, all around the world.

Mode 8 – Practicing sports and healthy lifestyle mode

This mode illustrates the necessity of maintaining physical and mental health by doing sports and eating wholesome meals. It supports the user in staying agile.

Mode activities and technology features: The automobile offers an (E-)bike carrier and access to guided tours around city parks, with the possibility to spend time in-between at the vehicle interior that provides cool beverages and small snacks in the integrated cooling box. The vehicle also proposes exemplary running routes, followed by community or company's internal ranking lists, and regular running group events with meeting points. The user has the option to book private sport instructors within diverse fields of expertise. During his exercises he can store his luggage and valuable objects inside an invisible safe and storage. Afterwards he has the possibility to return to his personal automobile refuge to change cloth, get refreshed, and to continue working (see Figure 46).

Space mode concept characteristics, and atmosphere: This mode considers exercises and body movement to prevent stress and to find an alternative energy compensation. The vehicle offers diverse possibilities to stay active and stores the sports luggage too.

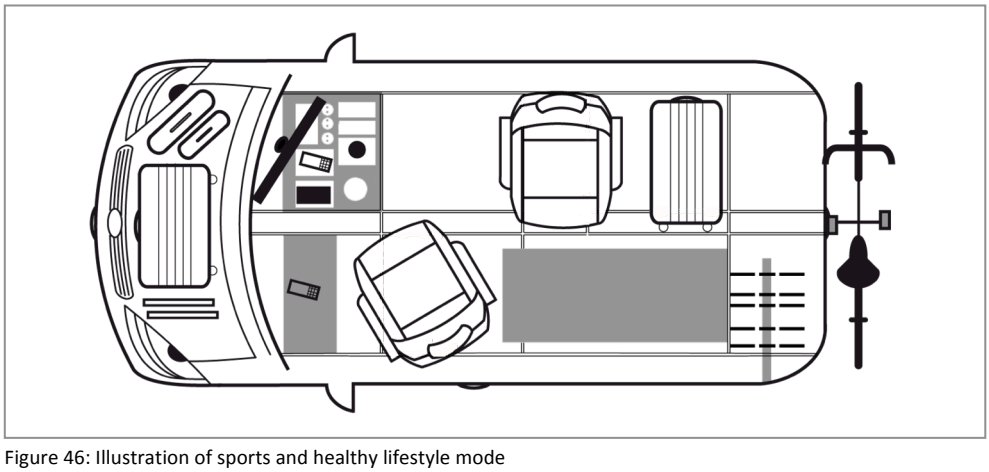


Figure 46: Illustration of sports and healthy lifestyle mode

7.3. Basic space mode creation

The above-described modes with its corresponding activities and technology features are summarized in Table 41. They are organized based on the number of its nominations.

Table 41: Interior functions and features based on the number of nominations

Corresponding interior functions and features	Mode								
	1	2	3	4	5	6	7	8	Number of nominations
One to two fold-out and rotatable sliding seats	X	X	X	X	X	X	X	X	8
Sound and sight isolated space	X	X	X	X		X			5
Shading glass surface	X	X							2
Self-explanatory HMI and space system	X	X	X	X	X	X	X	X	8
Music, telephone, and video conference equipment through the smart speaker system	X	X	X	X	X	X	X		7
Universal plug aggregation, partly via seamless charging	X	X	X	X	X	X		X	7
Free wifi with cloud access	X	X			X				3
Huge foldable screen or projector	X	X	X						3
Huge foldable mirror or screen with rack	X	X	X	X	X	X			6
Sliding doors with capacious entrance without B-pillar	X	X	X	X	X	X	X	X	8
Easy reachable, safe handbag depot at arm's length of the driver's position	X		X		X	X	X		5
Luggage storage without barriers, which is reachable from backseat	X	X	X	X	X	X	X	X	8
Wardrobe space with easily accessible coat-hangers	X	X	X	X	X	X	X		7
Work surface or table	X	X	X	X		X	X	X	7
Directional working light and atmospheric light scenario	X	X	X	X	X	X	X		7
Free circumferential 360° visibility	X	X			X		X		4
Personalization: Just-in-time user profile that matches the smart HMI system, remembers favourite music, atmospheric light settings, scent, space temperature, and seat positions	X	X	X	X	X	X	X	X	8
Printing machine	X	X							2
Space pre-conditioning system of temperature and air quality	X	X							2
Integrated cooling box with water bottles	X	X	X	X	X	X	X	X	8
Integrated cup and bottle holder	X	X	X	X	X	X	X		7
Invisible safe	X	X	X	X	X	X		X	7
Bin	X	X	X	X	X	X			6
Massage lounger			X	X					2
Free space situation (tidied and folded seats)			X				X		2
Personalizable scent			X						1
Access to one's own music collection			X						1
Book, magazine, or newspaper delivery on			X						1

request by concierge service									
Yoga mat			X						1
Facial mask with cooling gel			X	X		X			3
Additional pillow, neck pillow, or blanket			X	X					2
Wifi and device lock-out			X	X					2
Sporty driving and electrically powered vehicle					X				1
Possibility to change temporary from active driving mode into autonomous driving mode					X				1
Foldable steering wheel with HMI and control unit for manual driving					X				1
Just-in-sequence traffic updates of navigation system					X				1
Intelligent sightseeing guide and gastronomy adviser					X				1
Fun tracks and sightseeing route planner					X				1
Reserve storage of women and men's t-shirts, laundry bag offer (in former glove compartment)						X			1
Once-only configuration of personal profile preferences and user ID (with different welcome scenarios and mood settings)							X		1
User recognition (optical signals when user converges and withdraws from the automobile)							X		1
Time tracking (community or company's internal ranking lists)								X	1
Displaying exemplary running and cycling routes								X	1
Informing about regular running events and meeting points								X	1
Private sport instructor booking system								X	1
(E-)bike rental booking system								X	1
Autonomous driving car, picking up the user (technologically not solved yet)								X	1
E-bike carrier								X	1

Table 42 consists of two columns with relevant soft and hard factors. Soft factors are defined as non-haptic issues like atmospheric features, lighting, sound, wifi and scent. All other features are considered hard factors. To narrow down the selection of relevant space functions and features that should be integrated within the final basic space mode, a list with the most congruent issues is created. For the functions and features that are used at least 5–8 times in the space modes, a permanent placement inside the functional layout is found. The more of these functional placements could be defined, the better an automobile basic space mode can be created. Some additional space functions and features are placed in an own section called 'mode-specific priority settings', even when they are not repeatedly applied. They are essential for the function of specific mode activities.

Table 42: Listing of congruent functions and features nominations

Relevant soft factors	Relevant hard factors	Number of nominations
▪ Steady user profile matching through smart HMI system that remembers, and learns fa-	▪ Sliding doors with capacious entrance, and without B-pillar	8

vourite music selections, atmospheric light settings, scent, preconditioned space temperature, and seat positions ▪ Self-explanatory HMI and space system	▪ 1-3 fold-out and rotatable sliding seats ▪ Integrated cup- and bottle holder ▪ Self-explanatory HMI and space system ▪ Integrated cooling box with water bottles	
	▪ Universal plug aggregation partly via seamless charging ▪ Side table or depot surface ▪ Music, telephone- and video conference equipment through smart speaker system ▪ Invisible safe ▪ Luggage storage without barriers and reachable from backseat ▪ Wardrobe space with easy accessible coat-hangers	**7**
▪ Atmospheric light scenario	▪ Huge foldable mirror or screen with rack ▪ Bin	**6**
▪ Sound and sight isolated space	▪ Easy reachable, safe handbag depot	**5**
▪ Directional working light (3) ▪ Free wifi with cloud access (3) ▪ Access own music collection (1) ▪ Wifi and device lock-out (2) ▪ Space pre-conditioning system of temperature and air quality (2) ▪ Shading glass surface (2) ▪ Configuration of personal profile preferences once, and user ID (with different welcome scenarios, and preferred mood settings) (1) ▪ Just in sequence traffic updates of navigation system (1) ▪ Intelligent sightseeing guide, and gastronomy adviser (1) ▪ Fun tracks and sightseeing route planner (1) ▪ Possibility to change from active driving mode into autonomous driving mode (1) ▪ Book, magazine or newspaper delivery on request by concierge service (1) ▪ Personalizable scent (1)	▪ Foldable steering wheel with HMI and a control unit for manual driving (1) ▪ Free circumferential 360° visibility (4) ▪ Facial mask with cooling gel (3) ▪ Additional pillow, neck pillow/blanket (2) ▪ 1 massage lounger (2) ▪ Printing machine (2) ▪ Reserve storage of women/men t-shirts, laundry bag of former automobile glove compartment (1) ▪ Yoga mat (1) ▪ Sporty driving and electrical powered vehicle (1) ▪ E-bike carrier (1)	**Mode-specific priority settings**

Basic space mode illustration

Out of all collected priority nominations one condensed functionspheric[48] basic space mode is created. The functions and features nominated with at least five times within the processed space modes are placed permanently within the vehicle layout, in order to render an automobile standard situation.

Figure 47 illustrates a basic space mode setting, which can be transformed into an original automobile concept. To create a conceptual vehicle layout that can be further used in the design process briefing, 13 functional points are defined (see Table 43) and finally fixed in the basic space mode illustration.

[48] Word invention: The functional sphere is a junction of the terms functional and atmosphere. It expresses the combination of functional aspects together with atmospheric space issues. It is to reach a hybrid space layout corresponding to both of these usually oppositional aspects before any product styling is executed.

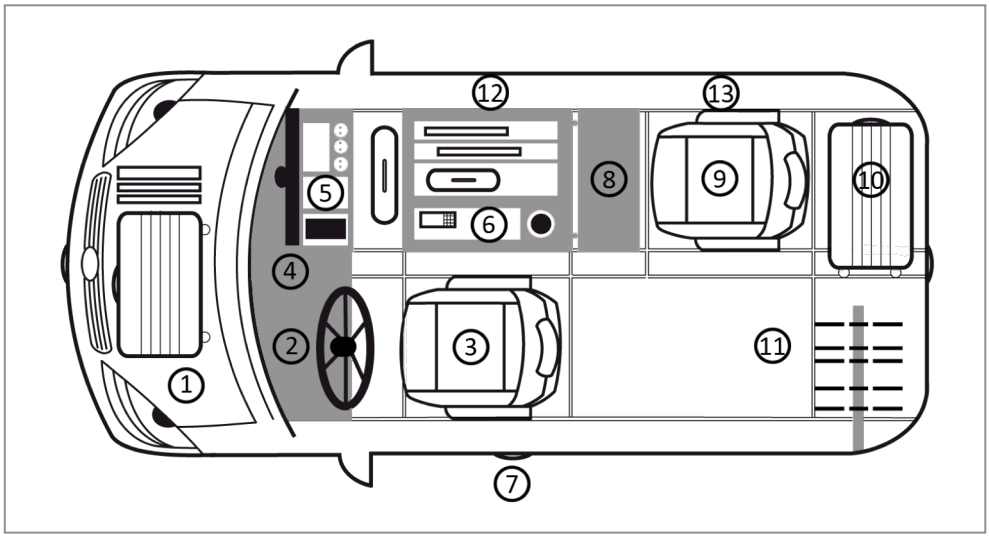


Figure 47: Illustration of basic space mode

Table 43: Description of basic space mode illustration (see Figure 47)

Point of reference	Description of basic space mode settings
1	Spacious luggage storage with net and compartment for heavy and bigger luggage sizes
2	Huge foldable mirror or screen with rack
	Sporty driving, electrically powered vehicle with fun tracks, and various sightseeing routes
	Foldable steering wheel with integrated HMI and manual driving control unit, with just-in-sequence traffic updates of navigation system, sightseeing guides, and gastronomy adviser
3	Free circumferential 360° visibility for the vehicle driver
	Massage lounger while being seated or lying down
	Once only configuration of personal profile preferences and user ID
	Steady user profile matching the smart HMI system that remembers and learns about favourite music selections, atmospheric light settings, scent, preconditioned space temperature, and seat positions
	Sound and sight isolated space with wifi and device lock-out
4	Screen, self-explanatory HMI, and space system
	Music, telephone, and video conference equipment through the smart speaker system with access to one's own music collection
5	Integrated cooling box for bottles and food (no freezer)
	Universal plug aggregation, partly via seamless charging
	Integrated printing machine
	Easy reachable, safe handbag depot
6	Integrated cup and bottle holder
	Invisible safe (in Din A4 size)
7	Sliding doors with capacious entrance and without B-pillar
8	Side table or depot surface
9	One to three fold-out and rotatable sliding seats that might be switched into a horizontal position

	Directional working light
	Shading glass surface
	Free wifi with cloud access
10	Luggage storage without barriers and reachable from backseat
	Foldable yoga mat storage
11	Wardrobe space with easy accessible coat-hangers
12	Bin integrated within the entrance door
13	Reserve storage of women's and men's shirts and laundry bags
	Storage of additional pillow, neck pillow, blanket, and facial mask with cooling gel

7.4. Discussion

A concept design was developed that offers a better orientation and discussion potential to the designers and engineers when designing future vehicles. The method uses the space modes as a descriptive form of space conditions. Figure 47 illustrates the central basic space mode that defines the functional vehicle design. The formgiving designers will apply this basic space mode in stage 2 of the NPD process later on (see Figure 48).

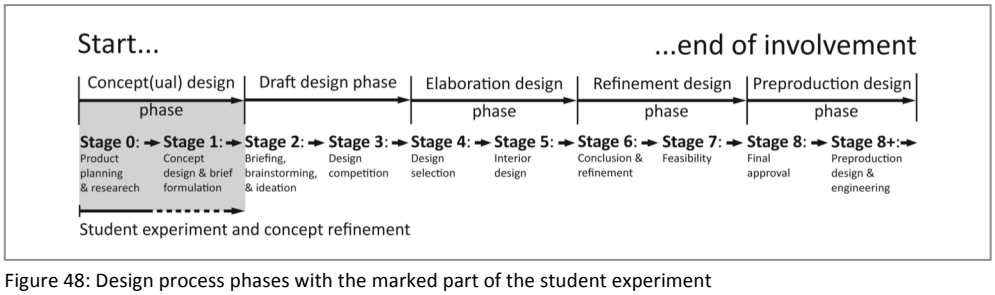


Figure 48: Design process phases with the marked part of the student experiment

The following sections reason the advantages of the conceptual design brief that was developed in this chapter. Thereby refers each paragraph to the joint expert statements of Table 12 in Chapter 3. These statements revealed different subject area in the design process that could be improved.

A design brief was created to visually support car designers in the early design phase: To better understand a design brief Point 2, 3, 4, and 6 of Table 12 emphasizes the difficulties of the inner- and interdisciplinary communication in design departments. To address this challenge, the design brief was created in a visual and a text form. The aim was to prevent the time-consuming misunderstandings that occur between participants from different functions, especially those between the design and the engineering department.

A design brief was created to guarantee an equal participation of the interior and exterior design in the design process: Point 16 of Table 12 brings up the subject that a breakthrough is in need within the automotive communication. The idea is that the different specialists participate on equal terms at the automobile conception process. That is why the functional space modes design has been introduced. Its aim is to inspire the formgiving designers, catch their attention and guarantee the design department a participative role within the automobile concept design creation process in NPD. With the help of

space modes, a concrete concept design and brief formulation tool was introduced (answer to Point 3 and 4 of Table 13).

A design brief was created to communicate in-between the exterior and interior design placement of functions: In order to create a successful product, the automobile interior and exterior design need to work more collaboratively in the design formation (see Point 12 and 13 of Table 12). The application of a design brief aim to balance these two disciplines, so that topics of both fields can be applied.

A design brief was created to better prioritize user requirements and organize space activities, functions and modes: In Point 9 and 11 of Table 12 it is mentioned that the vehicle interior design has to solve complex problems in team and co-operational work. The even larger quantity of extreme user requirements show that a clear hierarchy of space activities, functions and modes must be set, before starting with the styling and formgiving process. This method helps to reduce the design and conception complexity by organizing functional hierarchies within the automobile interior. The aim is to place multiple automobile settings in one single vehicle space (see Figure 38).

A design brief was created to place interior-related user innovations inside the vehicle: It is mentioned that the interior design should be involved at earlier stages in the design process (see Point 14, 15, 16 and 31 of Table 12). Therefore, this work proposes the involvement of interior design and user-centric topics right from the beginning of the automobile NPD process. The applied concept design helps to select, rank and organize not only functions but also possible innovations throughout a mode priorisation (answer to Point 1 of Table 13).

A design brief was created to support choices in a multi-use vehicle environment: The interviews showed that on one hand the future automobile interior should be rather defined through simplification and user-friendliness, but on the other hand will be characterized by an increase of complexities according to multiple space use (see Point 46 and 47 of Table 12). This fact requires a new need to reorganize functions within the automobile. At the same time it is necessary to consider a distinct range of automobile users that are eager to experience diverse automobile space and mobility scenarios. Dependent on the clients' usage priorities, the proper range of space modes must be identified, discussed, defined, sorted out and ranked. To reach this aim the basic space mode was proposed to be the central medium for this organization. It is also recommended that an individual target group research is conducted right from the start of every NPD project (answer to Point 1 and 2 of Table 13).

A design brief was created to serve as reviewable document if the vehicle design was implemented as agreed: It was mentioned by the interviewees that a modification of the design brief takes place, when it passes verbally from one party to the other (see Point 39 of Table 12). Hence, this work submits a textual as well as visual documentation of the original design tasks. The aim of the design brief is to serve as a checklist for the head of design, the executing designers and their disciplinarians. This means that all designers are working with one fixed brief that can be re-proofed and evaluated by its formerly defined parameters (answer to Point 5 of Table 13).

A design brief was created to prevent the designers from reproducing routine design: Wickenheiser criticizes that the new 'speed' in product development results in a mass production of many, but similar, vehicle designs (see Point 42 of Table 12). Even though a certain routine is crucial for the designer's work, this research wants to avoid the reproduction of the same car designs over and over again (see Point 36 of Table 12). Therefore it was tested to give the designer a written and illustrated design brief that highlights distinctive particularities.

Table 44: Chosen space modes per approach

Approach	Number of space mode proposals	Average number of space mode proposals per group
Inside-out approach	12	5
Outside-in approach	11	4,13

An unexpected insight of this research was that all groups identified a similar number of space modes independent from their chosen approach (see Table 44). It shows that they were on a comparable level of mode inventiveness like the evaluated activities and technology features in Table 35 that counted between 7.66–8 activities and technology features per group. Also there was no difference found in the field of the most applied space modes. Table 45 shows that all groups favoured nearly the same space modes (except the 'Feeling like home' mode). The only difference of the most chosen modes was the chronology of its sequence.

Table 45: Most applied space modes per approach

Approach	Most applied space modes
Inside-out approach	1. Individual working (11) 2. Business meeting (10) 3. Relaxation & stress release (9)
Outside-in approach	1. Individual working (6) / Relaxation & stress release (6) 2. 'Feeling like home' mode (5) 3. Business meeting (4)

This work proposes the functional space mode scenario as a basic structure for the later-styled automobile product in the concept design phase. It facilitates the former task of the so-called brief interpreters, and wants to produce more objective material for discussion. After having conducted Chapter 7, the process of applying concrete space mode scenarios as strategic brief for OEM-internal designers in the concept design phase proved to be a promising strategy. But nevertheless this model is seen as a theoretical proposal to the current challenges in the automotive field. This research ends here, but it is recommended to test this method in practice, adjust and further develop it for mass application.

CHAPTER 8 – RECOMMENDATIONS AND DISCUSSION

Table 1 at the beginning of this thesis describes 15 insights and assumptions of problems, the relevance of which is indicated by the literature and various interviews. In this last chapter, it is now possible to reflect on these assumptions. Recommendations for changes within the design process are described based on the work undertaken above. Figure 49 shows the corresponding research process.

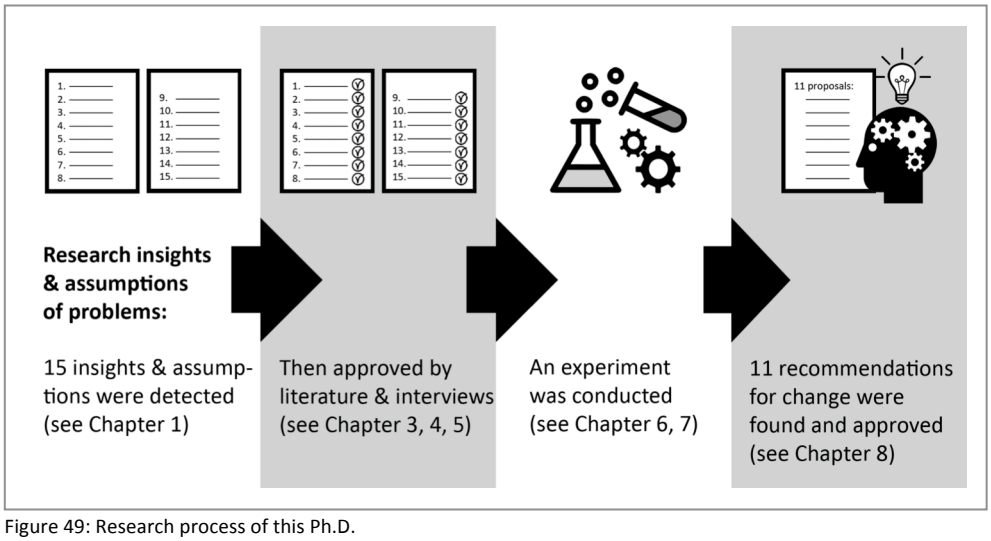


Figure 49: Research process of this Ph.D.

8.0. Recommendations for change

This chapter proposes 11 recommendations for change based on insights from the interviews and the student experiment. Each section links the formerly mentioned assumptions of problems in Table 1 with the proposals for change based on the present research.

The proposals are summarized in Table 49. The chapter concludes with some final reflections on this research work, as well as suggestions for future automotive design research.

1. Identifying a suitable design strategy

This thesis highlights the need to define a suitable design strategy within the early design phase. The expert interviewees also indicated that the automobile interior will receive greater attention in the future. The student experiment indicated that the inside-out approach resulted in a 10% higher interior achievement than the outside-in approach; however, the outside-in approach attained a 20% higher exterior achievement and only a 10% lower interior achievement. The two methods revealed different strengths and weaknesses in the design process, and should be applied according to its predefined aim.

The expert interviews revealed that a clear view on the design project goals is not always apparent within design groups. This work hence proposes to apply a precise design strategy from the beginning (before commencing the design process), to be shared with all team members. There are various ways to make the design strategy more explicit. **For instance, the head of design and/or the design conceptionist may choose in the fuzzy front-end of the design process to focus either on the interior or the overall vehicle design – whichever is deemed more suitable according to their strategy.** This decision is not intended to be permanent, and should be customized for each development project. In practice, these choices are often evident, but not expressed as such (see point 12 of Table 1). This research shows that the choice of designing from inside-out or outside-in influences both the outcome and the process, and should thus be made explicit. This recommendation for change contributes to points 5, 6, 13 and 14 in Table 1.

It was found that every time the students were involved in target group research, they applied some user-centred issues to their design outcomes (independent of the approach). Target group research hence seems to be expedient, and user involvement is an important factor in attaining a high level of automobile design quality, independent of the applied approach. Other studies such as that of Kok (2016) have also shown the positive effect of involving users in automotive design. **Therefore this work proposes to also apply at least some target group research to the design process** (independent from the chosen approach). This recommendation for change contributes to points 7, 13 and 14 in Table 1.

2. Redefining the designer's work content and tasks

The expert interviews indicated that there is a demand for more detailed, clearly arranged and easy-to-understand user and context information, so that the designers may create innovative design concepts (see points 20, 24 and 28 of Table 12). The interviews also revealed a current focus on stylistic–formgiving design after stage 0–1 of the concept design phase (see Chapter 3). Today, the conceptual aspects are mainly left to the head of design and the advanced exterior designers.

In arguing that diverging design profiles are needed in the future, Lipp states: *'I can imagine that it makes sense to have the designers working across the disciplines for finding fundamental concept ideas. This designer has to do a different job than a serial rim de-*

signer...'[49] She proposes developing the designer's original working tasks into a more holistic and conceptual approach. This idea can also be found in other literature studying the design process. Kersten et al. (2017) showed that a richer context in the beginning of the process influences the design and creates a basis for better solutions. **This work hence suggests to redefine the designer's work content and tasks by dividing the work into two categories:**

Category 1: Product vision and concept design
The designer acts as a strategic researcher, user observer, design manager, problem-solver, objective communication medium, and functional conceptionist.

Category 2: Formgiving, and styling design
The designer has an aesthetic function in terms of colour ranges, material definitions, formgiving, and atmospheric and digital design.

Chapter 3 addressed the task of designers in solving exclusive design problems related to form and function. It is argued that designers should add a conceptual content to the automotive NPD process as well. This work **proposes adding 'brief interpreters' within the OEM's transportation design microcosm that are capable of looking beyond the boundaries of accepted contemporary design practice. As per the task in Category 1, it is suggested that a so-called 'design conceptionist' be added to the design team.** Design conceptionists should act as simultaneous absorbers and senders of information whose role is to communicate innovative ideas to the executing designers (see Figure 50). This recommendation for change contributes to the points 7 and 8 of Table 1.

3. Proposing the design conceptionist's profile

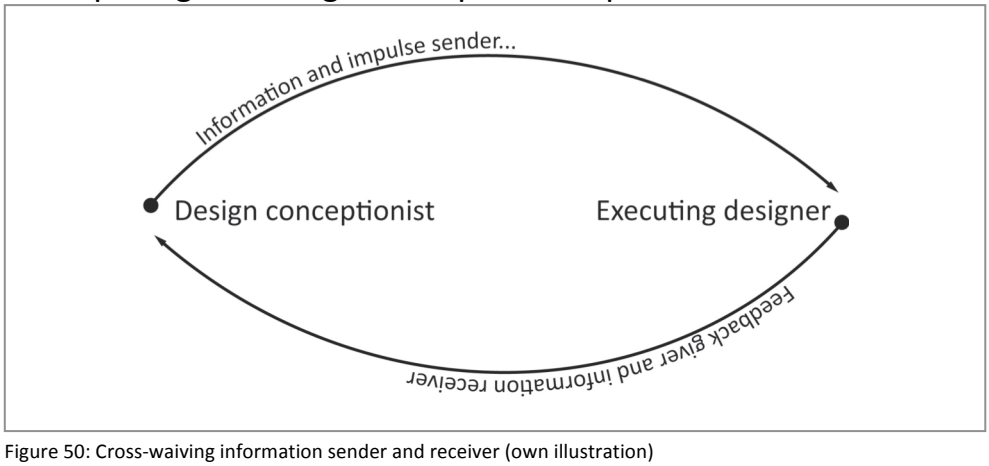


Figure 50: Cross-waiving information sender and receiver (own illustration)

[49] Translated from the German: *'Ich kann mir vorstellen, dass es sinnvoll ist Designer in fachübergreifenden Teams zu haben, um ganz grundlegende Ansätze zu finden. Dieser Designer, der ein Grundkonzept erarbeitet macht natürlich eine ganz andere Arbeit als eine Person die z. B. eine Felge für ein Serienfahrzeug gestalten soll...'*

The expert interviews mentioned the need for communication and exchange in the fuzzy front-end of the automobile concept. This insight was used during the student experiment to guide participants through the concept phase. Kersten et al. [2017] also promote a broader context view (CVD – Context Variation by Design) for the beginning of the design process, while Kok [2016] has demonstrated that greater effort applied to context and future vision leads to better design outcomes. **This work thus proposes adding the profile of a design conceptionist, whose role is to distribute re-processed insight-related information, videos, illustrations, and photos, as well as detailed (basic) space modes in the form of 2D layouts.** This task can be compared to that which Phillips [2004] terms a 'project owner', with responsibilities including the design brief definition, as well as the specification of success or failure of the project.

The design conceptionist's task is to keep a close eye on the key issues of the design brief, as well as implementing strategic criteria in brief and briefing form in the design process to manage the essential project goals. Together with the head of design, his main function is to manage a wide range of advanced design proposals together with the formerly defined criteria. He must identify and put forward possible design innovations, whereas the executing designer in turn provides him with regular feedback in iterative loops (see Figure 50).

Advanced and executing interior and exterior designers are the design conceptionist's partners within the fuzzy front-end NPD process. The idea is that in acting as an independent conduit between hierarchies, the design conceptionist creates substantial product value by fostering an open-minded, vivid design culture. He works as a representative project leader and communicates with the engineering, strategy, or marketing departments. This recommendation for change contributes to the points 7 and 8 of Table 1.

4. Adding reflective feedback loops to the process

The goal of this Ph.D. is to place disruptive innovations within the design process. Problems arise when there are no innovations found at a certain stage in the process. As of today, it is generally not possible to return to the visioning and content placement phase, there is hence a need for feedback. This is similar to the Hasso-Plattner Institute's design thinking method, where the participants apply repeated iterative cycles until they finally succeed. The loops describe repeating escape options by which to scrutinize brief parameters or foster output improvements [Hasso Plattner Institute of Design 2017].

Reflective feedback loops have therefore been added to the present design process. Two points of reflection are defined at the end of Stages 3 and 5 (see Figure 51**) to mark critical moments in the product development phase. These points offer one-to-two step reverse jumps to avoid fundamental mistakes in the early design brief, aim setting, consecutive formgiving, and future styling phases.**

The first point is set at the end of the concept(ual) design phase and questions whether the concept design or brief is correctly formulated and easy to understand. If this is not the case, there is the option to restart the process at Stage 0, or to redefine the functional content analysis and package settings at Stage 2.

The second point of possible return comes at the end of the draft design phase where the advanced and executing designers, divisional heads, design conceptionist and head of design are questioned about the adequacy of the design ideas proposed by them. Should these be deemed inadequate, the process can revert back to Stage 4 or Stage 2. Also if this is not necessary as the quality of outcome is sufficient; however, the option for a restart was established. This recommendation for change contributes to the points 3, 6, 11 and 13 of Table 1.

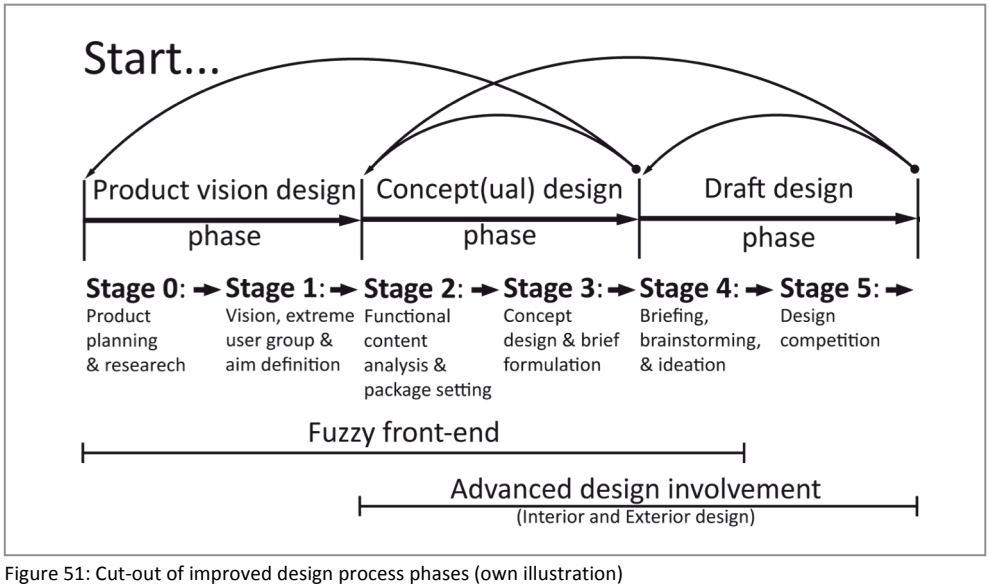


Figure 51: Cut-out of improved design process phases (own illustration)

5. Establishing additional process steps (Stages 1–2)

The documentation of the design process and the expert interviews revealed that within the early design phase visionary and content-related design steps were missing to set strategic design goals. This work thus proposes adding extra process steps based on six (instead of five) phases (see Figure 52). The first phase, 'product vision design', represents a pre-conception period intended to focus on functional content before the execution of any single concept or formgiving design. The aim is to generate ideas, foster inventions, and apply more disruptive innovations in the fuzzy front-end phase. Norman and Stappers [2015] also draw attention to the importance of the initial design phases, arguing that more of these should be added in complex design contexts. **The newly implemented Stage 1 concentrates on the vision, the extreme user group, and aim definition.**

The interviews in Chapter 3 show that the car interior and innovation topics need to be integrated earlier in the strategic design process (see points 5 and 13, 19 and 20 of Table 12). Interviewees also requested a documentation of the process to foster improvements in the structure (see point 29 of Table 12). **After the vision is defined, the most important key objectives (functional content and package setting) need to be set in the new Stage 2 that is part of the new introduced concept(ual) design phase.** This conceptual foundation ensures that the subsequent concept design and brief formulation phase is both ac-

curate and carried out in greater detail than before. This step was added following expert insights (see Chapter 3) where the need for concrete formulated briefs and defined briefings of consistent quality was highlighted (see points 32, 33, 36 38 and 39 of Table 12). This recommendation for change contributes to the points 1, 7, 8, 12, and 14 of Table 1.

6. Reformulating the design process flow

According to the proposed changes in the recommendations above, a new formulation of the whole design process flow is required based on the different user and expert interviews and the experiments insights (see Chapter 3–7). Chapter 3 describes the existing automobile standard design process, which was used as a baseline for the reformulation proposals in this section. The following paragraph describes the new introduced stages and their stage-by-stage consequences for the refined process flow (see Figure 52). This recommendation for change contributes to the points 1, 2, 8, 11, 13, and 14 of Table 1.

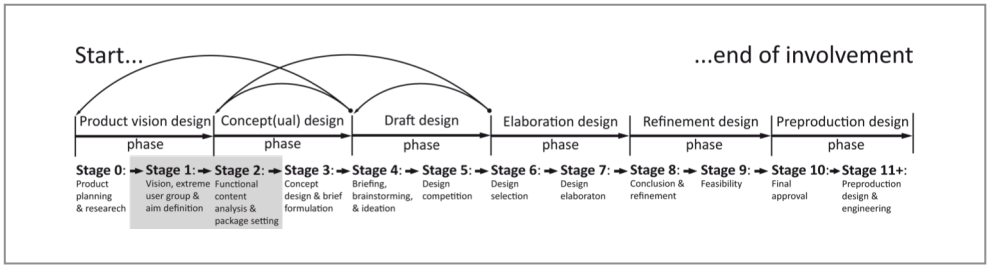


Figure 52: Improved design process with new stages highlighted (own illustration)

Stage 0	Product planning and research
Participants	Board of management, alternative strategic and technical departments, head of design, and design conceptionist

Stage 0 includes trend and tendency identification, future market analysis and user insight research. All relevant macro and micro trends are listed and prioritized. These insights should answer the questions: Which types of target or investor groups could seek what type of car for which specific context? How could this type of car fit into the OEM's portfolio strategy? Vink et al. [2008] and Kuorinka [1997] also emphasize the importance of the early planning phase. This stage remains the same as that described in Section 3.2.5, the only difference being the **addition of the design conceptionist to the fuzzy front-end phase of the NPD** (see Table 12).

Stage 1	**New stage:** Vision extreme user group and aim definition
Participants	Strategic and technical departments, head of design, design conceptionist, interior and exterior advanced design

Stage 1 was inserted to focus on deeper customer group research at the beginning of the project. The purpose of this research is to define the inner essence – the 'DNA' – of both the car and its target users. The aim is to take users' lifestyle and mobility behaviour as inspiration for the new product. It is also important to identify the future product's qualities, additional functions, and services that could be applied to diverse target groups, environments, and user studies. The expert interviews in Table 12 found that designers

require concrete and better-illustrated user information as part of the design brief. User profiles should thus be as concise as possible to give the designer an accurate impression of the future user. After filtering the user interviews, Chapters 4–5 define, describe and illustrate one to five archetypical personas. In this work Chapter 4 explores user trends and tendencies for the future business traveller, while Chapter 5 sets out three user profiles of the digital business nomad. **It then falls to the head of design to formulate (in text form) a joint product vision for the remainder of the design process.**

Stage 2	**New stage:** Functional content analysis and package setting
Participants	Strategic and technical departments, design conceptionist, interior and exterior advanced design

To validate the acquired user insights, experts are asked to verify the main objectives and challenges for the future design task in this new stage 2. This step allows for all information to be confirmed and bundled according to the conceptual aim. Stage 2 was performed in Section 3.1 and 4.1 of this research experiment. **The second novel element is the production of a common requirement list by the design conceptionist,** taking all joint concerns of the proper design field into account. This list relates to the fundamental functionalities that the final product must include from a packaging perspective.

Stage 3	Concept design and brief formulation
Participants	Head of design, design conceptionist, interior and exterior advanced design

While the two new stages 1 and 2 apply more visionary and analytical aspects to the design process, stage 3 defines the concept design and brief formulation. All acquired insights thus result in an initial brief formulation and the specification of the most important packaging criteria (see the experiment in Section 6.1). **The most important difference from the previous concept design and brief formulation stage is that the new brief is physically written down. This was one of the main insights taken from the expert interviews (see** Table 12**).**

The other change is that all participants create various functional space mode illustrations and descriptions after the brief has been formulated (see Section 7.2). The interviews in Table 12 revealed that an increasing number of additional functions need to be managed while creating the vehicle interior. An overview of the defined activities and technology features of all space modes is drawn up, with the different elements ranked in order of importance. The most important modes are then selected to generate a basic space mode design (in Section 7.3, one basic space mode was chosen from the range of all created space modes).

The final part of this stage includes goal setting and rough specifications, with the market, users, context, cost effectiveness, and timeframe parameters of future product qualities and quantities taken into account**. The type of approach (inside-out and/or outside-in) is applied according to its final goal (see Section 6.5)** as shown in the student experiment in Section 6.5. **At the end of Stage 3, the first two-step iteration loop can also be implemented.** This step was inserted in the event that any engineering problems need to be resolved or brief criteria altered. Wüsthoff and Hirzinger [2009] confirm the importance of

the equal integration of design and technology in the early design process. They argue that both parties should use this moment to discuss the integration of concept ideas and construction at this moment in the design process.

Stage 4	Briefing, brainstorming and ideation
Participants	Head of design, design conceptionist, interior and exterior advanced design, interior and exterior executing design

The draft design phase begins as soon as the design conceptionist and divisional heads have started to brief the operating interior and exterior design departments (see recommendation 10). **The inclusion of the design conceptionist, interior advanced, and executing designers in this early design stage is a new addition** resulting from the expert interviews (see Table 12), which revealed that interior designers should be involved earlier in the design process to achieve a more equal participation of early-stage design input. By using the illustrated target group profiles (videos, photos, stories, etc.) **the designers may discuss the previously introduced space mode settings and brainstorm about its further formgiving.** At this point, the interior and exterior advanced designers may present their initial thoughts, scribbles, collages and working models for the project. This step was executed in Section 0 of the student experiment (see Figure 27).

Stage 5	Design competition
Participants	Head of design, design conceptionist, interior and exterior executing design

After the executing designers have carried out exemplary customer journeys and performed extreme user research, common analysis rounds are made. **The aim of this activity is to understand the corresponding types and ranges of the other space modes, their rank order, and the selection of the subsequent concept design (especially in the case of the inside-out approach).** This stage was applied in Section 7.2 of this research work, where all identified space modes are listed. Each of these modes contains a list of corresponding space activities, distinguishing characteristics, technology features, and an atmosphere description. The subsequent creation of the basic space mode offers a platform for all possible space mode conditions, which are united in one central space design. **The design conceptionist's role from this point is solely that of an observer. His function is to keep an eye on the previously defined aims and criteria.**

This stage is the functional starting point for the formgiving design. Shortlists are drawn up to compare and validate all existing designs and to determine the final design direction. **All teams then produce comprehensive 3D interior and exterior designs of the final automobile, taking the previously developed functional layout as their main point of reference. If needed, the second two-step iteration loop can be implemented at the end of Stage 5.** This second loop was inserted to verify that the design proposals align with the prior defined design brief.

Stage 6+ following	Design selection…
Participants	Board of management, head of design, design conceptionist, interior and exterior executing design

In Stage 6, the design conceptionist is free to carry out an interim proof with users to ensure adherence to the original criteria and to follow a user-centric research path. As of now, the only change is in the numbering of the process steps, as two stages were added to the beginning of the design process the further description stops. The design process thus remains in line with that described in Section 3.2.5.

7. Dividing organizational powers within the hierarchy

The left illustration in Figure 53 shows the classical design hierarchy pyramid within an automobile design department. From the interviews, points 12, 13 and 14 of Table 12 indicate that the advanced interior and executing interior designers do not participate in the beginning of the fuzzy front-end design process. Currently, the most far-ranging decisions are made by the head of design and his most influential divisions such as the advanced exterior design that enjoys his exceptional trust. This circle of participants generally belongs to the first three triangles of Figure 53 on the left side (from top down). According to the interviewees, there is no central content management to keep track of the broader goals, aside from the head of design.

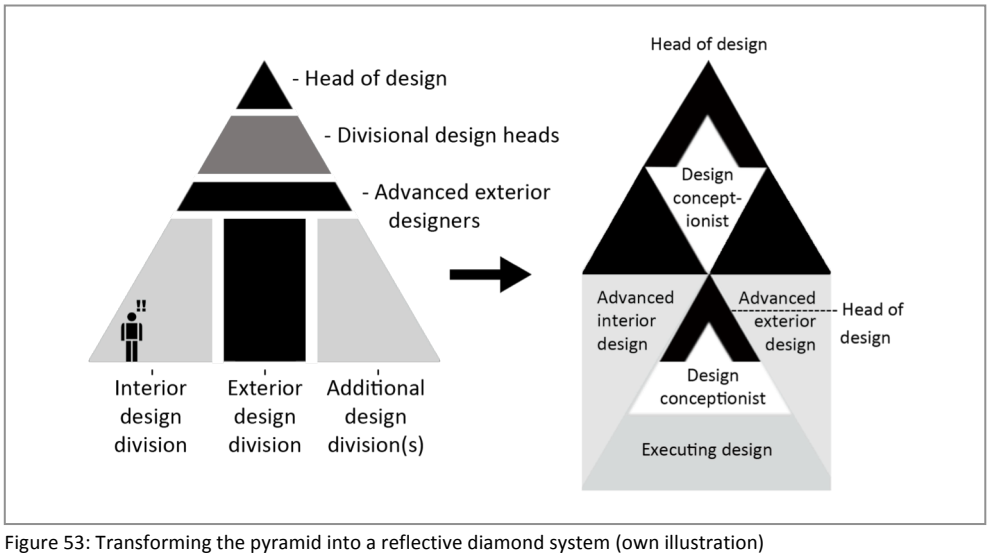


Figure 53: Transforming the pyramid into a reflective diamond system (own illustration)

This work hence proposes the intermediate placement of a neutral design conceptionist to keep an eye on the general content aims and ensure the equal participation of advanced exterior and interior designers (see the transformation from the left to the right side in Figure 53). Krzywinski and Klink [2009] also confirm the importance of participating parties' respective roles in the fuzzy front-end phase. They argue that carefully prepared information from different disciplines can be a useful innovation tool in the development phase**. The diamond graphic on the right side of** Figure 53 **shows the proposed improvement, the aim of which is to generate a more reflective and participative organizational structure within the hierarchy system.** This design process model is still top-down, but less steeply sloping and more evenly partitioned. Bottom-up feedback loops and discussion panels are implemented to question previous findings and insert new ideas.

This model allows for topics and feedback to be managed more comprehensively, in particular within the product vision design phase. The new mode includes a more significant division of powers relating to disciplinary responsibilities and project content. The design conceptionist's profile plays an important supporting role, which is similar to that of a model-specific line manager in an automotive industry product development cycle. Along with a small team, the design conceptionist manages independent divisions on a briefing basis. While the horizontal and vertical division of powers is common practice within the existing automotive hierarchy pyramid, it has yet to be implemented in the design department. This work hence proposes that this principle is applied to the design field. The above-formulated design tasks are divided into two formal categories: product vision, research and concept design (Category 1); and formgiving and styling design (Category 2). The categories are equally ranked, but must be executed in their defined sequences to guarantee sustainable NPD success. This recommendation for change contributes to points 6, 7, 9, and 15 of Table 1.

8. Changing hierarchical dominance into design leadership

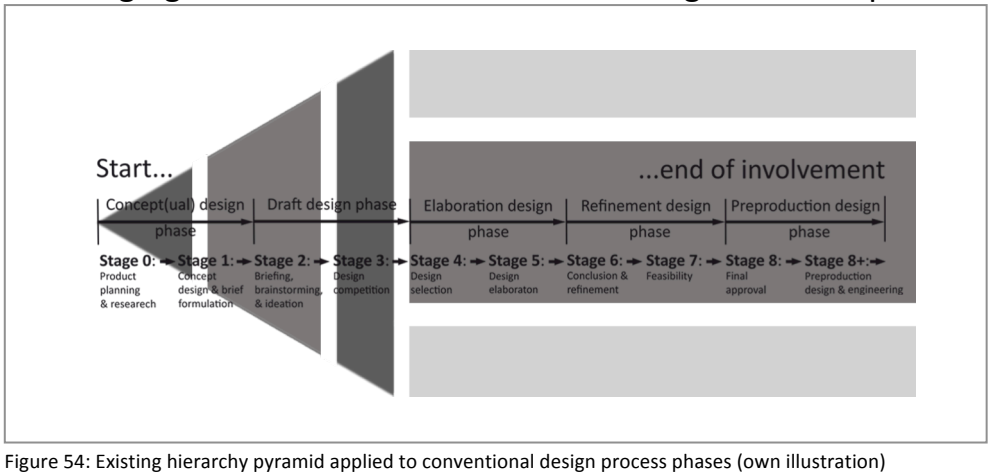


Figure 54: Existing hierarchy pyramid applied to conventional design process phases (own illustration)

The goal of this Ph.D. is to align the organizational aspects of the hierarchy system with the NPD process. The expert interviews in Chapter 3 revealed that dominant hierarchical behaviour within the design department is part of everyday practice (see Figure 54). This system, however, does not align with the desired proactive innovation implementation and agile work behaviour described above. The diamond graphic on the right side of Figure 53 recommends implementing a more reflective and participative organizational structure and is placed onto the improved design process. **This work thus proposes a changed hierarchy model as part of the improved design process (see Figure 55).** Under this model, bottom-up feedback loops and discussion panels are implemented to question previous findings and insert new ideas, allowing for the improved management of topics and feedback, in particular during the product vision design phase.

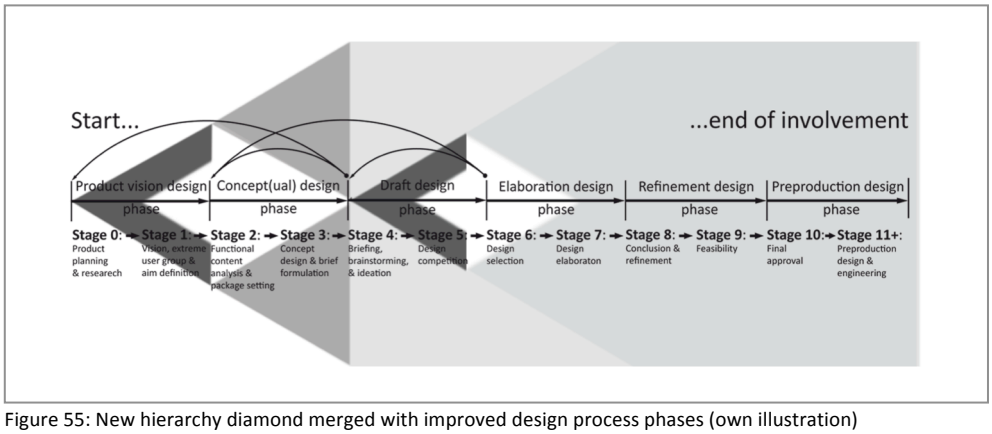


Figure 55: New hierarchy diamond merged with improved design process phases (own illustration)

9. Creating a written design brief (Stage 3)

The expert interviewees mentioned that there is a lack of well-prepared information – a brief that is weather not reaching the executing designers or does not exist within the corporate NPD process. This makes it difficult to find and apply new innovations. **Therefore, this work proposes that the design conceptionist creates a written design brief in stage 3 to be used as a project fundament and universal guiding tool to be handed over to the advanced- and executing designers across all NPD process steps** (see Figure 52). This recommendation for change contributes to points 7, 8, and 12 of Table 1. This written design brief should contain the following components:

Trend and tendencies research: Together with the expert interviews, a contextual user trend and tendency research should be performed and summarized in a final indicator map. This outcome will provide an overview of contemporary trend and tendency insights and significant related factors (see Section 4.3).

Persona profiles: At least three to five personas profiles ought to be created from the extreme user interviews (see Sections 5.0–5.2.3). After collecting user insights, all gathered information must be analysed, structured, and clustered into the representative persona groups. Each persona should be described and illustrated on a clearly organised profile sheet (see App. Figure 59–61). Key users are invited to return at a later stage in the process to carry out product tests and provide initial feedback. This research lays the ground for future market success to be desired by future customer, as confirmed by Lanz [2009].

Package criteria and aim formulation: The main project criteria shall be written down and handed to both advanced and operating designers. An explicit record offers the possibility to discuss further developments and review the designers' performance right from the start. The aim is to avoid the designer's repetition practice in the existing unique reference system, and to create novel design solutions that align with the project goal and contain high innovation potential (see Section 6.1). Lorek and Wilke [2009] describe this way of working at the tool manufacturer Metabo, where the design department is mainly responsible for integrating innovations within the briefing process.

Common requirement list: The use of personas (see Chapter 5) allows designers to highlight the essence of a project task, to make information explicit, and to add an emotional context (for the operating designers) to the design process (see Table 30). The common requirement list shows the range of interviewees' commonalities and opinions that should be taken into account for future automobile conceptions.

Basic space mode: The definition, ranking, selection, textual description, and illustration of all identified space modes represent a central method to create a comprehensive concept design (see Sections 7.0–7.3). The basic space mode incorporates all of the joint characteristics, activities and functions into a single mode (or space situation) that provides the starting point for the subsequent formgiving and styling phase. As such, its description should be as detailed and concise as possible (see Stages 2–3 of Figure 52).

10. Creating an alternative design briefing (Stage 4)

As well as the brief design, how the act of briefing takes place in the design process is important. The experts mentioned that the interior designers are currently left out of the fuzzy front-end design process, and that there is a need for executing designers to carry out independent field research in empathic ways (see points 1, 5, 7, 8, 10 and 11 of Table 1). To meet this requirement, this work **recommends a procedure for communicating the aim and project information to both the executing exterior and interior designers** (see Section 6.2). The following 11 points provide a framework for this briefing procedure.

1. Group formation of exterior and interior designers: The process starts with an official kick-off event involving the advanced and executing exterior and interior designers, allowing all parties to determine the initial project settings. Subsequently, the executing designers form multidisciplinary work groups and nominate one team leader as a representative. The advanced exterior and interior designers report their previous findings and present their initial ideas.

2. Persona presentation: To assist the operating designers initial ideas, the teams will receive detailed persona profiles to envision prospective future users. These personas are of real-life extreme users taken from the target group for the product in question. Their aim is provide the operating designers with an emotional proximity to target users, which may then be incorporated into the design.

3. Further persona research and information transformation into the future: Each design team selects one of the three personas and focusses on their lifestyle and daily behaviour. The teams then project these user insights some five to ten years hence. This marks an important intellectual step, as the designers must transpose current everyday patterns onto possible future scenarios. Market-, context-, and persona-based analysis allows designers to develop empathy for the chosen persona. Bart [2009] considers this empathic ability and the power of observation to be a crucial character trait in designers. Brown [2008], CEO and president of the design firm IDEO, also describes this as an important behaviour, which he terms 'integrative thinking'.

4. Exemplary customer journey illustration: Finally, the design teams present their chosen persona by means of an exemplary customer journey map featuring around three to

seven days of their future life. Again, they demonstrate their empathy by identifying the critical points and challenges of their chosen users' professional and private circumstances. At this moment, all designers make brief annotations and may add collateral ideas such as speculation about new or alternative car concepts.

5. Brief title, criteria (package), form, and content setting: The head of design and the design conceptionist then define the project-specific criteria regarding the title, package, form, and content. This is important for future quality approvals and retrospective project evaluation.

6. Handover of the common requirement list: The design conceptionist creates and distributes a CRL to share extreme user characteristics and opinions. This additional brief material emphasizes common perspectives concerning the prospective vehicle's usage, content, and form.

7. Inside-out and/or outside-in approach application: The head of design and the design conceptionist define the type of car that should be created and specify its relevant key aspects. This strategic decision includes determining what type of approach (inside-out and/or outside-in) should be applied.

8. Space modes re-evaluation and listing: Previous spaces modes are re-evaluated to create self-contained space situations that offer immediate added value to the user. These are then listed according to types and ranges.

9. Space modes ranking and selection: The group's task is to identify the eight most relevant space modes listed by the advanced design team. These should then be linked with each other to provide a fluid and easily interchangeable mode flow.

10. Selected space modes description and sequential arrangement: The selected mode activities and technology features, space mode concepts, characteristics and atmosphere(s) are then described, with accompanying illustrations. The logical linkage and further arrangement of the selected space modes, including the main space usage scenarios, must then be defined in detail (all possible combinations can be reviewed using a morphological chart). The space mode constellations deemed most suitable are crucial for the final product conception within a well-defined basic mode.

11. Basic space mode elevation: The advanced designers create a variety of space scenarios consisting of diverse modes with corresponding activities. These describe the previously defined substance of the basic space mode that renders a standard space situation: the most neutral mode, which is also convertible into the other space mode situations. In cases where activities and features are used repeatedly in various space modes, a permanent and central placement within the car concept needs to be found. The more these neutral placements are defined, the more definitely set and stable is the automobile basic space mode and its comprehensive concept design. The congruent activities and technology features are listed to create a single condensed functionspheric[48] basic space mode from the priority nominations collected previously.

After concluding the product vision and concept design phase (see Figure 52), the aim is to find a unifying space design that includes the formation of the eight selected modes within a single permanent situation. The basic space situation defined above takes the form of an illustrated package to be handed over to the formgiving design team. Up to this moment, brainstorming sessions can start to develop initial concept ideas in the form of scribbles, detailed drawings, graphics, videos, storytelling scripts, pictograms, portraits, real-life photos, physical prototypes, and many others.

11. Installing an innovation-friendly work atmosphere & culture

The expert interviews in Section 3.1 highlight the importance of **improving the overall work atmosphere and company culture inside OEMs. Interviewees believe that it is crucial for employees to put forward innovative ideas alongside regular project work.** This thesis hence proposes allowing bottom-up disruptive ideas to develop in parallel to the project reality. One suggestion is to establish idea pools where innovative thoughts can be collected, exchanged and requested when necessary. Similarly, space could be found for round-table discussions, workshops, and excursions (where the unthinkable can be addressed) as an open forum for the development of disruptive ideas. A combination of diverse environmental and cultural factors is necessary to create an innovation-friendly atmosphere. Borja de Mozota [1990/2003] considers innovation creation to be *'…a collective and interactive process that is close to the reality of the design process, since it mixes internal and external factors'.* She believes that *'…design is valued both for its superior product quality and its superior New Product Development process'.* To create this atmosphere, it is hence necessary to develop various innovation-friendly environments adapted to the structural and organizational context [Graf and Hartmann-Menzel 2009]. This recommendation for change contributes to points 2, 4, 5, 13, 14, and 15 of Table 1.

8.1. Expert validation of recommendations for change

In the previous section, 11 recommendations for change were made based on the literature, expert and user interviews, and a student experiment. The question thus arises: Are these recommendations able to change the existing design process and will they eventually lead to a better design output? A real-life experiment within an OEM to evaluate the outcomes is both ambitious and difficult to execute due to political bias. However, a short validation study was undertaken to gauge the reactions of scientists and industry practitioners to these proposals. The research questions were: Do practitioners and scientists agree on the 11 proposed recommendations for future car design? In their opinion, which recommendations have the most and the least innovation potential?

8.1.1. Method and procedure

Six experts (two with a scientific background and four from industry) were asked whether they agree with the 11 recommendations for change. They were also asked to rate which recommendations they considered to have the most and the least innovation potential. All interviewees had a background in automotive exterior/interior design and/or in the field of user studies (see below). The procedure was as follows: the 11 recommendations were sent to interviewees. If they required an explanation of some or all of the recommendations, answers could be given either via telephone or in person. For each recommendation, experts were asked to state their level of agreement on a Likert-scale from 1-

6 [Likert 1932]. Bertram [N.N.] states that this type of scale is *'…primarily used in questionnaires to obtain the participant's preference... Respondents are asked to indicate their level of agreement with a given statement by way of an ordinal scale.'* Bertram [N.N.] mentions that while a 5-point scale is mostly commonly used, a 6-point scale can *'add additional granularity'* by allowing participants to 'rather agree' or 'rather disagree' about a particular recommendation. A classical 'intermediate' rating is neither possible nor desired. The aim is that the experts think deeply and clearly about the ratings that they give with a clear tendency.

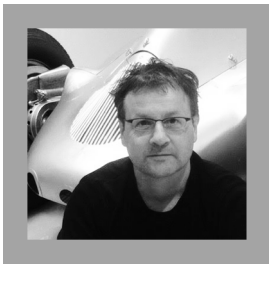
Interview guide

The English-language version of the questionnaire can be found in Figure 65–Figure 68 of the Appendix. Interviewees marked their answers with a cross and specified their most and least favourite recommendations by number at the end of the questionnaire.

Participant selection

According to Honer [1994], there are two important characteristics that every expert should possess: ten or more years of experience; and, in this case, a field-specific 'niche' knowledge of automobile design and innovation. To ensure a broad input, the experts were drawn from diverse backgrounds spanning practice-based industry to university research. Their varying educational and brand-related backgrounds were also chosen to provide the most non-homogeneous, objective range of opinions. The selected experts were asked to consider the transportation design scenery from different perspectives (culture, hierarchy, professional background, interior and exterior design), providing insight into transportation design subculture. Based on these criteria, the following six expert profiles were selected:

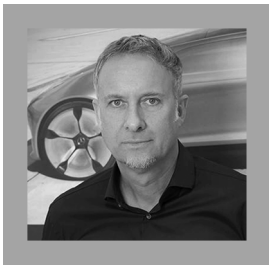
Expert 1: **Prof. Matthijs van Dijk**
Professional background: Professorship at the Delft University of Technology. Delft, The Netherlands
Field of expertise: Transportation interior and exterior design, strategic concept design, design processes and methods



Expert 2: **Ass. Prof. Elmer van Grondelle**
Professional background: Assistant Professorship at the Delft University of Technology. Delft, The Netherlands / Field of expertise: Transportation interior and exterior design, strategic design, design processes and methods, future mobility

Expert 3: **Margarete Wies**
Professional background: Head of holistic user-experience at Volkswagen AG, Wolfsburg, Germany
Field of expertise: Transportation design, user-centred design

Expert 4: **Lowie Vermeersch**
Professional background: CEO and Creative Director of granstudio, former Design Director of Pininfarina, Turin, Italy / Field of expertise: Automobile transportation interior and exterior design, mobility and space design



Expert 5: **Steffen Koehl**
Professional background: Head of Advanced Exterior Design Mercedes-Benz, Maybach, and smart Stuttgart, Germany Field of expertise: Automobile transportation exterior design

Expert 6: **Hartmut Sinkwitz**
Professional background: Head of Interior Design Mercedes-Benz, Maybach, and smart Stuttgart, Germany / Field of expertise: Automobile transportation interior design

Analytic procedure

All expert interviews were documented, counted and analysed (see Table 46–Table 47). Next, the main insights were summarized in an overview diagram (see Figure 56). They were examined from a qualitative perspective.

8.1.2. Expert interview results

Table 46 lists all of the expert ratings. The average rating for each recommendation is given using a score from 1–6 (fully agree =1 point; fully disagree = 6 points). The right-hand column gives the average scores for each recommendation, which can be also seen in the

diagram in Figure 56. The extremes range from 1.33 (question 11) to 2.5 (question 5), and are marked in the table. The final line of the right-hand column of Table 46 gives the average score for all answers (1.95).

Table 46:Overview of expert interview results

Expert ratings	Fully agree (1)	Agree (2)	Rather agree (3)	Rather disagree (4)	Disagree (5)	Fully disagree (6)	Average score
Recommendation 1: Identify a suitable design strategy in the process	3	1	2	-	-	-	1,83
Recommendation 2: Redefine the designer's work content and tasks	4	1	1	-	-	-	1,50
Recommendation 3: Propose a design conceptionist's profile	3	2	-	1	-	-	1,83
Recommendation 4: Add reflective feedback loops to the design process	4	-	2	-	-	-	1,67
Recommendation 5: Establish additional process steps (Stages 1–2)	1	1	4	-	-	-	2,50
Recommendation 6: Reformulation of the design process flow	-	5	1	-	-	-	2,17
Recommendation 7: Divide organizational powers within the hierarchy	2	2	1	1	-	-	2,17
Recommendation 8: Give more space to visionary design leadership	3	1	2	-	-	-	1,83
Recommendation 9: Create a written design brief (Stage 3)	3	2	-	-	1	-	2,00
Recommendation 10: Create an alternative design briefing (Stage 4)	1	2	1,5	1,5	-	-	**2,58**
Recommendation 11: Installing an innovation-friendly work atmosphere & culture	4	2	-	-	-	-	**1,33**
Average score of experts from science	**1,68**						
Average score of experts from practice	**2,03**						
Average score of all experts	**1,95**						

All experts had a high degree of agreement (**average score of 1.95 out of 6**) concerning the proposed recommendations for improvement, with most adding further ideas of their own. There was a slight difference in the ratings given by experts from science and industry (see Table 46). **The experts from science rated on average higher (average score of 1,68)** than the **experts from practice (average score of 2,03**). **It appears that the experts from science have a more visionary approach to design model changes than their industry counterparts. This conclusion is in line with the presumption that science is behind the future commercial success of novel mental models.**

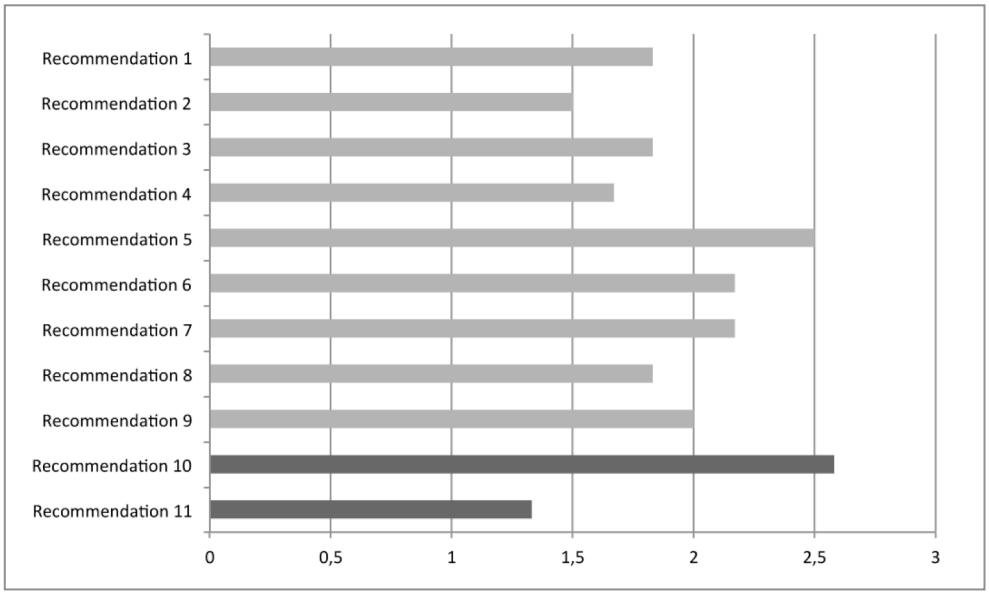


Figure 56: Diagram overview with the average score for each question

In the second part of the request interviewees were asked to rate the recommendation with the most and the least innovation potential according to their opinion. Table 47 gives the summarized expert ratings. **The point that stands out is the triple nomination of question 11 as having the most innovation potential.** This outcome correlates with the ratings from Figure 56, where question 11 also received the highest total score. No other recommendation was nominated more than once. **Recommendation 11 can therefore be named the proposal with the most innovation potential. Concerning the least innovation potential, there was no consensus about the recommendation with the least innovation potential** (whether in Figure 56, nor Table 47).

Table 47: Overview of expert results for recommendations with the most and the least innovation potential

	Most innovation potential	**Least innovation potential**
Summarized expert ratings	**3x question 11** 1x question 1 1x question 6	1x question 1 1x question 3 1x question 4 1x question 10

8.2. Discussion

There is currently a debate about the ideal approach to automobile design. Given the scarcity of related scientific literature, this thesis seeks to add knowledge to the field. In the beginning of this thesis the following questions to study were formulated:

1. Should the current automobile design process be questioned, reversed (from outside-in towards inside-out), or completed within the NPD process?
2. Is the inside-out approach in automobile design preferable to the outside-in approach concerning the innovation capacity of user-centred design?

For the first question, the 11 recommendations for change and the reactions of the six experts show that questioning the design process is certainly a worthwhile pursuit. The experiment showed that the decision whether the inside-out or outside-in approach is more promising depends on prior target setting. It was found that both approaches have their advantages and disadvantages and should be applied in a goal-oriented manner.

For the second question, this work tried to find out whether user solutions created using the inside-out approach were somehow different. Whether, for instance, they created additional, innovative value; and whether they were adapted to specific needs or situations. The experiment and the expert interviews showed the utility of considering user solutions. Both revealed a slight preference for increased focus on the inside-out approach, with the user as the central reference point.

Veryzer and Borja de Mozota [2005] claim that *'…In many ways it (design) is the focus on deep understanding of the customer or user…that transforms a bundle of technology with the ability to provide functionality into a product…'* Kok [2016], meanwhile, has demonstrated that there is room for improvement regarding user involvement, pointing to an even greater shortfall in relations between automotive designers and car users. As argued by Desmet and Hekkert [2007], users must play a more central role in the proper use and design of cars. Independent from the applied approach, to improve the overall design quality of automobile products while addressing both form and function, this work therefore proposes that users be given a more central role in the conception process, with greater scope for dialogue with designers. This insight is based on outcomes from the above interview.

8.2.1. Limitations of this work

Table 48 shows the positive points of this work, as well as those that could be improved from a researcher perspective. Positive points relate to forward-looking user insights such as the desire for a greater and more varied range of storage options and the importance of the automobile interior functioning as a workplace. The inclusion of (extreme) users allowed insights to be explored first-hand with an eye to the future, before being applied to the automobile concept. The expert interviews also offered a unique overview of the automobile industry status quo and its design process, leading to some initial proposals for future design improvements. The experts' answers giving design practice insights also consolidated information in existing literature. Another positive was that the students chosen for the experiment had no prior experience of the fixed structure and OEM working methods, and were thus able to approach the task without bias. Their open-mindedness helped to implement this experiment unconditionally. In Chapter 7, the concept design was realized via a functional design brief in both text and illustrative form – a method that enhances the visibility of functional topics and allows concept details to be discussed prior to the commencement of the formgiving design process.

A point for improvement is the application of digital business nomads, representing extreme users. It was assumed that their lifestyles and opinions on mobility had future relevance; however, this assumption is open to debate. Similarly, the interviewed experts came exclusively from European institutions and OEMs, while including experts from Ja-

pan, China or the United States may have provided a more international perspective. The TU Delft courses place a strong focus on the user. The user perspective thus probably receives more attention than it would from average car industry designers. In terms of our choice of subject, the students could have been already experienced transportation designers, so that real experts would have been able to approve and utilize the experiment's work outcome. While this may have made it easier to evaluate the method's practical usability, it may also have produced biased results. A final point for improvement is that both the students' experiment brief and its outcome displayed a reduced complexity (compared to an industry brief). However, this may result in important information being either lost or difficult to interpret for the student designers. This reduction was due to the experiment being centred on the main aim: to reveal the respective advantages and disadvantages of the outside-in and inside-out approaches.

Table 48: List of positive and negative reflections of this research work

Positive points	Potential improvements
+ Users brought future-oriented niche insights into the design practice.	− The DBN's extreme lifestyles were considered representative of society. However, this assumption may be open to debate.
+ Experts gave insights on the ideal design process and made suggestions for improvements.	− The experts interviewed came exclusively from European institutions and OEMs.
+ The students had no direct work experience in the automotive design field, so their opinions were non-biased.	− Ideally, the students should have been experienced transportation designers, providing expert proof of the work outcomes.
+ The condensed brief design in text and illustrative form of Chapter 7 offers benefits for future designers in terms of discussion and dialogue.	− The experiment brief and design outcome displayed a reduced complexity.

8.2.2. Reflections on this research

The following section revisits the work on a chapter-by-chapter basis.

In Chapter 3, the automobile design status quo is described based on expert interviews. The results indicated that communication could be improved and better documented. The number of in-depth interviews was limited, and more interviews could have produced alternate or more diverse insights. However, people with different functions were interviewed to give a broader overview of focus topics. Ideally, more OEMs could have been involved. On the other hand, the findings of this chapter are in line with the literature and confirm the interview statements.

In Chapter 4, user trends and contextual tendencies are described based on the literature and expert interviews. The results identified changes in business culture, work conditions, work profiles, and work environment. The number of in-depth interviews in this chapter was limited, and more interviews may have produced alternate or deeper insights. However, the intention was to inspire designers and provide some fundamental research insights – a goal that was achieved.

Chapter 5, digital business nomads are portrayed based on user interviews. As extreme users, it was assumed that their issues align with those of future mass users. This assumption could be open to debate, however, as the validity of future forecasts is uncertain. On the other hand, extreme users were chosen to stretch the limits of the vehicle's full usage potential and to push disruptive innovations relating to vehicle interiors.

Chapter 6 describes an experiment involving 92 master's students from TU Delft. The experiment brief and its outcome displayed a reduced complexity (see Table 48 Ideally, the students should have been experienced transportation designers; meaning real users could have retroactively approved their design outcomes. On the other hand, this work sought to conduct an experiment in a protected and neutral university environment using open-minded participants without any company-political bias.

In Chapter 7 an automobile concept design is implemented, including the outcome of the student experiment. These illustrations propose a concrete, simple way to create alternative design briefs. In reality, however, a complete user-inspired automobile design requires much more than a concept design alone. Organizational, behavioural and cultural elements were hence added to accommodate these differences.

All 11 points from the beginning of this chapter have been transformed into recommendations for improvement. Each point in Table 49 (see the corresponding sections in Chapter 8) provides concrete advice for producing an optimal user-inspired design.

Table 49: Overview of recommendations for change

Recommendations for action
1. Identifying a suitable design strategy ▪ Identifying the most important project goals before commencing the process. ▪ Distinguishing between product follow-ups, NPDs, and specific project goals, and deciding whether to apply the inside-out or outside-in design approach. ▪ Introducing a cross-departmental working culture to support the constantly changing project structure according to the applied design approach. ▪ Increasing the awareness of real user needs to reach a superior level in the conception of automobile interiors (via the inside-out approach). Intuitively, designers also involve some human factors when applying the outside-in approach. ▪ Following a user-centred design and an open innovation strategy, instead of black-box behaviour.
2. Redefining the designers work content and tasks ▪ Supporting multidisciplinary teamwork in the fuzzy front-end of NPD. People of different age groups, genders, educational backgrounds, and disciplines should interact to develop new product qualities. ▪ More proactive participation in the overall NPD process.
3. Proposing the design conceptionist's profile ▪ Initiating a cooperative joint venture between design strategists and styling specialists to achieve more versatile, diverse, and broader design results. ▪ Establishing an independent mediator profile between the existing head of design and the communication apparatus of the executing designers. ▪ Opening up the design process to diverse parties within the hierarchy to attain a more profound, user-centric variety of design outcomes in the NPD (from which the head of design and board can choose).
4. Adding reflective feedback loops to the process ▪ Installing iterative feedback loops to question the original brief and project aim in the NPD process flow.
5. Establishing additional process steps (Stages 1–2) ▪ The addition of Stage 1 involves the envisioning of extreme user groups and its overall aim definition.

- The addition of Stage 2 adds a functional content analysis and package setting to the process of the modified concept(ual) design phase.

6. **Reformulating the design process flow**
   - Strengthening the fuzzy front-end concept design phase so that it can affect the product outcome.
7. **Dividing organizational powers within the hierarchy system**
   - Transforming the existing pyramid system into a more reflective diamond system.
   - Dividing powers and responsibilities strategically so that interests are more evenly distributed and unique design content can blossom.
8. **Changing hierarchical dominance into design leadership**
   - Maintaining a diamond-shaped organizational structure overseen by a charismatic and visionary design leader.
   - Installing a space in parallel to the classical hierarchy structure where innovative ideas can blossom, irrespective of their creator's position or project task.
9. **Creating a written design brief (Stage 3)**
   - Making note of the brief criteria so that the process remains precise and verifiable in its late stages. All executing designers should have access to this information.
   - Providing sociocultural trends and tendencies, brief criteria, a CRL of users, and concrete persona descriptions as part of the design brief.
   - Formulating open design tasks so that designers are faced with intellectual challenges. Designers are able to create design solutions at eye-level with engineers.
   - Formulating functional design briefs without specifying any formgiving issues.
   - Illustrating more empathic, alternative user and context insights to provide brief content for immediate design use. It is to challenge designers' curiosity via an appealing, multi-sensual array of details.
   - Placement of persona profiles within the automobile design brief to make it easier for designers to empathize with and meet the needs of the project's target group in the concept.
   - Mentioning actual user challenges in the design brief, to which designers can find concrete answers (specific-to-generic mode of operation).
   - Applying extreme user profiles to the design process to gain possible market foresight and strategic or time-sensitive advantages.
   - Applying the space mode method to illustrate functional brief content as part of the concept(ual) design phase. The strategic design content can ideally be transferred in the form of selected space mode scenarios, descriptions, and illustrations.
   - Inserting the basic space mode in such a way that it incorporates all other space modes and functional features. The basic space mode represents the skeletal structure for later products.
10. **Creating an alternative design briefing (Stage 4)**
    - Applying different design approaches that are best suited for each specific design task (inside-out or outside-in approach).
    - Organizing more on-site research so that the designers can apply their research insight to future product designs directly.
    - Addressing more unconventional briefings with the help of target group involvement.
11. **Installing an innovation-friendly work atmosphere & culture**
    - Applying simultaneous changes to the design process, organization, and corporate culture to foster radical product innovations (Köstner and Wagner 2009).
    - Paying attention to new ideas to support an innovation-friendly bottom-up corporate atmosphere.
    - Establishing idea pools to source or exchange innovative ideas when needed.
    - Introducing round-table discussions, workshops, and excursions where the unthinkable can be addressed, allowing disruptive ideas to develop (outside of the NPD process reality and the current research status quo).

8.2.3. Future research

This section proposes recommendations for future research in the field of automotive design. To proceed with the concept developed in Chapter 7, a comprehensive design cycle from stage 0–9+ should be executed (see Figure 52). The quality of this outcome should then be evaluated using the defined brief criteria, employing additional extreme user tests and comparisons with traditional designs. If the outcome is positive, as this research as-

sumes, then the theoretical concept model can be applied to the NPD process of OEM internal design departments. The scientific task is to publish the design process model, disseminate more detailed information about this black-box field, and stimulate discussions.

Iterative learning and improvement cycles will then be enabled, and the existing transportation design process transformed into a participative design model. This in turn may stimulate designers to propose new ideas, facilitating both interior and exterior innovations for new automobile products. To ensure its ongoing improvement, this design process should be documented and tested in a real-life setting. It is important to continually address the product in a holistic, systemic manner. As stated by the Zukunftsinstitut [2012], the task of designing the future automobile should be interpreted as '*…a universal type of future creation …it is not just about covering functions, but rather about developing overall systems.*'[50]

The user and expert interviews and the experiment indicated that the inside-out design approach might potentially be applied to the automobile design process in industry, with interesting outcomes. However, the reality is more complex. The experiment and the expert interviews showed that the right method (outside-in or inside-out approach, or even a good balance between the two) must be chosen right from the beginning according to the intended goal and accompanying strategy.

[50] Translated from the German:*'…als universelle Zukunftsgestaltung. Und dann geht es nicht um das Verkleiden von Funktionen, sondern um das Entwickeln von Systemen.'*

SUMMARY
SAMENVATTING

SUMMARY

Changes in user behaviour, urban policies and technical developments have caused the mobility sector to transform. For business people – flexible individuals – the understanding of car usage has changed substantially. They show less interest in product ownership and more concern for unique (service) experiences and alternative space use. Several studies predict that the future automobile user will be less of a driver and more of an active passenger within an autonomously moving vehicle. While being driven, the user is able to spend time on alternative activities within the car's interior.

This new user needs and technical innovations are not yet incorporated into the automobile's interior. To implement these in the automobile design (process), disruptive changes must occur. The question is whether an inside-out approach, which starts with the design of the interior, will be more appropriate in future than the current most used outside-in approach that initiates with the styling of the exterior. Would an inside-out approach – starting with the design of the interior – be more appropriate than the current outside-in approach that begins with the exterior styling? Hence, the design department must redefine its strategy to meet these future challenges. This work focuses on the fuzzy front-end phase of OEM-internal design processes to modify its strategy and foster innovations right from the start.

Chapters 2 to 6 of this work deal with user and environmental analyses, on-site observations, and an experiment that questions the status quo of automobile design.

Chapter 3: Almost no OEM-internal design processes have been published to date. Therefore, the *status quo* was described with the help of literature research, expert interviews and onsite observations. The following main constraints were found:

- There are few variations in the visionary face of automobile concept development. The exterior is of main relevance, with other parts left out.

- The NPD process suffers from time and budget cuts. There is also an enormous innovation 'production' pressure that does not allow for experimental trial and error tests. As a result, employees mainly innovate in an additive form that creates general information overload in the vehicle.

- The up-to-date attribute of digital products is hard to guarantee. The complexity of planning and the development cycle make it difficult to react quickly to market trends.

- The executing designers do not gather relevant target group information during the design process, as these insights do not match their specific curiosities.

- Most designers do not receive written briefings from their superiors. This makes it difficult to measure their target achievements in hindsight, thereby creating a culture of knowledge repetition instead of innovation creation.

- The design hierarchy system is organized top-down and isolated from the engineering departments. It is challenging for designers to skip levels and implement bottom-up innovations or communicate cross- departmental.

Chapter 4, 5 and 6: The above constraints require rethinking the existing automobile design culture and processes to find alternative ways to approach innovation. This work has focused on the fuzzy front-end concept design of NPD through an exemplary student experiment: A test environment with 92 student participants was set-up to seek a real-life comparison with an OEM design department. The students were divided into Groups A and B and received exactly the same design brief. The only difference was that Group A had to design a car from inside-out (inside-out approach) and Group B from an outside-in (outside-in approach). The design brief included influential user trends and tendencies, a common requirement list from 16 extreme users interviewed, three transformed persona profiles, as well as a short task description. Each student group chose one persona and developed a functional car concept for this individual. The main insights were:

- Using the outside-in approach, the interior and exterior tasks achieved a comparable quality level in their outcomes. Using the inside-out approach, however, deepened awareness for user's needs and reached a higher level in the automobile interior without being notably affected by exterior design.

- As soon as an executing designer came in touch with any target group insights, they intuitively involved them in their designs (independent from the applied approach).

Chapter 7: In this chapter, all experiment designs were summarized, evaluated and grouped into functional space modes. This idea of space modes illustrates a novelty in the automobile design environment and was tested within the scope of this project. The space scenarios consisted of functional and atmospheric aspects that are combined into a single automobile space concept. All space proposals were ranked, selected and narrowed down to the eight most important user issues within the vehicle. Each mode was then separately described and illustrated. If functions and features were applied repeatedly in the layout, they were placed permanently within the final basic space mode, representing the future car concept.

Chapter 8: In this chapter, 11 final improvement proposals are formulated based on the previous chapters in the field of the design brief, the briefing phase, the design process and the hierarchy system within the NPD process. These final proposals offer solutions to the constraints highlighted above, and were approved by six automobile experts. The improvement-, expert-endorsed proposals demonstrate the utility of questioning the design process. Both the experts and the experiment revealed a slight preference for the inside-out approach, with the user as the central reference point. Increased attention to end users and the fuzzy front end were also advised. The conclusions of this thesis are that implementing these proposals in the fuzzy front-end of the NPD can be a pragmatic way for automobile designers, students and researchers to incorporate user insights and disruptive innovations into their work on future car concepts. Developing this model's effectiveness requires further testing in a practical, real-life design environment.

SAMENVATTING

Wijzigingen in gebruikersgedrag, mobiliteitsbeleid en technische ontwikkelingen hebben ertoe geleid dat de mobiliteitssector is getransformeerd. Voor zakenmensen – flexibele individuen – is het begrip van autogebruik sterk veranderd. Ze hechten minder waarde aan het bezitten van een wagen, maar willen eerder unieke (diensten-)ervaringen en de ruimte alternatief gebruiken. Verschillende studies voorspellen dat de autogebruiker van de toekomst minder een bestuurder en meer een actieve passagier is binnen een autonoom bewegend voertuig. Terwijl hij wordt rondgereden, kan de gebruiker zich in de wagen met iets anders bezighouden.

Deze nieuwe gebruikersbehoeften en technische innovaties zijn nog niet geïntegreerd in het interieur van wagens. Om deze nieuwigheden te implementeren in het autodesign(-proces) zijn radicale wijzigingen noodzakelijk. De vraag is of van binnenuit ontwerpen, waarbij men begint met het ontwerpen van het interieur, in de toekomst niet meer geschikt is als strategie dan de nu veel toegepaste ontwerptechniek waarbij men begint met de styling van de buitenkant. Zou van binnenuit ontwerpen, waarbij men begint met het ontwerpen van het interieur, niet meer geschikt is als strategie dan de nu veel toegepaste ontwerptechniek waarbij men begint met de styling van de buitenkant? Daarom moeten ontwerpafdelingen hun strategie aanpassen en in spelen op deze toekomstige uitdagingen. Dit werk focust op de vage voorste fase van OEM-processen voor intern ontwerp om de strategie te wijzigen en reeds van in het begin innovaties te implementeren.

Hoofdstukken 2 tot 6 van dit werk bevatten analyses van gebruiker en omgeving, plaatselijke waarnemingen en een experiment dat de status quo van autodesign in vraag stelt.

Hoofdstuk 3: Tot op vandaag werden bijna nog geen OEM-processen voor intern ontwerp gepubliceerd. Daarom werd de *status quo* beschreven met behulp van literatuuronderzoek, interviews met experts en plaatselijke waarnemingen. De volgende belangrijkste beperkingen werden vastgesteld:

- Er is weinig variatie in de visie op de ontwikkeling van het autoconcept. Het belangrijkste is de buitenkant, zonder rekening te houden met andere onderdelen.

- Het NPD-proces lijdt onder besparingen op het gebied van tijd en budget. Er is ook een enorme innovatieve 'productiedruk' waardoor experimentele trial-and-error-tests zo goed als uitgesloten zijn. Als gevolg daarvan vindt innovatie plaats door toevoegingen, zonder dat rigoureuze innovaties mogelijk zijn.

- Digitale producten up-to-date houden is een enorme uitdaging. De complexiteit van de plannings- en ontwikkelingscycli maakt het moeilijk om snel te reageren op nieuwe markttrends.

- De uitvoerende ontwerpers verzamelen tijdens het ontwerpproces niet de juiste informatie over de doelgroep aangezien hun inzichten niet zijn afgestemd op hun specifieke bijzonderheden.

- De meeste ontwerpers ontvangen ook geen schriftelijke briefings van hun leidinggevenden. Hierdoor is het moeilijk om achteraf hun doelprestaties te meten, en ontstaat er een cultuur van kennis herhalen in plaats van vernieuwen.

- Het huidige ontwerpsysteem is georganiseerd volgens een piramide (top-down) en werkt geïsoleerd van de technische afdelingen. Het is voor ontwerpers een uitdaging om niveaus over te slaan en bottom-up-innovaties toe te passen of te communiceren over de verschillende afdelingen heen.

Hoofdstuk 4, 5 en 6: Bovenstaande beperkingen vereisen een hertekening van de bestaande ontwerpcultuur en -processen in de autosector om alternatieve manieren te vinden om innovatie te benaderen. Dit werk focuste op de vage voorste fase van het conceptontwerp van NPD aan de hand van een experiment met studenten: er werd een testomgeving opgezet met 92 studenten en zij werden vergeleken met een echte OEM-ontwerpafdeling. De studenten werden onderverdeeld in Groep A en Groep B en kregen exact dezelfde ontwerpinstructies. Het enige verschil was dat Groep A een wagen moest ontwerpen en hierbij moest beginnen met het interieur (inside-out) en dat Groep B moest beginnen met de buitenkant (outside-in). De ontwerpinstructies bevatten invloedrijke gebruikerstrends, een gezamenlijke lijst met vereisten van 16 bevraagde extreme gebruikers, drie getransformeerde persoonlijke profielen en een korte taakomschrijving. Elke studentengroep koos één persoon en ontwikkelde voor dit individu een functioneel autoconcept. De belangrijkste inzichten waren:

- De outside-in-groepen behaalden voor de opdrachten voor interieur en exterieur een vergelijkbaar kwaliteitsniveau. De inside-out-groepen waren zich echter beter bewust van de gebruikersbehoeften en ontwierpen een interieur met een hoger kwaliteitsniveau zonder dat dat ze door het exterieur werden belemmerd.

- Zodra een uitvoerend ontwerper in contact kwam met inzichten van een doelgroep, betrok hij deze intuïtief in zijn ontwerpen (onafhankelijk van de gebruikte benadering).

Hoofdstuk 7: Dit hoofdstuk bevat een overzicht van alle ontworpen interieurs, waarna ze werden geëvalueerd en gegroepeerd in functionele ruimtemodi. Dit idee van ruimtemodi is nieuw in het autodesign en werd in het kader van dit project getest. De ruimtescenario's bestonden uit functionele en atmosferische aspecten die worden gecombineerd in één autoruimteconcept. Alle ruimtevoorstellen werden gerangschikt, geselecteerd en beperkt tot de acht belangrijkste gebruikersproblemen in het voertuig. Elke modus werd vervolgens afzonderlijk beschreven en geïllustreerd. Zijn functies en kenmerken werden herhaaldelijk toegepast in de lay-out, en permanent in de definitieve ruimtemodus geplaatst, om zo het toekomstige autoconcept te vertegenwoordigen.

Hoofdstuk 8: In dit hoofdstuk worden op basis van de eerdere hoofdstukken 11 voorstellen voor verbetering geformuleerd met betrekking tot de ontwerpinstructies, de briefingfase, het ontwerpproces en de hiërarchie binnen het NPD-proces. Deze definitieve voorstellen bevatten oplossingen voor bovenstaande beperkingen, en werden goedgekeurd door zes automobielexperts. De door experts goedgekeurde voorstellen voor verbeterin-

gen tonen aan dat het noodzakelijk is om het ontwerpproces in vraag te stellen. Zowel de experts als het experiment wezen op een lichte voorkeur voor de inside-out-benadering, met de gebruiker als centraal referentiepunt. Het is ook raadzaam om meer aandacht te besteden aan eindgebruikers en de vage voorste fase. Deze thesis besluit dat het toepassen van deze voorstellen in de vage voorste fase van NPD een pragmatische manier kan zijn voor auto-ontwerpers, studenten en onderzoekers om inzichten van gebruikers en disruptieve innovaties te integreren in toekomstige autoconcepten. De efficiëntie van dit model ontwikkelen vereist bijkomende tests in een praktische, reële ontwerpomgeving.

ABBREVIATIONS

LIST OF ABBREVIATIONS

App.	Appendix
ACEA	European Automobile Manufacturers Association
ACD	Automobile Concept Design
BBS	Black-Box-Syndrome
B2B	Business to Business (business model type)
B2C	Business to Customer (business model type)
CAD	Computer Aided Design
CD	Concept Design
CI	Corporate Identity
CoC	Centre of Competence
CRL	Common Requirement List
CSI	Customer Satisfaction Index
CVD	Context Variation by Design
C2C	Car-to-Car
DBN	Digital Business Nomad
DSP	Design Strategy Project
ECTS	European Credit Transfer System
ED	Electrical Drive
e.g.	exempli gratia (for example)
et al.	et alii/et aliae/et alia (and others)
EV	Electrical Vehicle
GM	General Motors
HCD	Human-Centred Design
HMI	Human Machine Interface
HPI	Hasso-Plattner-Institute
HR	Human Resources
i.a.	Inter alia (amongst other things)
IAA	Internationale Automobil Ausstellung (International Automotive Fair)
ICE	Intercity Express (German high-speed train)
IDS	Interactive Data Screen
IDT	Interactive Data Table
i.e.	id est (that is)
IIA	Individual Improvement Activities (consumer innovators)
IRL	Individual Requirement List
IT	Information Technology
KTD	Institut für Konstruktionstechnik und Technisches Design (Institute for Engineering Design and Industrial Design)
l.c.	Loco citato (in the place cited, see section before)
LBS	Location Based Services
LEV	Low Emission Vehicle
MAYA	Most Advanced Yet Accepted
MIT	Massachusetts Institute of Technology
MOPF	Modellpflege (automotive term for an optical model upgrade)
MP	Mobility Pattern
NFC	Near Field Communication

N.N.	Nomen Nescio (name/number is unknown)
NPD	New Product Development
NSA	National Security Agency (U.S.)
OEM	Original Equipment Manufacturer
ÖPNV	Öffentlicher Personennahverkehr (short-range public transportation)
Pc	Personal computer
PDP	Product Development Process
PDeP	Product Design Process
PEP	Product Evolution Process
PEV	Personal Electric Vehicle
PLC	Product Life Cycle
PV	Personal Vehicle
RFT	Radio Frequency Transmission
R&D	Research and Development
SMART	Swatch Mercedes ART
SMS	Short Message Service
SOP	Start Of Production
TD	Transportation Design
TID	Transportation Interior Design
UAE	United Arab Emirates
UCD	User-Centred Design
USP	Unique Selling Proposition
UX	User Experience
UI	User Innovation
VDA	Verband Deutscher Automobilhersteller (German Association of the Automotive Industry)
WLAN	Wireless Local Area Network
Yumpies	Young upwardly mobile professionals
ZEV	Zero Emission Vehicle
2D	Two-Dimensional
3D	Three-Dimensional

General remarks:
For practical reasons, this book uses masculine forms only; however, the masculine pronoun may be taken to indicate both genders.

Since the transportation design field contains both political and free-market elements, personal statements by the interviewees may lead to future complications for the individuals concerned. This work therefore respects instances where interviewees have requested not to be cited by name. In cases of particular interest concerning specific statements, please do not hesitate to contact the author (see contact information at the end).

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APPENDIX

APPENDIX

The following Appendix is organized according to the chapters order above. It contains tables, figures and illustrations that were too long to apply at the text passages above, but carry along some important background information.

App. Chapter 3: Automobile New Product Development

Table 50: Translation of interview guide in English and German language

Questionnaire in English language	Questionnaire in German language
Portrait and personal data collection:	Portrait:
May you shortly introduce yourself (name, age, place of living, car type/km driving per year/ being first or second car owner, expertise)?	Wären Sie so nett und würden sich kurz vorstellen (Name, Alter, Wohnort, zurückgelegte km pro Jahr, Erst- bzw. Zweitbesitz des Fahrzeugs und Erläuterung der Fachexpertise)
What is your professional background?	Was machen Sie beruflich?
You are educating transportation designer. What typical challenges need to be faced within the automobile industry? What typical characteristics do your students have that are of advantage within OEM's?	Sie bilden an in ihrem Fachbereich sogenannte Transportation Designer aus. Welche besonderen Herausforderungen gilt es in der Automobilbranche zu bewältigen? Welche Eigenschaften zeichnen diese ihrer Meinung nach innerhalb eines Industriekonzerns, einer Firma besonders aus?
What type of role do designers take up especially in German OEM's?	Welche Rolle nehmen Designer speziell in deutschen Automobilunternehmen ein?
Are there significant differences in-between the automobile exterior and interior design? Are any target groups related issues (user-centred approach) influencing this work? For you what is the difference in-between target group-related design and user-centredness?	Gibt es bedeutende Unterschiede zwischen dem automobilen Exterieur und Interieur Design? Welche? Welche Rolle spielen Menschen bzw. Zielgruppen (user-centred approach) dabei? Was ist für Sie der Unterschied zwischen Zielgruppen- bzw. benutzerorientiertem Design?
This research concentrates on the early stages of the design process and therefor I am interested what type of information and communication is in need to develop user-centred cars.	Ich interessiere mich für die frühen Schritte innerhalb des Designprozesses (early stages of the design process), dafür, welche Art von Informationen bzw. Kommunikation das Transportation Design benötigt, um das automobile Interieur mit einem benutzerorientierten Fokus weiter/neu zu entwickeln?
The key interfaces within the Product Development Process are causing complex personal as well as professional challenges in communication. What do you know about the interface in-between the product conception and the design (challenges, problems…)? How does a first product briefing take place?	Überall dort, wo es Schnittstellen im Produktentstehungsprozess gibt, entstehen komplexe zwischenmenschliche und auch fachliche Herausforderungen in der Kommunikation. Diese sind in der Automobilbranche besonders vielfältig und technik- bzw. funktionsorientiert. Was wissen Sie über die Schnittstelle der Produktkonzeptionisten aus der Forschung und Entwicklung und dem Design (Herausforderungen, Probleme...)? Wie sieht so ein Produktbriefing aus?
Exists there a kind of practical knowledge of how to handle new projects or interpret information inside the company? Do you know if the final design is approved by the prior brief information?	Ist das dann eine Art Erfahrungswissen, wie man bestimmte Projekte in einer Firma bearbeitet bzw. die Informationen interpretiert? Gibt es da nicht auch eine Problematik des Beweisens. Also, wenn ich z. B. ein Produkt fertiggestellt habe, kann oder möchte ich dann soz. beweisen, ob ich das Briefing beachtet bzw. dem entsprochen habe?
Do you feel a kind of extraordinary movement within the automobile branch in the moment? Who are the	Ist die Branche in Bewegung? Wer oder was sind die Driver oder Vorbilder? Warum? Denken Sie, dass in-

driver and role models? Why? Do you think that innovative insights should enter the company from inside or outside?	novative Informationen von außen oder von innen in die Firma eingespeist werden müssten?
How do you define (design) innovations? Are these user innovations, semantic or aesthetical innovations…?	Was sind (Design-)Innovationen für Sie? Benutzerinnovationen, Bedeutungsinnovationen, ästhetische Innovationen...?
From where derive automobile interior innovations mainly? Are they of a more incremental or radical nature? Why? Do you think the incremental product development will end or actually restart within the automotive interior field ('next big thing')?	Woher kommen die Innovationen im automobilen Interieur? Entstehen sie ihrer Einschätzung nach eher inkrementell oder radikal? Warum? Erwarten Sie ein Ende, oder einen Neuanfang der inkrementellen Produktentwicklung (‚the next big thing')?
Do you rather believe in process or product innovations? Do you believe that a process innovation could be a prerequisite for a long-term product innovation? How do you interpret product concept and PDP logics? Do you think that the redesign of the hierarchy pyramid might cause the implementation of more product innovations?	Glauben Sie eher an Prozess- bzw. an Produktinnovationen? Könnte eine Prozessinnovation Voraussetzung für eine dauerhafte Produktinnovation im Transportation Design sein? Wie verstehen Sie die Logik der Produktkonzeption bzw. des Produktentstehungsprozesses? Könnte der Abbau von Hierarchiestufen zu Produktinnovationen führen?
Do designers need more freedom concerning their work content (design research)? Who talks to external departments (Head of design, team leader)? Does the design today do the wrapping-up, decoration job?	...Bräuchten Designer schlichtweg mehr Freiraum für eigenen Studien (Design Research)? Welcher Designer spricht mit externen Abteilungen (Head of design, Teamleiter)? Hat das Design nur noch die 'Einpack- bzw. Ausschmückungsrolle?
May you relate the following terms with the automotive interior? Content, function, individuality, high-level quality.	Können Sie die Bedeutung folgender Wörter in Bezug zum automobilen Interieur setzen? Inhalt, Funktion, Individualität, Hochwertigkeit und Qualität.
Final statement: Exists a new or different demand of users that requires rethinking the automobile idea and usage fundamentally? What might happen when the pure addition of always more functions might not generate an added value for the interior as well as the end-users anymore?	Finale Äußerungen zu den aufgestellten Hypothesen und Forschungsfragen: Gibt es ein neu- oder andersartiges Anforderungsprofil, dass ein grundsätzliches Umdenken zum Thema Automobilnutzung bzw. Automobilkonzeption erfordert? Was passiert, wenn eine Anhäufung von Funktionen keinen hinreichend bedeutungsvollen Mehrwert) mehr für das automobile Interieur bzw. die Kunden verkörpert?
Proposition 1: In future for the urban autonomous, respectively partly autonomous driving car not the active driving, but the free accessible and flexible mobile space it will be of mayor importance – the car as the new mobile office. What do think about that idea? Do you think new content concerning the vehicle application seems probable?	Hypothese 1: Für das urbane autonom bzw. teilautonom fahrende Stadtfahrzeug mit E-Antrieb wird in Zukunft weniger das aktive Fahren wichtig sein, sondern vielmehr der zur Verfügung stehende in sich flexible, mobile Raum wird Priorität besitzen – Das Auto als mobiles Büro. Was halten Sie davon? Kann es neue Inhalte geben?
And then when this moving object, a moving interior represents at first instance a flexible office (instead of a car) should we still term it automobile?	Wenn dieses Produkt in erster Linie ein Büro ist und erst in weiter Instanz ein Automobil ist, dann stellt sich folgende Frage, ob man das noch Automobil nennen sollte?
Proposition 2: There should be created a kind of new relationship towards functional themes, the interpretation of individualisation and the definiton of content within the automobile interior. Thereby the most important fact is user-centred thinking in cyclical courses (e.g. see daily-weekly routines of business nomad). The aim is to manage a break-through of hitherto practices, to create new behavioural cultures and processes that affect a different kind of information transfer into the automobile interior.	Hypothese 2: Es muss eine neue Beziehung zu der Funktionsthematik, dem Verständnis von Individualisierung und der Definition von Inhalten im automobilen Interieur gefunden bzw. hergestellt werden. Dabei geht es um ein benutzerorientiertes Denken in Tagesabläufen und Abfolgen aus dem Leben der Menschen (siehe Beispiel der sog. extreme-user = Businessnomaden).Das Ziel ist, bisherige Praktiken durch das radikale Beispiel der extreme-user zu durchbrechen, um neuen Verhaltenskulturen und Abläufen (Prozessen) Platz zu schaffen, die wiederum

	einen andersartigen Informationstransfer in das automobile Interieur Design ermöglichen.
Many thanks for the interview.	Vielen Dank für das Gespräch.

App. Chapter 4: Influential user trends and tendencies

Table 51: Translation of interview guide in English and German language

Questionnaire in English language	Questionnaire in German language
Portrait and personal data collection:	Portrait:
May you introduce yourself (name, age, place of living, car type/km driving per year/ being first or second car owner, expertise)?	Wären Sie so nett und stellen sich vor (Name, Alter, Wohnort, zurückgelegte km pro Jahr, Erst- bzw. Zweitbesitz des Fahrzeugs, Ihre Fachexpertise)
What is your professional background?	Was machen Sie beruflich?
What is the Design Hotels AG[51] doing exactly? On what type of target group are you specialized and how many of these hotel visitors are actual business travellers? What bandwidth of this target group is really represented at the Design Hotels?	Was macht die Design Hotels AG genau und auf welche Zielgruppen hat sie sich spezialisiert? Wie viele davon sind als Businessreisende unterwegs? Welche Zielgruppen (Bandbreite) sind hauptsächlich bei den Partnerhotels der Design Hotels AG vertreten?
Can you explain what makes these business travellers standing out (characteristics, philosophies, ideas etc.)? Do you think that they increasingly combine private and business maters during their hotel stay (experience and recreation factor etc.)?	Was zeichnet diese Businessreisende aus (Eigenschaften, Philosophien, Ideen)? Bzw. verbinden diese zunehmend Privates und Geschäftliches mit einem Hotelaufenthalt (Erlebnisfaktor, Erholungsfaktor)?
What differentiates the business client of today/tomorrow? What types of changes are taking place (in the field of work and mobility culture)?	Was zeichnet den Businesskunden von heute/morgen aus? Welche Veränderungen finden statt (Arbeitskulturen, Mobilitätskulturen etc.)?
How do these people work (daily rhythm)? What type of extraordinary expectations and wishes do these clients want the hotel to fulfil?	Wie arbeiten diese Menschen (Tagesablauf)? Welche außergewöhnlichen Ansprüche und Wünsche haben Sie an ein Hotel (Räumlichkeiten, Service)?
What types of objects are the client bringing along (work utensils such as iPads, pc etc.)?	Was bringt der Kunde ins Hotel mit (Arbeitsutensilien wie iPad, PC etc.)?
Does the traveller mainly do deskwork or deal with business meetings at the hotel such as appointments, conferences, creative brainstorming's, office work and telephone calls?	Arbeitet er hauptsächlich oder erledigt geschäftliche Termine im Hotel wie Besprechungen, Konferenzen, Kreativmeetings, Büroarbeit und Telefonate)?
What aspects do you consider problematic or challenging of a flexible working traveller's daily life?	Was denken Sie ist besonders problematisch oder herausfordernd im alltäglichen Leben eines flexiblen Arbeitenden der reist?
What distinguishes a real business nomad? Does he have special talents? What means spending time at the airport, hotel or car for him? Does he have some special requirements concerning the interior design, space quality and atmosphere? What means quality, individuality, mobility and flexibility to this target group?	Was kennzeichnet einen Businessnomaden? Hat er besondere Talente? Was bedeutet ein Flughafen, Hotel bzw. Auto für ihn? Hat er besondere Ansprüche bezugnehmend auf die Innenraumausstattung, Raumqualität und Atmosphäre? Was bedeutet Qualität, Individualität, Mobilität und Flexibilität für diese Zielgruppe?
Do you think hotel rooms and interiors should be changeable or flexible in future? Should they offer heterogeneous atmospheres for work, sleep, relaxation etc.? May the customer be able to actively change these? And may it be possible to individually adapt some of the space factors?	Müssen Hotelräume (Interieurs) der Zukunft wandelbar, flexibel sein? Bzw. verschiedene Atmosphären fürs Arbeiten, Schlafen, Relaxen etc. anbieten? Soll der Kunde diese selbst einstellen können, bzw. wird er vom Hotel eingestimmt? Ist eine individuelle Anpassbarkeit der Raumfaktoren möglich?

[51] Interview-specific point

What characterizes a high-quality working space of the future (for example within a hotel)? Can you imagine a flexible rental of spaces (similar to coworking areas) that is managed by local (design) communities for instance?	Was kennzeichnet einen qualitativ hochwertigen Arbeitsraum der Zukunft (z. B. in einem Hotel)? Könnte es ähnlich wie bei Coworking spaces eine sehr flexible Anmietung von Räumen geben, die z. B von einer lokalen (Design) Community verwaltet werden?
Hotels may capture an enhanced role in regard to business travellers, representing a temporary overnight stay, recreation space, creative work area, convention centre. Does this seem probable to you?	Hotels könnten in Zukunft eine noch größere und umfassendere Rolle in Bezug auf Businessreisende spielen und damit temporärer Übernachtungs-, Aufenthalts-, kreativer Arbeits-, Versammlungs- und Erholungsort zugleich sein. Ist das wahrscheinlich?
What type of role may the automobile play in this context (sequence: Airport – hotel – office – restaurant…)? Is something missing?	Welche Rolle könnte das Automobil in diesem Kontext spielen (Abfolge: Flughafen – Hotel – Büro – Restaurant –...)? Fehlt etwas?
Proposition 1: In future for the urban autonomous, respectively partly autonomous driving car not the active driving, but the free accessible and flexible mobile space it will be of mayor importance – the car as the new mobile office. What do think about that idea? Do you think new content concerning the vehicle application seems probable?	Hypothese 1: Für das urbane autonom bzw. teilautonom fahrende Stadtfahrzeug mit E-Antrieb wird in Zukunft weniger das aktive Fahren wichtig sein, sondern vielmehr der zur Verfügung stehende in sich flexible, mobile Raum wird Priorität besitzen – Das Auto als mobiles Büro. Was halten Sie davon? Kann es neue Inhalte geben?
And then when this moving object, a moving interior represents at first instance a flexible office (instead of a car) should we still term it automobile?	Wenn dieses Produkt in erster Linie ein Büro ist und erst in weiter Instanz ein Automobil ist, dann stellt sich folgende Frage, ob man das noch Automobil nennen sollte?
2: There should be created a kind of new relationship towards functional themes, the interpretation of individualisation and the definiton of content within the automobile interior. Thereby the most important fact is user-centred thinking in cyclical courses (e.g. see daily-weekly routines of business nomad). The aim is to manage a break-through of hitherto practices, to create new behavioural cultures and processes that affect a different kind of information transfer into the automobile interior.	Hypothese 2: Es muss eine neue Beziehung zu der Funktionsthematik, dem Verständnis von Individualisierung und der Definition von Inhalten im automobilen Interieur gefunden bzw. hergestellt werden. Dabei geht es um ein benutzerorientiertes Denken in Tagesabläufen und Abfolgen aus dem Leben der Menschen (siehe Beispiel der sog. extreme-user = Businessnomaden).Das Ziel ist, bisherige Praktiken durch das radikale Beispiel der extreme-user zu durchbrechen, um neuen Verhaltenskulturen und Abläufen (Prozessen) Platz zu schaffen, die wiederum einen andersartigen Informationstransfer in das automobile Interieur Design ermöglichen.
Many thanks for the interview.	Vielen Dank für das Gespräch.

Table 52: Search field – key-drivers of the changing business culture

Influential factors	What changes in detail?	How might the future look alike?	User trend and tendency
Urbanisation	▪ Always more people are living in cities ▪ It transforms into a point of interest for doing business	▪ The city offers new possibilities and forms of doing business ▪ Urban life inspires the digital worker sustainably ▪ Trends are made and also captured there ▪ Public office ▪ An urban think tank	Public work tank

Digitalization	▪ Spending more time working online ▪ Being more location-independent ▪ The way we deal, and handle information ▪ Work re-organization	▪ Towards new, intangible work formats ▪ More intangible, digitalized data and information ▪ Easier data exchange, transfer, and transportation	Virtual data dealer
Knowledge age	▪ Shifting values and work content ▪ The way we deal, handle & manage information (content) ▪ From producing towards a service-orientation ▪ More knowledge-based work ▪ Knowledge and ideas are the main source of economic growth ▪ Work reorganisation	▪ A post-industrial era ▪ Knowledge-, information-, and service-oriented economy ▪ Post-industrial economy ▪ From a producing towards a service-based new economy ▪ Knowledge and ideas are the main source of growth	Knowledge economy

Table 53: Search field – key-drivers of developing work conditions

Influential factors	**What changes in detail?**	**Towards…**	**User trend and tendency**
Barrier-free communication	▪ Democratic hierarchy and communication ▪ Free space ▪ Collaborative thinking and acting ▪ Seamless communication	▪ Flexible open space offices ▪ Collaborative working ▪ The office as sociocultural meeting place to exchange information ▪ *'The crowd meets at certain places and exchanges branch-relevant information'*	Collaborative office playground
Freelance contracting system	▪ Shifting from an employee, towards an employer position ▪ Short-term thinking and temporary contracting ▪ Corporations are reducing their human capital	▪ Flexible and independent know how worker ▪ Positioning in always leaner, self-regulating systems ▪ Employer-independent types of money earning ▪ Outsourcing of know-how	Outsourced know-how worker

Table 54: Search field – key-drivers of flexible work profiles

Influential factors	**What changes in detail?**	**Towards…** (Work-related consequences)	**Future trends, and tendencies**
Innovative creativity application	▪ Shifting user skills and work content that cannot be done by computers	▪ Generating new ideas, visions, strategic concepts, and innovations	Creativitas [Jacobs 2007]
Mobile working - physical work mobility	▪ Location-independent working ▪ Work is mainly market-, company-, or stakeholder-driven ▪ International work is easier, as phone calls etc. can be also done from home (also when the office is closed) ▪ Reorganisation of work ▪ More flexibility required	▪ New workforces can be acquired ▪ Free locations selection ▪ Work-related location adoption ▪ Strategic work site election ▪ Global collaboration and communication is made easier (time shifts) ▪ A public office	Mobile location adopters

		▪ Adaptable office space	
Business travelling	▪ Extensive travelling for business reasons	▪ Extreme mobility	Digital nomads
Fusion of private and professional life	▪ Loss of privacy, the private life ▪ Difficult to divide in-between private and professional life	▪ Temporary recreation, and individual working situation needed ▪ A strict separation of these two issues?	Private pro
Flexible office culture flexible working times	▪ No core working times ▪ Flexible working times ▪ More work performance	▪ Flexibility in time ▪ Confidential work time	Private pro working times
Cloud computing	▪ Location-independent way of data access, saving, information protection	▪ Companies need to create – offer to their mobile worker a save digital space (work tool)	Virtual collaboration society
Sharing culture	▪ Exchange and collaboration concerning digital issues ▪ Open data sharing	▪ Open source mentality ▪ Sharing = balanced taking and giving philosophy ▪ Participatory culture of know-how project worker	Participative sharing community

Table 55: Search field – key-drivers of the changing work environment

Influential factors	**What changes in detail?**	**Towards…** (Work-related consequences)	**Future trends, and tendencies**
Genius loci	▪ People look for the perfect place to work and live	▪ A specific identity, importance, or strategic advantage ▪ Places will be rated and qualified	Genius loci
Importance of urbanity - globalization	▪ City offers infrastructure, mobility options, electricity supply, wifi, gastronomy, and a certain potential client-density are offered, this area gains an immense attractiveness	▪ An interrelated set of experiences within the public ▪ A combination of the built environment, diverse people of all ethnicities, nationalities, religions, and sexual orientations, who interact with each other, and the vibrancy of the street life, café culture, arts, and music	Global urbanites
Public working	▪ Cities are places of contradiction	▪ The pure energy of these clashing positions creates an immense attraction, and produces many creative outputs	Public co-working
Attractiveness of locations	▪ The crowd meets at certain places and exchanges branch-relevant information	▪ Dynamic news exchange ▪ An example is the Berlin-based club called Soho House	Hot-spot society
Corporate identity in office design	▪ Employees try to attract their own staff ▪ They want them to stay longer at work ▪ They manifest their identities through labelling office spaces ▪ The office gets a marketplace of knowledge	▪ Office is a venue for social interaction ▪ Reflecting the corporate philosophy ▪ Using intuitive, and multi-channel tools to express a brand statement ▪ 2D and 3D office designs	Corporate employer branding
De-centralized,	▪ Work environment changes according to personal needs	▪ Situation-dependent work environment	Flexible work

adaptable work environment	▪ Retreats and private space are also needed ▪ A temporary adaptability is needed	and modifiable features ▪ Adaptable workbay[52] ▪ Adjustable space situations that are partially open, transparent, bright, offer cross-connections, as well as recreation areas, meeting and telephone zones[53]	layouts
Changes in work content and social behaviour takes place	▪ There occur new environmental needs ▪ Our surrounding inner space needs to adopt these socio-cultural mutations	▪ Everything is *'affiliated to how we use things…'*[54] ▪ Surfaces, materials and whole objects like furniture are reacting - range of flexible, temporary adjustable space situations ▪ Reactive and changing environments ▪ Temporary adjustable space situations	Reactive environment and corresponding objects
Changing priorities within the work environment	▪ The point of reference is not anymore the classical built work environment	▪ Work environment means: Social interaction, collaboration, *'relationship with co-workers and supervisors, organisational culture, room for personal development, etc.'*[55]	Quality co-working atmosphere

Table 56: Search field – key-drivers of future work skills and user behaviour

Influential factors	**What changes in detail?**	**Towards…** (Work-related consequences)	**Future trends, and tendencies**
Digital age	▪ Strong computational thinking skills, and communication technology knowledge from individuals are required	▪ A constant mobile status ▪ Attending virtual university lectures, a medical consultation or a business conference ▪ Using more cloud computing	New media literacy
Physical work mobility	▪ Demands a more flexible organisation of work time and place	▪ Less place- and time-dependent work behaviour ▪ People work for the same project within a group or team, but live in completely different locations, cultures and time zones	Interdependent intercultural working
Digital age and company culture	▪ Possible to access, down- and upload content and information via the web all the time, everywhere ▪ No more complete settledness for the rest of life	▪ Being always more mobile (mobile status) ▪ Mobile worker stays always longer online, in order to guarantee a permanent reachability, wherever they are located ▪ All-time availability guarantee ▪ Question: What combinations and spectrums of mobility do people live, and therefor what kind of needs do they have for any built environment	Permanent mobile state

[52] According to the Vitra Workbay office system. See reference above.
[53] According to the NL Architects. See reference above.
[54] Statement of Konstantin Gricic. See quote above.
[55] Statement of Michael Poh. See quote above.

Digital age	▪ Doing several tasks at the same time ▪ Prioritizing information and giving it hierarchies	▪ A simultaneous information management ▪ To work well organized, with higher efficiency and productivity in a certain time ▪ Many different single modes and actions will merge into joint ones	Multi-tasking ability
Knowledge work	▪ A good t-shaped[56] education obtains to be the basic requirement for future knowledge work	▪ People should improve their work profile through vocational trainings, further education and so on to remain competitive and raise their market value ▪ Their interdisciplinary knowledge turns into a company potential	Interdisciplinary work approach
Creativity, corporate innovation generation	▪ The economy furthermore needs completely new profiles that develop slowly within the academic scenery ▪ Creativity is highly appreciated and does not know office times	▪ People should be trained for autonomous, novel and adaptive thinking ▪ They should learn to think differently, or in new contexts	Novel adaptive mindset
Creativity, corporate innovation generation	▪ Creative bride-building ▪ Learning and applying iterative creativity methods to generate corporate innovations	▪ Searching for the right people and environment to apply these creativity methods, according to its specific topic	Design thinking and creativity application
Digitalization, global networking	▪ Virtual collaboration in an international context requires a very intuitive and sensible communication	▪ More cross-cultural competency within the daily work environment	Social-emotional intelligence

App. Chapter 5: User exploration

Table 57: Translation of interview guide in English and German language

Questionnaire in English language	**Questionnaire in German language**
Portrait and personal data collection:	**Portrait:**
Portrait: May you shortly introduce yourself (name, age, place of living, car type/km driving per year/ being first or second car owner)?	Wärst du so nett und stellst dich kurz vor (Name, Alter, Wohnort, Automobilbesitz, zurückgelegte km pro Jahr, Erst- bzw. Zweitbesitz des Fahrzeugs?
What is your professional background?	Was machst du beruflich?
What is your personal business idea, talent, attitude towards work and opinion concerning innovation(s) management?	Welche besonderen Fähigkeiten sind bei deiner jetzigen Arbeit gefragt? Wie stehst du, bzw. siehst du das Thema Innovationen/Innovationsmanagement?
Does your work embody creative potential? Have you already improved certain situations?	Erfordert deine Arbeit kreatives Potential? Bzw. verbesserst du beruflich bestimmte Zustände/ Situationen? Entwickelst du neue Ideen/Konzepte, oder fertigst Prototypen an?
Do you live a digital life from a private and professional point of view?	Wie (digitalisiert) würdest du deinen Lebens-/Arbeitsstil beschreiben?
Mobility pattern:	Mobilitätsmuster:
How often per month/year do you travel for business reasons? How long does an average trip last?	Wie oft im Monat/Jahr bist du beruflich unterwegs? Wie lange dauern diese Reisen im Durchschnitt?

[56] See explanation in text above

What media/modes of transport do you normally use there? Why?	Mit welchen Verkehrsmitteln reist du meistens an diesen Ort/Stadt? Warum (Gründe)?
How does your typical sequence of a travel day look like (Airport -> Hotel -> Meeting…)? How do you move within your area of destination?	Wie sieht ein typischer Reisetag (Mobilitätskette/Dauer) bei dir aus (Flughafen -> Hotel -> Meeting…)? Wie bewegst du dich bevorzugt am Zielort?
What do you carry around with you while traveling (type of luggage…)?	Was nimmst du alles mit auf Reisen (Gepäck…)?
What are the 3–5 most important items you always carry with you? Why?	Was sind die 3–5 wichtigsten Dinge, die du immer mit dabeihast? Warum?
How do you create a 'being at home' feeling (smell, music, photos) while travelling?	Wodurch kannst du ein 'zu Hause-Gefühl' generieren (Geruch, Musik, Photos) während du unterwegs bist?
What do you think is particularly problematic or challenging in the life of a flexible worker and traveller?	Was denkst du ist besonders problematisch, oder herausfordernd im Leben eines flexiblen Arbeitenden und Reisenden?
Business culture:	**Arbeitskultur:**
What kind of business culture do you belong to? What type of work style do you practice?	Was bedeutet arbeiten für dich (im Büro sitzen...)? Welche Art von Arbeitsstil hast du?
Do you have a typical work pattern or rhythm of work (similar to a office day)? How does a typical daily work sequence look like?	Hast du feste Arbeitszeiten oder Rhythmen (ähnlich eines Bürotages)? Wie sieht ein typischer Tagesablauf aus?
How strictly do you separate your private from professional life? How do you connect one aspect with the other?	Trennst du dein Berufsleben streng vom Arbeitsleben? Bzw. wie verbindest du beides miteinander?
Do you work while travelling to a destination?	Arbeitest du, währenddessen du reist?
What daily communication devices do you bring along with you (mac, smartphone…)? Which one(s) are the most important pieces for work reasons?	Was sind deine täglichen Kommunikationsmittel und Tools, die du mit dir herumträgst/mit auf Reisen nimmst (Mac, Smartphone...)? Welche davon stellen deine wichtigsten Arbeitsmittel dar?
Is there a certain company image or brand culture in your immediate environment while travelling (Apple, Nokia, BMW, Starbucks, illy, PD, MCM, Victorinox, Samsonite, Prada…)? Do you trust in some of them specifically? Are they mediating a safety feeling or certain lifestyle to you?	Welche Rolle spielt in diesem Zusammenhang eine bestimmte Firmen- oder Markenkultur in deiner unmittelbaren Umgebung (Apple, Nokia, BMW, Starbucks, illy, PD, MCM, Victorinox, Samsonite, Prada...)? Genießen einige davondein besonderes Vertrauen, vermitteln Sicherheit oder einen bestimmten Lebensstil?
What characterizes a premium work environment to you?	Was macht für dich eine Premium Arbeitsumgebung aus?
Work environment:	**Arbeitsumgebung:**
What is your usual work place/environment (airport, hotel lobby, office…)?	Was sind deine üblichen Arbeitsorte und Umgebungen (Flughafen, Hotellobby, Büro...)?
What is your preferred work place or environment? Why? What is important (technical details, individuality, quality…)?	Wo arbeitest du am liebsten (Ort, Umgebung, Ausstattung, Service)? Warum? Auf was legst du besonderen Wert (technische Details, Individualisierung, Qualität...)?
Do you look for different work environments for different types of work? Why yes/no?	Brauchst, oder suchst du für verschiedene Arbeiten auch unterschiedliche Umgebungen/Ambiente? Warum ja/nein?
How many different types of work situations do you have (creative/inspirational, relaxing power nap, telephone call, concentrated working/quiet place)?	Was für unterschiedliche Arbeiten erledigst du (bzw. welche Atmosphäre benötigst du dazu (kreative, inspirierende Atmosphäre, Entspannung, Mittagsschlaf, Telefonanruf, konzentrierte Ruhe)?
What marks these atmospheres and environment specific qualities?	Was zeichnet diese Atmosphäre(n) und Umgebungen qualitativ aus?

What marks a creative atmosphere to you (specific environmental factors)?	Was zeichnet für dich eine kreative Atmosphäre aus (spezifische Umfeldfaktoren)?
Would you share a space like this with others fellow workers temporary? Yes/No? Why? If yes, under what kind of circumstances?	Würdest du diesen Raum mit anderen Geschäftsreisenden auf begrenzte Zeit teilen? Ja/Nein? Warum? Unter welchen Umständen?
Personalization:	**Personalisierung:**
Are the actual situations sufficient to your work needs? What could be improved? What do/did you adjust, change or improve properly?	Bist du zufrieden mit den bisherigen Möglichkeiten an Arbeitsumgebungen? Was könnte man verbessern? Bzw. was veränderst du, bzw. machst du dir je nach Bedarf passend?
How important is the personalization of your work environment to you? Do you need to be in a certain mood for working properly?	Wie wichtig ist dir die Personalisierung deiner Arbeitsumgebung? Hast du das Gefühl, dich dazu in eine bestimmte Stimmung versetzten zu müssen?
Do you create a specific atmosphere or a certain work type or purpose (music, temperature, lighting, ergonomics, noise isolation…)? Is the surrounding environment important for you? Why?	Kreierst du bewusst bestimmte Atmosphären und Stimmungen für einen bestimmten Arbeitstypus, oder ein Vorhaben das du hast (Musik, Temperatur, Licht, Ergonomie, Geräuschabschottung...)? Ist die unmittelbare Umgebung wichtig dafür? Warum?
How do you create a certain 'feeling at home' while travelling?	Wie schaffst du ein 'zu Hause Gefühl' während du reist?
Do you attach importance to an exclusive privacy during work? How do you create that?	Legst du Wert auf eine exklusive Privatsphäre beim Arbeiten?
Could you imagine mixing private and professional issues within the same interior? Would a professional working atmosphere continue to exist? Would you like to change space settings according to needed situations? What type of situations would be helpful (States: Sleeping, chatting with another person, telephone conference, debating, working…)?	Würdest du im gleichen (Innen)Raum Berufliches und Privates verbinden oder vermischen wollen? Bleibt dadurch eine ernsthafte Arbeitsatmosphäre erhalten? Möchtest du diese je nach Situation verändern können? Welche Situationen könntest du dir vorstellen (Zustände: Schlafen, mit anderer Person im Raum unterhalten, eine Telefonkonferenz führen, debattieren, arbeiten...)?
How would your personal 'dream office' look like while travelling? What should be customizable?	Wie sähe dein persönliches 'Traumbüro' auf reisen aus? Was sollte personalisierbar sein?
Would you share that space with somebody else? Yes/no? Under what conditions?	Würdest du diesen Raum mit jemandem teilen? Ja/Nein? Unter welchen Umständen?
Automobile:	**Automobil:**
What kind of significant value has the usage of cars in your daily life? Is it a status symbol or more a functional item such as a mobility option to you?	Welchen Stellenwert hat die Nutzung/Besitz von Autos in deinem Alltag? Ist es ein Statussymbol oder eher ein funktionaler Gegenstand, eine Mobilitätsoption für dich?
What type of car(s) do you drive? For what do you need them specifically?	Welche Art Auto(s) fährst du (Fahrzeugklasse)? Wofür brauchst du Sie genau?
How many kilometres are you driving per year?	Wie viele Kilometer legst du mit dem Auto pro Jahr zurück?
How much time do you spent (driving) inside a car?	Wie viel Zeit verbringst du im Auto (fahrend)?
Did you work, relax, pass some time inside the automobile interior without driving actively?	Hast du bereits passiv Zeit im Auto verbracht, gearbeitet, relaxt, geschlafen ohne dabei zu fahren?
What is not suitable there so far, or should be changed?	Was ist dort deiner Meinung nach noch nicht passend, bzw. sollte verbessert werden?
Future urban car	Urbanes Auto der Zukunft
What do you think about that? How could it look like? Ideas, wishes, proposals?	Was denkst du darüber? Wie könnte es aussehen? Ideen, Wünsche, Vorschläge?
Please describe some typical characteristics.	Bitte beschreibe typische Charaktereigenschaften die du damit verbindest.

Urban vision 1: Car interior as mobile work space (parked car status)	**Urbane Vision 1:** Das Fahrzeuginterieur als mobiler Arbeitsraum (parkendes Auto)
Could you imagine that the interior of urban-parked cars might gain a completely new importance? If yes, in what functional or emotional ways?	Könntest du dir vorstellen, dass dem Interieur urban parkender Autos eine neue Bedeutung oder Rolle zukommt? Wenn ja, auf welche funktionale bzw. emotionale Art und Weise?
What additional benefit could it offer to you?	Welchen Mehrwert könnte es für dich bieten?
Are there concrete features you would like to add there?	Gibt es bestimmte Features die du gerne hinzufügen würdest?
Should the automobile interior look the same as it does today? Should the room be more flexible or have any other quality? Would you call it still a car then?	Müsste das automobile Interieur so aussehen, wie es heute aussieht? Bzw. der Raum flexibler sein, oder eine andere Qualität haben? Würdest du es überhaupt noch Auto nennen?
Urban vision 2: (Partially) autonomous driving car	**Urbane Vision 2:** (Teil-)autonom fahrendes Auto
Imaginable? Yes/No? Why? How?	Vorstellbar? Ja/Nein? Warum? Wie?
What would you do with all the recovered time (sequences) you spend inside the car? What would be an additional value for you?	Was würdest du währenddessen mit der wiedergewonnenen Zeit (Sequenzen) im Automobil tun? Was könnte einen Mehrwert darstellen?
(Auto)mobile dream interior	(Auto)mobiles Trauminterieur
What would be your personal 'dream interior' in the year 2020/30? What type of characteristics would be important to you (emotional/functional)?	Was wäre dein persönliches Trauminterieur für das Jahr 2020/2030? Welche Charaktereigenschaften wären für dich wichtig (emotional/funktional)?
Would you like to relax in the car or have a short nap there? What about the different seating positions (more variability needed)?	Würdest du dort gerne entspannen, oder einen Powernap machen? Wie denkst du über die Flexibilität der Sitzpositionen (mehr Flexibilität gefragt)?
Would you like to change or adjust the car interior according to your spatial needs (to gain more freedom of individual space use)?	Würdest du gerne das Interieur verändern bzw. es je nach Situation und Tätigkeit anpassen können (Variabilität in der persönlichen Raumnutzung)?
Would you prefer some non-visible parts inside the vehicle to store items or for having some privacy areas (for sleeping by darkening windows etc.)?	Sollte es von außen nicht sichtbare Elemente des Interieurs wie Staumöglichkeiten für Gepäck, Raumverdunkelungsoptionen (zum Schlafen und für die generelle Privatsphäre) geben?
What about temporary storage possibilities (such as luggage, cloth/shoes/jewellery, work material, important documents…) and a safe?	Sollte das Interieur einen zeitweiligen Stauraum für Dinge wie Gepäck, Kleidung, Schuhe, Arbeitsmaterial, Schmuck und wichtige Dokumente vorhalten? Sollte ein Safe vorhanden sein?
Would you navigate, customize the car via your personal smartphone (app)? Via voice command?	Kannst du dir vorstellen das Autointerieur über dein persönliches Smartphone (App) zu steuern bzw. zu personalisieren? Via Sprachsteuerung?
Do you need other, additional communication possibilities or tools?	Brauchst du noch andere, zusätzliche Kommunikationsmöglichkeiten?
Is there a need for location-based services? What is important to you (traffic jam warning, hotel finder, tourism guide…)?	Brauchst du location-based Services? Was kannst/könntest du besonders gut brauchen (Stauwarnung, Hotelfinder, Touristenführer...)?
What would you need to be able to work properly within a car (table, screen, board, storage, energy…)?	Welche Elemente müssen vorhanden sein, um gut in einem automobilen Interieur arbeiten zu können (Tisch, Armablage, Screen...)?
Would you like to leave a statement of 1-2 sentences to the transportation interior design students what makes your personal dream interior for 2020/2030?	Möchtest du den Studenten 1-2 Sätze zu deinem persönlichem Trauminterieur 2020/2030 mitgeben?

Table 58: Persona 1 – Individual Requirement List

Travel and organisation	▪ Pragmatic and functional oriented ▪ Travelling should be absolute fast and reliable as he wants to reach his meetings in time ▪ Do not like queue for rental cars etc. ▪ Drives less with the car and uses more public transportation
Food accessibility, supply and placement	▪ Are very selective with food, want qualitative good, healthy gourmet food (know the certain places to go) ▪ Are willing to travel longer, when they have a nice place with good food guaranteed ▪ Prefer to sit down while eating properly at a restaurant as they do not like take-away food (in this point they are hedonists)
Space and travel system	▪ Sharing in the sense of multiple use is widely accepted (hotel, train, lounge) but less simultaneously ▪ Love privacy ▪ Consider driving a car as waste of time (luxury issue for holidays or sparetime) ▪ Claim that their business car is a 'more functional object' than an emotional one
Travel luggage	▪ Credo: 'Reduce to the max.' and transport the least possible (max. of 3 pieces) ▪ Pragmatic, multi-functional, high-end travel equipment (stabile to sit on a suitcase or use it as a table) ▪ Luggage must be generally lightweight ▪ They want to transport the least number of luggage pieces possible, the laptop is mostly integrated into another bag ▪ Detailed, accurate system to pack one's bags
Mobile worker, work and work tools	▪ 1 private iPhone, 1 private iPad with personal music collection, 1 business smartphone, and 1-2 pc's ▪ Prefer good working conditions and do not like light reflections on their screen while working in the train ▪ They emphasize a functional, up-to-date and user-friendly technology (no experiments) ▪ Tendency of an unbalanced private and professional life as the business takes it all ▪ Work pattern: Main work gets done in their traditional office, but do phoning and emails while travelling ▪ They do not like talking on the phone at public places because of privacy issues ▪ They do not like when their pc screen is visible to outsiders as sensible business data might be seen ▪ They have their own system of status symbols and services (priority check-in, Lufthansa lounge access, VIP cards, frequent flyer cards, Business- and first class tickets, seats with wifi and own socket) ▪ Basis facility needs: A flat table or surface, electrical charging possibilities and wifi
Future urban mobility and important automobile details	▪ Car sharing is a welcome solution but needs to be clean, functional and of premium quality ▪ Car should have an additional and bigger screen with possibilities to check emails, find restaurants (not necessarily a pc) ▪ The less they need to carry around, the better it is (in-car storage) ▪ Parallel charging options of smartphones and pc within the car while driving are desired ▪ Car should have an integrated and well operating navigation system what is very important to them as it is linked with punctuality ▪ Extreme temperatures such as extreme cold or heat while entering the car are inconvenient (interior pre-conditioning is needed)
Common opinions and thoughts on design and technology	Design: ▪ Less is more (credo) ▪ Apple design as overall benchmark ▪ They appreciate superb design quality Technology: ▪ More technology placed in the car doesn't make it implicitly better

	▪ Do not like complicated operating systems inside the car, everything needs to be easy understandable, intuitive and user-friendly (tendency to simple touchscreens) ▪ Working inside the automobile is too tight and narrow ▪ They appreciate a well-working and up to date navigation system ▪ Prefer a just-in-time alert system in case the train arrives with delay, or there is a traffic jam to make the best use of their time

Table 59: Persona 2 – Individual Requirement List

Travel and organisation	▪ Do not like queuing for car rentals, check-in etc. ▪ A functional and good travel organisation has supreme priority for them ▪ They intent to use time gaps in-between meetings etc. for doing sports, charging batteries, relaxing or sleeping gives them a good feeling, especially when there is a double use of time
Food accessibility, supply and placement	▪ Need something to drink e.g. water and want to store that cool inside the car (small cooling food and drink compartment needed) ▪ Take small snacks, sandwiches, fruits or vegetables with them as it is not sure if they can gain healthy, qualitative good food during their trip ▪ They long for proactive hints where the next good restaurant, cafe, lounge is, to find quality spaces so location-based services are welcome ▪ Love healthy take-away food to save the eating time
Space and travel systems	▪ Sharing in the sense of multiple use is widely accepted such as hotel, train, lounge space but not at the same time ▪ Want their professional privacy area or space for a safe data protection ▪ Claim that their business car should be emotional object of fun and a functional item at the same time ▪ They consider pure driving as a waste of time, a luxury issue that doesn't make sense
Travel luggage	▪ 'Reduce to the max.' means transporting the least possible ▪ Use a trolley for 2-5 day, and a suitcase for longer trips ▪ Never transport more than three pieces of luggage ▪ Woman often carry an additional handbag ▪ Detailed and accurate system to pack one's bags ▪ All pieces of the luggage are well chosen (an appealing material, good finishing, style and practical issues count most) ▪ Luggage must be generally lightweight (principle) ▪ Women generally do not like to lift luggage in the car, train, airport so they search for an easy and elegant way of storage, where they do not need to bother other fellows ▪ Most users own 2 smartphones (1 private good equipped one, mostly an iPhone and 1 business phone, mostly a Blackberry phone)
Mobile worker, work and work tools	▪ They emphasize a functional, up-to-date and user-friendly technology ▪ Insight: The blackberry is already a little computer to help them out, but has a too small screen ▪ They do execute their workload according to their daily environment and travel situation inside the airplane, office, or café ▪ They have always less time for travelling and any local acclimatization so when something is not working is means a high stress factor ▪ Work pattern: Do full workload while travelling or sitting in cafés what is work situation and environment dependent ▪ For content-related, strategic and concentrated work they need a quiet place so that they are in search of suitable retreats like hotel rooms ▪ They do not like when their pc screen is visible to outsiders as sensible business data might be visible ▪ Extensive travellers = extreme requirements = strong personalities ▪ They have their own system of status symbols and services such as priority check-in, Lufthansa lounge access, VIP cards, frequent flyer cards, business- and first class tickets, seats with wifi and own socket ▪ Manage an immense workload with unlimited working hours

	▪ Basis facility needs: A flat table or surface, electrical charging possibilities and wifi
Future urban mobility and important automobile details	▪ Car sharing is a welcome solution but needs to be clean, functional and of premium quality ▪ Claim that the automobile interior is from stone age concerning communication technologies, charging systems, and smartphone adaptation ▪ Flexible office board with electricity supply and wifi ▪ Parallel charging options of smartphones and pc within the car are desired ▪ The less they need to carry around, the better it is (wardrobe inside car) ▪ Prefers sporty, agile and smart vehicles what can be charged quickly ▪ Wants a safety deposit box within the car (for pc, A4 documents etc.) ▪ Need to change cloth within the car (opaque cabin concept is needed) ▪ Car should have an additional and bigger screen with possibilities to check emails, find restaurants (not necessarily a pc) ▪ Want an elaborated holder for their mobile phone with simultaneous charging possibilities (phones, pc…) ▪ Want an intelligent and sophisticated storage system for their luggage inside the car as they do not like to lift up luggage ▪ The less they need to carry around, the better it is (in-car storage) ▪ Car should be connected to the internet with integrated cloud system to have access to their personal music collection ▪ Car should have an integrated and well operating navigation system ▪ While entering the car extreme temperatures such as cold or heat are inconvenient (want pre-conditioning of the car interior)

Table 60: Persona 3 – Individual Requirement List

Travel and organisation	▪ They intent to use time gaps in-between appointments for working, charging batteries, relaxing or meeting friends
Food accessibility, supply and placement	▪ They long for proactive hints, where the next nice restaurant, café, or lounge is located, and where they can find real quality food via location-based services ▪ They are willing to travel even longer when they have a nice, good, cosy, stylish place guaranteed
Space and travel systems	▪ Sharing in the sense of multiple and parallel use, a mutual information exchange are absolutely accepted and desired ▪ Most claim that their business car is a more ‘functional object’ than an emotional one
Travel luggage	▪ Credo: ‘Reduce to the max.’ and transport the least possible ▪ They want to transport the least number of luggage pieces possible, so the laptop is mostly integrated into another bag (max. of 3 pieces) ▪ Luggage must be generally lightweight ▪ All their luggage is well chosen according to appealing materials, good finishing, style and practical issues
Mobile worker, work and work tools	▪ They emphasize a functional, up-to-date and user-friendly technology for cars, phones and pc’s ▪ They do execute their workload according to their daily environment and travel situation (airplane, office, café…) ▪ For concentrated work such as money counting they search for quiet places (private retreats, refugees like hotel rooms, offices…) ▪ They are extensive travellers with extreme requirements and creative personalities able to overcome problems ▪ Manage an immense workload and unlimited working hours, but are able to balance their life throughout making something meaningful ▪ Their private-professional life has been mixed up (work = life = satisfaction and happiness) ▪ Basis facility needs: A flat table or surface, electrical charging possibilities and wifi ▪ Would like to have a safety deposit box within the car for pc, A4 documents and so on ▪ Change cloth and shoes within the car (opaque cabin is needed)

Future urban mobility and important automobile details	▪ Car sharing is a more than welcome solution but needs to be cool and offer first of all a plug and wifi inside ▪ Want an elaborated holder for their mobile phone with simultaneous charging possibilities (phones, iPad, pc…) ▪ Want an intelligent and sophisticated storage system for their luggage inside the car (do not like lifting up luggage) ▪ Claim that the automobile interior is from stone age concerning communication technology, the charging system, smartphone adaptation and so on ▪ Car should offer an additional and bigger screen inside to check emails, find restaurants (not necessarily a pc) ▪ The less to carry around, the better it is for them (in-car storage)! ▪ Car should offer wifi with cloud system to access their personal music collection ▪ Car should be equipped with an integrated and well operating navigation system ▪ Extreme temperatures such as cold or heat within the car while entering are inconvenient (want pre-conditioning of the car interiors)
Common opinions and thoughts on design and technology	Design: ▪ High-end design affinity (credo: Less is more!) ▪ The apple design is their overall benchmark ▪ They appreciate a superb design quality, representing a kind of luxury, a connoisseur issue for them ▪ Old time luxury and status symbols are out Technology: ▪ More technology in the car doesn't make it implicitly better, only when it makes sense and helps them out ▪ Do not like complicated operating systems inside the car, everything needs to be easy understandable, intuitive and user-friendly (tendency to simple touchscreens) ▪ Working inside the automobile is not comfortable today as it is too tight and narrow ▪ Again they would really appreciate a well-working navigation system ▪ Prefer to use a just-in-time alert system to make the best use of their time in case the train arrives with delay, there is a traffic jam etc. ▪ Want a location-based proposal system for restaurants, hotels etc.

Table 61: Common Requirement List

Travel and organisation	▪ They are travelling 2-5 days per week ▪ People do not like wasting time waiting or queuing at car rental stands, train stations, or airport gates ▪ A functional and good travel organisation has supreme priority for them ▪ They intent to use time gaps in-between meetings for doing pc work, charging batter-ies, relaxing or sleeping as a wise occupation of time gives them a satisfactory feeling
Food accessibility, supply and placement	▪ Need something to drink (water…), and want to store it cool inside the car ▪ Take small snacks, sandwiches, fruits or vegetables with them as it is not sure if they can get healthy and qualitative food during their trip ▪ They long for proactive hints, where the next good restaurant, cafe, or lounge is located, where they can find quality food (location-based services) ▪ They are willing to travel even longer, when they have a nice, cosy, stylish place with good food guaranteed
Space and travel systems	▪ Sharing a hotel room, train cabin or lounge space in the sense of multiple use is widely accepted but not at the same time ▪ People are in search of privacy while working during their travel time ▪ They do not like light reflections on their screen while working ▪ They consider car driving as a waste of time (luxury issue) ▪ Most claim that their business car is a more 'functional object' than an emotional one
Travel luggage	▪ Credo: 'Reduce to the max.' and transport the least possible ▪ Everybody has a detailed and accurate system to pack one's bags ▪ Their luggage is well chosen (good material quality, appealing materials,

	good finishing's/workmanship, style and practical issues count most) ▪ Luggage must be generally lightweight (principle) ▪ They try to carry never more than 2, and a max. of 3 pieces ▪ Women generally do not like to lift luggage in the car, train, airport as they search for an easy and elegant way of storage, where they do not need to bother other fellows ▪ Personas use 1 trolley for a 2-5 day trip, and 1 suitcase for longer trips ▪ Most users have 2 smartphones (1 private good equipped iPhone and 1 business phone, mostly a Blackberry) ▪ Woman carry an additional handbag
Mobile worker, work and work tools (hard- & software)	▪ They emphasize a functional, up-to-date and user-friendly technology ▪ Insight: The blackberry is already a little computer with a too small screen ▪ Manage an immense workload and long unlimited working hours ▪ Tendency of an unbalanced private and professional life ▪ They have always less time left for traveling and a local acclimatization, so when something is not working out they suffer from a high stress factor ▪ There are two extremes of mobile workers: 1. Their main work is done in a traditional office and they only do phone calls and emails while travelling 2. Their main work load is done while travelling having stop-overs inside cafés, airport lounges and external offices, so their work situation is environment dependent ▪ To do content-related, strategic and concentrated work they need a quiet place, therefor they are in search of suitable retreats, refugees like hotel rooms, offices etc. ▪ They do not like phoning at public places because of privacy and business issues ▪ They do not like that their pc screen is visible to others because of sensible data ▪ They are extensive travellers with extreme requirements and creative personalities able to overcome problems ▪ They follow their own system of status symbols and services such as a priority check-in, airport lounge access, VIP cards, frequent flyer cards, business- and first class tickets, seats with wifi and own socket ▪ Basic facility needs: A flat table or surface, electrical charging possibilities and wifi
Future urban mobility and important auto-mobile details	▪ Car sharing is welcome but needs to be clean, functional and of premium quality ▪ Want an elaborated fixture and cooling system for food & beverages inside the car ▪ Want an elaborated holder for their mobile phone with simultaneous charging possibilities of phones, pc's etc. ▪ Want an intelligent and sophisticated storage system for their luggage inside the car as they do not like lifting up luggage ▪ Claim that the automobile interior is from stone age concerning communication technology, charging system, smartphone adaptation etc. ▪ Car should have an additional and bigger screen with possibilities to check emails, find restaurants, not necessarily a pc ▪ The less they need to carry around, the better it is (in-car storage) ▪ Working inside the automobile is not at all comfortable today ▪ Car should be connected to the internet with integrated cloud system for accessing the personal music collection ▪ Car should have an integrated and well operating navigation system ▪ Extreme temperatures such as cold or heat are inconvenient when entering the car, so they prefer a general pre-conditioning of car interiors
Common opinions and thoughts on design and technology	Design: ▪ Less is more (credo) ▪ The apple design is their overall benchmark ▪ They appreciate a superb design quality, as it represents a contemporary luxury issue to them (old time luxury and status symbols are out) Technology: ▪ More technology in the car doesn't make it implicitly better, only when it makes sense and helps them out ▪ Do not like complicated operating systems as everything needs to be

	easy understandable, intuitive and user-friendly (prefer simple touchscreens) ▪ Again they really appreciate a well-working navigation system ▪ Prefer to use a just-in-time alert system to make the best use of their time in case the train arrives with delay, or there is a traffic jam ▪ Want a location-based proposal system to find good restaurants, hotels etc.

Table 62: Reprocessing the CRL towards automobile preferences

Mixture of private and professional life (1st place)	▪ Want an intelligent and sophisticated storage system for their luggage inside the car: Do not like lifting up luggage ▪ Want a customizable place of destination for the laptop, handbag and trolley within the car: They want to transport the least number of luggage pieces possible, so the laptop is mostly integrated into another bag ▪ Car should be connected to the internet with integrated cloud system: To get access to their personal music collection ▪ A private space or mode in public is needed within the automobile: People are in search of privacy while working on travel ▪ Want smart location-based service offers to find excellent restaurants, hotels and other places: They are willing to travel longer, when they have a nice, cosy, stylish place with good food guaranteed. They long for proactive hints, where the next great restaurant, cafe, or lounge is located to find quality food (location-based services) ▪ Want location-based offers also for private life mode: Such as where to meet a friend, where to go swimming, eat ice cream… Want a location-based (app) proposal system (e.g. combined with the navigation system for good restaurants, hotels etc. Tendency of an unbalanced private and professional life as the business takes it all) They use time gaps in-between meetings for work, charging batteries, to relay or sleep ▪ Want a safe place to store and charge several digital devices simultaneously within the car: Most users have 2 smartphones (1 private, well-equipped phone and 1-2 less well-equipped business phones). Want an elaborated holder for their mobile phone with simultaneous charging possibilities for phones, pc etc.
Design affinity (2nd place)	▪ Prefer minimalistic avant-garde design with significance: Less is more ▪ The apple design is their overall benchmark ▪ Need a new type of timeless emotional design offer: Most users claim that their business car is a more 'functional object' than an emotional one but they 'love' their digital devices emotionally, so a similar status placement could be achieved for the automobile interior too ▪ Superb design quality signifies a luxurious issue to them: They appreciate superb quality also in the filed of design and lifestyle
Multimodal mobility-mix (3rd place)	▪ Want just-in-time pre-conditioning of the car interior: Extreme temperatures such as cold or heat while entering the car are inconvenient ▪ Prefer a just-in-time alert system of time delays of every mean of transport they plan to use: In case the train arrives with delay, there is a traffic jam to make the best use of their restricted time
Synchronous work and travelling (4th place)	▪ **The automobile must offer alternatives in the field of efficient timesaving to the user** such as working possibilities, baggage storage, autonomous driving etc.: They consider driving as a waste of time (luxury issue) ▪ **Need better designed flexible space modes within automobile interiors:** Working inside the automobile is not comfortable today as it is too tight and narrow. ▪ **Need in-car working options:** Basic facility needs are a flat table or surface, electrical charging possibilities and wifi. ▪ **Need a relaxing in-car refugee:** New meaning of automobile space usage: DBN do constantly search refugees to work, powernap… ▪ **Install a smooth, trustworthy and fast travel organisation with supreme service and assistance:** Offering parking slots, valid parking, baggage transfer, car hand-over etc. as there is always less travel time. People do not like wasting time waiting or queuing at car rental stands, train stations, or airport lanes. A functional and good travel organisation has supreme priority for them as they consider it as an essential issue.

	▪ **Would really appreciate invisible and safe in-car-storage options**: The less they need to carry around, the better it is. ▪ **Need a feature or tool what protects them from the sun: Work and non-transparency status for changing cloth, sleeping etc.**
Technology affinity (4th place)	▪ **Need a reliable, up-to-date and smart navigation system:** Car should have an integrated and well operating navigation system. Again they really would appreciate a well-working navigation system that knows every destination and is up to date. ▪ **Want up-to-date technology and HMI systems inside the car that easy adapt with their personal devices:** Claim that the automobile interior is from stoneage concerning communication technologies, charging system, smartphone adaptation. ▪ **Prefer less but reasonable technology features and buttons what make really sense to them:** More technology in the car doesn't improve its all-over value necessarily. ▪ **Want more user-friendly and intuitive operating systems within the car** (HMI)**:** Do not like complicated operating systems inside the car, everything needs to be easy understandable, intuitive and user-friendly like a simple touch screen. Furthermore they emphasize a functional, up-to-date and user-friendly technology.
General sharing mentality (5th place)	▪ **Real premium car sharing needs to be offered:** Car sharing is a welcome solution but needs to be clean, functional and of premium quality. ▪ **Appreciate a staged sharing principle:** They do not like when their screen is visible to outsiders, or talking via phone in public, so only staged sharing comes into question. Sharing in the sense of multiple use is widely accepted but not at the same time.
Level of digital work environment & communication tools (5th place)	▪ **A bigger screen for multiple applications with web access is needed** for web access, navigation etc.: The average business phone is already a computer but has a too small screen. Also possibilities to check emails, find restaurants etc. are interesting to them.
Importance of personalization (5th place)	▪ Need more freedom to act, and find creative challenges within the automobile interior such as various space constellations and digital adaptation with own music etc. ▪ Prefer a more user-friendly and elegant way of storing luggage without any baggage lifting or greater barriers: Women generally do not like to lift luggage in the car, train, airport, as they do not want to bother other fellow passengers. ▪ Want a designated customizable place for their handbag, trolley and suitcase within the car: 'Reduce to the max.' Transport the least possible and never carry more than three pieces of luggage. Want to have direct access to their luggage also within the car (for changing cloth etc.).
Pragmatic & functional lifestyle (6th place)	▪ Install a small food compartment for cooling food and beverages: Want an elaborated holder and cooling system for food and beverages inside the car as they carry sandwiches, fruits or vegetables with them. ▪ Treat their luggage with caution as they are their closest travel companions: All pieces are well chosen in the sense of good material quality with an appealing haptic, high-end finishing, style and practical usage.
Car is main status symbol (7th place)	▪ VIP retreat areas are needed: They want some extras such as a special service treatment comparable to the Lufthansa Lounge access, a frequent flyer bonus or VIP card
User belongs to the creative class (8th place)	-
Importance of fixed local office (8th place)	-

Table 63: Explanation of rating scores for netgraphic master

Rating score	Rating description
5	Very high/very often/plenty of
4	High/often/many/a lot
3	Frequently/several/a bit more
2	From time to time/some/sometimes/a bit
1	Existent/fulfilled/basically yes

App. Chapter 6: Student experiment

Table 64: List of Delft University of Technology project participants

Name, job title and function	Project functions and tasks
Prof. Dr. Jan A. Buijs Chair in Management of Innovation, Department of Product Innovation Management, Faculty of Industrial Design Engineering, TU Delft	Professor in charge of the TU Delft Design Strategic Project (DSP) master, course and student advisor, lecturer responsible for strategic cooperation from the TU Delft site
Assoc. Prof. Dr. Frido Smulders Associate Professor Management and Organization, Director Master in Strategic Product Design, Product Innovation Management and Entrepreneurship, Department of Product Innovation Management, Faculty of Industrial Design Engineering, TU Delft	Mentoring associate professor, presentation moderator, student advisor and part of the judging panel
Eric Roscam Abbing External lecturer and owner of Zilver innovation, Department of Product Innovation Management, Faculty of Industrial Design Engineering, TU Delft	Lecturer and student advisor
Ass. Prof. Elmer D. van Grondelle Assistant professor and programme manager minor automotive Design and the master specialisation Advanced Automotive Design, Faculty of Industrial Design Engineering, TU Delft	Lecturer, student advisor for special automotive-related questions and part of the judging panel
Ass. Prof. Dr. Giulia Calabretta Assistant professor, Department of Product Innovation Management, Faculty of Industrial Design Engineering, TU Delft	Part of the judging panel

Table 65: List of Daimler AG project participants

Name, job title and function	Functions and tasks
Dr. Frank Ruff Head of department, Society and Technology Research Group Research and Development, Daimler AG	Responsible for strategic cooperation from the Daimler site, part of the judging panel
Alexander Pothoven Manager coordination concepts Smart Research and Development, Daimler AG	Part of the judging panel
Jan Fischer Manager new vehicle concepts Research and Development, Daimler AG	Part of the judging panel
Etienne Oomen Account manager dimplomatic sales Mercedes Benz Cars Showroom Den Haag, the Netherlands	Welcoming interested students to ask automobile specific questions and have a look at the Mercedes-Benz product range
Anja C. Hofmann External Ph.D. candidate Department of Product Innovation Management, Faculty of Industrial Design Engineering, TU Delft Society and Technology Research Group Research and Development, Daimler AG	Set-up experiment, concept and execution, lecturer, student advisor and communicator

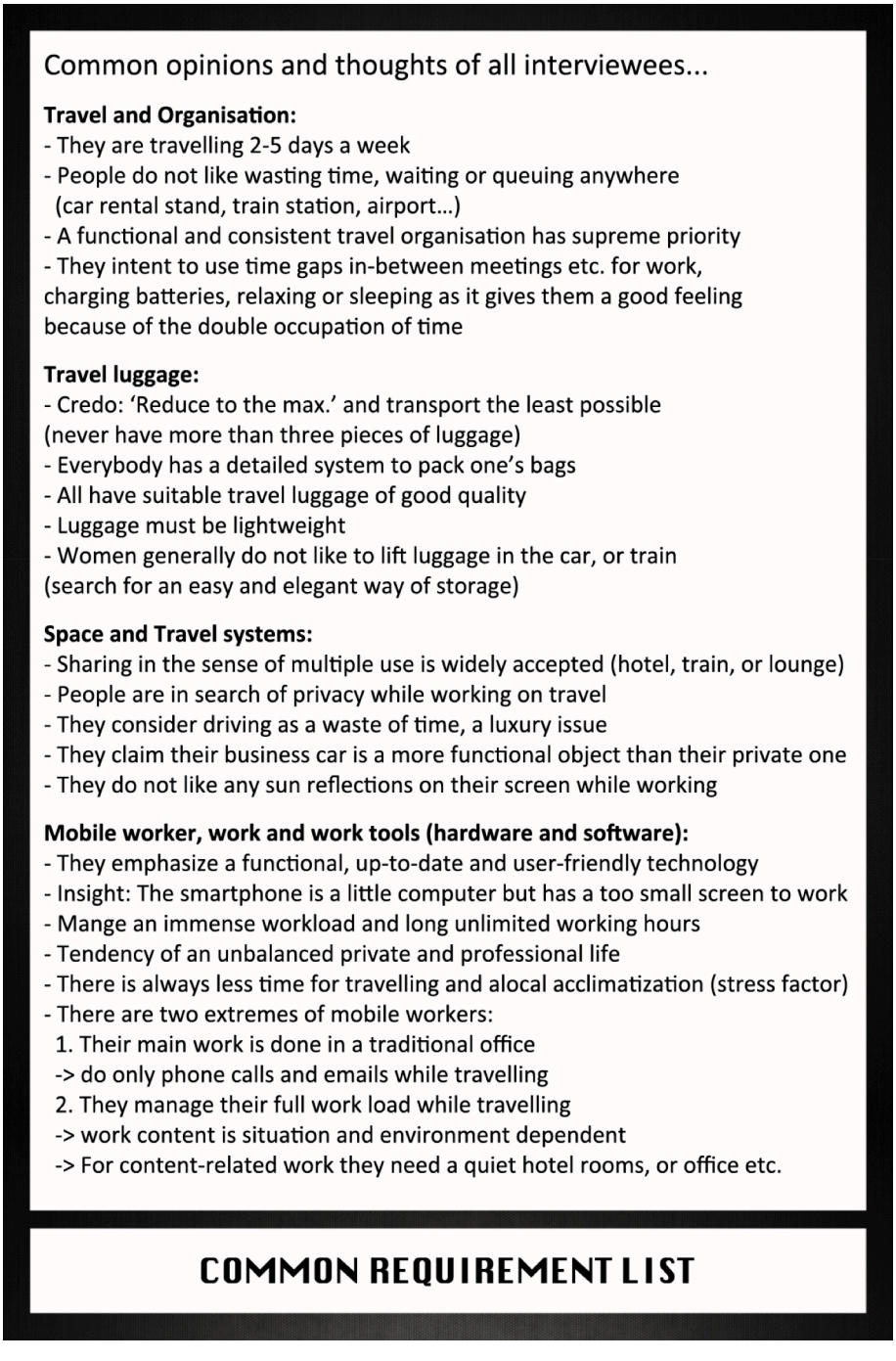


Figure 57: Common Requirement List part one (self-generated list based on interview information)

Mobile worker, work and work tools (hardware and software):

- They do not like talking on the phone at public places because of general privacy and business secrets
- They do not like when their pc screen is visible to strangers as they manage sensible business data
- Extensive travellers = extreme requirements = strong, extreme personalities
- They have their own system of status symbols and services (-> priority check-in, Lufthansa lounge access, VIP cards, frequent flyer cards, Business- and first class tickets, seats with wi-fi and own socket)
- Basis environmental conditions for mobile worker: They need a flat table area, electrical charging possibilities and wifi

Automobile:

- Car sharing is accepted, but needs to be clean, functional and premium
- Want an elaborated holder, cooling system for food and beverages in the car
- Want an universal holder for their mobile phone with simultaneous charging possibilities
- Want an intelligent and sophisticated storage system for their luggage
- They claim that the automobile interior is technology-wise from stone age concerning communication, charging system, and the smart phone adaptation
- Car should have an additional and bigger screen with possibilities to check emails, find restaurants (not necessarily a pc)
- Car should be connected to the internet with integrated cloud system to access the personal music collection
- Car should have an integrated and well operating navigation system with just-in time updates on traffic jams etc.
- Working inside an automobile is not comfortable today (too tight and narrow)
- Experiencing extreme cold/warm temperatures inside the car is not convenient
- In general they do not like complicated operating systems inside the car (-> prefer simple touch screens and intuitive HMI systems)

Design:

- Credo: Less is more
- There is a huge demand for superior design- and lifestyle that is perceived as a contemporary luxury issue
- The apple design is their general benchmark
- They appreciate a well-reasoned and elevated design quality (connoisseur)

COMMON REQUIREMENT LIST

Figure 58: Common Requirement List part two (self-generated list based on interview information)

Figure 59: Persona 1 – Smart competitive pragmatic (self-generated persona content based on user interview information)

Figure 60: Persona 2 – Digital efficiency pro (self-generated persona content based on user interview information)

Figure 61: Persona 3 – Creative networking enthusiast (self-generated persona content based on user interview information)

Student work evaluation record

TU Delft, Industrial Design Engineering – Design Strategy Project (DSP) with
Prof. dr. J.A. Buijs, Product Innovation Management and Anja C. Hofmann, Ph.D. candidate
Student work presentations and evaluation on 23rd of January 2013

Dear judging panel,

the following inquiry is part of my Ph.D. research and the DSP student project evaluation process. This research focuses on abstract thinking and conception pattern of a potential transportation interior design(er). It is of mayor interest to evaluate how the designers are reasoning their works, how the content is integrated into the final product, and how the final goal is accomplished.

Please fill in the following information and leave some notes concerning your personal impressions on the student works in due consideration of the given task:

Figure 62: Jury evaluation list (master) part one (self-generated record based on interview information)

Urban (auto)mobility 2030.
Design an (auto)mobile space for tomorrow's digital business travellers!

The parameters are:
- Design an urban vehicle (4 wheels)
- Minimal space consumption (max. of 4m length)
- E-drive (e.g. engine placed in the wheels)
- Premium automobile (high-end equipped)
- Design a car for temporary use (Premium Sharing Concept -> People are not owning it)
- 2+x-seater (-> at least 2 adequate seating possibilities)
- 2030 (-> market introduction)
- Multiple space use (-> it is not just about driving, but…)

Many thanks for your support. I am looking forward to receiving your responses!

Judge – individual profile:

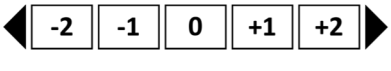
Full name: _____

Professional background: _____

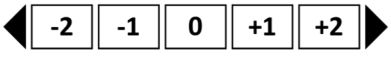
Field of expertise: _____

Student work evaluation
1st group:

_Visionary?
Is the project future-oriented, or has it a visionary approach for the year 2030?



_Innovative?
Does the work have innovative potential, or any distinctive USP?



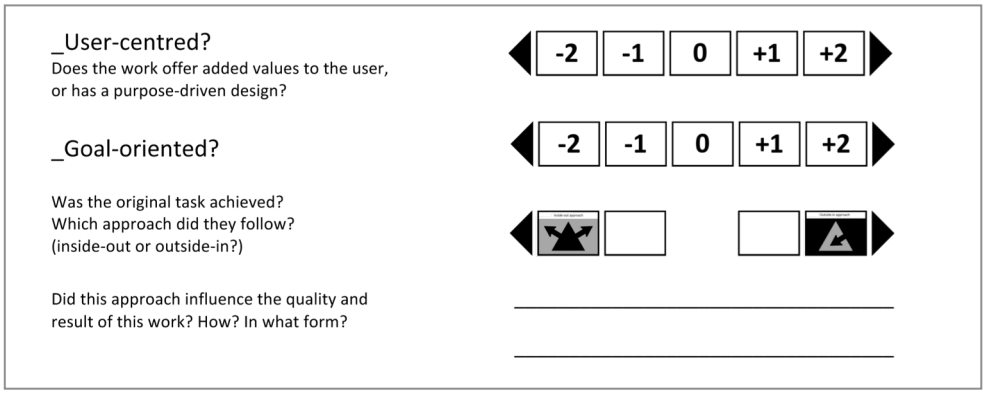


Figure 63: Jury evaluation list (master) part two (self-generated record based on interview information)

Student winner group evaluation

Dear judging panel,

- Please give some reasons why you think that this work is so outstanding and qualifies for being the best, ground-breaking, and innovative work within this student project.
- What aspects are important to you?
- What do you think about the originality of the idea?
- Design process: Is the work 'inside-out' (user-oriented) or 'outside-in' (context-oriented)?
- Do you think or see that the type of process had an influence on the actual product output, and quality? How? What is the actual benefit?

Reasoning:

_Visionary?

Is the project future-oriented, or has a visionary approach for 2030? What is special?

_____

_____

_Innovative?

Does the work have innovative potential, or any distinctive USP? What is outstanding?

_____

_____

_User-centred?

Does the work offer added values to the user, or any purpose-driven design?
What makes the 'more'?

_____

_____

_Goal-oriented?

Was the original task achieved? Which approach did they follow?
(inside-out or outside-in?)

_____

_____

_Design process?

Did this approach influence the quality and result of this work? How? In what form?

Figure 64: Jury evaluation list (master) part three (self-generated record based on interview information)

Table 66: Evaluation list of inside-out approach outcomes

Group name	Basic Space System	Activities - types of interaction	Technology features
All4One	Mobile Life Center (MLC): Automobile service means to charge, clean, maintain the car and to have an all-over plan of the travel including flight ticket, hotels stay and the MB Lounge	▪ Mood adaptation (mass-customization) ▪ Time-schedule & business planning ▪ Social networking & digital communication (for local appointments) ▪ Local advisory (guide) ▪ Charging Pc, iPhone via seamless (IDT) ▪ Privacy situation (darkening window) ▪ Disposal space (bigger bin) ▪ Mobile, flexible comfort seating (seat, couch, bed) ▪ Storage ▪ Safe Storage ▪ Temporary vehicle lock and un-lock (code) ▪ Automated pick-up service	▪ Autonomous driving ▪ Machine intelligence (user- & environment interaction) ▪ Nanotechnology self-repairing and recyclable materials) ▪ Car drives with bio fuels/electricity ▪ IDS - Interactive Data Screen ▪ IDT - Interactive Data Table
Craft Design	KEYS (service system) Nomad (automobile - amplified & generous space concept to feel free)	▪ Storage ▪ Seamless car charging & parking ▪ Local advisory/parking ▪ Just-in-time-schedule & business planner ▪ Mobile & flexible comfort seating (stretchable seat) ▪ Darkening windows (privacy issue)	▪ Interior materials are self-cleaning (nano technology) ▪ Digital assistant (smart personality) ▪ Electrical vehicle ▪ Seamless battery charging ▪ Autonomous driving ▪ Darkening windows (opacity change to control light permeability) ▪ OLED technology (surface illumination) ▪ Anti- collision system ▪ Applying more eco-friendly, smart materials ▪ Engine placed inside the wheels ▪ Trackpad -> touchpad + gesture control system
Die Dromedar	M.I.T.T. (Mercedes Integrated Transport Technology)	▪ E-learning & mental challenges (continuing online education) ▪ Mood adaption & flexible personalization system ▪ Mobile & flexible comfort seating ▪ Flat working surface/table ▪ Seamless pc/iPad charging ▪ Design car's temporary outer look & style ▪ Darkening windows (privacy issue) ▪ Just-in-time agenda & business planner ▪ Social networking ▪ Local advisory (restaurant reservations, parking etc.) ▪ Storage ▪ Safe storage	▪ Electric vehicle ▪ Autonomous driving ▪ Interactive windshield, dashboard ▪ Gesture- & voice control ▪ Darkening windows (opacity change to darken room) ▪ Key: Personal iris scan ▪ Augmented reality ▪ Highly efficient energy use ▪ Cloud-based system
KITT	Single mode	▪ Storage	▪ RFID technology

	Work mode Sleep mode	▪ Safe storage ▪ Just-in-time agenda & business planner ▪ Wireless pc, iPad charging ▪ Mobile & flexible comfort seating ▪ Seamless car charging ▪ Trustworthy navigation system	▪ GPS-tracking system ▪ OLED interior lighting ▪ Sensitive & responsive interior ▪ Interactive environment ▪ Electric vehicle (fuel cell-powered) ▪ Ubiquitous computing (wifi everywhere) ▪ Accident-free driving ▪ Inter-vehicular communication (C2C communication) ▪ Voice-controlled concierge ▪ Autonomous driving ▪ Wireless pc/iPad charging ▪ Shape-shifting interior
Nico's Angels	Mercedes to you: Pee Vee (MB rental system)	▪ Local advisory & tour guiding ▪ Storage ▪ Safe storage ▪ Temporary & safe lock and un-lock system	▪ Seamless car charging ▪ Park assist: Car moves when entrance is blocked ▪ Electrical vehicle ▪ Cooperative driving (flexible manual & autonomous driving mode)
Pinpoint	The Move: E-Benz & E-bike The Bond: MB bracelet	▪ Mood adaption & personalization ▪ Medical video conferences (doctor) ▪ Local advisory (to find healthy food, make restaurant reservations, bar finder, spare-time organizer) ▪ Just-in-time agenda & business planner ▪ Social networking & local appoint-ments (to maintain relationships)	▪ Heart-rate tracking system (health conditions) ▪ Wireless pc/iPad etc. charging ▪ Emergency button ▪ Electric vehicle + bike ▪ MB App ▪ Medical video conference ▪ Autonomous driving ▪ Seamless car charging ▪ Augmented reality ▪ Automated user-recognition
Shift	Mercedes PSS: ▪ Member club system (exclu-sivity issue) ▪ Mercedes Lounge (space) ▪ Personalizable mode & interior positions ▪ Car - user relationship	▪ Storage (hang 3 outfits, and 1 suitcase) ▪ Seamless pc charging	▪ Seamless vehicle charging ▪ Electrical vehicle ▪ Autonomous driving ▪ Automated notification system (sends sms when car arrives) ▪ Mercedes App (booking) ▪ Digital concierge (service) ▪ Location-based services ▪ Car-to-x-communication ▪ OLED touch screen window ▪ Key: DNA fingerprint ▪ Darkening windows (privacy) ▪ Seamless device charging (Pc, iPad, smartphone)
Shifting	C3: Control Centre Chauffeur	▪ Mood adaptation & personalization (music, chair position) ▪ Time-schedule & business planner (travel agency) ▪ Social networking possibilities ▪ Privacy situation (translucent window) ▪ Car charging (EV) ▪ Car maintenance ▪ Smart car parking	▪ Autonomous driving (limited areas) ▪ Augmented Reality ▪ Sharing program ▪ Car key NFC (Near Field Communication) ▪ Electric vehicle ▪ Accident-free driving ▪ Interactive touch screens, displays & interfaces
Snabb	Athena concept: Personal digital	▪ Social networking & local appoint-ments (family meetings/networks)	▪ Electric vehicle ▪ Autonomous driving

	assistant wellbeing - butler - concierge (states)	▪ Local advisory (bars, restaurants…) ▪ Mood adaptation & personalisation ▪ Physical movements & sports ▪ E-learning & mental challenges ▪ Just-in-time agenda & business planner ▪ Wireless pc etc. charging ▪ Mobile &, flexible comfort seating ▪ Seamless car charging	▪ Carbon fibre body ▪ Entertainment system ▪ Individual climate control ▪ Personal music library within cloud ▪ Noise isolation (from outside)
Strategic Cookie	▪ The Moof (mobile office): ▪ Generous, amply interior that offers a large capacity ▪ Car-to-car linkage (space solution) ▪ Car-to-hotel linkage (space solution)	▪ Storage for drinks & food ▪ Safe storage ▪ Seamless car charging ▪ Seamless charging of work tools (pc etc.) ▪ Trustworthy navigation system (travel) ▪ Automated pick-up service & parking ▪ Rotating & flexible comfort seating ▪ Automated driving & parking (slot finder) ▪ Darkening windows (privacy issue)	▪ Autonomous driving ▪ Adaptable system, offering user space ▪ Darkening windows (opacity for privacy) ▪ Interactive car windows (smart glass technology) ▪ Luminous textiles ▪ Link: Car-to-car and car-to-hotel
Utopi	Utopi: Athena, Hestia, Nyx and Gaia (states)	▪ E-learning & mental challenges ▪ Social networking & local appointments ▪ Physical movements & sports ▪ Automated pick-up & parking service ▪ Just-in-time agenda & business planner ▪ Storage (smart system) ▪ Safe storage	▪ Autonomous driving ▪ Flexible, interactive display(s) ▪ Bio fibre body (ultra-lightweight) ▪ User-recognition system ▪ Spherical wheels (for a better manoeuvrability)
Xtrovert	James the Butler: ▪ Travelling on a daily basis ▪ Paying a membership fee (subscription & pay-per-use) ▪ Exclusively for MB ▪ Loyal customer service ▪ Station independent car use (not fixed) ▪ Collections of miles & km ▪ International Hotel partner	▪ Automated pick-up service ▪ Personal profile & mood adaptation (interior adapts to personal style & preferences like scent, music, colours, textures) ▪ Personal look definition (vehicle exterior) ▪ Time-schedule & business planner (weather forecast, traffic jam warner, bookings) ▪ Social networking & wifi ▪ Storage (luggage, drinks & food) ▪ Safe temporary storage ▪ Seamless charging (pc, smartphone) ▪ Local advisory (scenic city tour) ▪ Automated pick-up service ▪ Car charging while parking ▪ Privacy situation darkening window)	▪ Facial & fingerprint recognition ▪ Automated driver pick-up service ▪ GPS-positioning of vehicles ▪ Human beings will be replaced by robotics! ▪ Uncrackable password system ▪ Smart anti-collision system (accident prevention)

Table 67: Evaluation list of outside-in approach outcomes

Group name	**Basic Space System**	**Activities - types of interaction**	**Technology features**

Cayak	Mercedes Mirror (system): ▪ Automobile ▪ Activity modules ▪ Lounge ▪ Artefact (key chain) ▪ App	▪ Activity modules (sports, music etc.) ▪ Automated pick-up service ▪ Local advisory ▪ Digital communication & social networking ▪ Outer look & style (status) ▪ Physical movement & sports ▪ Automated pick-up & parking service ▪ Personalization (persona fit)	▪ Augmented reality (via Google glasses) ▪ Cloud solutions ▪ Colour changing glass (vehicle interior) ▪ Autonomous driving ▪ Highly energy-efficient ▪ Automated user/client identification (by car)
Cilly 5	Horizon (user-oriented service system): ▪ Hub (vehicle) ▪ Lounge (service area)	▪ Agenda setting & business planner ▪ Seamless/automated car charging ▪ Trustworthy navigation system ▪ Local advisory & city guide (hotels & restaurants) ▪ Storage (works in modules) ▪ Automated pick-up service, delivery & parking (proactive system with automated return to parking hub) ▪ Mood adaptation & personalization (seat, colour concepts etc.) ▪ Outer look & style (welcoming the user through lighting) ▪ Entry (vehicle recognizes user)	▪ Small work devices ▪ Comprehensive seamless communication ▪ E-drive unit ▪ Sharing mentality (less ownership) ▪ Cloud-based system ▪ Autonomous driving (connected to other cars of the infrastructure) ▪ Solar rooftop ▪ Inductive charging (magnetic infrastructure) ▪ Energy recuperation ▪ Finger-print recognition ▪ Window screens ▪ Integrated augmented reality system ▪ Visualisation of energy generation (solar) and status
Hip'po	Mercedes G10 Series	▪ Mobile & flexible comfort (seating) ▪ Reserved parking space ▪ Seamless car charging ▪ Disposal space (bin) ▪ Privacy (darkening windows) ▪ Storage (for shoes too) ▪ Wardrobe & cloth hanger ▪ Safe storage ▪ Mood adaptation & personalization (persona fit) ▪ Automated pick-up/drop-off service & parking ▪ Trustworthy navigation system ▪ Local advisory (restaurants etc.) ▪ Social networking & local appointment (support) ▪ Agenda setting & business planner ▪ Automated shoe cleaner with pedal ▪ Automated holder (get in & out)	▪ Autonomous driving ▪ Interactive touch screens ▪ Video conferencing ▪ Car glass roof/window (opaque from the outside, transparent with digital screen from the inside) ▪ Ergonomical driving balance ▪ Automated temperature regulation (personal profile) ▪ Electric vehicle ▪ Cloud system ▪ C2C (Car-to-Car) communication ▪ Automated coffee cup stabilization program ▪ Automated fresh & clean air delivery
MfN (Mobili-ty for Nicole)	Flex-MoB and MSS System (Mobility Support System): Embedded in a Product Service System as an entire portfolio	▪ Automated pick-up service ▪ Temporary vehicle lock & unlock system ▪ Flexible comfort seating ▪ Privacy ▪ Seamless charging ▪ Physical movement & sports ▪ Gaming ▪ Social networking	▪ Permanent internet access ▪ Cloud-based system ▪ Implemented augmented reality ▪ Smart textiles ▪ High energy efficiency ▪ Sharing mentality (less ownership) ▪ Finger-print recognition ▪ Electric vehicle

Nack	Modular car system with sports - work - family setting	▪ Doing sports (biking) ▪ Storage	▪ Electric vehicle ▪ Car modules (sport - work - family) ▪ Autonomous driving
Studio 030	Mercedes EVE (mobility service)	▪ Mobile & flexible comfort seating ▪ Agenda setting & business planner (just-in-time updates) ▪ Mood adaptation & personalization ▪ Automated pick-up service & parking ▪ Entry (individual welcome of users) ▪ Automated vehicle neutralisation (from physical and digital use)	▪ Augmented reality ▪ Cloud solutions ▪ Social media as mass phenomenon ▪ Hybrid & e-drive units ▪ Autonomous driving ▪ Car-to-X-communication ▪ Elevated video conference technology ▪ Virtual servants ▪ Robotic technology ▪ Mind control (automated mind direction) ▪ Multi-touch surfaces
Sugar Power	▪ MB Platform (for real life interaction): ▪ Organized meetings: Shared rides posted on social media platform ▪ Meetings inside the car with additional persons that can board in parallel ▪ Spontaneous meetings outside the car: At MB partner places like bars, restaurants as a leisure activity ▪ MB Luxury = High-end material finish, special material selection, personal assistant, space customization	▪ Social networking ▪ Local advisory for private appointments ▪ Mobile & flexible comfort seating ▪ Automated pick-up service & parking (service system with parking solution) ▪ Mood adaptation & personalization ▪ Privacy situation (darkening windows, feeling at home mode) ▪ Just-in-time agenda setting & business planning (booking service)	▪ Autonomous driving ▪ Darkening windows ▪ Digital booking platform ▪ Attachable cars (plug-into each other) ▪ RFT electronics inside the car (Radio Frequency Transmission) ▪ Electric vehicle
The work-shop	M.U.M. model: ▪ Car = individualist ▪ Panoramic roof (transparent from the inside, opaque from the outside)	▪ Mood adaptation & mass customization (complete individualisation) ▪ Service unity (picking up your cloth) ▪ Outer look & style (see biomimicry) ▪ Local advisory ▪ Privacy ▪ Flexible & mobile comfort seating (seat -> lounger)	▪ Electric-drive unit ▪ Autonomous driving unit (connected to other cars and infrastructure) ▪ Wifi and web access ▪ Biomimicry (morphed butterfly -> colour display) ▪ Automated air refreshment ▪ Built-in pc ▪ Glass roof (opaque from the outside, transparent with digital screen from the inside)

App. Chapter 7: Concept design creation

Table 68: List of space mode proposals

Group name	Basic Space System	Space modes
All4One	Mobile Life Center (MLC): Automobile service means to charge, clean, maintain the car and to have an all-over plan of the travel including flight ticket, hotels stay and the MB Lounge	▪ Individual working mode ▪ Business meeting mode ▪ Relaxation & stress release mode ▪ Refreshing & dress-up mode ▪ Mobile toilet mode ▪ Manual driving mode ▪ Privacy mode
Craft Design	KEYS (service system): Nomad (automobile - amplified & generous space concept to feel free)	▪ Power napping/sleeping mode ▪ Individual working mode ▪ Relaxation & stress release mode ▪ Emergency mode
Die Dromedar	M.I.T.T. (Mercedes Integrated Transport Technology)	▪ Business meeting mode ▪ Individual working mode ▪ Relaxation & stress release mode ▪ Power napping/sleeping mode ▪ Manual driving mode ▪ Privacy mode
KITT	Single mode Work mode Sleep mode	▪ Individual working mode ▪ Business meeting mode ▪ Power napping/sleeping mode
Nico's Angels	Mercedes to you ▪ Pee Vee (MB rental system)	▪ Power napping/sleeping mode ▪ Individual working mode ▪ Business meeting mode ▪ Refreshing & dress-up mode ▪ 'Feeling like home' atmosphere mode ▪ Manual driving mode
Pinpoint	The Move: E-Benz & E-bike The Bond: MB bracelet	▪ Relaxation & stress release mode ▪ Power napping/sleeping mode ▪ Sports & healthy lifestyle mode ▪ Business meeting mode ▪ Individual working mode ▪ Dining room mode (digital menue tasting) ▪ Emergency mode (calling automatically authorities, medical video conferences)
Shift	Mercedes PSS: ▪ Member club system (exclusivity) ▪ Mercedes Lounge (space) ▪ Personalizable modes & interior positions ▪ Car - user relationship	▪ Business meeting mode ▪ Individual working mode ▪ Refreshing & dress-up mode ▪ Relaxation & stress-release mode ▪ Power napping/sleeping mode ▪ Dining room mode
Shifting	Control Centre Chauffeur (C3)	▪ Individual working mode ▪ Business meeting mode ▪ Relaxation & stress release mode ▪ Sleeping mode/ power-napping mode

Snabb	Athena concept (personal digital assistant): Wellbeing - butler - concierge (states)	▪ Practicing sports & healthy lifestyle mode ▪ Relaxation & stress release mode ▪ Driving mode (the user decides) ▪ Individual working mode ▪ Business meeting mode ▪ Refresh & dress-up mode ▪ 'Feels like home' atmosphere mode
Strategic Cookie	The Moof (mobile office): ▪ Generous, amply interior ▪ Car-to-car linkage (space solution) ▪ Car-to-hotel linkage (space solution)	▪ Refreshing & dress-up mode ▪ Relaxation & stress release mode ▪ Individual working mode ▪ Business meeting mode
Utopi	Utopi: Athena - Hestia - Nyx - Gaia (states)	▪ Relaxation & stress release mode ▪ Practicing sports & healthy lifestyle mode ▪ 'Feels like home' atmosphere mode (gullwing door for easy entrance) ▪ Manual driving mode (as an experience)
Xtrovert	James the Butler: ▪ Travelling on a daily basis ▪ Paying a membership fee (subscription & pay-per-use model) ▪ Exclusively MB ▪ X-tra service for loyal customers ▪ Fixed station independent car use mile/km point collection ▪ Worldwide Hotel/Hilton partnership	▪ Individual working mode ▪ Business meeting mode ▪ Refreshing & dress-up mode ▪ Emergency mode (ant-collision system)
Cayak	Mercedes Mirror (system): ▪ Automobile with activity modules ▪ Lounge ▪ Artefact (key chain) ▪ App	▪ Practicing sports & healthy lifestyle mode ▪ 'Feeling like home' mode
Cilly 5	Horizon (user-oriented service system): ▪ Hub (vehicle) ▪ Lounge (service area)	▪ Manual driving mode ▪ Individual working mode ▪ Business meeting mode ▪ Emergency mode
Hip'po	Mercedes G10 Series	▪ Relaxation & stress-release mode ▪ Individual working mode ▪ Business meeting mode ▪ 'Feeling like home' mode ▪ Manual driving mode ▪ Refreshing & dress-up mode
MfN (Mobility for Nicole)	Flex-MoB and MSS System (Mobility Support System): Embedded in a product service system	▪ Relaxation & stress-release mode ▪ Individual working mode ▪ Business meeting mode ▪ Practicing sports & healthy lifestyle mode
Nack	Modular car system with sports - work and family setting	▪ Individual working mode ▪ Business meeting mode ▪ Sleeping mode/power-napping mode ▪ Manual driving mode
Studio 030	Mercedes EVE (mobility service)	▪ Relaxation & stress-release mode ▪ Individual working mode ▪ Neutralization (of identity and space) ▪ Automated pick-up service & parking ▪ 'Feeling like home' mode

Sugar Power	MB Platform (for real life interaction): ▪ Organized meetings: Shared rides posted on a social media platform ▪ Spontaneous meetings: While riding, an additional person can board ▪ Spontaneous meetings outside the car: At MB partner places like bars, restaurants etc. as a leisure activity ▪ MB Luxury = High-end material finishing ▪ Special material selection ▪ Most-elevated technology ▪ All-included services ▪ Personal assistant ▪ Spending quality time ▪ Level of space customization!	▪ Relaxation & stress release mode ▪ Automated pick-up service & parking ▪ 'Feeling like home' mode ▪ Individual working mode
The workshop	M.U.M. model: ▪ Car = individualist ▪ Panoramic roof (transparent from inside, opaque from the outside)	▪ 'Feeling like home' mode ▪ Refreshing & dress-up mode ▪ Relaxation & stress-release mode

App. Chapter 8: Recommendation and discussion

Expert validation of innovation proposals

This interview is used for the validation of a Ph.D. research and will last 15-20 minutes of time.
Thank you for taking part.

Please read the following instructions carefully:

A Ph.D. research was done with the aim to improve the current innovation output of an automobile development process. The questions of this survey refer to the automobile design field and focus on user-centredness. Based on user-, and expert interviews and an experiment, 11 recommendations for change are proposed.

- It is the question whether these recommendations are valuable and whether there is agreement on the content of these questions. Therefore, I would like to have your input.

1. **Please mark in the scales how you rate the following proposals for change (from agree – disagree). It is important to answer them one after another.**
2. **In the final question write down which recommendation for change has the *most* and which has the *least* innovation potential according to your opinion.**

Let me know if you agree to publish your name and photo in my Ph.D. Only averages of the outcomes will be published. So, your answers will not be visible. Please return the questionnaire with a personal foto to: anjacarolinhofmann@gmail.com

Recommendation 1: **Identify a suitable design strategy in the design process**

One can design a car with two different approaches – from the inside towards the outside or from the outside towards the inside.

This recommendation proposes to set the actual design strategy at an early moment in the design process (outside-in and/or inside-out approach).

fully agree	agree	rather agree	rather disagree	disagree	fully disagree

Recommendation 2: **Redefine the designer's work content and tasks**

The conceptional part in car design will increase.

fully agree	agree	rather agree	rather disagree	disagree	fully disagree

Recommendation 3: **Propose a design conceptionist's profile**

Because of new conceptual needs in the field of automobile design, this work proposes to install the 'design conceptionist's profile' within the design department.

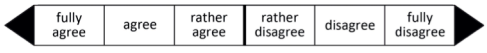
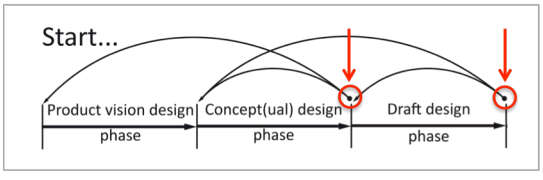
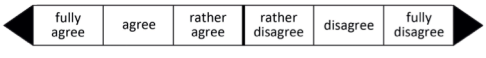


Figure 65: Expert validation part 1

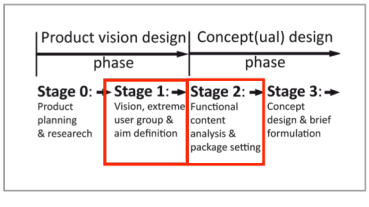
Recommendation 4: **Add reflective feedback loops to the design process**

It is proposed to install reflective feedback loops inside the design process (see illustration below).





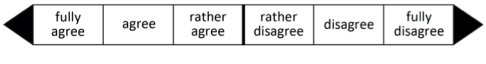
Recommendation 5: **Establish additional process steps (Stages 1–2)**



Two new process stages are proposed:

Stage 1 is called vision, extreme user group & aim definition.

Stage 2 is called functional content analysis & package setting.



Recommendation 6**: Reformulation of the design process flow**

The most important changes are:

- A change in the flow is that the design brief is physically written down in text form or figure(s)
- In Stage 3 the type of approach that should be applied (inside-out and/or outside-in) needs to be defined.
- There is a long strategic design phase, only up to Stage 5 starts the formgiving design
- Not only the advanced exterior designer, but also the interior designer are joining the fuzzy front-end phase.

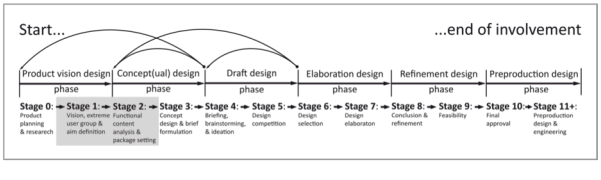
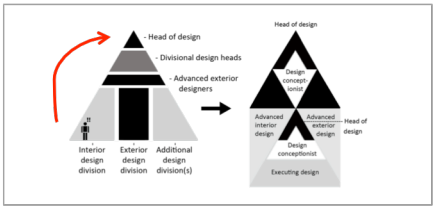


Figure 66: Expert validation part 2

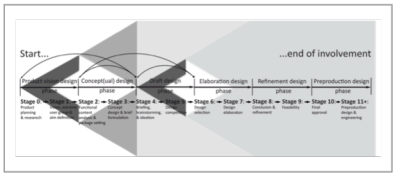
Recommendation 7: **Divide organizational powers within the hierarchy**

Both the interior and exterior design parties participate equally and have the same power. A neutral design conceptionist guides through the process.



fully agree	agree	rather agree	rather disagree	disagree	fully disagree

Recommendation 8: **Give more space to visionary design leadership**



The design conceptionist accompanies all first stages in the design process.

fully agree	agree	rather agree	rather disagree	disagree	fully disagree

Recommendation 9: **Create a written design brief (Stage 3)**

Use a written design brief that is used as project fundament and universal guiding tool.

fully agree	agree	rather agree	rather disagree	disagree	fully disagree

Recommendation 10: **Create an alternative design briefing (Stage 4)**

Exterior and interior designers start at the same time doing user research, working with persona profiles to look for innovative ideas.

fully agree	agree	rather agree	rather disagree	disagree	fully disagree

Figure 67: Expert validation part 3

Recommendation 11: **Install an innovation-friendly work atmosphere & culture**

One proposal is to establish idea pools, introduce round-table discussions, external workshops and excursions to source creativity and exchange innovative ideas when needed.

fully agree	agree	rather agree	rather disagree	disagree	fully disagree

Now as you finished with the validations, **which recommendation for change has** according to you **the *most* and *least* innovation potential**? Please state why:

Figure 68: Expert validation part 4

EPILOGUE

Dear professor Stübbe,
To return to our prior discussion and your statement:
'Design is not a question of democracy.'

This work confirms your statement.
I confirm your statement in the sense that not all designers could have exactly same voice simultaneously within a single company. Clearly, this would lead to a communication collapse, with outcomes that are either absent, poor, or – at best – moderate.

Furthermore, I confirm your statement in the sense that not every designer is able to play a long-term distinctive role handling complex issues in a global context, such as Head of Design within a large-scale corporation (not every individual can be a design visionary, talented communicator, and design leader all at once). It is of course good to fill these prominent positions with charismatic individuals.

This work disagrees with your statement.
I disagree with your statement in the sense that I believe that every hierarchy, especially those steep hierarchies operating in the automobile industry, must have legalized/official de-escalation processes where serious objections and doubts are able to be reported (anonymous, if desired). Real improvement of content within a lively company culture is only possible when individuals feel empowered to do this, without fear of personal consequences.

I disagree with your statement in the sense that every political system needs the immanent division of powers to be able to operate as a 'healthy' system (which equally applies to the automobile OEM) and that such a division guards against the development of purely narcissistic systems – the counterpoint to any functional democracy. My disagreement is based on the claim that ideas lie at the genesis of 'every' innovation of every kind. Ideas are free of charge, are individual property, and have the capacity to bring about fundamental improvements leading to economic success in the corporate environment.

Ideas are subject to 'bottom up' communication and not hierarchy dependant. They are neither controllable nor constrainable, they do not cause change or conflict to individuals, and they are (theoretically) free of charge. They offer options to attentive observers and provide alternative solutions to present challenges. Ideas can be a source of disruption and change for entire industries, and are answerable to nobody – they literally speak for themselves and seek their own path.

With thanks for inspiring me to think about these questions.

CURRICULUM VITAE

Finally I want to add my personal vision of future life and mobility in the year 2050. The German Council for Sustainable Development has published a collection of these personal visions under the title 'future lab Germany' [Bachmann and Engelke 2013].

Personal vision for 2050

'[…] I consider intellectually and physically flexible automobility as the basic condition for a high-quality life. My wish for the year 2050 is for flexible possibilities that will give me the choice as to when, where and what mobility I use. To attend my weekly yoga lesson, for example, I use public transportation or a bike. However, a car becomes essential when purchasing items for my home or attending out-or-town business meetings. My mobility goal is to be independent of both time and weather, which means continual access to a ready-to-use, and efficient automobile. In this context, it is of little significance whether I am the sole owner of a vehicle or have access to it via a club membership. Feasibility, user-friendliness and environmental sustainability are of greater importance to me than the status that my chosen means of transport may confer. Saying this, I don't rule out the idea of bringing out my smart 'good old days' electric two-seater from time to time and zipping about the countryside wearing a sunhat and a pair of Italian sunglasses from the (20)20s…

Life is supposed to be fun, right? A number of factors will have a decisive influence on my quality of life as a 66-year-old. As I mention above, one element is intellectual and physical health. I ask myself whether I will still have the physical skills to travel autonomously. Where and how will I live when I am old? An urban environment would make it much easier for me to participate in the cultural and social life around me. As well as this, I want to have frequent access to my family and friends. The part of the city where I live is filled with people from a diverse range of generations and cultures. These days, we take it for granted that people help each other when faced with everyday problems. For instance, I regularly run errands for my neighbour while he teaches me a foreign language or cooks for me in the evening. By and large, I have financial security, which provides the ideal conditions for me to truly enjoy developing and implementing a social business idea with a group of like-minded people. Our concept encourages the exchange of home services and neighboured repair work, as well as facilitating intergenerational childcare. My hope is that this activity will allow me to remain physically and intellectually mobile and to fulfil a meaningful, creative role in society.'

Curriculum vitae

Anja Carolin Hofmann holds a German degree in interior architecture (Dipl.-Ing.) from the University of Applied Sciences, Coburg, and an Italian master's degree in design management (M.A.) from the Domus Academy/University of Wales, Milan. She completed her foreign exchange studies at the Faculty of Architecture and Graphic Design at the Universidad La Salle in Mexico City, and at the Faculty of Architecture and Design at the Università Politecnico di Milano in Italy.

During her time as an external Ph.D. candidate at the Department of Product Innovation Management of the Technical University of Delft, she worked as a doctoral researcher at the Society and Technology Research Group of Daimler AG in Berlin. There she carried out future foresight research in the field of urban and contextual target groups, automobile design trends concerning long-run tendencies. During this time she participated in the Hasso-Plattner-Institute's D-school in Potsdam and considered ways in which Design Thinking methods might be implemented in the field of transportation design. She is currently working as a retail design strategist and interior architect in the Marketing Department of Mercedes-Benz cars, where she is seeking to define the company's future 3D brand appearance.

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Thanks to...

- Prof. Dr. J.A. Buijs, Jan gave me the chance to begin this Ph.D. at TU Delft, becoming my promotor until 2015. Thank you for sharing this innovative mindset, love for Italian design, food and cars with me by discussing how to change the world for the better. I believe we were soulmates. Our common understanding was that I would be Jan's 'last Ph.D.' to be guided through the doctoral project – unfortunately, there was not enough time: Jan passed away in December 2015. During our last meeting, he luckily made the connection with Peter Vink and asked me to write this story.
  Jan, my promise has been realised here.

- Prof. Dr. P. Vink, Peter for being my promotor since January 2016 – being your new Ph.D. cannot be taken for granted! You 'adopted' me as your candidate from one day to the next. You encouraged me, supported me, led me with hints and proofread to transform my Ph.D. dissertation into the present result.
  Thank you!

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- My parents, Roland and Greta, for their blind trust and belief in me and my work;
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- Chris, for being the first and hardest critic, for his endless power of endurance as a coach, motivator, IT specialist and data preserver, living through the emotional ups and downs of two concurrent Ph.D.'s (his and mine). This was true patience.

'Per aspera – ad astra'
(through hardships to the stars)
Thank you so much.

The mobility sector is radically transforming due to changes in user behaviour, urban policies and technical developments. For business people - flexible individuals in particular, the concept of car usage has changed fundamentally. It is presumed that the automobile interior might turn into a 'third place, of residence for them. While being driven, the user is able to spend his time on alternative activities within the car interior.

While these new needs and technical possibilities are yet to manifest in the automobile interior, they nevertheless demand a comprehensive rethink of the way that automobile design is carried out. This work thus focuses on the fuzzy front-end of OEM-internal design processes, with the aim of modifying strategies and fostering innovation from the outset.

This Ph.D. seeks to contribute to improvements in future car design.

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